



Emergency Medicine Clinical Guidelines

Preface

Medical emergencies will always exist, regardless of the established prevention measures that societies institute. In Rwanda, however, as in much of sub-Saharan Africa, the discipline of emergency medicine is in its infancy and emergency care training and infrastructure is limited. Delayed medical response to acute conditions such as injuries from road traffic accidents, severe malaria, obstetric complications and diarrhea contributes significantly to mortality. In addition, currently in Rwanda, the vast majority of healthcare providers lack the basic training necessary to triage and provide patients with adequate care in medical emergencies.

The need for emergency care training in Rwanda is particularly significant as the country is undergoing an epidemiologic transition where, communicable diseases and emergency obstetric conditions, injuries resulting from road traffic accidents and industrial accidents, and non communicable disease constitute an increasingly large proportion of the national burden of disease. Both of these broad condition domains require specific emergency care training and expertise in order to secure adequate patient management and favorable outcomes.

The clinical guidelines and protocols for the practice of emergency medicine presented in this document are designed to be a useful resource not only for those wishing to become emergency medicine specialists, but also for general practitioners and other healthcare providers tasked with caring for patients in hospital emergency departments. Healthcare providers using this Emergency Medicine Clinical Guideline (EMCG) are provided with fundamental concepts and principles essential to emergency medicine and the management of patients with undifferentiated emergency conditions.

The EMCG was developed specifically for the Rwandan context using intermediate input surrounding the emergency medicine protocols, for specialty topics within emergency medicine. The guidelines are intended to standardize care at both district and referral hospitals. I hope that by using the EMCG, health care professional will be able to identify acute medical conditions and the appropriate emergency interventions, in a refined manner.

The Ministry of Health is grateful for the effort of all those who contributed to develop, review, edit, and validate the EMCG. We would like to thank the many nurses and physicians from district hospitals, physician specialists and nurses from Kigali University Teaching Hospital, and the Emergency and Critical Care Medicine physician residents at the College of Medicine and Health Sciences, and (sidHARTe) program for their technical support.

The image shows a handwritten signature in blue ink on the left and the official seal of the Ministry of Health of Rwanda on the right. The seal is circular with a blue border containing the text 'MINISTRE DE LA SANTE' at the top and 'RWA' at the bottom. Inside the seal, there is a central emblem featuring a caduceus (a staff with two snakes) and other medical symbols, surrounded by a wreath.

Dr. Agnes BINAGWAHO Minister of Health

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References
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ACRONYMS

ABG: arterial blood gas
AED: automated external defibrillator
ALT: alanine aminotransferase
ARDS: acute respiratory distress syndrome
AST: aspartate aminotransferase
AV: arterovenous
AVPU: alert, verbal, pain, unresponsive
BID: bis in die (twice daily)
BP: blood pressure
BPM: beats per minute
BVM: Bag-valve mask
Ca: calcium
CHF: congestive heart failure
CO: cardiac output or carbon monoxide
CO₂: carbon dioxide
CNS: central nervous system
COPD: chronic obstructive pulmonary disease
CPR: cardiopulmonary resuscitation
Cr: creatinine
CT: computer tomography
CVA: costovertebral angle or cerebrovascular accident
CXR: chest x-ray
DIC: disseminated intravascular coagulation
DKA: diabetic ketoacidosis
DVT: deep venous thrombosis
EBV: Epstein-Barr virus
ECG: electrocardiogram
EM: emergency medicine
ENT: ear, nose and throat
FAST: focused assessment with ultrasound in trauma
FBC: full blood count
FFP: fresh frozen plasma
FNA: fine needle aspiration
GABHS: Group A beta-hemolytic Streptococcus
GCS: Glasgow coma score
GI: gastrointestinal
GU: genitourinary
HELLP: Hemolysis, Elevated Liver enzymes, Low Platelets
Hg: hemoglobin
HIV: human immunodeficiency virus
HSP: Henoch-Schonlein Purpura

HR: heart rate
HSV: herpes simplex virus
HUS: hemolytic uremic syndrome

Hx: history
IM: intramuscular
INH: Isoniazid
INR: international normalized ratio
IO: intra-osseous
ITP: idiopathic thrombocytopenia purpura
IV: intravenous
IVC: inferior vena cava
JVD: jugular venous distention
LDH: lactate dehydrogenase
LMWH: low molecular weight heparin
LR: Lactate Ringer's
MAP: mean arterial pressure
MDI: metered dose inhaler
mEq: milliequivalents
ml: milliliters
MI: myocardial infarction
NAC: N-Acetylcysteine
NG: nasogastric
NIPPV: non-invasive positive pressure ventilation
NS: normal saline
OPD: outpatient department
PA: posterior-anterior
PE: pulmonary embolism
PEA: pulseless electrical activity
PEEP: positive end expiratory pressure
PO: per os (oral administration)
PPV: positive pressure ventilation
PT: prothrombin time
PTT: partial thromboplastin time
PTX: pneumothorax
PUD: peptic ulcer disease
RBC: red blood cells
RR: respiratory rate
RTA: road traffic accident
RUG: retrograde urethrogram
RV: right ventricle
SAH: subarachnoid hemorrhage
SBP: systolic blood pressure
SJS: Stevens Johnson Syndrome
SL: sublingual
SSTI: Skin and soft tissue infections

STI: sexually-transmitted infection
SVT: supraventricular tachycardia
TBSA: total body surface area
TMP-SMZ: Trimethoprim/sulfamethoxazole
TEN: Toxic Epidermal Necrolysis
TIA: transient ischemic attack
TB: tuberculosis
TRALI: transfusion-related lung injury
TTP: thrombotic thrombocytopenic purpura
US: ultrasound
UTI: urinary tract infection
VT: ventricular tachycardia
XR: x-ray

Chapter 1

General Approach to Emergencies

ABCs and Beyond: Initial Approach to the Patient in Emergency Medicine

The delivery of emergency medical care is dictated by what is found on patient assessment. The emergency care provider must employ an assessment system that rapidly identifies and addresses critical illness or injury first and foremost. This initial system needs to be systematic and simple to quickly and efficiently perform, but also effective and robust to not miss anything life-threatening.

Primary Survey (ABCD): First 5 minutes of patient encounter

- Focused history and physical exam
- Critical diagnostic tests
 - Vital signs, bedside glycemia, oxygen saturation
- Immediate treatment
 - Airway repositioning, oxygen, glucose, CPR, consider cervical collar

This initial cycle constitutes the ABCs, or primary survey. Once these critical problems are addressed, the provider then moves through another and deeper cycle of assessment and treatment known as the secondary survey.

Secondary Survey: First 15 minutes of patient encounter

- More in-depth history
- Complaint-specific physical exam
 - Include bedside ultrasound assessment here
- Other time-sensitive interventions
 - Chest drain, anti-seizure medications, etc.

Both the primary and secondary survey should be completed in less than 20 minutes, correcting problems along the way. Providers do not move on to the secondary survey until problems with the primary survey have been addressed.

The ABCs of Emergency Medicine- An Overview

The ABCs provide a framework for the evaluation and treatment of severely ill patients. This process is also known as the primary survey.

"A" is for Airway

Definition: Ensuring the airway is open so a patient can breathe. In any critically ill patient, management of the patient's airway is a priority.

Initial approach to assessment and management

Assess for evidence of airway obstruction:

- Are there abnormal breathing noises?
- Is the patient unable to speak normally?
- Is there swelling, excessive secretions or a foreign body in the oropharynx causing obstruction?
- Is there neck or facial trauma/burns or a compressive mass?
- Is the patient choking?

Management

If the patient is choking, but is awake and responsive, follow these instructions:

- Call for help
- If they can move some air (partial obstruction), encourage them to expel the object by coughing
- If they can't move air, perform the Heimlich maneuver (figure 1.3a)

If the patient is unresponsive, position and clear the airway:

- If there is no pulse, start CPR
- Open the airway using a jaw thrust or head-tilt-chin-lift maneuver (consider spinal precautions in trauma patients) (see figure 1.3b&c)
- Use suction to remove excessive airway fluids
- Remove any foreign body with forceps

After above steps complete, reassess airway and attempt rescue breath if patient is not breathing. If airway remains obstructed:

- Place an oropharyngeal and/or a nasopharyngeal airway device and attempt several breaths with a Bag-valve-mask (BVM) device. Ensure an adequate mask and face seal. Two-person BVM usually provides better oxygen delivery than one-person BVM (see figure 1.3d&e).

If the patient remains obstructed, you must proceed to an advanced airway device:

- Place a laryngeal mask airway (if available in the district hospital) or proceed directly to endotracheal intubation (if trained to do so)

If airway devices are not available, arrange for immediate transfer to referral center



Figure 1.3a: Heimlich Maneuver

Figure 1.3b: Jaw thrust. The fingers are lifting up from under the angle of the jaw



Figure 1.3c:
Chin lift



Figure 1.3d: One-person
BVM. Note the thumb and
index digits apply
pressure to maintain a
seal on patient's face,
while the third, fourth
and fifth fingers LIFT
the jaw UP into the mask.
This is a KEY skill to
master.





Figure 1.3e: Two-person BVM. The primary EM provider applies the mask and focuses on bringing the patient's jaw up into the mask. A second provider squeezes the bag. Two-person BVM is usually best.

"B is for Breathing": Resuscitative Breathing Management

Definition: The resuscitation efforts of breathing focus on delivering oxygen to the lungs. Though breathing assessment and management should only proceed after any airway issues have been addressed, airway and breathing are often dealt with simultaneously. In many cases the patient will be suffering from a problem of BOTH airway and breathing. Emergency care providers must be efficient and effective in the almost simultaneous management of airway and breathing problems.

Initial approach to assessment and management

Is the patient breathing?

- Look for symmetrical chest rise and accessory muscle use
- Listen to the chest and determine if there is bilateral good air entry
- Determine the respiratory rate

Is the breathing effort adequate?

- Check for hypoxia and signs of respiratory distress
 - Tachypnea (RR>25/min) or bradypnea (RR<12/min)
 - Increased work of breathing - accessory muscle use (suprasternal, subcostal, intercostal in-drawing), nasal flaring, pursed lip breathing, asymmetrical percussion noted, decreased or abnormal breath sounds
 - Altered mental status (agitation, confusion, coma)
 - Evidence of associated chest, neck, head or facial trauma
 - Low oxygen saturation (<94%) on room air

Differential diagnosis

There are many causes of respiratory distress. Develop a clear approach to organize all of the information gathered from often limited history and physical exam. In acutely unwell patients with breathing problems, treatment must be started at the same time that a differential diagnosis is being generated. In the sick patient, consider:

- Pneumonia - bacterial, viral or fungal
- Pulmonary edema - heart failure, intoxication (e.g.: organophosphate poisoning), infection
- Tension pneumothorax
- Hemopneumothorax
- Pericardial tamponade
- Massive pleural effusion
- Asthma or COPD exacerbation
- Pulmonary embolism

Management

Provide supplemental oxygen to all patients with breathing problems. In the hypoxic or tachypneic patient, provide as much oxygen as possible initially.

- Non-rebreather mask (face mask with a reservoir) at a flow rate of 10-15L/min
- Put patient in a semi- sitting position

If the patient is not breathing, or respiratory rate is less than 12, use a bag-valve mask (BVM) with to provide positive pressure ventilation.

- BVM usually requires two people to do effectively.
 - One person uses both hands to provide an excellent seal between the patients face and the mask while adequately opening the patient's airway with a jaw thrust and chin lift maneuver

"C" is for Circulation

Definition: Assessment of the cardiovascular system.

Initial approach to assessment and management

Feel for a carotid or femoral pulse for 10 seconds. Ask the following questions:

1. Is the pulse absent?

- If absent
 - Start CPR and assess the rhythm with AED or defibrillator
- If rhythm on monitor is shockable (ventricular fibrillation, pulseless VT)
 - Defibrillate and continue CPR
- If rhythm on monitor is not shockable (PEA, asystole)
 - Continue excellent CPR and look for a reversible cause
 - Hyperkalemia (is there a history of renal failure)?

- Give Calcium gluconate IV
 - Hypoxemia (is there adequate oxygenation?)
 - Ensure supplemental oxygen
 - Hypovolemia (is there shock or bleeding?)
 - Place IV and give IV fluids
 - Hypothermia (was the patient sleeping on the street in the rain?)
 - Check temperature, warm the patient
 - Hydrogen ions (acidosis like DKA or septic shock?)
 - Consider sodium bicarbonate IV
 - Tamponade (blood around the heart?)
 - Thrombosis (pulmonary embolus or coronary)
 - Toxins
 - Tension pneumothorax (no lung sounds on one side?)
 - Place emergent chest tube
- If a pulse is present, ask:
 - Is the pulse weak and very rapid or very slow? ○ Are there signs and symptoms of profound hypotension (slow capillary refill, altered mental status, tachypnea)?
 - Place TWO large IV lines
 - Give a 2L bolus of fluid (NS or LR) quickly
 - Reassess pulse and blood pressure after fluid
 - Consider placement of foley catheter to monitor urine output

"D" is for Disability

Definition: Rapid assessment of neurological system

Initial approach to assessment and management

- Assess the level of consciousness by calculating Glasgow Coma Score (GCS- see appendix) OR the AVPU scale (see appendix).
- Look for any focal neurological deficit including limb motor function, rectal tone, and pupil responses.
- Check bedside glycemia for any patient with an abnormal mental status: confusion, agitation, coma
 - Correct hypoglycaemia immediately and reassess GCS and mentation once glycemia is normal

"E" is for Exposure/Environment:

Definition: Identify any other immediate dangers by fully undressing the patient.

Initial approach to assessment and management

- Are there other injuries? Are there environmental threats/exposures to the patient and staff (e.g. chemical exposure, hypothermia, etc)?
- How to assess exposure: If recent trauma, remove all of patient's clothing to examine head to toe.
- It is also important to remove all clothing in patients with fever and confusion. Look for rashes under clothing, bed sores, GU redness/swelling, or other missed areas of possible infection.

Acute Respiratory Failure

Definition: Respiratory failure is an inadequate gas exchange (adequate O₂ intake and/or CO₂ elimination). Can be caused by decreased alveolar ventilation or oxygenation or decreased tissue gas exchange.

Causes

- Central
 - Head injury, stroke, or toxins can damage central respiratory centers, leading to hypoventilation
- Upper airway
 - Obstruction of upper airways leads to inability to ventilate or oxygenate
 - Upper airway burns
 - Neck hematomas
 - Epiglottitis
 - Angioedema
 - Tongue will often obstruct airway in obtunded patients
- Lungs
 - Alveolar collapse/ obstruction with fluid
 - Pneumothorax
 - Pneumonia
 - Tuberculosis
 - Pulmonary edema (cardiogenic and non cardiogenic)
 - Hemothorax
 - Lung contusion
 - Aspiration (common in setting of low GCS)
 - Lower airway obstruction
 - Chronic obstructive pulmonary disease (COPD)
 - Asthma
- Neuromuscular
 - Weakness of respiratory muscles leads to ineffective ventilation
 - Guillain- Barre
 - Myasthenia gravis
 - Poliomyelitis
 - Organophosphate poisoning
 - Tetanus
- Thoracic wall abnormalities
 - Flail chest
 - Abdominal distension that prevents diaphragmatic excursion
 - Ruptured diaphragm
 - Circumferential burns
- Metabolic
 - Sepsis leading to poor delivery of oxygen to tissues
 - Anemia leading to poor oxygen delivery to tissues

Signs and symptoms

- History
 - o Regardless of cause, most acute respiratory failure will present with abnormal breathing (either too fast or too slow) and/ or signs of upper airway obstruction
 - o Ask about recent trauma, any possible ingestions o Ask about timing of onset (minutes, hours or over days) o Ask about co-morbidities such as heart failure, immunosuppression, COPD/ asthma, renal failure o Associated symptoms may include chest pain, fever, cough, hemoptysis, wheezing
- Exam
 - o Airway:
 - Can the patient speak clearly?
 - If yes, then upper airway obstruction is not cause of respiratory failure
 - Stridor, gurgling, hoarse voice indicate obstruction
 - Coma with GCS < 8 generally means patient is not protecting the airway from obstruction by the tongue and/or from aspiration of secretions and gastric contents
 - Facial or inhalational burns, angioedema or neck hematomas can all rapidly worsen leading to complete airway obstruction
 - o Breathing:
 - Are the breath sounds present, normal and equal?
 - Is the respiratory rate too fast or too slow?
 - Accessory muscle use?
 - Is the oxygen saturation normal?
 - o Circulation
 - Signs of concomitant shock seen in many cases of respiratory failure such as pneumonia with sepsis, tension pneumothorax, or traumatic brain or lung injury with hemorrhagic shock
 - o Disability
 - Patients with respiratory failure will develop a change in mental status
 - Agitation common in hypoxia
 - Obtundation/coma common in hypercapnea
 - o Other findings- Is there:
 - Crepitus or deformity of chest wall or neck?
 - Obvious facial or neck trauma?
 - Pallor? (severe anemia can cause respiratory distress)
 - Muscle weakness?
 - Murmur?
 - Abdominal distension?
 - Edema or signs of fluid overload?

- Bedside Tests
 - Bedside ultrasound
 - Heart: Evaluate ejection fraction (EF), presence of mitral stenosis, evidence of RV strain?
 - Lungs: Pneumothorax, effusions, consolidations?
 - IVC: Fluid overloaded or depleted?
 - Abdomen: Free fluid?

Differential diagnosis

- Tachypnea can be a sign of a non-respiratory problem
 - Expect oxygen saturation to be normal, CO₂ to be low
 - Most commonly seen in academic states in which the patient is trying to get CO₂ out of the body (e.g. diabetic ketoacidosis, sepsis, aspirin/aspergillus poisoning)
 - Can also be caused by anxiety but is a diagnosis of exclusion

Investigations

- Labs: renal labs (urea, creatinine), FBC, AST, ALT, consider ABG
- Imaging:
 - Chest X-ray: look for cardiomegaly, interstitial edema, enlarged pulmonary artery, pleural effusions, pneumothorax
 - Chest CT scan: if indicated

Management: General goal is to start by stabilizing the ABCs. All patients in respiratory distress or failure need to be on a monitor, if available, or have vital signs taken every 15min until stable. They need supplemental oxygen (use high flow, non re-breather mask turned all the way up to deliver most oxygen possible) and two large IVs.

- Airway
 - Chin lift to pull tongue off of back of oropharynx
 - Use jaw thrust in patients with trauma and concern for cervical spine injury
 - Only place oral airways in patients *without* a gag reflex (GCS <8)-placing an oral airway in an awake patient will cause vomiting and aspiration
 - Heimlich maneuver if suspect foreign body aspiration
 - Bag mask ventilation
 - If patient has respiratory arrest or severe hypoventilation
- Breathing
 - Needle decompression followed by chest tube for tension pneumothorax
 - Chest tube for large effusion or hemothorax
 - Positive pressure ventilation
 - Useful for most causes of hypoxic respiratory failure
 - Exclude pneumothorax prior to initiating

- Can be done non-invasively in spontaneously breathing patient who can protect his airway
 - Attach PEEP valve to bag valve mask
 - Attach patient to a ventilator on a non invasive setting
- Intubation (to be performed only by trained, experienced providers)
 - o Indications:
 - Improve oxygenation
 - Improve ventilation
 - Protect the airway
 - Anticipated course
 - o **Should only be performed by experienced providers** as intubation done by untrained providers will cause harm and possibly death.
 - SAFE intubators MUST:
 - Understand the importance of preoxygenation and other techniques to avoid critical hypoxia during the procedure
 - Be able to anticipate a difficult airway and prepare accordingly
 - o Beware especially of using paralytics if not an experienced intubator
 - Ensure access to appropriate post intubation care to prevent traumatic extubation, ventilator associated pneumonia, etc.
 - Anticipate need for ventilator in patients who are being intubated for respiratory failure.
 - o T piece alone is only appropriate when the sole reason for intubation was for airway protection

Recommendations

- Respiratory failure is a common presentation in Rwanda and can be caused by many etiologies.
- Bedside ultrasound can be very helpful in distinguishing among the different causes
- Oxygen is an essential medication. Make sure that there is ALWAYS a full back up tank of oxygen if the oxygen system fails.
- Recognize the capabilities of your facility. If you are not able to ventilate or intubate and a patient is in severe respiratory distress, consider early transfer *before* respiratory failure occurs.
 - o Even at the most basic facility, every patient can have stabilization with two IV lines, full monitoring of vital signs, and supplemental oxygen.

Shock

Definition: Shock is a state in which there is inadequate blood flow to the tissues to meet the demands of the body; it is a state of generalized hypoperfusion. Although shock and hypotension often coexist, hypotension *need not be* present, and a normal blood pressure does NOT exclude the diagnosis of shock.

Causes

1. Hypovolemic shock: due to a loss of intravascular volume
2. Cardiogenic shock: due to cardiac pump failure
3. Obstructive shock: due to obstruction to cardiac filling or emptying
4. Distributive shock: due to exaggerated peripheral vascular dilatation

| Signs and symptoms | History | Signs | Bedside Tests |
|---------------------------|---|--|---|
| Hypovolemic shock | <ul style="list-style-type: none"> • Blood loss (trauma, ruptured ectopic, GI bleeding) • Third spacing (peritonitis, burns, bowel obstruction) • Renal losses (DKA) | Tachycardia, decreased JVD, cold extremities | <ul style="list-style-type: none"> • Hb level • Pregnancy test in all females • Abdominal US (collapsed IVC and/or free fluid) |
| Cardiogenic shock | <ul style="list-style-type: none"> • Difficulty breathing • Orthopnea • Chest pain • Chest trauma | Tachycardia, increased JVD, cold extremities, crackles in lungs, heart murmur | <ul style="list-style-type: none"> • Heart US (decreased contractility) • IVC US (increased or full) • Chest XR (cardiomegaly) |
| Distributive shock | <ul style="list-style-type: none"> • Anaphylaxis (swollen lips, hives) • Sepsis | Tachycardia, decreased JVD, warm extremities, short capillary refill time | <ul style="list-style-type: none"> • IVC US (decreased or collapsing) |
| Obstructive shock | <ul style="list-style-type: none"> • Shortness of breath (ptx, PE) • Chest pain (tamponade) | Tension ptx: Unilateral decreased breath sounds, hypoxemia, decreased JVD, hypotension Cardiac tamponade: hypotension, tachycardia, muffled | <ul style="list-style-type: none"> • Lung US (look for ptx) • Heart US (fluid around the heart) • Chest XR (enlarged heart, ptx) |

| | | | |
|--|--|--|--|
| | | heart sounds, cold extremities, increased JVD Massive PE: tachypnea, hypoxemia, hypotension, tachycardia, increased JVD | |
|--|--|--|--|

Investigations

Labs

- FBC, glycemia, renal function test, liver function tests, coagulation tests (PT, PTT) and lactate level if available

Imaging

- Chest X-Ray, Extended FAST exam

Management: General goal is to stabilize patient first while simultaneously trying to determine type of shock. Recognition of an unstable patient is critical in emergency care. Transfer early any patient that doesn't respond to initial resuscitation efforts, especially if cause of shock is unclear.

- **Hypovolemic shock**

- o Obtain full set of vital signs, place on monitor, if available, place TWO large IVs (18g or larger in an adult), give supplemental oxygen to maintain saturation >93%
- o Give IV fluids (NS or LR)
 - Bolus 500-1000 ml and then evaluate
 - Repeat if needed
- o If patient is losing blood (recent trauma, GI bleeding), transfuse early
 - If patient remains with low blood pressure or tachycardia despite 2L fluid bolus
 - If patient is actively bleeding with hypotension or tachycardia or cold extremities
 - If Hb<7 and actively bleeding
- o Bedside abdominal US (FAST exam) is a very good tool to assess the patient with abdominal trauma o EVERY woman of a child bearing age requires a pregnancy test

- **Cardiogenic shock (see Cardiogenic Shock chapter for more details on treatment)**

- o Obtain full set of vital signs, place on monitor, if available, place TWO large IVs (18g or larger in an adult), give supplemental oxygen to maintain saturation >93%
- o Give fluid in small boluses (100 ml of crystalloids)

- Check urine output, feel if extremities are still cold, check IVC to see if it is full (volume overloaded) or collapsing (dehydrated), and check creatinine
 - If there is NO increase in the blood pressure, or patient isn't making urine, or extremities remain cold, or patient is in renal failure, STOP all fluids and start a dopamine infusion
 - Dopamine drip/infusion- usual dose range - 5-20 mcg/kg/min
 - Mix 200mg in 500mL of NS (concentration 400mcg/ml)
 - Use the chart in the appendix to determine how quickly to let the infusion drip (see appendix).
 - Vasopressor infusions should be started at the lowest possible dose and moved up every 10-20min to reach a blood pressure goal of MAP>65 or SBP>100.
Once goal is reached, the infusions should be lowered slowly as blood pressure tolerates (do not turn off completely at once).
 - If the cause of shock is valvular heart disease, the prognosis is very poor in the absence of valve replacement or repair; involve cardiologist, if available.
- **Distributive shock**
 - Obtain full set of vital signs, place on monitor, if available, place TWO large IVs, give supplemental oxygen to maintain saturation >93%
 - If the cause is **sepsis**, give broad-spectrum antibiotics as soon as possible, ideally in the first hour. If you think malaria is a possible cause, start treatment
 - Give 3-4L of IV fluids bolus
 - Place Foley catheter to watch urine output
 - Check for a source of infection and see if there is a need of a surgical procedure to control it: abscess, empyema, peritonitis, etc.
 - If the source is **anaphylaxis**, and you hear wheezing or stridor (loud sounds with breathing), or the patient has swelling of the tongue or back of throat or patient is hypotensive, give Adrenaline
 - Adrenaline 0.5mg IM (to be repeated every 1-2hr as needed for recurrence of above symptoms)
 - Give fluid boluses for hypotension or tachycardia
 - Hives, rashes, or itching alone is NOT an indication for adrenaline
 - Patient should be on a heart monitor, if available

- **Obstructive shock** (address the cause)
 - Obtain full set of vital signs, place on monitor, if available, place TWO large IVs, give supplemental oxygen to maintain saturation >93%
 - **Tension pneumothorax:** immediate needle decompression followed by chest tube
 - **Massive pulmonary embolism:** IV heparin, if available OR Lovenox (enoxaparin) injection
 - **Pericardial tamponade:** pericardiocentesis

Recommendations

- One of the most difficult tasks to determine what type of shock a patient is in. However, regardless the cause of shock, every patient will display signs of end organ hypoperfusion: confusion, decreased urinary output (<0.5 ml/kg/h), a capillary refill time that will be prolonged (>3 seconds)
- Every patient with signs of shock needs TWO large IVs (18g or larger in an adult), a Foley catheter, regular vital sign checks (or on a monitor), and close nursing care
- How do you know when to stop giving fluids to a patient in shock? Your therapeutic end-points are the following:
 - MAP > 65 mmHg
 - Urinary output > 0.5ml/kg/h
 - Resolution of tachycardia
- When to transfer to referral center:
 - When a patient in hemorrhagic shock needs an acute intervention (laparotomy) that cannot be safely performed in the district
 - When a patient has a correctable, reversible cause such as tension pneumothorax (after needle decompression!), pericardial tamponade, peritonitis, ectopic pregnancy.
 - Patient continues to be in shock (hypotension, tachycardia, end renal failure, confusion) despite appropriate initial steps to reverse shock.

Volume Resuscitation in Children

Definition: Children in hypovolemic shock are in urgent need of fluid replacement. To prevent further morbidity, it is important to not under or over volume resuscitate the pediatric patient. The key to providing appropriate hydration is early recognition of volume depletion, correcting the underlying cause, and providing IV rehydration in a stepwise and controlled manner.

Causes of Low Volume

- Blood loss
- Sepsis
- Fluid losses from burns, vomiting, or diarrhea
- Inadequate intake, malnutrition
- Cardiogenic

Signs/Symptoms

- Obtain vital signs, including heart rate, oxygen saturation, blood pressure and body weight in kilograms
- Ask the following questions during your exam of the child:
 - Is the child tachycardic?
 - Is the blood pressure low?
 - Is the capillary refill time more than 2 seconds?
 - Are the peripheries cool and mottled?
 - Is there evidence of end-organ poor perfusion
 - Confusion, decreased urine output
- Use the pediatric assessment triangle (figure) to evaluate the child
- Signs and symptoms of hypovolemic shock on the pediatric assessment triangle are:
 - Appearance: weak, pale, lethargic
 - Work of breathing: tachypnea without increased work of breathing
 - Circulation: pale, mottled, decreased capillary refill, weak or absent peripheral pulses, tachycardia, cool extremities, sunken eyes, dry mucous membranes, hypotension (a late finding)

Investigations

- Labs
 - Check for the glycemia upon arrival for any child that is ill-appearing
 - FBC, renal function, lactic acid (if available)
 - Blood cultures, malaria smear, urinalysis
- Imaging
 - Chest XR if sepsis is in differential

Management

General

- Establish IV or IO access

- o Before and after every fluid bolus check the inferior border of the liver, breath sounds, jugular veins to ensure no evidence of fluid overload

Children that are only mildly dehydrated can be treated with oral and/or enteral hydration strategies

Initial Phase (the first 30 minutes)

- Frequent reassessment of cardio-respiratory status and patient response to fluid boluses is essential
 - o Give 10-20ml/kg NS or RL IV, reassess and repeat boluses of 10-20ml/kg until perfusion has improved
 - o If blood loss is suspected as the primary cause, start blood transfusion as soon as possible
 - o If fluid loss is from a burn injury, start the Parkland formula (see Burns Chapter)
 - o If there is evidence or great clinical concern for heart failure, start with fluid boluses of 5-10ml/kg and reassess patient's cardio-respiratory status more frequently

Rehydration Phase (the next 4 to 24 hours)

- If there are no contraindications, most children > 3months of age should be rehydrated over the next four hours
 - o Use ORS (oral rehydrating solution) by NG tube

OR

- IV D5% + 1/2NS with 20mEq KC1 at 10-20ml/kg/hr
 - o How to make D5%+1/2NS with KC1
 - Take out 250cc from 500cc NS bottle. Discard fluid
 - Add 250cc D5% solution to the NS bottle to create a 500cc bottle of 50/50 mix
 - Add 20 mEq of potassium (check how much potassium is in local ampule as it varies by manufacturer) to the 500cc bottle of mixed solution
 - Drip combination formula into IV over four hours
- Children with contraindications should be rehydrated over 24 hrs
- Contraindications to 4 hour rehydration strategies include:
 - o Infants <3 months of age
 - o Severe acute malnutrition
 - o Significant cardio-respiratory co-morbidity
 - o Neurological co-morbidity
 - o Hypernatremia or hyponatremia

Maintenance Phase (as required until able to eat and drink normally)

- "4,2,1 Rule"

- o Give 4mls/kg/hr for first 10kg of body weight, 2mls/kg/hr for next 10 kg of body weight and 1ml/kg/hr for any additional kgs o

Example: Fluids for a 40kg child would be

- $4\text{mLs} \times 10\text{kg} + 2\text{mL} \times 10\text{kg} + 1\text{mL} \times 20\text{kg} = 40+20+20 = 80\text{mLs/hr}$

Fluid Choice

- o Infants and children: D5%+1/2NS o

Adolescents D5%+NS Potassium

Supplementation

- o If child is producing urine and there is no laboratory evidence of hyperkalemia, 20mEq KCL may be added to maintenance IV fluids

Chapter 2

TRAUMA

General Approach to the Trauma Patient

Definition: A systematic approach is the key to the management of the trauma patient. Objectives of the initial evaluation are to identify and manage injuries that can threaten the patient's life.

Causes

- Mechanisms considered to be high risk of critical injury:
 - High speed road traffic accidents (RTA)
 - Pedestrian struck by vehicle
 - Fall from greater than 3 meters
 - Explosions
 - Penetrating injuries
 - Limb amputations
 - Crush injuries
 - Burns
 - Ejection from vehicle

Signs and symptoms

- History
 - Ask about timing of injury, mechanism of injury and any symptoms related to injury
 - Head injury: Headaches, loss of consciousness and neck pain, vomiting
 - Chest injury: shortness of breath, chest pain
 - Abdominal injury: abdominal pain
- Exam
 - Examine every trauma patient in the same manner: primary survey, bedside ultrasound, secondary survey (see Management below for details)

Differential diagnosis

- Intracranial: hemorrhage, diffuse axonal injury, contusions
- Thoracic: pneumothorax, hemothorax, sucking chest wound, tamponade, flail chest
- Intra-abdominal injuries or pelvic fractures
- Orthopedic injuries
- Spinal injuries

Investigations

- Labs
 - FBC, type and cross for blood if hypotensive or tachycardic
- Bedside testing
 - Extended Focused Assessment with Sonography in Trauma (e-FAST)
 - Glycaemia if altered mental status

- Imaging
 - Trauma series: C-spine, CXR, pelvis X-ray are standard x-rays ordered in all major trauma patients
 - Additional X-rays and CT as indicated

Initial approach to assessment and management of the trauma patient

- Place two large bore IV lines, ensure oxygen supply, obtain vital signs, place on cardiac monitor, if available.
- Primary Survey (ABCDE evaluation)
 - Airway: Ensure that the airway is patent
 - Signs of airway obstruction include: change in voice, use of accessory muscles, cyanosis, hypoxia, visible vomit or blood in the mouth, stridor, visible foreign body
 - Intervention: Clear and appropriately position the airway, suction, possible endotracheal intubation
 - Stabilize cervical spine
 - Place hard collar or blanket rolls secured with tape to stabilize C-spine.
 - Maintain in-line immobilization when managing airway.
 - Breathing: ensure adequate airway movement to lungs
 - Signs of ventilation compromise: asymmetric rise and fall of chest wall, hypoxia, sucking chest wounds, deviation of the trachea
 - Intervention: Administer high flow O₂ to keep saturation >93%, needle decompression in tension pneumothorax, or immediate chest tube placement
 - Circulation: ensure adequate perfusion, identify and treat shock
 - Signs of circulation compromise: tachycardia (first sign), hypotension (late finding)
 - Intervention: Place TWO large bore IV lines, give 2L NS or RL bolus, control external hemorrhage (compressive wrap)
 - If patient remains tachycardic or hypotensive after a 2L bolus of fluids, order blood for transfusion
 - Disability: assess neurologic status
 - GCS or AVPU
 - Consider neurogenic shock if there is persistent hypotension after adequate resuscitation in patient with severe spinal injury
 - Exposure: expose the whole body (remove all clothing), note obvious deformities/hemorrhage, avoid hypothermia by putting sheet/blanket over patient
- eFAST exam (bedside Ultrasound)

- o A positive FAST is indication for immediate intervention and possible surgery; these patients will likely need to be transferred to a referral hospital
- Secondary Survey
 - o Head to toe examination and set priorities for care
 - Examination includes head, neck, chest, abdomen, pelvis stability and limbs
 - o If patient is awake, can possibly clear c-spine and remove collar at this point
 - Nexus Criteria- Cervical collar can removed from patient if:
 - No focal neurological deficit present (moving all limbs equally, no sensory deficits or paresthesia)
 - No midline spinal tenderness (palpate cervical spine under collar)
 - No altered mentation (GCS=15)
 - No intoxication
 - No distracting injury (at discretion of doctor, but typically a limb amputation would be an example of a distracting injury)
 - If patient does NOT meet above criteria, keep c-collar in place and consider cervical spine imaging (X ray or CT scan)
 - o Using log roll technique, roll the patient to check his back for injuries and palpate the spine for pain or deformities (see appendix for log roll instructions) o Take the patient's history
 - A: Allergies
 - M: Medications
 - P: Past Medical History
 - L: Last meal
 - E: Event
- Repeat the primary survey if the patient's condition worsens
- Repeat vital signs frequently preferably continuous monitoring

Recommendations

- Treat every major trauma patient with the same steps: begin assessment with ABCDE and resuscitation
 - o During each step of the ABCDEs, perform the intervention that is indicated before continuing
- Indications for referral include: positive FAST, hemodynamically unstable (tachycardia or hypotensive despite fluid bolus), penetrating trauma, open fracture, GCS<13 and need for CT scan, obvious polytrauma or at the discretion of the practitioner.

Head Trauma

Definition: Head injury is defined as physical trauma to the head. It can be classified into two categories: open and closed head injury. Open head trauma includes scalp laceration with an underlying skull fracture. Closed head trauma is defined as head injury with no communication with the outside environment.

Causes

- Road traffic accidents
- Assault
- Fall from heights
- Sports injuries
- Child Abuse

Signs and symptoms

- History: Ask patient or family members about loss of consciousness, vomiting, recent alcohol use, any seizure activity, and severity of any headache or neck pain.
- Exam: Patients need a full neurological exam including GCS, sensation and movement in all limbs, test gait (be sure the patient is able to walk normally on his own).
 - Cushing's Triad (sign of increased intracranial pressure) includes hypertension, bradycardia, irregular breathing
 - Signs of herniation: Unequal sizes or sluggish reactivity of pupils or fixed dilated pupils
 - Signs of basilar skull fracture: bruising around the eyes or behind the ears, bleeding behind the tympanic membrane, clear fluid draining from the nose or ears

Differential diagnosis

- Skull fracture
- Diffuse Axonal Injury
- Intracerebral hemorrhage/contusion
- Traumatic subarachnoid hemorrhage (SAH)
- Subdural hematoma (tear of bridging veins)
- Epidural hematoma (tear of meningeal artery)
- Scalp laceration

Investigations

Labs

- Glycemia, FBC type and cross for blood

Imaging

Indications for CT scan without contrast:

- o If GCS 14-15 (mild head injury): patient needs brain CT *only* if
 - GCS remains < 15 for more than 2hr after injury
 - GCS is falling since injury
 - Patient has focal neurological deficit
 - Patient has seizure
 - Patient has vomited more than 1 time since injury
 - Signs of depressed or basilar skull fracture (blood from the ear, bruising around both eyes)
 - Patient is intoxicated and not able to give reliable exam
- o GCS 3-13 (moderate to severe head injury): Transfer patient for immediate brain CT after stabilizing other injuries. Place c-collar. o Skull XRs are not useful in head injury patients.

Management: General goal for head injured patients is to stabilize and do full trauma evaluation before deciding if patient needs to be transferred to referral hospital for brain CT.

- Place TWO large IVs, supplemental oxygen supply, full vital signs
- ABCDE (see General Approach to Trauma)
- Avoid secondary injury to brain by preventing hypotension (SBP <90 mmHg), hypoxia (spO₂<92%), and by preventing elevation of intracranial pressure (ICP)
 - o Elevate head of the bed to 30 degrees
 - o Sedation and analgesia can reduce ICP (but avoid hypotension)
 - Paracetamol as needed for mild pain
 - IV analgesics are options but do not administer in patients with hypotension
- o Avoid hypo/hyperglycaemia o Do **not** give steroids
 - o Mannitol may offer temporary reduction in ICP; give only if neurosurgery is pending and the patient is not hypotensive
 - Mannitol 0.5 -1mg/kg IV
- Skull Fracture
 - o Non-depressed, linear fracture with scalp intact does **not** need treatment o Depressed skull fractures should be transferred for neurosurgery consultation
- Intracranial Hemorrhage/Contusions
 - o Consult neurosurgery
 - o Most patients are non-surgical and are observed
- Scalp Laceration
 - o Can bleed excessively

- o Irrigate with at least 1L NS or sterile water, debride any contamination or foreign bodies and suture. Apply compression dressing to reduce bleeding

Recommendations

- Patients with GCS of 14-15 after head trauma without any other injuries can be observed for 12-24hr for any decrease in GCS. If they have normal mentation they can be discharged home *without* a head CT.
- Definitive indications for brain CT include GCS 3-13

Maxillofacial Trauma

Definition: Maxillofacial trauma is defined as injury to the face including eyes, nose, and oropharynx. The greatest complication is airway compromise.

Causes

- Fall
- Assault
- Direct blow to the face by an object
- Penetrating trauma
- RTA

Signs and symptoms

- History
 - Dyspnea, hematemesis and hemoptysis from blood draining into oropharynx
 - Blurry vision or vision loss
- Exam
 - Begin by looking at the patient's face
 - Is there asymmetry? Is one eye sunken or enlarged? Is one side of the face enlarged or sunken?
 - Look inside the nose to see if there is a septal hematoma?
 - Ask the patient:
 - Can you see normal? Ask the patient to read your name badge
 - Can you open your mouth normal? If you bite your teeth together, does your jaw fit together normally?
 - Feel the face:
 - Palpate around the eyes, cheeks, nose, jaw. Is there any bony tenderness? Is there loss of sensation anywhere? Is there emphysema or crepitus? Are there any open wounds communicating to the mouth?
 - Specific Exam Findings
 - Hyphema: layer of blood in the anterior chamber, decreased vision
 - Orbital wall fractures: inability to move the eye with orbital floor fracture that causes entrapment of ocular muscles, depressed eye
 - Ruptured globe: tear drop shape of pupil, decreased vision
 - Nasal bone fracture: check for CSF rhinorrhea (clear fluid drainage), subcutaneous air on palpation, nasal septal hematoma appears as a grape like structure along the septum
 - Malocclusion of jaw could be from mandibular fracture, Le Fort fracture (facial fracture), zygomatic fracture.
 - Mandibular fracture: can't open mouth wide (trismus), asymmetry in jaw, teeth don't line up

- Bedside test: Ask patient to bite down on a piece of gauze. When biting, attempt to pull gauze out of mouth. If patient cannot hold gauze, suspect mandible fracture
- Midface fracture (Le Fort injuries): movement of central face when the roof of the mouth is moved; associated bilateral orbital ecchymosis, CSF leaks from nose, significant hemorrhage and swelling
- Dental fracture/avulsion

Differential diagnosis

- Eyelid laceration
- Orbital wall fracture
- Ruptured globe
- Nasal bone fracture
- Midface fracture
- Dental trauma

Investigations

- Labs: FBC if significant bleeding
- Imaging:
 - o Obvious facial deformities need CT face for characterization

Management: Depending on severity of facial trauma, patients require general stabilization like other trauma patients with close attention paid to airway.

- Place large IV, ensure oxygen supply, obtain vital signs
- Place face mask or nasal cannula loosely if facial fractures suspected
- ABCDE (see page 26)
- Antibiotics for any open fracture, CSF leak, or oral cavity lacerations
- Ruptured globe- any full-thickness injury to the cornea, sclera or both
 - o Needs emergent ophthalmology consult. Transfer immediately
 - o Once globe rupture is suspected, the eye should not be further examined or manipulated.
 - o Do not measure IOP, place eye shield and transfer
- Eyelid laceration
 - o Rule out ruptured globe by examining the eye.
 - o Typically requires repair with very small suture (6.0 or smaller); if available, can repair small lacerations. This is to be done by experienced providers only.
 - o Indications for repair by specialist: lid margin or lacrimal duct / sac involvement, within 6-8 mm of medial canthus, inner surface of the lid, cannot open or close eye fully
- Orbital Wall Fracture/Zygomatic Fracture
 - o Commonly involves inferior and medial wall which can entrap the inferior rectus muscle and prevent it from moving

Eye Trauma

Definition: Trauma to the eye can be blunt (fist or hard object striking eye) or penetrating. Any deformity or complaint of eye pain or vision change after trauma must be fully evaluated.

Signs and symptoms

- Immediate evaluation as a part of the secondary survey during the trauma work up.
- You **MUST** open the eye and examine it; exam includes:
 - Visual acuity, pupil exam (are pupils equal, round, reactive to light, and check accommodation). Note pupil size and shape.

LOOK

- Fat herniating? Suggests open injury
- Examine ocular position and motility
 - Exophthalmos- if yes, consider retrobulbar hematoma
 - Extra-ocular movements- Inability to gaze upwards suggests entrapment of eye muscle (needs facial CT of bone to look for fracture)
- Visual acuity decreased? If yes, suggests problem with retinal nerve or stretch of retinal artery
- Pupils unequal or one pupil with tear drop shape (no longer round)- if yes, suggests globe rupture or hyphema
- Pupils with blood in anterior chamber? If yes, suggests hyphema
- Anterior chamber is flat (eye is not round)? If yes, suggests ruptured globe

ASK

- Eye pain or decreased visual acuity? Floaters or flashing lights suggest retinal detachment

Differential diagnosis of eye emergencies **NOT** to miss

- Retrobulbar hematoma: Blunt trauma causes increased intraocular pressure, decreased blood flow to optic nerve, and loss of vision
 - Symptoms include eye pain, proptosis, decreasing vision
 - **Management:** do emergency lateral canthotomy (if trained in procedure) or refer immediately to nearest ophthalmology clinician to save sight
- Hyphema: Blood in the anterior chamber from ruptured iris root vessel
 - **Management:** Sit head of bed up (don't let patient lay flat, if possible with other injuries) Refer to ophthalmology as soon as other trauma issues are stabilized
 - Re-bleeding is common, which will increase intraocular pressure

Retinal detachment: Retina detaches from back of eye

Symptoms include flashers or floaters

- o Diagnosis can only be made by a trained ophthalmology clinician performing a full slip lamp exam.

Management: Refer any trauma patient noting flashes or floaters to ophthalmology within 24hr of stabilizing other trauma issues

Ruptured globe: Sudden elevation of intra-ocular pressure causes rupture

Suspect in any patient with periorbital ecchymosis (bruising), limitations of extra-ocular movements, or gaze paralysis with severe eye pain; may or may not have decreased visual acuity Management:

- o Do NOT manipulate the eye
- o Elevate the head of bed
- o Place protective shield over eye
- o Give broad-spectrum IV antibiotics
- o Immediate transfer to ophthalmology as soon as other trauma issues are stabilized

Chest Trauma

Definition: Any blunt trauma to the chest (See Penetrating Trauma Chapter for details on penetrating chest trauma).

Causes

- Acceleration-deceleration injuries
- Fall from height
- Road traffic accident
- Seatbelt injury
- Assault to chest

Signs and symptoms

- History
 - Difficulty breathing
 - Chest pain
- Exam
 - Assymetric or unsynchronized chest rise
 - Hypoxia
 - Tachypnea or respiratory distress
 - Breath sounds: unilateral decreased breath sounds may indicate pneumothorax or hemothorax
 - Subcutaneous emphysema may indicate pneumothorax
 - Tracheal deviation may indicate tension pneumothorax
 - Cardiac exam: distant or muffled heart sounds, jugular venous distention or Hypotension may indicate cardiac injury or tension pneumothorax
 - Localized chest wall tenderness may indicate rib fracture
- Bedside ultrasound
 - eFAST can diagnose
 - Pneumothorax/hemothorax
 - Pericardial effusion
 - Major intra-abdominal injury

Differential diagnosis

- Rib fractures
- Flail chest
- Pneumothorax/hemothorax
- Lung contusion
- Blunt cardiac injury
- Diaphragmatic rupture
- Intra-abdominal injury (splenic injury, hepatic injury)

Investigations

- Labs: FBC, type and cross for blood if hypotensive or significant tachycardia
- Imaging
 - Chest X-ray- upright

Management: General goal is to treat all trauma patients with a thorough primary and second survey, and stabilize with TWO large IVs, supplemental oxygen as needed, fluids, and frequent reassessment of vital signs while waiting for diagnostic imaging.

- Rib fractures
 - Oxygen if hypoxic
 - Analgesia
 - Admit for observation
 - Repeat CXR after 24h
 - Rule out associated pneumothorax, hemothorax or lung contusion
 - Pulmonary physiotherapy to prevent pneumonia: give patient a latex glove to blow up several times a day
 - Isolated rib fractures in patients with normal saturation are not life threatening.
 - Ibuprofen 800mg PO every 8hr as needed for pain (sometimes require stronger medication like Tramadol for pain control)
 - Discharge home. Patient should expect pain to resolve in about 4-6 weeks
- Flail chest
 - Fractures of >2 adjacent ribs
 - Paradoxical movement seen on exam
 - Admit for observation, supplemental oxygen
 - Transfer if patient has hypoxemia despite supplemental oxygen or if respiratory rate remains above 25 despite oxygen and opiate pain control
 - Intubation and mechanical ventilation may be indicated in severe cases
- Pneumothorax (see Pneumothorax Chapter for details)
- Hemothorax,
 - Upright CXR
 - Treat with tube thoracostomy (drain). See Pneumothorax Chapter for instructions on chest tube placement.
 - Massive hemothorax defined as drainage of more than 1.5 L of blood initially, or 200 mL/hr for 2 hours
 - Consider transfusion of blood (and platelets and FFP where available)
 - Transfer to referral center immediately

- Lung contusion
 - o Observe for hypoxia, dyspnea
 - o May have delayed presentation, initial x-ray may be normal
 - o Treat with bronchodilator, chest physiotherapy
 - o Transfer if patient has worsening hypoxemia despite supplemental oxygen, respiratory rate above 25 despite oxygen, or hypotension ■ Intubation and mechanical ventilation in severe cases

- Blunt cardiac injury
 - o Stunned myocardium with transient hypokinesia
 - o Contusion with infarction
 - o Cardiac valve rupture, papillary muscle or chordae rupture, septal rupture
 - o Cardiac wall rupture
 - o Pericardial effusion
 - o Treatment in emergency department is supportive with aggressive resuscitation; invasive management should be pursued only in operating theater

- Diaphragmatic rupture
 - o May present similar to pneumothorax
 - o Left sided diaphragm rupture is more common than right sided
 - o Bowel may herniate through defect in diaphragm
 - o Rare to diagnose with chest XR; often diagnosed on CT scan only.
 - o Often missed injury.
 - o Requires operative management

Recommendations

- Bedside eFAST ultrasound is a helpful diagnostic tool during trauma assessment.
- Transfer to referral center
 - o All polytrauma patients with hypotension or severe tachycardia despite IV fluids
 - o Any polytrauma patient requiring blood transfusion
 - o Blunt chest trauma patients with hypoxemia despite supplemental oxygen and treatment (chest tube, etc)
 - o Blunt chest trauma patients with respiratory rate >25 despite supplemental oxygen and treatment
 - o Place chest tube for hemothorax, pneumothorax prior to transfer if facilities allow

Blunt Abdominal Trauma

Definition: Blunt abdominal trauma is defined as injury due to a direct blunt force. Such injuries can crush solid (liver, spleen) and hollow (bowel, stomach) organs against the vertebral spine or pelvis causing significant damage. In patients with abdominal pain due to trauma, intraperitoneal injury can be difficult to exclude even when imaging and FAST ultrasound are negative.

Causes

- Blows or crush injuries by animals
- Direct impact from road traffic accident
- Acceleration / deceleration
- Fall from height
- Sports
- Explosion
- Assaults

Signs and symptoms

- History
 - Abdominal pain
 - Vomiting
 - Kehr's Sign: Left shoulder pain with splenic injury
 - Right shoulder pain with liver injury
- Exam
 - Tenderness
 - Abdominal distension
 - Seat belt sign (bruising in the shape of where seat belt goes across chest and abdomen)
 - Consider lumbar fracture; 20% associated with abdominal injury
 - Cullen sign (periumbilical bruising)
 - Suggests retroperitoneal or intra-abdominal bleed
 - Grey Turner sign (flank or groin bruising)
 - Suggests retroperitoneal hemorrhage
 - Peritonitis: rigid, severe abdominal tenderness with percussion
- Bedside tests: FAST ultrasound can identify intraperitoneal fluid

Differential diagnosis

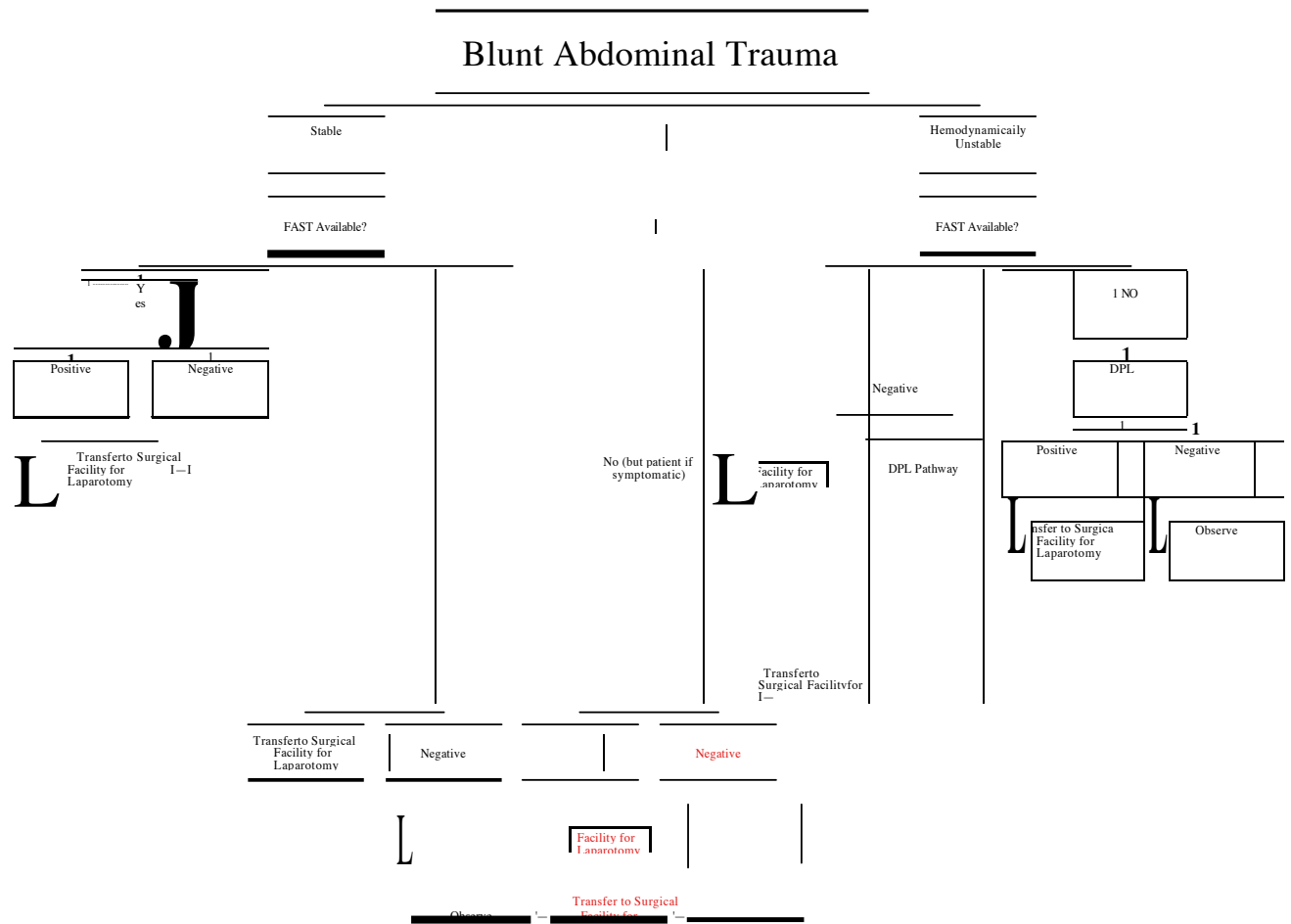
- Hollow viscus injury (bowel, bladder, stomach)
- Solid organ injury (liver, spleen)
- Vascular injury

Investigations

- Labs: FBC, crossmatch for blood if tachycardic or hypotensive
- Imaging

- o FAST ultrasound at bedside
- o CXR to exclude free air below the diaphragm
- o Pelvis XR to exclude pelvic fractures
- o In patients with normal vital signs and positive FAST, consider CT with IV contrast to define injury (also do serial FBC to see if Hb is dropping)
 - Also consider CT if patient has negative FAST but persistent severe pain (FAST exams miss hollow organ and retroperitoneal injuries]

Management: General goal is to obtain a full set of vital signs and stabilize patient with TWO large IVs, supplemental oxygen, and IV fluids while determining extent of injury. See General Approach to Trauma Patients Chapter for more details. See table below to help determine which patients to transfer and which to keep and observe.



Algorithm for the management of blunt abdominal trauma. Created from MOH Surgical Guidelines (pg 124) and the algorithm located at http://openi.nlm.nih.gov/detailedresult.php?img=2663535_1757-7241-17-13-6&req=4

Recommendations

- Patients with normal imaging or negative FAST but continued abdominal pain should still undergo serial abdominal exams over a few hours with at least two FBCs to ensure Hb is not dropping
- Indications for transfer to referral center include:

- o Positive FAST

- o Continued abdominal pain (even if FAST is negative & vital signs are normal)
- o Unexplained hypotension or continued tachycardia
- o Free air on upright chest or abdominal XR
- o Continued GI bleeding

Pelvic Trauma

Introduction: Pelvic trauma can tear the arteries in the pelvis and cause significant bleeding leading to hemorrhagic shock. If a pelvic fracture is found there may be additional injuries present in the head, chest, or abdomen.

Causes

- Blows or crush injuries by animals, heavy loads, etc.
- Direct impact from road traffic accident
- Fall from height

Signs and symptoms

- History
 - Lower abdominal or groin pain
 - Pain with lower limb movement
- Exam
 - Tenderness to palpation
 - Pelvis moves easily when pressure is applied
 - Injury to the urethra: blood at the tip of the penis, hematuria
 - Injury to genitalia: scrotal enlargement / tenderness/ hematoma, blood from the vagina
 - Injury to rectum: blood from rectum
 - Limb shortened, lengthened or rotated
- Bedside tests: FAST ultrasound can show intraperitoneal hemorrhage, but FAST will often be negative due to retroperitoneal hemorrhage.

Differential diagnosis

- Lateral compression
- Antero-posterior compression (open book)
- Vertical shear
- Fracture of acetabulum
- Hip dislocation

Investigations

- Labs: FBC, cross match for blood transfusion if tachycardic or hypotensive, urinalysis to look for obvious blood (indicates renal or urethral injury)
- Imaging:
 - Pelvic XR in all trauma patients
 - Consider abdomen/pelvis CT with IV contrast concern for intra-abdominal injury
 - CTs should only be obtained in stable patients (normal blood pressure). Unstable patients with positive findings typically need theatre.

Management: General goal is to obtain a full set of vital signs and stabilize patient with TWO large IVs, supplemental oxygen, and IV fluids while determining extent of injury.

- Assessment of pelvis during primary and secondary trauma survey
 - Assess the stability of the pelvic ring by pushing the pelvic rim in an inward motion
 - If hips have a greater amount of laxity than normal, consider an open book pelvic fracture
 - Significant pelvic fractures can lose up to 4L of blood before patients goes into hemorrhagic shock
 - Pelvic binding: Use Log roll precautions Slip a bedsheet under a patient's hip and tie firmly across the greater trochanters
 - This is a temporary measure that can help up to 6 hours, and gives you time to transfer patient to referral hospital
 - Move the pelvis as little as possible
- Urethral injuries
 - If there is blood at the meatus, suspect a urethral injury
 - The absence of hematuria does not rule out a urethral injury
 - Do not pass a catheter. Transfer immediately to referral center for general surgery/urology review
 - If CT is not going to be pursued for other injuries, a retrograde urethrogram can be performed to assess for urethral injury (see Appendix)
- Avulsion fractures
 - Small fractures at edges of pelvic ring
 - Manage with pain control and bed rest
- Lateral compression
 - Decreases pelvic volume
 - Life threatening bleeding is more common the higher degree of fracture
 - Transfer to referral center
- Antero-posterior compression (open book ring disruption)
 - Widening of the pubic symphysis seen on XR
 - Associated with sacroiliac fracture or dislocation
 - Can cause significant bleeding
 - Pelvic binding as described above
 - Transfer to referral center immediately
 - Transfuse blood if patient is tachycardia or hypotensive despite 2L IV fluid resuscitation

- Vertical shear
 - o Can cause life-threatening bleeding
 - o Consider indications for pelvic binding as noted above
 - o Transfer to referral center

- Fracture of acetabulum
 - o Acetabulum is the place where the femur meets the pelvis
 - o Caused by flexed knee striking a fixed object which pushes the head of the femur into the pelvis
 - o Transfer to referral center

- Hip dislocation
 - o True orthopedic emergency (see pg ?? on reduction technique)
 - o Hip dislocations need to be reduced (placed back into a normal position) within 6 hours to decrease the incidence of avascular necrosis of the femoral head

Recommendations

- Many types of pelvic fractures can lead to hemorrhagic shock. Other than simple avulsion fractures or isolated pubic rami fractures, pelvic fractures should be transferred to referral center for orthopedic review
- Other indications for transfer include
 - o Hemodynamic instability (tachycardia or hypotensive despite 2L IV fluids)
 - o Evidence of polytrauma and/or other significant traumatic injury

Spinal Injuries

Definition: Spinal cord injuries (SCI) injuries can be classified as complete or incomplete. Complete SCI involves complete loss of sensory and motor function below the level of the lesion. SCI is not diagnosed as complete until spinal shock resolves. Incomplete SCI preserves some motor or sensory function.

Causes

- High speed road traffic accidents
- Pedestrian struck by vehicle
- Fall from height greater than 3 meters
- Explosions
- Penetrating injury
- Fall while carrying heavy load on head

Signs and symptoms

- History
 - Numbness of upper or lower extremities
 - Decrease or absence of power in upper or lower extremities
 - Midline spine pain
- Exam
 - Maintain restricted movement of head and back during examination by log rolling the patient (one person holds the neck stable while two people roll the patient)
 - Palpate for midline spine tenderness, edema or step off
 - Thorough neurological exam is VERY important to aid in diagnosis and treatment options
 - Determine level of injury to aid in choosing imaging studies. Basic levels include
 - Flex elbows: C6
 - Extend elbows: C7
 - Ability to fully abduct little finger (pinky): T1
 - Motor loss at level of nipples: T4
 - Motor loss at level of umbilicus: T10
 - Motor exam (must be done on all four limbs independently!) includes looking for
 - Complete paralysis vs. only decreased power
 - Loss of rectal tone
 - Loss of bowel or bladder control
 - Sensory exam (must be done on all four limbs independently!) includes looking for
 - Paresthesia
 - Decreased sensation of pain or fine touch
 - Autonomic response from neurogenic shock: warm, flushed, bradycardia, hypotension

- o Brown-Sequard syndrome: loss of touch and power on ipsilateral side with loss of pain and temperature on the contralateral side
- o Anterior cord syndrome: loss of power, pain and temperature on both sides below the lesion while position, vibration and light touch are preserved
- o Central cord syndrome: motor loss in the arms greater than legs

Differential diagnosis

- Spinal fracture
- Spinal ligamentous injury
- SCIWORA (spinal cord injury without radiographic abnormality)

Investigations

- Labs: FBC, type and cross for unstable patients with tachycardia or hypotension
- Imaging: Order imaging of spine based on level of injury (using a good neurological exam). For example, if a patient has full strength/power in the bilateral upper arms, they likely do NOT have a cervical spine injury
 - o Cervical spine XR (lateral and AP to evaluate C1-T1, odontoid view to assess C1-C2)
 - o Thoracic or lumbar spinal XR (AP and lateral view) o CT without contrast may be indicated if fracture is not obvious on XR and patient has loss of motor or sensation
- Ligamentous injuries are not directly seen on XR and can cause an unstable spinal column that can injure the spinal cord.
 - o If a patient continues to have midline tenderness in the neck, but a negative XR, keep cervical alignment with a collar until cleared by a specialist

Management: General goal is to obtain a full set of vital signs and stabilize patient with TWO large IVs, supplemental oxygen, and IV fluids while determining extent of injury.

General recommendations for spinal cord injury

- o Stabilize the spine by restricting head and spine movement
 - Use a cervical collar
 - If collar not available, put two bags of NS on either side of head next to ears and tape head to stretcher so patient cannot move neck
- o Do **not** give steroids
- o Do **not** give antibiotics if closed injury
- o If patient has evidence of spinal cord injury on XR, transfer to referral center for review by neurosurgery o If patient has no evidence of fracture on XR, but has sensory or motor deficits, transfer to referral center for review by neurosurgery

Recommendations

- All patients with suspected spinal cord injury need a thorough neurological exam to assess level of injury, motor deficits, and sensory deficits
- Spinal cord injury may be present without radiographic findings. Transfer patients with any neurological dysfunction despite negative XRs to referral center for CT and neurosurgical review
- Stabilize the spine by restricting movement of the neck and back
 - Keep cervical collar in place
 - Log roll patient for movement
- Indications for referral: signs of spinal cord injury on exam or radiographs

Penetrating Trauma

Definition: Penetrating trauma is defined as an injury due to any object that pierces the skin. Penetrating chest trauma most commonly results in pneumothorax and hemothorax. In patients, who have hemothorax, 75% will also have pneumothorax. Penetrating abdominal trauma will likely require emergency laparotomy. A delay to surgery can increase morbidity.

Causes

- Gunshot wounds
- Stabbing
- Impalement by objects
- Shrapnel

Signs and symptoms

- History
 - Penetrating chest trauma:
 - Shortness of breath
 - Hemoptysis
 - Penetrating abdominal trauma:
 - Abdominal pain
 - Vomiting
- Exam
 - Penetrating chest trauma
 - Respiratory distress: tachypnea, intercostal retractions (sucking in of chest wall), nasal flaring
 - Hypoxia
 - Open pneumothorax or airway injury: chest wall or neck crepitus (emphysema), open wound to the chest with airway sounds heard
 - Tension Pneumothorax: Decreased breath sounds on the affected side, distended neck veins, hypotension, trachea moves away from the affected side
 - Pericardial Tamponade: Becks Triad (hypotension, neck vein distension, distant heart sounds)
 - Penetrating abdominal trauma
 - Signs of shock (tachycardia is the first sign, then later hypotension)
 - Peritonitis: fever, tenderness with percussion, abdominal distension
 - Bowels or omentum coming out of the wound
 - Rectal or vaginal bleeding
- Bedside tests
 - eFAST exam

Differential diagnosis:

- Penetrating chest trauma
 - Stable pneumothorax
 - Tension pneumothorax
 - Open pneumothorax
 - Cardiac tamponade
 - Tracheobronchial airway injury
 - Impalement
 - Hemothorax
- Penetrating abdominal trauma
 - Bowel injury
 - Retroperitoneal bleeding

Investigations

- Labs: FBC, type and crossmatch for blood transfusion
- Imaging: Do not delay necessary surgery to obtain imaging.
 - Upright chest XR or AP and lateral abdominal XR to look for free air under the diaphragm or pneumo/hemothorax. If wound is from gunshot mark the path of injury by placing a paper clip on the skin at the first wound and a bent paper clip on the second exit wound.
 - CT scan only for stable patients, but do not delay laparotomy
 - Bedside ultrasound: e-FAST exam to evaluate for free intraperitoneal fluid, pneumothorax and hemopericardium

Management: General goal is to stabilize the patient while waiting for general surgery to evaluate for OT (or for transfer to referral hospital)

- General Management in all patients: Place TWO large IVs, ensure oxygen supply, obtain vital signs. Primary survey includes ABCDE. Positive FAST in penetrating trauma is indication for immediate surgery. Offer pain control and tetanus update. If patient remains hypotensive or tachycardic after a 2L NS bolus, consider blood transfusion and transfer immediately.
- Open pneumothorax
 - Place a one-way valve dressing as a temporary measure and follow with a chest tube/drain as soon as possible:
 - Place a 4x4 gauze over the open chest wound
 - Tape the gauze on any THREE sides only
 - Do not tape directly over the wound
 - The gauze creates a flap that should close with each inspiration
- Cardiac tamponade
 - Give a fluid bolus to increase filling pressure in the right atrium
 - In unstable patient, perform pericardiocentesis, if trained to do this procedure and materials available. Should be guided by ultrasound where available. May place triple lumen catheter to drain if available.

- o Typically requires emergent surgical repair, however, at the time of publication this service was not available in Rwanda
- Impalement
 - o DO NOT remove any impaled objects, make a dressing to secure foreign object in place o Stabilize and transfer to referral hospital
- Penetrating abdominal trauma
 - o Broad spectrum antibiotics
 - o Serial abdominal exams
 - o Indications to transfer to referral hospital:
 - Hypotension or tachycardia
 - Free air noted on upright chest XR
 - All gunshot wounds
 - Extruding bowel (place bowel within abdomen and cover with moist sterile dressing)
 - Peritonitis

Recommendations

- Resuscitation and ABCs are critical to survival of patient. Place two large IVs in any patient with penetrating trauma, start fluids and order blood transfusion early. Consider early transfer for most cases, unless patient is very stable.

Trauma in Pregnancy

Definition: Resuscitation is key to decreasing morbidity and mortality in pregnant patients. Fetal survival is dependent on stabilization of the mother. Even minor trauma may lead to maternal or fetal death. All females aged 10-50 that present to the emergency room for any reason, but particularly for trauma, should have a pregnancy test

Causes

- Falls
- Road traffic accidents
- Penetrating injuries

Signs and symptoms

- History
 - Abdominal pain
 - Nausea, vomiting
 - Decreased fetal movement
 - Vaginal bleeding or leakage of fluid
- Exam
 - Inspection
 - Abdominal tenderness
 - Mom's heart rate: normally increases 10-20 bpm in 2nd trimester
 - Mom's blood pressure normally decreases by 10 mmHg in 2nd trimester
 - It may be difficult to assess whether tachycardia, hypotension or anemia are due to blood loss or normal physiologic changes in pregnancy
 - Fundal height approximately measures fetal age:
 - 12 weeks at the pubic symphysis
 - 20 weeks at the umbilicus
 - 36 weeks at the lower part of the sternum
- Bedside FAST ultrasound and hand held fetal Doppler, if available

Differential diagnosis

- Preterm labor or premature rupture of membranes (PROM)
- Abruptio placentae
- Uterine rupture
- Abortion

Investigations

- Labs
 - FBC, type and screen with Rh incompatibility
- Imaging
 - Shield uterus and perform all necessary imaging, including XRs and CTs

- Do not delay imaging of mother for life threatening bleeding or fracture because she is pregnant. If the mother needs imaging for diagnosis, shield uterus and perform imaging

Management: General goal is to treat mother first as patient. If mother does not do well or does not survive, then baby will also surely die.

- Place 2 large bore IV, ensure oxygen supply, obtain vital signs as in all trauma patients
 - Give IV fluids if tachycardic or hypotensive and transfuse blood early if patient remains with abnormal vital signs after 2L bolus, just as you would a non-pregnant patient
 - If type and screen not yet available and blood transfusion is emergent, give O- blood
- Treatment of pregnant trauma patients that differs from others
 - If patient is greater than 20 weeks gestation, place on her left side while on the spine board to prevent compression of IVC by gravid uterus
 - Remove from spine board as soon as possible to avoid pressure sores on back/buttocks (within 1 hour)
 - Any patient with abdominal pain or vaginal bleeding after trauma **MUST** be transferred to facility with OB physician *immediately*
 - Give Rh-antibody 300 ug IV/IM for Rh negative mother if any vaginal bleeding has occurred
 - Assess fetal heart rate: 120-160 beats per minute is normal
 - Six hours of fetal monitoring for all >20 weeks gestation
 - Even patients with very minor trauma and no symptoms (no abdominal pain, vaginal bleeding, etc.) need six hours of fetal monitoring!
 - Absence of vaginal bleeding or a normal ultrasound does NOT rule out placental abruption
 - Transfer any patient who has fetal heart tones <120 beats/min
 - Administer tetanus toxoid to all patients with any open wounds
 - Pregnant patients have high riding diaphragms so placement of chest tube differs slightly
 - Chest tube should be placed one rib space higher than normal to avoid diaphragm

Recommendations

- Resuscitation of the mother may save the fetus
- Remember left lateral tilt to prevent IVC compression and hypotension
- Absence of abdominal pain or a normal ultrasound does NOT rule out placental abruption. All pregnant patients >20 weeks require at least six hours of fetal monitoring even after minor trauma

Indications for transfer include polytrauma that requires specialty consultation (fractures, head injury), hypotension or tachycardia despite 2L fluid bolus or need for blood transfusion, any detection of fetal heart tones less than 120 bpm during 6hr of monitoring, any vaginal bleeding, or any persistent abdominal pain. Early Involvement of neonatology for a pregnancy of 28 weeks and above

Trauma in Pediatrics

Definition: A systematic approach is key to the management of trauma in the pediatric population. Children deteriorate later than adults but once clinical decline begins it is severe and occurs rapidly. Serious internal injury may occur without fractures.

Causes

- Child abuse
- Road traffic accidents
- Explosions
- Blunt or penetrating trauma by animals
- Fall from height

Signs and symptoms

- History
 - o Ask child what hurts and document symptoms related to injury
 - o Ask family if child is acting normal or has vomiting (head injury)
 - o Has child walked since incident?
 - o Seizures
- Exam
 - o Head injury: unequal pupils, slurred speech, neurologic deficits, vomiting more than one time, drowsiness, irritability
 - o Chest injury: hypoxia, tachypnea
 - Children's bones are different than adults and can result in serious lung injury (contusion) without fractures
 - o Abdominal/GU injury: bruising, distension, seat belt markings
 - Abdominal examination is not reliable in 45% of children. This means they may not have abdominal pain on exam, but can have significant internal injury
 - o Spinal injury: children have flexible spines and may have spinal cord injury without findings on X-ray
 - Do full neurological exam. Assess motricity and sensibility in all four limbs. Record GCS. Assess gait if possible.
 - o Critically ill children: AVPU score other than alert, tachycardia, tachypnea, bradypnea, cyanosis, grunting, nasal flaring, use of accessory muscles, seizures

Differential diagnosis

- Head injuries
- Spine injuries
- Chest trauma
- Abdominal trauma
- Burns
- Non-accidental trauma

Investigations

- Labs: FBC, type and cross for transfusion if hypotensive and tachycardic after fluid bolus
- Imaging: Order XRs per clinical findings or complaints of pain
- All patients need Focused Assessment with Sonography in Trauma (FAST), if available
 - Bedside FAST ultrasound
- Indications for CT head in pediatric patients:
 - Witnessed loss of consciousness (LOC) for >5 minutes
 - Cannot remember events
 - Drowsiness
 - >2 episodes vomiting without cause
 - Seizure after trauma
 - GCS<14
 - Suspected skull fracture
 - Focal neurological deficit
 - Scalp hematoma
 - Severe mechanism of injury
- Indications for c-spine protection and cervical x-ray in pediatric patients:
 - Fall from height greater than twice the child's height
 - Multiple traumatic injuries
 - Altered mental status
 - High speed road traffic accident
 - Coma
 - Tenderness over cervical spine
 - Unable to move limbs

Management

- Initial approach specific to trauma in pediatric patients (also refer to the general approach to trauma section)
 - Place two large IV lines, ensure oxygen supply, obtain vital signs and recheck vital signs frequently
 - Primary Survey (ABCDE evaluation)
 - Airway:
 - Children have a larger tongue, large epiglottis, and the larynx is located more anterior and superior
 - Reposition airway by placing 2-4cm of sheet/blanket under shoulders to open neck area.
 - Place hard collar or blanket rolls secured with tape to stabilize C-spine. Maintain in-line immobilization when managing airway.
 - Breathing:
 - Infants <6 months breathe through their nose

- Facial trauma in this age group may cause demonstrate significant respiratory distress
- Give supplemental oxygen as needed
- Listen for bilateral breath sounds
- Circulation:
 - Signs of circulation compromise: tachycardia (first sign), hypotension (late finding), slow cap refill, decreased responsiveness, cool extremities
 - Normal systolic BP $> 70 + (\text{age} \times 2)$
 - If an IV is not successful after 2 attempts), place an intraosseous line (IO) if available
 - Fluid resuscitation includes an initial 20 mL/kg bolus.
 - If patient is still tachycardic or hypotensive, give another 20 mL/kg/bolus
 - If patient is still tachycardic or hypotensive after two fluid boluses, give 10mL/kg of packed red blood cells and prepare for immediate transfer to referral center
- Disability:
 - Bulging of the anterior fontanelle suggest increased intracranial pressure
 - Signs of neurologic compromise: use AVPU or the modified GCS score (see Appendix)
- Exposure: Children have a greater surface area to mass ratio and are at greater risk of hypothermia
 - Expose the whole body, note obvious deformities / hemorrhage, and then cover with a bed sheet to keep warm
- o Secondary Survey
 - Head to toe examination of injuries and set priorities for care
 - Examination includes head, neck, chest, abdomen, pelvis stability
 - Log roll the patient to evaluate the back
 - Take the patient's history if applicable
- o Repeat the primary survey if the patient's condition worsens
- o Repeat vital signs frequently

Recommendations

- Pediatric trauma patients can present with normal vital signs initially, but then decompensate quickly. They need frequent reassessment of vitals.
- Treat them the same as adults in performing ABCs and secondary survey.
- Consider child abuse when there is a delay in presentation or the pattern of injury does not match the history.
- Indications for referral:
 - o Any child with tachycardia or hypotension after two fluid boluses

- o Evidence or concern for spinal cord injury
- o Evidence of severe head or facial trauma or GCS<14
- o Positive FAST ultrasound on exam
- o Any penetrating head, chest or abdominal injury

Chapter 3

ORTHOPEDICS

General Approach to Fractures

Definition: Fracture refers to any break in the continuity of a bone. Fractures can be classified as open or closed fractures, multi-fragmented (comminuted) or simple and displaced or non-displaced. Fractures most often result from trauma, however occasionally underlying diseases, such as bony malignancy, undermine the strength of the bone such that bone fracture results from minimal trauma. Dislocation refers to a joint dislocation or luxation that occurs when there is an abnormal separation in the joint. The two conditions can co-exist and may be associated with injury of nearby vessels or nerves.

Causes

- Falls
- RTAs
- Assault

Signs and symptoms

- History
 - Mechanism (helps identify injury patterns and reveal occult injuries)
 - Exact time of injury
 - Changes in sensation (numbness, increasing pain)
 - Change in function (tendon injuries)
 - Right or left hand dominance (for upper extremity injuries)
 - Tetanus vaccination status
 - Consider non-accidental trauma injuries (abuse)
 - Pathologic fractures: cancer, malnutrition, bone cysts
- Exam
 - Hemodynamic instability: is the patient bleeding? o
 - Inspection
 - Color: bruising, pallor, mottled appearance
 - Edema or effusions
 - Deformities: angulation, extremity shortening
 - Foreign bodies
 - Palpation
 - Pulses: including capillary refill
 - Temperature: cold extremity may indicate vascular compromise
 - Tenderness
 - Assess for compartment syndrome "6Ps"
 - Pain with passive motion, pallor, poikilothermia (coolness), paresthesias, paralysis, pulselessness
 - Pulselessness is a LATE finding in compartment syndrome. Do not assume that if a patient has pulses, there is no compartment syndrome.
 - Range of Motion: test joints distal and proximal to the injury

Differential diagnosis

- Fracture, open or closed. Fractures may be occult (initial XR looks normal, but fracture is present)
- Dislocation
- Contusion
- Tendon tear- complete or partial
- Ligament tear- complete or partial

Investigations

- Labs: If significant trauma or multiple injuries or open fractures, do FBC and crossmatch for possible pre-operative evaluation
- Imaging:
 - o All areas of concern should be evaluated with XR in at least 2 views.
 - o Be sure to XR joints above and below the injury.

Management: General goal is to assess for possible neurovascular compromise (associated motor and sensory injuries, compartment syndrome), reduce any dislocations, clean any open fractures, and splint as early as possible for comfort. Providers need to understand which fractures need transfer immediately vs. urgently vs. not at all. See following chapters for management of specific fractures

- If XRs are negative and patient continues to have pain or refusal to range joint consider splinting/immobilization of the affected area and repeat XR in one week
- Transfer immediately any open fractures or injuries associated with neurovascular compromise.

Management of Open Fractures

Definition: An open fracture refers to the disruption of the skin and underlying soft tissue that results in communication between the fracture and the outside environment. Severity of the open fracture is based on the Gustilo-Anderson Classification:

- *Grade I:* The wound is less than 1cm long. It is usually a moderately clean puncture.
- *Grade II:* The laceration is more than 1 cm long, and there is no extensive soft-tissue damage. There is a slight or moderate crushing injury, moderate comminution of the fracture and/or moderate contamination.
- *Grade III:* These are characterized by extensive damage to soft- tissues, including muscles, skin, and neurovascular structures, and a high degree of contamination (Bone is exposed).

Causes

- RTA
- Farm accidents
- Sports accidents
- Assaults

Signs and symptoms

- History
 - Ask about exact time of injury
 - Changes in sensation (numbness, increasing pain)
- Exam
 - Assess hemodynamic instability: is the patient bleeding?
 - Inspect for deformities: angulation, extremity shortening
 - Foreign bodies
 - Palpate pulses and assess capillary refill
 - Temperature
 - Cold extremity may indicate vascular compromise ◦ Look for other injuries that may be more subtle, such as tendon injuries in the hand.

Differential diagnosis

- Grade I
- Grade II
- Grade III

Investigations

- Labs: Send FBC for pre-operative
- Imaging: Do x-ray in at least 2 views. Include joints above and below the injury.

Management: General goal of open fracture management includes prompt and thorough wound irrigation, administration of IV antibiotics, temporary splinting, and transfer for timely surgical debridement in the operating theatre.

- Wound care
 - Irrigate with sterile water or normal saline immediately upon arrival
 - Remove gross contamination
 - Apply moist sterile dressing
- Tetanus prophylaxis
- Splint the limb
 - Even if patient will eventually go to surgery, temporary splinting with backslab or hard surface provides pain relief and helps reduce any neurovascular compromise
- Antibiotics should be given within 6 hours. The choice of antibiotic to be used depends on the fracture type and the likely contamination of the fracture site.
 - Grade 1: 1st generation cephalosporin
 - Cloxacillin 500mg IV
 - Grade 2: 1st- generation cephalosporin + or - an aminoglycoside depending on the level of wound contamination
 - Cloxacillin 500mg IV

AND

- Gentamicin 4mg/kg IV
- Grade 3: 1st- generation cephalosporin and an aminoglycoside
 - Cloxacillin and Gentamicin as above
- Any wound that is at high risk for anaerobic contamination (farming, open water) should also be treated with Penicillin or Ampicillin.
- Transfer for orthopedic intervention after above measures are completed at the health center or district hospital

Recommendations

- Open fractures should be transferred *after* thorough wound irrigation, antibiotic administration, and splinting

Fall on Outstretched Hand (FOOSH)

Definition: A Fall on an Outstretched Hand (FOOSH) can result in dislocations or fractures of the bones of the hand, wrist, or forearm. Commonly affected bones include the distal ulna, radius or carpal bones (scaphoid, lunate, triquetrum, pisiform, trapezium, trapezoid, capitate and hamate bones).

Causes

- Fall on the outstretched hand and extended wrist
- RTA
- Sports contact injury

Signs and symptoms

- Exam
 - Determine exact location of pain
 - Palpate individual bones beginning at the sterno-clavicular joint and move distally
 - Assess for numbness or tingling
 - High risk of associated nerve or vascular injuries. Sensory changes may be an early sign.
 - Range all joints from the shoulder to the carpometacarpal joint
 - Axial loading and palpation of the anatomical snuffbox to evaluate for occult scaphoid fractures
 - Examine pulses and capillary refill
 - Do a focal motor and sensory exam

Differential diagnosis

Children

- Buckle or torus fractures of the distal radius
- Greenstick fractures of the distal radius
- Distal radius fractures
- Supracondylar humerus fracture
- Radial head fracture
- Clavicle fracture or dislocation

Adults

- Distal radius fracture: Colles vs. Smith fracture
- Scaphoid and other carpal fractures
- Scapholunate and perilunate dislocation
- Distal radio-ulnar dislocation
- Monteggia fracture
- Supracondylar fracture
- Proximal humerus fracture- especially in elderly
- Clavicle fracture

Investigations

- Labs: none
- Imaging: X-ray area of tenderness/deformity and joint above and below
 - Dedicated views may be required: scaphoid fractures

Management

- Distal radius and ulnar fractures
 - Displaced fractures must be reduced as quickly as possible and splinted with sugar tong splint.
 - Reduction should be attempted by supplying axial traction
 - Pull on the thumb and ring finger while an assistant holds the elbow.
 - Pull the distal segment back up and out
 - With traction at the distal segment and the arm pronated, use both thumbs to push down and into anatomical position.
 - Control XR after reduction to ensure good position ◦ Once good position achieved, place sugar tong splint for one week, followed by POP in same position for 4-6 weeks
 - The wrist should be placed in 20-30° of extension; the metacarpophalangeal (MCP) joints should be immobilized in 70-90° of flexion, with the dorsal aspect of the splint extending to the IP joints; and the volar aspect should end at the distal palmar crease.
 - Transfer for orthopedic management if reduction unsuccessful or good alignment not achieved
- Scaphoid fracture
 - Initial XRs are negative 10% of time! Suspect if swelling, pain on palpation of the anatomic snuffbox and pain with axial loading of the first metacarpal
 - If fracture noted on x-ray or if above physical exam findings, immobilize in a thumb spica splint and refer to OPD orthopedics
- Other Wrist Bone Fractures
 - Sugar tong splint initially, then short arm POP cast for 8 weeks

Recommendations

- Transfer all injuries associated with neurovascular compromise **after** attempting prompt reduction

Shoulder Dislocation

Definition: Most shoulder dislocations are anterior; posterior dislocations are less frequent and more difficult to diagnose.

Causes

- Forced external rotation with abduction in the extended arm
- Falls

Signs and symptoms

- Pain, tenderness and swelling of the affected shoulder
- Arm of the affected shoulder is held in abduction and external rotation
- Decreased range of motion
- Loss of deltoid contour compared with contralateral side
- Prominence of the acromion and palpable head of the humerus anteriorly in the axilla

Differential diagnosis

- Anterior dislocation
- Posterior dislocation
- Fractures
- Elderly patients may have humeral shaft fractures

Investigations

- Labs: none
- Imaging
 - Anterior-posterior (AP) view and scapular Y view X ray
 - AP view will confirm if dislocation is present
 - Y view will confirm whether dislocation is anterior or posterior

Management

General goal is reduce shoulder dislocations as quickly as possible.

- Analgesia and/or procedural sedation prior to reduction (see Chapter on procedural sedation)
 - Relaxation of the muscle is most important in reduction success!
- Look for associated fractures on XR before attempting reduction.
 - If fractures present, reduction still necessary, but reduction needs to be more gentle
- Reduction techniques
 - Traction/Countertraction
 - Patient supine with arm abducted and elbow flexed at 90 degrees. Place a bed sheet across patient's thorax/chest (under the affected arm) and then around the waist of an assistant.

- One provider applies gentle traction by holding the affected forearm and pulling while the assistant also pulls the sheet in the opposite direction
 - Gentle internal and external rotation or outward pressure on the proximal humerus may help
 - Milch technique
 - With the patient in supine position, provider gently abducts then externally rotates the arm to the overhead position. Once overhead and fully extended, apply gentle traction on the arm.
- Arm sling after reduction for 2-3 weeks
- Do control XR after reduction
- Orthopedic OPD follow up for chronic dislocation
- Always check for neurovascular function before and after reduction attempt
 - Check sensation along the deltoid region

Recommendations

- Dislocations must be reduced as soon as possible to avoid permanent injury or surgical intervention
- Transfer to referral center if unable to reduce using procedural sedation and above techniques

Elbow Injuries in Adults and Children

Definition: Elbow injuries are common in upper extremity trauma. Supracondylar fractures are the most common childhood injury.

Causes

- Fall on outstretched hand
- Direct blow to the elbow

Signs and symptoms

- History
 - o Ask patient about mechanism (helps identify injuries as well as other occult injuries)
 - o Consider non-accidental injury in children (child abuse)
- Exam
 - o Range of motion of the elbow: active and passive
 - Elbow flexion and extension
 - Pronation and supination
 - o Deformities: angulation, extremity shortening
 - o Focal tenderness, swelling
 - o Loss of olecranon prominence
 - o Distal pulses and sensory function
 - Up to 20% will have associated neurovascular injury

Differential diagnosis

- Supracondylar fracture
- Olecranon fractures
- Radial head fractures
- Radial head subluxation (children)
- Dislocation

Investigations

- Labs: none
- Imaging
 - o AP and lateral x-rays:
 - 'Fat pad' sign seen in articular injuries
 - Anterior fat pad is normally a narrow radiolucent stripe near distal humerus
 - If the radiolucency develops perpendicular, or triangular component, concerning for fracture.
 - Posterior fat pad is always abnormal and a sign of fracture
 - o AP and lateral x-rays: Children
 - Fractures often occur through unossified cartilage
 - Do not confuse ossification site for fracture

- Look closely for alignment: A line drawn down the anterior surface of the humerus should always bisect the capitellum in the lateral view.

Management: The general goal is to assess for associated neurovascular injuries, as they are very common in elbow fractures. Of particular concern is compartment syndrome in the forearm.

- Supracondylar fracture
 - Xray
 - Check for Neurovascular injuries
 - Place back slab
 - On lateral XR, the anterior humeral line should run through the middle third of the capitellum
 - Misalignment suggests a supracondylar fracture
 - In children, a posterior fat pad (sail sign) on lateral x-ray may suggest an occult supracondylar fracture.
 - Check for neurovascular injuries in all patients
 - Median nerve injury
 - Ask patient to make the "OK" sign
 - Compartment syndrome
 - Ask patient to open and close hand (severe pain suggests possible compartment syndrome), forearm tenderness
 - Place backslab splint
 - Double sugar tong splint (above and below elbow) with the elbow flexed at 90 degrees and the forearm in neutral position
 - Any case with neurovascular compromise needs immediate transfer
 - Keep arm with possible compartment syndrome elevated above the level of the heart during transfer
 - Other cases need urgent transfer to orthopedics OPD for surgical repair (within one week)
- Olecranon fractures
 - Tenderness over the olecranon and inability to extend the elbow against pressure is highly suggestive of a fracture
 - Splint all fractures
 - Double sugar tong splint (above and below elbow) with the elbow flexed at 45-90 degrees and the forearm in neutral position
 - Displaced fractures or those with evidence of neurovascular compromise require urgent referral to orthopedics for surgical treatment
 - Non-displaced fractures may go to orthopedics OPD within 2-3 weeks

- Radial head fractures
 - o Often present with tenderness over the radial head and painful extension of the elbow. o Most common occult fracture in adults
 - Suspect if posterior fat pad is seen on lateral x-ray
 - o Non-displaced fractures may be treated with analgesia and sling for 5-7 days. o Displaced or angulated fractures should be splinted with backslab and referred to orthopedics OPD in 1 weeks for surgical reduction

- Radial head subluxation (children)
 - o Often called nursemaid's elbow
 - o Occurs in children between ages of 1 and 3 yrs old when traction force is applied to the arm with the elbow extended and the wrist pronated. o Suspect when child refuses to move the elbow, which is held in flexed and pronated position o Management includes reduction with gentle but rapid hyperpronation and flexion of the elbow o No orthopedic follow up needed if child is able to move arm without pain after reduction

- Dislocation
 - o Most dislocations are posterior and associated with fractures.
 - Look for associated with brachial artery injuries
 - Growing and pulsatile hematoma, pale or cold extremity, absent or weak pulses
 - Transfer possible brachial artery injury immediately
 - o Management includes reduction by stabilizing the humerus and applying gentle traction to the wrist, then flexion at the elbow o After reduction elbow should be immobilized with splint
 - Double sugar tong splint (above and below elbow) with the elbow flexed at 90 degrees and the forearm in neutral position
 - o Control XR required after reduction

Recommendations

- Transfer any injury associated with neurovascular compromise **after** attempting prompt reduction
- All children with supracondylar fractures will require surgery. Transfer to orthopedics OPD within one week for evaluation
- Elbow fractures can easily be missed on initial XR. If patient has swelling, tenderness, or refusal to range elbow with a negative XR, put in posterior backslab with elbow at 90 degrees and repeat XR in one week.

Hand Exam and Fractures

Definition: Hand fractures can involve any of the 5 metacarpals or 14 phalanges. Fractures of the hand and fingers are commonly accompanied by dislocation or tendon injury.

Causes

- Fall on outstretched hand
- Direct blow

Signs and symptoms

- Assess for pain, swelling, deformity and limited range of motion
- Hand examination:
 - Look: If fingers misaligned consider fracture with rotation or dislocation.
 - Flex all fingers at the MCP joint and maintain extension in PIP and DIP joints: each finger should point towards the radius without overlap
 - Feel: For radial and ulnar pulses, capillary refill time
 - Sensation: Assess for sensation at radial, ulnar, and median nerve
 - Radial: dorsal web space of the thumb and index finger
 - Ulnar: volar tip of the little finger
 - Median: volar tip of the index finger
 - Motor: Assess for motricity at radial, ulnar, and median sites
 - Radial: wrist extension and finger flexion
 - Ulnar: spread fingers against resistance
 - Median: thumb abduction (flexion) while dorsum of the hand is flat on the table.
 - Other muscle groups
 - Flexor digitorum superficialis (FDS): Inserts into proximal phalanx. Individually tested by holding other fingers in hyperextension and asking patient to flex at the proximal interphalangeal joint (PIP)
 - Flexor digitorum profundus (FDP): Inserts into distal phalanx. Tested by fixing the PIP joint and asking patient to flex at the distal interphalangeal joint (DIP)

Differential diagnosis

- Fractures
- Dislocation
- Ligamentous/tendon injury

Investigations

- Labs: none
- Imaging: X-ray hand or finger, AP and lateral views

Management

- Metacarpal fractures
 - Look for angulation of fractured piece. Some angulation at fourth and fifth metacarpal is okay. Any angulation at first and second metacarpal should be reduced prior to splinting
 - Types of splint
 - Index, middle finger fractures: Radial gutter splint
 - Ring, small finger fractures: Ulnar gutter splint
 - Best splint position
 - Forearm-based, extending over the dorsal and palmar aspect of the entire metacarpal
 - Place wrist in 20-30° of extension
 - Metacarpophalangeal (MCP) joints immobilized in 70-90° flexion
 - Dorsal aspect of the splint extends to the IP joints
 - Volar aspect ends at the distal palmar crease
- Distal phalanx fractures
 - Volar splint on tip of finger only
 - Do not immobilize the PIP
- Middle/proximal phalanx fracture
 - "Buddy tape" - secure fractured finger to unaffected finger with tape and a piece of gauze in between fingers
- Thumb proximal phalanx
 - Thumb spica splint
- Open hand fractures
 - Transfer for IV antibiotics and orthopedic evaluation if hand appears infected
 - All wounds need immediate cleaning and prophylactic antibiotics
 - Wash wound thoroughly with *at least* 500cc sterile water/normal saline.
 - Start antibiotics immediately
 - Penicillin 500mg PO every 6hr for 7 days
 - OR
 - Amoxicillin-Clavulanate 625mg PO 3x/day for 7 days
 - Patient should return to health center or district hospital for daily wound checks until wound has healed
- Amputations
 - Replant surgeons are not widely available in Rwanda, but may be found at Kanombe, King Faisal, or CHUK. Transfer patient for management and include affected limb/digit when possible
 - Place amputated section in gauze soaked with saline, then inside a plastic bag. Do not place body part directly on ice.

Recommendations

- Verify neurovascular status after applying splint
- Refer hand injuries to OPD orthopedic care for surgical evaluation

Hip Fractures and Dislocations

Definition: Fractures of the proximal femur are divided into intracapsular (femoral head and neck) and extracapsular (intertrochanteric, trochanteric or subtrochanteric) fractures. In hip dislocation, the femoral head may lie anterior (10%) or posterior (90%) to the acetabulum. Hip fractures are often associated with DVT formation. Delay in repair of certain hip fractures or hip dislocation can lead to avascular necrosis of the femoral head.

Causes

- Falls
- RTA

Signs and symptoms

- Unable to walk
- Leg held in a fixed position; neck of femur fractures may be shortened and externally rotated
- Limited range of motion
- Assess neurovascular status: palpate pulses and check capillary refill
- Patient may report pain in the groin, hip, thigh, or medial aspect of the knee

Differential diagnosis

- Femoral head fracture (rare)
- Femoral neck fracture
- Intertrochanteric fracture
- Trochanteric fracture
- Subtrochanteric fracture
- Dislocation

Investigations

- Labs: none
- Imaging: AP pelvis and lateral hip x-rays

Management

- Femoral neck fractures
 - o High risk for avascular necrosis
 - o Avoid traction with elasto-plasty as blood flow to femoral head may be further compromised o Call consultant and refer to orthopedics OPD for early surgical fixation (ideally <6hrs)
- Intertrochanteric fractures
 - o Typically occur along a line between the greater and the lesser trochanter o Initial traction with elasto-plasty

- o Operative treatment within 48 hours is preferred, but consult OPD orthopedics for timeline of intervention
- Trochanteric fractures
 - o Isolated lesser trochanter fractures are rare and require surgical fixation
 - o Greater trochanter fractures with less than 1cm of displacement can be treated with bed rest (until pain improves), weight bearing as tolerated with crutches, full weight bearing in 6-8wks
- Subtrochanteric
 - o Require surgical treatment
 - o Refer to orthopedics OPD for internal fixation or hip replacement, where available.
- Hip dislocation
 - o **This is a true orthopedic emergency** - early reduction leads to better outcome. Must attempt reduction in the district hospital!
 - o Posterior dislocation reduction (Allis maneuver)
 - Requires two practitioners
 - One assistant stabilized the pelvis, by applying posterior pressure to the pelvis.
 - The second practitioner stands on the foot of the stretcher and gently and slowly flexes the hip and the knee to 90 degree.
 - The hip is then gently adducted and internally rotated while increasing sustained traction is applied by pulling on the knee.
 - o Anterior dislocation reduction
 - Requires two practitioners.
 - The assistant applies longitudinal traction and gentle internal rotation to the femur in its abducted position.
 - Practitioner holds the pelvis and applies gentle pressure to the femoral head to push it back into the acetabulum.
 - o Control XR is required to confirmed reduction
 - o Transfer all dislocations that cannot be reduced immediately

Recommendations

- Hip dislocations are a true orthopedic emergency and must be reduced as soon as possible for best outcome.

Long-Bone Fractures of the Leg

Definition: Long bone fractures of the lower extremity may affect the tibia, fibula, or femur.

Causes

- Falls
- RTA

Signs and symptoms

- Unable to walk
- Swelling, deformity and/or tenderness at the site of the injury
- Compartment syndrome very common in the lower leg.
 - Examine for severe, worsening pain, pallor, and paresthesias.
 - Decreased or absent distal pulses are a LATE finding

Differential diagnosis

- Femur fracture
- Tibial plateau fracture
- Tibial shaft fracture
- Isolated fibula fracture

Investigations

- Labs: FBC for all femur fractures as large amount of blood can be lost
- Imaging: X-ray the long bone/femur, as well as joint proximal and distal to the injury.

Management

- Femur fractures
 - Assess for neurovascular compromise
 - Feel for distal pulses at top of foot
 - Place elastoplasty and traction splint as quickly as possible
 - Refer to orthopedics OPD for all femur fractures, typically within 1-2 weeks.
 - Many children do well without surgery, but most adults may require operative intervention in the future
 - Be aware of non-accidental trauma in pediatric femoral fractures. Have elevated concern for abuse if the child is not yet ambulatory and has a femur fracture or if the history is not consistent with the type of fracture.
- Tibial plateau fracture
 - Initial management requires immobilization with long leg splint/backslab with knee at 5 degrees flexion.
 - Non-weight bearing.

- o OPD orthopedics referral in 1-2 weeks for evaluation for possible surgical management.
- Tibial shaft fracture
 - o Associated with compartment syndrome
 - Feel for significant swelling at calf region, pain out of proportion to exam, pain with flexion/extension of ankle, and check for distal pulses (absent pulses is a late finding)
 - o Non-displaced fractures can be managed conservatively with a long-leg splint for one week, followed by POP for 6-8 weeks
 - o Displaced fractures require prompt reduction in the emergency department, followed by long leg backslab
 - o Transfer to referral center immediately if reduction isn't possible or if any concern for compartment syndrome
- Isolated distal fibula fracture
 - o Splint with posterior backslab
 - o Bear weight as tolerated with crutches for 4-6 weeks
 - o Typically no orthopedic follow up needed

Recommendations

- A significant amount of blood can be lost with a femur/long bone fracture. Reduce with traction as soon as possible and send serial FBCs to ensure no transfusion is needed.
- Transfer all open fractures after washing out wound with sterile water, placing affected joint in splint or traction, updating tetanus, and starting IV Cloxicillin
- Repeat neurovascular assessment frequently for evidence of compartment syndrome. If any evidence of compartment symptoms, refer to orthopedics immediately.

Knee Injuries

Definition: Knee injuries are common and can be accompanied by significant vascular or neurologic injuries. For instance, popliteal artery injuries occur in approximately 35% of knee dislocations.

Causes

- Falls
- RTA
- Direct force to the knee

Signs and symptoms

- Use the Ottawa knee rules (100% sensitive in adults)
 - If patient has any one of the following, they need an XR of the knee
 - Age >55 years
 - Isolated patellar tenderness
 - Tenderness at the head of the fibula
 - Inability to flex knee to 90 degrees
 - Inability to bear weight (four steps) immediately after injury and when examined
- Test passive range of motion to evaluate for ligament and meniscal integrity as they will have joint laxity
 - Medial and lateral laxity should be tested at 20 degrees flexion of the knee.
 - Laxity in the joint is best assessed by comparison to the unaffected side.
- Knee dislocations are at high risk for popliteal artery injury or peroneal nerve injury
 - Evaluate popliteal, posterior tibialis and dorsalis pedis pulses
 - Peroneal nerve injury shows decrease sensation of 1st web space, inability to dorsiflex the foot

Differential diagnosis

- Knee ligament injuries
- Patellar dislocation
- Patellar fracture
- Quadriceps and patellar tendon rupture
- Tibial plateau fracture

Investigations

- Labs: none
- Imaging: AP and lateral views of knee
- Use the Ottawa knee rules (100% sensitive in adults)
 - If patient has any one of the following, they need an XR of the knee
 - Age >55 years

- Isolated patellar tenderness
- Tenderness at the head of the fibula
- Inability to flex knee to 90 degrees
- Inability to bear weight (four steps) immediately after injury and when examined

Management

- Knee ligament injuries (pain/swelling at knee, but no fracture on XR)
 - Make a "knee immobilizer" by placing long backslab behind knee (keep ankle joint free to rotate) at 5 degrees flexion
 - Non-weight bearing until OPD orthopedics follow-up in 1-2 weeks
 - Patient can remove backslab to flex and extend knee once a day
- Patellar dislocation
 - Presents with knee locked in flexion, patellar felt laterally
 - Reduce by extending the knee and pushing the patella medially
 - Obtain control XR after reduction
- Patellar fracture
 - Initial management is immobilization with backslab splint for 4-6 weeks.
 - If unable to extend knee against gravity, treat as quadriceps or patellar tendon rupture (see below).
 - Displaced or comminuted fractures should be referred to OPD orthopedics for possible surgical intervention.
- Knee Dislocation
 - Dislocations should be reduced immediately and immobilized with backslab.
 - Reduction may be accomplished with longitudinal traction
 - Post-reduction the knee should be splinted in 20 degrees of flexion
 - Serial vascular assessments necessary due to the high risk for popliteal artery injury
 - Consult orthopedics or surgery for any concerns for vascular compromise (weak or absent distal pulse, sluggish capillary refill)
- Quadriceps and patellar tendon rupture
 - Suspect with low or high riding patella and inability to fully extend leg at the knee.
 - Immobilize the knee in full extension
 - Refer to OPD orthopedics for possible surgical intervention

Recommendations

Knee injuries have high risk for neurovascular injuries. Always check for distal pulses

- o Failure to re-vascularize the popliteal artery within 6-8 hours leads to approximately 90% amputation rate.

Ankle Injuries

Definition: Injuries can include ligament injuries, tendon injuries, dislocation or fracture of the tibia, fibula and/or talus. Partial or complete ligament tears are the most common ankle injuries (ankle sprain). Associated proximal tibial and fibular fractures are often seen; therefore careful inspection of the entire leg distal to the knee is very important.

Causes

- Forceful inversion/eversion
- External rotation
- Dorsiflexion
- Falls

Signs and symptoms

- "Ottawa Ankle Rules" determine which patients need **ankle** x-ray:
 - Ottawa rules are 100% sensitive
 - Only validated in patients > 5 years old
 - Pain with palpation of distal 6cm of tibia and fibula (medial and lateral malleoli)
 - Inability to bear weight for 4 steps after injury **and** in the ED
 - Determine which patients need **foot** x-ray:
 - Bony tenderness at base of 5th metatarsal (pinky toe)
 - Bony tenderness at the navicular (mid foot)
 - Inability to bear weight as above
- Evaluate for active plantar flexion (Achilles tendon rupture)
- Complete evaluation of proximal tibia, fibula and the knee (Maisonneuve fracture is ankle fracture with associated fracture at head of fibula)
- Every exam needs to include palpation of distal pulses (top of foot and behind medial malleoli)

Differential diagnosis

- Ankle ligament injuries
- Achilles tendon injury
- Distal tibial fractures (pilon fracture)
- Malleolar fractures
- Trimalleolar fractures
- Maisonneuve Fracture
- Ankle dislocation
- Open fractures

Investigations

- Labs: none needed unless going to OT
- Imaging: XR of ankle or foot
 - If an unstable injury is relocated, you must obtain post-reduction films

- o Imaging of proximal tibia and fibula if suspected Maisonneuve Fracture (tender at head of fibula)
- o Imaging of foot if suspected foot fracture (base of 5th metatarsal or midfoot tenderness)

Management

- Open fracture: refer to Open Fractures chapter
- Displaced ankle joint
 - o All displaced fractures should be have closed reduction through traction/manipulation as soon as possible
 - o Always check a neurovascular exam before and after reduction (look for pulses at top of foot and behind medial malleolus, check capillary refill, and basic sensory exam)
 - o A slight flexion of the knee is often necessary to successfully reduce the ankle
 - o Reduce the ankle before x-rays if there is skin tenting or neurovascular compromise on exam.
 - o Analgesia should be given prior to attempting reduction
 - o Do a control XR after reduction to ensure success
- Ankle ligament injuries/sprains (no fracture on XR, but swelling and pain present)
 - o Provide support with elastic bandage, non-weight bearing until acute pain resolves
 - o Patient should elevate leg at home
 - o Provide analgesia until swelling improves
 - Ibuprofen 800mg PO every 8hr as needed for pain
- Achilles tendon injury (often caused by sudden dorsiflexion)
 - o Non-operative management consists of serial plaster: initial cast applied is a long-leg cast with some knee flexion and ankle plantar flexion to allow free edges of the Achilles to approximate. The plaster is changed in series, decreasing the plantar flexion and eventually moving toward short-leg casts in a neutral ankle position. This treatment lasts 6-12 weeks.
 - o Refer to OPD orthopedics as young, active patients may benefit from operative management.
- Distal tibial fractures (pilon fracture)
 - o Non-displaced fractures without articular involvement can be treated conservatively.
 - Initially place splint (backslab) for 1 week.
 - Then change to long leg POP and non-weight bearing for 6-8 weeks.

- o Displaced tibial fractures or those with articular involvement should be immobilized with a backslab and referred to OPD orthopedics for surgical management.

Malleolar fractures

- o Non-displaced stable fracture patterns with an intact syndesmosis can be treated with short leg, well-molded posterior backslab with ankle in neutral position (at 90 degrees) for 6-8 weeks
 - OPD orthopedics follow-up
- o Displaced fractures must be promptly reduced in the emergency department
 - Place backslab after reduction
 - Order control XR to ensure proper alignment
 - Refer to OPD orthopedics within one week for possible surgical intervention

Bimalleolar (both distal fibular and distal tibia fractured) and trimalleolar fractures (a third fracture is noted on the lateral ankle film in the posterior region)

- o Inherently unstable fractures and will eventually need surgery
 - Immobilize with a back slab short leg splint
 - Refer to OPD orthopedics within one week for surgical management

Recommendations

- Exam must include exam of joint above (knee/fibular head/tibia head) and below (foot) to ensure no associated injuries
- Exam must include neurovascular check (distal pulses, capillary refill, sensory exam)
- Prompt reduction of dislocation or displaced fracture should occur at health center or district hospital
- Prompt wash out of the wound, tetanus shot, and antibiotics should be given for open fractures PRIOR to transfer

Chapter 4

RESPIRATORY

General Approach to the Dyspneic Patient

Definition: Shortness of breath or difficulty in breathing is a very common reason people go to the hospital, and it has a very large differential diagnosis. Respiratory failure (patient is not able to maintain adequate oxygenation or ventilation) is also a very common cause of death in Rwanda. It is a physician's job to first stabilize the patient in respiratory distress (the work of breathing is increased) and then to find the cause so that appropriate treatment can be started.

Causes

- Inability to oxygenate (cannot get oxygen into lungs)
- Inability to ventilate (no CO₂ exchange; cannot push air out of lungs)
- Decreased mentation (inability to keep airway open to exchange air)

Signs and symptoms

- The first five minutes that a patient presents in respiratory distress is the most important. Always start with ABCS:
 - o A: can the patient speak? If yes, the airway is good. Is there significant oral airway edema or trauma? Has the patient recently vomited? If yes, there is an increased aspiration risk
 - If airway is NOT intact, STOP. Position patient with the jaw thrust and chin lift maneuvers. Look for foreign body. Suction if needed. Start oxygen with non-rebreather mask (bag reservoir) and consider intubation if possible.
 - o B: Check saturation- Is there hypoxemia? Are breath sounds equal bilaterally? Is the patient posturing (sitting upright, uncomfortable, with increased work of breathing)? Is the trachea midline? A shifted trachea is a sign of tension pneumothorax.
 - If breathing is NOT intact, STOP. Position patient with the jaw thrust and chin lift maneuvers., start oxygen with non-rebreather mask (bag reservoir). Do needle decompression if possible pneumothorax or tension pneumothorax. Place oral airway *only* if patient is in coma. Start Salbutamol if wheezing.
 - o C: Is the patient in shock? If extremities are cold, then yes. Check BP for hypotension; Are pulses weak and rapid? Are they tachycardic? Pale?
 - If circulation is NOT good, STOP. Get two large IVs and start 2L bolus NS or LR before continuing.
 - o D: Do GCS score.
 - If patient has low GCS, check glycemia immediately. Give dextrose if low.
- Do not continue with history and exam until ABCs are stabilized.
- A focused respiratory exam includes looking at saturation on room air, checking for distended neck veins, listening to breath sounds and also heart

sounds (cardiac issues can cause respiratory distress). Look for edema and note if it is unilateral (sign of DVT). Ask about recent trauma.

- A focused bedside ultrasound exam should be a part of your initial triage, if machine is available.
 - Look at lung sliding to exclude pneumothorax
 - Linear probe, mid-clavicular line, 2nd rib space
 - Look for pleural effusion or hemothorax
 - Look for pericardial effusion
 - Look for B-lines (sign of pulmonary edema)
 - Do a full FAST exam to look for free fluid in abdomen (ascites if liver or kidney failure; blood in recent trauma)

Differential diagnosis

- Pulmonary edema
 - Congestive heart failure chapter
 - End stage renal disease (see renal failure chapter)
 - End stage liver disease (see liver disorders chapter)
 - ARDS (non-cardiogenic shock- usually from sepsis)
- Wheezing
 - Asthma (see asthma/COPD chapter)
 - COPD (see asthma/COPD chapter)
 - Allergic reaction
- Hemoptysis
 - TB
 - Bronchitis
 - Pneumonia (see pneumonia chapter)
 - Pulmonary embolism (see pulmonary embolus chapter)
 - Malignancy
- Rapid breathing with a *normal* pulmonary exam
 - Pulmonary embolism
 - High amount of acid in body (sepsis, diabetic ketoacidosis (DKA), aspirin toxicity)
 - Anxiety
- Fever
 - Pneumonia
 - Bronchitis
 - Epiglottitis
 - TB
 - Malignancy
 - HIV
- Chest pain with shortness of breath
 - Pulmonary embolism
 - Pleural effusion (see pleural effusion chapter) or hemothorax
 - Myocardial infarction (see acute coronary syndrome chapter)
 - Spontaneous pneumothorax

- o Aortic dissection
- Recent vomiting
 - o Aspiration
 - o Esophageal rupture
- Stridor (inspiratory noise with breathing that you hear from the neck area- do not need a stethoscope to hear it)
 - o Epiglottitis
 - o Upper airway obstruction (cancer, foreign body, mass)
 - o Retropharyngeal abscess (see pharyngitis and complications chapter)
- Associated rash, itching, tongue swelling, fainting
 - o Angioedema
 - o Anaphylaxis

Investigations

- Labs: FBC, electrolytes, renal panel, liver tests, HIV, malaria, urine pregnancy
- Other tests that are important for diagnosis but limited availability
 - o D-dimer (in case of possible PE)
 - o ABG (to differentiate an oxygenation or a ventilation problem)
 - o EKG (to look for ischemia)
 - o Troponins (in case of possible myocardial infarction)
- Imaging: All patients with shortness of breath should have at least a chest XR, even if the suspicion is high for emotional upset or anxiety
 - o Bedside ultrasound should be performed on all patients with dyspnea if machine is available

Recommendations

- Stabilization of ABCs is absolutely critical to preventing death in your patient. Consider early intubation if the equipment is available in your hospital and the physician is trained on the procedure. More importantly however, is stabilizing the patient until they reach a referral center.

Pneumonia

Definition: Infection in the lung space that can be caused by a virus, bacteria, and less often a fungus. Pneumonia and other lung infections remain a leading cause of death in Rwanda. It is important to diagnose early, start the appropriate treatment early, and initiate NIPPV (non-invasive positive pressure ventilation) where available if there is respiratory distress or failure.

Causes

- Simple community-acquired pneumonia
 - *S. pneumoniae*, *Mycoplasma*, viruses
- Community-acquired pneumonia in patients with co-morbidities (diabetes, old age, renal disease, alcohol, malignancy)
 - Also consider *Haemophilus influenzae*, gram-negative bacteria, *S. aureus* (in addition to above common pathogens)
- Aspiration pneumonia
 - *Klebsiella*, anaerobes
- HIV patients
 - PCP, pulmonary Kaposi's sarcoma, TB, in addition to above pathogens
- Tuberculosis

Signs and symptoms

- Start with ABCs- signs of severe respiratory distress include increased work of breathing, hypoxemia, accessory muscle use, cyanosis. Immediately start oxygen mask, place two large IVs, and isolate any patient at high risk for TB
- Ask about new cough, possible hemoptysis, fever or chills, sweats, or myalgias. Consider length of time cough is present and any weight loss or night sweats (concern for TB, cancer, or HIV)
- Consider co-morbidities like asthma, tobacco use, daily alcohol use (possible aspiration), previous TB
- While dullness to percussion and crackles may be present in pneumonia, sometimes the lung exam can be normal.

Differential diagnosis

- Asthma, COPD
- Congestive heart failure
- Pulmonary edema
- Pneumothorax
- Pulmonary embolism
- Influenza
- Malignancy
- Myocardial infarction
- Severe anemia
- Transfusion related acute lung injury (TRALI)

Investigations

- Labs: FBC, HIV test if unknown
 - If patient in respiratory distress or shock, also order electrolytes, renal function, blood cultures
 - If TB risk, order sputum
- Imaging: Chest XR, PA and lateral

Management: The goal is to recognize early any respiratory distress and treat aggressively with oxygen, early antibiotics and IV fluid support for dehydration or shock. Consider a Foley catheter in any patient who is ill appearing and be sure urine output is atleast 0.5-1cc/kg/hr. If respiratory status does not get better with oxygen, initiate (or if not available transfer early) for NIPPV (non-invasive positive pressure ventilation) or intubation.

Antibiotics: Treatment regimens are typically based on local sensitivities for pathogens. Large studies do not exist for pathogens specific to Rwanda therefore we must use other guidelines to direct our care. The following antibiotic recommendations are based off the Infectious Disease Society of America (2007) guidelines and the British Thoracic Society guidelines (2009) and can be found in summary in the AFEM Handbook for Emergency Medicine.

Example respiratory antibiotics by class

| Beta-lactams | Macrolides |
|-------------------------------------|---|
| Ceftriaxone 1g IV 1x/day | Azithromycin 1g PO once, then 500mg PO/IV 1x/day for 5 days |
| Cefotaxime 2g IV 3x/day | Erythromycin 500mg PO every 6hr |
| | Doxycycline 100mg PO BID (alternative) |
| Anti-pseudomonal beta-lactam | Respiratory Fluoroquinolones |
| Imepinem 500 mg IV every 6hr | Levofloxacin 750mg IV/PO 1x/day |
| | Moxifloxacin 400mg PO/IV 1x/day |

**If an antibiotic is listed as a possible treatment, it was confirmed on the list of Essential Medicines for Rwanda handbook 2012*

- Community-acquired pneumonia without co-morbidities (well appearing and stable for outpatient treatment, able to take food/water by mouth, no signs of respiratory distress or shock)
 - Rwandan Internal Medicine Guidelines Preferred: Amoxicillin 500mg PO BID
 - Infectious Disease Society of America and British Thoracic Society Guidelines Preferred: macrolide PO x 5 days (Azithromycin or Erythromycin)
 - Infectious Disease Society of America and British Thoracic Society Guidelines Alternative: Doxycycline 100mg PO BID x 7-10 days

- Community-acquired pneumonia, inpatient treatment (requires IV treatment, mildly ill appearing, mild respiratory distress, or significant comorbidities)
 - Beta-lactam AND macrolide
 - Ceftriaxone IV AND Azithromycin OR Doxycycline OR Erythromycin
 - OR
 - Respiratory Fluoroquinolones
 - Levofloxacin OR Moxifloxacin
- Aspiration pneumonia (coma, alcoholic, witnessed aspiration, nasal gastric tube)
 - Metronidazole 500mg IV 3x/day OR
 - Clindamycin 600mg IV 3x/day
- HIV (Treat common bacterial causes as above. Consider PCP if patient is hypoxic on room air, in shock or severe respiratory distress, symmetrical bilateral infiltrates on CXR, and CD4<200)
 - Always treat common bacterial causes as above
 - PCP
 - First line: Co-trimoxazole 320mg TMP PO 3x/day
 - Prednisolone 40mg PO BID followed by 2 week taper for severe hypoxemia or respiratory distress
 - Consider TB in any +HIV patient with respiratory symptoms. Always isolate and test sputum
- Severe infection without focus and patient is septic shock
 - Cloxacillin 2g IV 6x/day
 - AND
 - Ceftriaxone 1g IV 4x/day
 - AND
 - Metronidazole 500mg IV 3x/day

Recommendations

- Pneumonia is a leading cause of preventable death in Rwanda. You will save your patient's life by starting oxygen early (if hypoxic), starting appropriate antibiotics early, and initiating NIPPV (non-invasive positive pressure ventilation) or intubation if there is respiratory distress or failure. If your patient remains hypoxic or severely tachypneic (respiratory rate >25) despite supplemental oxygen and antibiotics and NIPPV or intubation is not available at your hospital, consider early transfer to referral hospital.
- Poor prognostic indicators include age less than 2 years old or greater than 65 years old, significant co-morbidities (cancer, liver or kidney disease, cardiomyopathy, diabetes, regular alcohol, sickle cell, HIV), coma, tachypnea, hypoxemia, hypotension, very low temperature or very high temperature

($T < 35$ or $T > 40$), multilobar involvement, significant anemia or significant uremia ($BUN > 30$). Treat these patients aggressively.

Pneumonia is a common cause of septic shock. Remember to follow your ABCs. Keep airway open, put on oxygen early as needed, have two large IVs in place with at least 2L NS/LR bolus to start. Use catheter to monitor urine output to ensure no shock.

If you do transfer to referral hospital, record what antibiotics were given and for how many days so referral specialists know how to guide treatment upon arrival.

Pneumothorax

Definition: A collection of air between the two layers of pleura.

Causes and types

- **Spontaneous:** in individuals with no clear precipitating event.
 - **Primary spontaneous:** without known lung disease; smoking is a risk factor
 - **Secondary spontaneous:** with underlying lung disease (TB, asthma)
- **Posttraumatic:** after blunt or penetrating chest trauma
- **Iatrogenic:** as a result of medical procedure (e.g. pleural tap/thoracocentesis or central line placement)
- **Tension pneumothorax:** air enters the pleural cavity during inspiration and does not escape during expiration, resulting in progressive hyperinflation of the affected lung. Results in mediastinal displacement and kinking of the great vessels, which compromises preload and cardiac output and can cause cardiac collapse/death
- **Open pneumothorax (sucking chest wound):** due to a direct communication between the pleural space and surrounding atmospheric pressure

Signs and symptoms

- Clinical status and stability of patient is related to size of pneumothorax.
- Patients often note sudden onset chest pain on the side of the pneumothorax. They can have shortness of breath, but low saturation is not always present.
- Exam findings include absent/reduced breath sounds on affected side, asymmetrical hyper-resonance on percussion, subcutaneous emphysema (not always present)
- Look for associated hypotension, signs of poor perfusion (cold extremities), tachycardia, dilated neck veins (concerning for tension pneumothorax)
 - Criteria for stable patient with pneumothorax:
 - RR < 24 breaths/min
 - No dyspnea at rest, speaks in full sentences
 - HR > 60 and < 120/min
 - Normal blood pressure for patient
 - O₂ saturation > 90% on room air
 - Absence of hemothorax
 - Bedside Tests:
 - Lung US: absent lung sliding, no visible comet tails. In M mode, presence of a bar code sign. May also see associated hemothorax. US shown to be more sensitive than supine CXR for detection of pneumothorax after trauma.

Differential diagnosis

- Hemothorax
- Pulmonary embolism
- Pneumonia
- Musculoskeletal chest pain
- Pericardial or pleural effusion
- Heart failure
- Acute coronary syndrome

Investigations

- Imaging
 - o Chest XR: **MUST BE UPRIGHT IF POSSIBLE!** More sensitive than supine since air rises. Air between the visceral pleural line and chest wall seen as area of black without vascular or lung markings. Visceral pleural line seen as convex line under radiolucent area. Air fluid level sometimes seen and indicates hydropneumothorax.
 - Supine chest X-Ray: Not very sensitive (28-75%). May see "deep sulcus sign" (deep lateral costophrenic angle)
 - o Chest CT without contrast: Not usually necessary. In COPD, can differentiate bullae from PTX

Management: The patient's clinical status, rather than the pneumothorax size, determines treatment options.

- Stable pneumothorax
 - o Give supplemental oxygen- even if saturation is normal, oxygen will help pneumothorax to resorb, healing faster
 - o If pneumothorax is small (pleural line < 2 cm from chest wall), observe for 6 hours on oxygen and repeat imaging. If patient's condition does not worsen and the pneumothorax is not larger, patient can be discharged
 - o If the pneumothorax is large and simple, can attempt needle aspiration
 - Place the patient in semi upright position
 - Sterile prep and drape. Wear sterile gloves.
 - Use ultrasound to identify area of pneumothorax and depth of pleura from the chest wall.
 - Anesthetize the area above the rib with 2mL Lidocaine
 - Attach a 16 or 18 gauge IV needle to a 5ml or 10mL syringe with 2mL of NS inside.
 - Insert the needle into the area of pneumothorax, entering the skin perpendicular to the body. If you do not have US, place in the 2nd intercostal space in the midclavicular line. Aspirate as you advance slowly until you get bubbles in your NS, indicating you have entered the pleural space.
 - Remove the needle as the patient coughs to avoid air from entering into the needle

- Attach a 3 way stopcock to prevent air from entering the pleural space when you remove the syringe
 - Attach a 20-50 mL syringe to aspirate. Aspirate until can no longer pull back air. If more than 2.5L are aspirated, stop the procedure and place a thoracostomy tube, as there is probably an air leak
 - Get a post procedure chest x-ray
 - Observe for 6 hours
 - If worsening clinically or there is failure to aspirate adequately, place a thoracostomy tube
 - If the pneumothorax is large and NOT simple (i.e. traumatic or in the setting of underlying lung disease), place a thoracostomy tube. If the patient will be intubated and/ or given positive pressure ventilation, a chest tube should be placed as a small pneumothorax may be made larger (see Appendix)
- If patient does not meet the criteria for stability:
 - Give supplemental oxygen
 - Perform immediate need decompression:
 - Insert 14 -18 gauge needle into the 2nd or 3rd intercostal space, just above the inferior rib, at the mid clavicular line
 - Place a chest tube as above
- If open pneumothorax:
 - As a temporary measure, the skin wound should be occluded on three sides with a dressing of gauze or plastic sheet:
 - Leave one side of the dressing open to act as a flutter valve (i.e. allow air to exit but not to enter).
 - If the dressing is completely occlusive or if you suture the wound an open PTX may be converted to a tension PTX.
 - Open will require a chest tube (see above). Do NOT place the chest tube through the existing skin wound, which should be presumed to be dirty

Recommendations:

- All patients should receive oxygen, regardless of level of hypoxia. Oxygen will actually help the pneumothorax resolve more quickly
- If clinical signs and symptoms of a tension pneumothorax, don't hesitate to perform needle decompression followed by tube thoracostomy
- Most patients with pneumothorax can be managed at district hospital, provided there are materials and knowledge needed to place and manage the tube. Any patient who will be transferred for management of pneumothorax should be evaluated for stability; if there is any question of a tension pneumothorax, needle decompression should be performed BEFORE transfer and the catheter left in until a chest tube can be placed.

Pulmonary Edema

Definition: The presence of excess fluid in the alveoli, leading to impaired oxygen exchange. Pulmonary edema can result from either high pulmonary capillary pressure from heart failure (cardiogenic) or from non-cardiogenic causes, such as increased capillary leak from inflammation.

Causes

- Cardiogenic: Fluid "backs up" into the lungs
 - High afterload (hypertensive emergency)
 - Often leads to acute (or "flash") pulmonary edema
 - May or may not actually be fluid overloaded
 - Left ventricular failure (cardiomyopathy, myocardial ischemia)
 - Poor left ventricular filling (valvular dysfunction, arrhythmia)
 - Fluid overloaded states (chronic congestive heart failure, renal failure)
- Non-cardiogenic: Often due to increased capillary permeability in the lungs as a result of some insult
 - Diffuse:
 - Acute Respiratory Distress Syndrome (ARDS)
 - Transfusion-related Lung Injury (TRALI)
 - Focal
 - Lung contusion
 - Re-expansion pulmonary edema (after collapsed lung is re-expanded quickly)
 - Aspiration/ pneumonitis

Signs and symptoms

- Ask about dyspnea, orthopnea, tachypnea. May be acute or gradual in onset depending on cause.
- Signs/exam findings include bilateral rales (crackles) often worse at the bases. Can atypically present with wheezing. Other findings include tachycardia, hypoxia, agitation
 - Hypertensive Emergency: BP is elevated (> 140/mmHg and often > 180/100) and skin is diaphoretic
 - Cardiogenic Shock: Low output cardiogenic pulmonary edema (systolic BP<90mmHg): signs of decreased tissue perfusion with cold extremities, oliguria, confusion
- Bedside tests:
 - US: Lung ultrasound will reveal bilateral B lines. Cardiac ultrasound useful to look for LV dysfunction and mitral stenosis as possible causes of cardiogenic pulmonary edema. Assessment of IVC size helpful in determining overall fluid status.

Differential diagnosis

- Asthma/ COPD
- Pulmonary embolism
- Pneumonia

Investigations

- Labs: urea, creatinine, FBC, AST, ALT
- Imaging:
 - o Chest X-ray: cardiomegaly, interstitial edema, enlarged pulmonary artery, pleural effusions
 - o Lung US: check for B lines, associated pleural effusion
 - o Heart US: to globally assess the left ventricular function, presence of mitral stenosis or pericardial effusion

Management: General goal is to support patient's respiratory function while giving medications to reduce fluid in the lungs. Keep patient in upright, sitting position.

Give oxygen with non-rebreather (reservoir) mask at 15L/min.

- Hypertensive Emergency (very high BP, diaphoretic skin)
 - o Rapidly decrease afterload to allow the left side of the heart to empty.
 - Nitroglycerin: 0.3-0.5 mg SL Q 1-5 minutes or IV 50-300 mcg/min until blood pressure declines and/ or symptoms improve
 - Hydralazine 5-10mgIV or IM if nitro not available. Repeat the dose in 30 minutes until you reach a desirable effect
 - Captopril: 25-50 mg SL if IV agents not available
 - o Consider adding Furosemide/Lasix AFTER reducing afterload. Many patients with acute hypertensive pulmonary edema may not be fluid overloaded! Diuretics are not very effective initially because of poor renal perfusion. After above medications, try Furosemide/Lasix
 - No prior use: Furosemide 80 mg IV once
 - Prior use: Double usual PO dose as IV bolus
 - If no effect (no diuresis) in 30 minutes from the first dose: double the dose
 - Side effects: possible worsening of renal function, lowers potassium and magnesium
 - If oliguria or anuria and renal failure possibly acute, consider referral for dialysis for fluid removal
- Cardiogenic Shock (low BP, cold extremities, low ejection fraction)
 - o Difficult to manage as patients often have renal dysfunction. Furosemide tends to lower blood pressure as well as diuresis, so do not use until Mean Arterial Pressure (MAP)>65 or systolic BP >100
 - o If blood pressure is very low, but patient is fluid overloaded, start with inotropic support to get blood pressure higher
 - Dobutamine

- Dopamine
 - Currently the only inotropic medicine available on the Rwandan list of Essential Medicines. Studies have shown that it is an inferior vasopressor compared to others (such as norepinephrine) in cardiogenic shock (Debacker, et al), but it is the best option to temporarily increase blood pressure.
- Norepinephrine
 - If available.
- Once blood pressure adequate (MAP > 65 or SBP > 100), can add on Furosemide (see above) for diuresis as these patients tend to be fluid overloaded
- If blood pressure can tolerate, low dose Captopril or nitroglycerin might be helpful but be cautious
- Has poor prognosis
 - If viral myocarditis, peripartum cardiomyopathy or from sepsis, patient has greater chance to improve. Otherwise, mortality very high. Counsel family and patient early to decide when appropriate to switch goals of care towards palliation.

Recommendations

- In high-afterload states, attempt to decrease afterload BEFORE diuresis with Furosemide.
- Non-Invasive ventilation can be extremely useful in patients with acute pulmonary edema, especially if they have high blood pressure
 - If positive pressure ventilation is not available at district level, consider referral for patients who have respiratory failure in the setting of pulmonary edema
- Patients with cardiomyopathy and pulmonary edema with low blood pressure have a very poor prognosis. Transfer to referral center *only after* discussion with family and consideration of whether there is possibility of recovery.
- Consider referral of patients with pulmonary edema in setting of acute renal failure for dialysis, again considering the patient's overall prognosis

Asthma/COPD

Definition: Asthma is a disease characterized by bronchoconstriction, bronchial wall edema and thick secretions. Chronic obstructive pulmonary disease (COPD) is an inflammatory response in the small airways and lung parenchyma that causes airflow obstruction and inflammation. While the two are different and often unrelated processes, their clinical symptoms and treatments are similar.

Causes

- Asthma
 - Allergic/extrinsic
 - Family history or related to seasons, animals, dust
 - Nonallergic/intrinsic
 - More common; inciting allergen can't be identified
- COPD
 - Non-tobacco related
 - Probably most important in Rwanda
 - Cooking smoke (from indoor cooking), environmental pollution, passive smoke inhalation, occupational exposure, genetic
 - Tobacco

Signs and symptoms

- Always start with ABCs- Get a full set of vitals, including saturation. Put patient on a small amount of oxygen, if needed, and start IV line.
- Ask about recent steroid use, prior hospital visits, recent illness
- COPD patients will have chronic shortness of breath, and often hyperventilate to compensate for lung's inability to oxygenate the blood. Breath sounds are diminished and there is prolonged expiratory phase. They will note chest tightness, dyspnea, and possibly change in sputum.
- COPD patients will often have chronic hypoxia as a result of alveolar destruction and saturations between 85 and 89% may be baseline for them
- Asthma patients typically have cough, dyspnea, wheezing with prolonged expiratory phase. Can present anxious (because of inability to breathe), tachypneic, tachycardic, and with wheezing.
- Severe asthmatic attacks may have a "silent chest"- there is no wheezing because there is no airflow. This is a severe form of asthma attack.
- Patients with asthma attacks typically have normal oxygen saturation levels. A low saturation level is a very serious sign of impending respiratory failure.
 - Other signs of respiratory failure include confusion, cyanosis, inability to speak

Differential diagnosis

- Pneumonia
- Pneumothorax

- Bronchitis
- Croup
- Bronchiolitis
- Congestive heart failure (CHF)
- Pulmonary embolism
- Allergic reactions
- Upper airway obstruction from foreign body or edema

Investigations

- Labs: FBC not very helpful unless pneumonia or other infection also present; electrolytes and renal function more helpful in chronic COPD patients or to rule out renal failure as etiology of shortness of breath
 - If ABG is available, COPD patients with decreased mentation (confusion) will have high pCO₂ (obstructive process means they can't exhale CO₂ out of lungs). However, management will be guided by clinical findings, not the ABG.
- Imaging: Chest XR to rule out opacity, pleural effusion, pneumothorax

Management

- Asthma exacerbation
 - Mild attack (normal vital signs, talks in full sentences, comfortable appearing)
 - Salbutamol MDI inhaled: 2 puffs every 2-6hr as needed
 - If patient is better with MDI alone, and doesn't require nebulization, steroids likely not needed.
 - Moderate attack (normal vital signs, talks in short sentences, comfortable appearing, but requires nebulization)
 - Salbutamol nebulization: 2.5mg every 2-4hr as needed
 - Prednisolone 60mg PO 1x/day for five days (no taper needed)- PO steroids as effective as IV steroids!
 - Consider admission if patient is not better with three nebulizations and four hours of observation
 - Severe attack (abnormal vital signs, patient not talking well, ill appearing, "silent chest")
 - Salbutamol nebulization 2.5mg every 15 minutes or a continuous nebulization with 10 - 15mg/ hour
 - If nebulization solution is not available, use MDI 2 puffs at least every 15 minutes (10 puffs replaces one nebulization)
 - Use IV steroids if patient is unable to swallow by mouth
 - Hydrocortisone 100mg IV once
 - Ipratropium 500mcg nebulized or MDI every 15min for 3 doses, then every 6hr
 - Magnesium Sulphate 2gm IV over 20 minutes (rapid infusion will cause hypotension)

- For worsening respiratory failure consider
 - Adrenaline 0.3mg IM of 1:1000 ratio
 - Adrenaline 5mg nebulized (mix with NS)
 - If available, use non-invasive ventilation with ambu-bag and PEEP valve
 - Intubation ONLY in extreme circumstances and ONLY by experienced provider with access to an intensive care unit.
 - Use Ketamine for induction agent
 - Keep patient on low tidal volume on vent, with respiratory rate at least 18
- COPD exacerbation
 - Use oxygen to maintain saturation at goal of 90-92% in all patients (COPD patients generally have a low saturation at baseline; it is not necessary to get them to 100% saturation and could be dangerous)
 - Studies show that antibiotics are useful in COPD exacerbations, even if mild
 - Doxycycline 100mg PO BID x 7 days
 - Mild attack (normal vital signs, talks in full sentences, comfortable appearing)
 - Salbutamol MDI inhaled: 2 puffs every 2-6hr as needed
 - Moderate attack (normal vital signs, talks in short sentences, comfortable appearing, but requires nebulization)
 - Salbutamol nebulization: 2.5mg every 2-4hr as needed
 - Prednisolone 40-60mg PO 1x/day with 7-10 day taper- PO steroids as effective as IV steroids!
 - Consider admission if patient is not better with three nebulizations and four hours of observation
 - Severe attack (abnormal vital signs, patient not talking well, confusion)
 - Salbutamol nebulization 2.5mg every 15 minutes or a continuous nebulization with 10-15 mg/ hour
 - If nebulization solution is not available, use MDI 2 puffs at least every 15 minutes (10 puffs replaces one nebulization)
 - Use IV steroids if patient is unable to swallow by mouth
 - Hydrocortisone 100mg IV once
 - Ipratropium 500mcg nebulized or MDI every 15min for 3 doses, then every 6hr
 - Less evidence for Magnesium Sulphate in COPD patients, but okay to try in severe cases if renal function is normal
 - 2gm IV over 20 minutes (rapid infusion will cause hypotension)

- Non-invasive positive pressure ventilation is most helpful to prevent respiratory or ventilatory failure in these patients. If NIPPV is not available at your hospital, transfer early if patient appears ill or is not getting better with nebulization alone.

Recommendations

- Hypoxemia is a late, serious sign in an asthmatic.
- Be prepared to intubate for respiratory failure or transfer early.
- Goal saturation in a COPD patient is 90-92%. Main concern in these patients tends to be build-up of CO₂ in body and academia due to obstructive airflow. NIPPV most helpful, when available.

Hemoptysis

Definition: Blood within the respiratory tract. Can range from small volume and insignificant to life threatening. *Massive hemoptysis* is rare but frequently fatal; definitions vary from 100-600 ml of blood over 24 hours.

Causes

- Infection (TB, bronchitis, pneumonia, lung abscess)
- Malignancy
- Cardiovascular (mitral stenosis, CHF, pulmonary embolism)
- Trauma
- Other: Autoimmune diseases, AV malformation, chemical pneumonitis, coagulopathy
- *Massive hemoptysis* most commonly caused by malignancy, tuberculosis, and vascular malformations
- In 30% of cases no cause is found

Signs and symptoms

- History
 - Important to have patient differentiate between coughing up blood (hemoptysis) and vomiting blood (hematemesis)
 - Hemoptysis usually bright, frothy
 - Try to determine amount the patient coughed up
 - Blood stained sputum vs. frank blood or clots?
 - Estimation of amount can be difficult
 - Associated symptoms key to dx:
 - Cough? Fever? Chest pain?
 - History of cardiac disease?
- Exam
 - ABC's
 - Massive hemoptysis can cause hypoxia, hypotension
 - Careful exam to rule out other sources of bleeding (ENT, GI tract)
 - Lung exam: Signs of infiltrate? Effusion?
 - Heart exam: Murmur?
 - Pallor, signs of anemia?
 - Unilateral swelling suggestive of DVT?
- Bedside tests
 - Bedside ultrasound to look for underlying cause (mitral stenosis, PE, CHF) and to examine the lung (consolidation? Effusion?)

Differential diagnosis

- GI hemorrhage
- ENT hemorrhage

Investigations

- Labs: FBC, creatinine, sputum for tuberculosis, HIV
- Imaging:
 - o CXR: Look for sign of TB, pneumonia, malignancy
 - o CT is diagnosis unclear
 - o Bronchoscopy: can help with diagnosis in cases of malignancy or immune mediated process. Only consider if prognosis is reasonable and referral facility will be able to obtain useful tests (i.e. cytology, etc)

Management

- Massive hemoptysis
 - o Can rapidly cause asphyxiation
 - o May need intubation to help improve oxygenation
 - Will likely need PEEP. Use ventilator or PEEP valve.
 - o Place lung with hemorrhage down to improve oxygenation of good lung
 - o Transfuse blood early
 - Transfuse without an Hb if patient has massive hemoptysis and hypotension
 - Transfuse if ongoing hemoptysis or melena
 - Transfuse for Hb<7 if hemoptysis has stopped
 - o FFP and platelets if suspect coagulopathy
 - o All patients must be transferred to referral center IMMEDIATELY
- Mild-moderate hemoptysis
 - o Not life threatening
 - o Suppress cough to avoid progression to more severe hemoptysis
 - o If unclear how severe, can check two FBCs, about six hours apart, and see if Hb is dropping
 - Transfer to referral center if Hb drops more than 1 point during the 6hr or if hemoptysis resumes while patient is being observed
- Other management aimed at underlying cause (e.g. diuresis for CHF, antibiotics for pneumonia)

Recommendations

- Most hemoptysis is minor and not life threatening. If you are unsure, check two FBCs six hours apart and look for dropping Hb
- Massive hemoptysis can be rapidly fatal even with excellent management
- Hemoptysis can be difficult for patients to distinguish from other sources of bleeding (GI or ENT). Take the time to tease this out in the history and physical exam.

Pleural Effusion

Definition: Fluid in the pleural space. Normally, there is < 20 cc between the parietal and visceral pleura. Effusions can be either transudative (caused by changes in the hydrostatic and or osmotic gradient) or exudative (caused by pleural inflammation and increased permeability). An empyema is an abscess surrounding a pneumonia.

Causes

- Overall, CHF, TB, pneumonia and malignancy most common causes
- Transudative
 - Fluid overloaded states and/ or hypoalbumen states
 - CHF, cirrhosis, nephrotic syndrome, hypothyroidism, constrictive pericarditis, pulmonary embolism
 - Often bilateral
- Exudative
 - Infection
 - Tuberculosis, pneumonia (parapneumonic effusion or empyema), intra-abdominal abscess, hepatitis
 - Inflammation
 - Pancreatitis, viral or uremic pleuritis, pulmonary embolism with infarction, ARDS, autoimmune disorders (lupus, rheumatoid arthritis)
 - Malignancy
 - Leukemia, lymphoma, lung cancers

Signs and symptoms

- History
 - May be asymptomatic if small
 - Often will have pleuritic chest pain and dyspnea
 - History key to determining underlying cause
 - Fever, cough -> infection
 - Chronic cough, weight loss -> suggests TB or malignancy
 - Risk factors for TB (HIV? Exposures?)
 - Risk factors for malignancy? (Smoking? indoor smoke exposure?)
- Exam
 - If large, can result in hypoxia and increased respiratory rate
 - On lung exam, will have decreased breath sounds and dullness to percussion
- Bedside tests
 - Bedside ultrasound essential in accurately diagnosing. Will see black fluid surrounding lung above diaphragm. May see septations suggesting loculations. Always look to rule out associated

pneumothorax. Also look for other abnormal fluid collections (pericardial or ascites).

Differential diagnosis

- Pulmonary embolism, pneumonia, and pneumothorax can all cause dyspnea, and hypoxia
- Trauma causing pneumothorax and/ or hemothorax can have similar presentation

Investigations

- Labs
 - o Creatinine, FBC, HIV, serum protein, serum LDH (if available) o Most effusions will require aspiration for diagnosis, unless they are bilateral in a patient with known CHF.
 - Send fluid for: cell count (RBC, neutrophils, lymphocytes), microcopy, tuberculosis, protein and LDH.
 - Grossly bloody fluid: TB or malignancy until proven otherwise
 - If have concern for malignancy, send fluid to referral center for cytology (to look for malignant cells)
 - If not clear if is a transudate or exudate, send protein and LDH, It is likely to be exudate if Light's Criteria is met:
 - Pleural/ serum protein ratio > 0.5
 - Pleural/ serum LDH ratio > 0.6
 - Pleural LDH $> 2/3$ upper limit of normal for serum
- Imaging
 - o CXR: Will show blunting of the costophrenic angles. May also show associated pneumonia or lesions suggestive of TB
 - o Ultrasound as above to look for other fluid collections (common in TB) o CT scan can help to diagnose cause if malignancy is in question

Management

- Any effusion *other than that in a patient with CHF and bilateral effusions* should be aspirated for diagnostic purposes
- Any effusion that is compromising oxygenation should be drained for therapeutic purposes
 - o Thoracentesis
 - Procedure is the same whether diagnostic or therapeutic; only the volume of fluid removed will differ
 - Contraindications: platelets $< 20,000$, mechanical ventilation, overlying cellulitis, uncontrolled cough or hiccups
 - Place patient in sitting position with arms and head resting on a bedside table. If unable to sit, lie patient on affected side with ipsilateral arm above head

- Use ultrasound to find the largest pocket of fluid and measure distance from skin to fluid. Take note of the depth of the pocket determined on ultrasound to help guide you.
- If US not available, mark site 1-2 intercostal spaces below where dullness ends in the hemithorax midline (approximately 5-10 cm lateral to the spine). To avoid intra-abdominal injury, do not go below the 9th rib space. Mark site with permanent marker.
- Sterilely prep and drape skin
- Anesthetize skin with Lidocaine, and then anesthetize tissues along expected tract, going over the rib. Aspirate as you go avoiding injecting into a vessel. Stop once fluid is aspirated and inject some Lidocaine to anesthetize the parietal pleura.
- Advance an 18-20-gauge angiocatheter attached to a syringe over the rib through the anesthetized area while aspirating. Stop once fluid is aspirated.
- Remove the needle, leaving the plastic catheter in place.
- Attach a 3-way stopcock and tubing to the catheter and aspirate the desired amount. Make sure to turn the stopcock to the off position when removing the syringe to prevent air from entering the pleural space.
 - Remove 100 cc for diagnostic purposes
 - Remove 500cc-1 L for therapeutic purposes
 - Avoid removing >1.5 L at one time as increasing risk of pulmonary edema
- When finished draining fluid, have patient take a deep breath and hum to increase intrathoracic pressure and decrease the risk of a pneumothorax while you remove the catheter.
- Cover site with a sterile occlusive dressing
 - If effusion is very large and expected to accumulate, might consider placement of chest tube to drain. Be careful of draining >1.5 L at a time.
- Other management will be aimed at treating the underlying cause
- Patients who are stable may be discharged to have their workup completed as an outpatient.

Recommendations

- A pleural effusion is not a diagnosis, but rather a finding suggestive of a disease process
- Patients should be referred if initial drainage at district hospital has not been successful, if they need CT scan for malignancy investigation AND have a good prognosis, or if there is another reason for referral for diagnosis or management of the underlying disease state (e.g. surgical evaluation for valvular heart disease)

Pulmonary Embolism (PE)

Definition: Obstruction of a pulmonary artery by a blood clot. Can range from occult and insignificant to massive, causing obstructive shock and death.

Causes/ risk factors

- Bed rest >48-72h
- Age > 50 years old
- Immobilization of the hip and knee
- Surgery in the previous 4 wks
- Malignancy (diagnosed or suspected)
- Pregnancy (highest risk after C section delivery)
- Oral contraceptives
- Nephrotic syndrome
- Congestive heart failure
- HIV may also be an important risk factor

Signs and symptoms

- History
 - o Ask all patients with unexplained shortness of breath about risk factors as above
 - o Usually acute onset shortness of breath with or without pleuritic chest pain
 - Consider PE in a patient who complains of shortness of breath, but has a normal lung exam and a normal chest XR
 - o Hemoptysis
 - o Syncope
 - o Most patients with PE and baseline cardiopulmonary disease describe dyspnea with PE as "worse than usual"
- Exam
 - o Often non-specific, leading to frequent misdiagnosis
 - One half of previously healthy patients with first time PE have normal vital signs at presentation
 - o Hypoxemia, tachycardia, tachypnea
 - o Usually CLEAR lungs at auscultation
 - o May see unilateral leg swelling (DVT),

Differential diagnosis: Other causes of acute dyspnea

- Acute pulmonary edema
- Pneumothorax
- Pneumonia

Investigations

- Labs: FBC to check for associated anemia, low platelets, renal function, liver function (AST, ALT) and coagulation factors if possible (aPTT, PT, INR)

- o ECG: non specific and insensitive. May see sinus tachycardia, signs of right heart strain (T wave inversion in V1-V4, S1Q3T3 pattern, right bundle branch block)
- Imaging:
 - o Ultrasound: of the lower limb veins (to document a possible thrombus in a vein) and of the heart (large PE can cause signs of right heart strain: increased in size of the right ventricle compared with the left and shift of the intraventricular septum)
 - o CXR to rule out alternate diagnosis (chest XR for patients with PE is typically normal)
 - o CT thorax with contrast
 - Gold standard test

Management: Patients with PE can present within a range of illness, from having normal vital signs to severe shock. The general goal is support patient with IV fluids (patients are preload dependent) and supplemental oxygen while starting anticoagulation.

- All patient need two IVs, supplemental oxygen, and to be on a monitor (or frequent vital signs check)
- Give 2L bolus for any tachycardia or hypotension (patients are preload dependent)
- Start empiric systemic anticoagulation when you have a high clinical suspicion (risk factors present with signs of DVT or abnormal vital signs) even in the absence of confirmatory tests
 - o Low molecular weight heparin (LMWH)
 - Does not require lab monitoring or a pump
 - Enoxaparin (Lovenox): 1mg/kg subcutaneous every 12 hours or 1.5 mg/kg subcutaneous every day
 - o Warfarin
 - Potential to cause iatrogenic bleeding if not managed closely
 - Requires frequent blood level checks (INR)
 - Start at 5mg PO every night and adjust according to INR levels (goal INR 2-3)
 - o Unfractionated Heparin: 80ui/kg bolus then 18ui/kg/h infusion
 - Typically started during hospitalization and requires pump and ability to check aPTT frequently
- Patients will usually have to continue at least 3 months of anticoagulation as an outpatient with either Warfarin (if INR testing and appropriate anticoagulation monitoring is available) or with LMWH
- In patients with massive PE causing shock, fibrinolysis with streptokinase may be a consideration..

Suspect PE
(RF + Hx/Sx)

Bedside US
shows large RV
and/or DVT?

Yes

Treat empirically
atDH

No

CXR, bedside US, ECG
suggest other diagnosis
more likely?

Yes

Treat for
alternate
diagnosis

No

i

Multiple co-morbid conditions
and poor underlying prognosis
and no contraindication to
anticoagulation?

Yes

Treat empirically
atDH

No

CT capable of PE
imaging available
and no contraindications
to anticoagulation?

Yes

Transfer for CT

Consider empiric treatment
at DH if no
contraindications to
anticoagulation

Recommendations

- Consider pulmonary embolism in patients with shortness of breath with no alternative diagnosis, clear lungs, or normal chest XR.
- Transfer to referral hospital for CT and further management after discussion with the receiving team.
 - o For CT scan
 - If diagnosis is in question AND anticoagulation is likely to improve overall patient outcome
 - Avoid referring patients with underlying comorbidities and poor prognosis (e.g. malignancy, stroke, chronic CHF). Instead, consider empiric treatment at DH.

Chapter 5

CARDIOLOGY

General Approach to the Patient with Chest Pain

Definition: Chest pain is any discomfort perceived to originate from the thoracic region. It may originate from an organ located in the chest or be referred from another part of the body.

Signs and symptoms

- History: Ask about the following factors
 - Duration: Constant (likely not cardiac) vs. intermittent
 - Quality: Pleuritic (pulmonary or pericardial pathology), positional (pericarditis); dull (cardiac ischemia), tearing (aortic dissection)
 - Radiation: to arms, jaw or neck (cardiac ischemia); to back (PUD, aortic dissection)
 - Associated symptoms: Fever, cough, wheezing, nausea/ vomiting, abdominal pain, edema, unilateral leg swelling
 - Situation: exertional (ischemia, pulmonary embolism, mitral stenosis), Trauma (pneumo/hemothorax, tamponade, aortic dissection, rib fracture/ contusion), heavy lifting (muscle strain), after eating (peptic ulcer disease/PUD)
 - Risk factors: tobacco use, hypertension, diabetes (ischemic heart disease); HIV status (TB, pneumonia); prolonged immobility, cancer, or long bone fracture (pulmonary embolism), forceful vomiting or endoscopy (esophageal rupture) family history of heart disease
- Exam
 - Focused cardiopulmonary exam:
 - Signs of trauma: obvious deformity or injury
 - Breath sounds: Unequal (pneumothorax/hemothorax, pleural effusion), wheezes (asthma) or crackles (heart failure, pneumonia)
 - Heart sounds: muffled (tamponade), arrhythmia (bradycardia, tachycardia, atrial fibrillation), murmur (valvular disease, cardiomyopathy), friction rub (pericarditis)
- Bedside tests
 - ECG: Arrhythmia, ischemia
 - Bedside ultrasound: cardiomyopathy, pericardial effusion, right heart strain, mitral stenosis, pneumothorax, pleural effusion, pneumonia

Differential diagnosis

- Life-threatening causes:
 - Cardiac ischemia: Still estimated to be very rare in sub-Saharan Africa, even among populations with many risk factors.
 - Pneumothorax/hemothorax
 - Aortic dissection
 - Pulmonary embolism
 - Esophageal rupture

- o Pericardial effusion/ tamponade
- Other causes
 - o Pneumonia
 - o Pleural effusion (cancer, trauma, peripneumonic)
 - o Musculoskeletal
 - o Abdominal pathology (PUD, gallbladder disease)
 - o Severe anemia

Investigations

- No routine investigations required beyond ECG
- Labs: No routine labs needed. Consider FBC for anemia in women or men with history of bleeding. Troponin can be considered if available in patients with risk factors and history consistent with cardiac ischemia
- Imaging:
 - o Bedside ultrasound useful to look for cardiac and pulmonary pathology o CXR to look for pulmonary disease. Often not necessary if normal bedside lung ultrasound
- Endoscopy can be useful if suspect esophageal or stomach pathology

Management

- Initial Approach
 - o Assess ABCs. Look for signs of hypoxia (PE, pneumonia, asthma/ COPD, pneumo/hemothorax, pleural effusion) or shock (tension pneumothorax, tamponade, pulmonary embolism, aortic dissection, acute myocardial infarction)
- Cardiac ischemia (see acute coronary syndrome chapter)
 - o Diagnosis difficult with limited resources. Normally will suspect based on classic history, risk factors and an ECG suggestive of ischemia (e.g. regional ST depressions or elevations) o Beware of ECG mimics of myocardial infarction (e.g. pericarditis, left ventricular hypertrophy, hyperkalemia, benign early repolarization, acute stroke, subarachnoid hemorrhage) many of which could be made worse by treatments indicated for cardiac ischemia o Aspirin (325-500 mg) provides a 23% reduction in mortality from myocardial infarction and should be given to anyone with suspected cardiac ischemia
 - o Oxygen only if patient is hypoxic o Pain control with opiates; these medications can drop patient's blood pressure, therefore use carefully o Nitroglycerin, if available, can help relieve symptoms. Avoid if concerns for right ventricular involvement as can cause profound hypotension o Thrombolytics indicated for patients with ST elevation myocardial infarction presenting within 12 hours of onset of chest pain AND with

ST elevation of >1mm in 2 contiguous limb or precordial leads. Would need immediate referral.

- Pulmonary embolism (see pulmonary embolus chapter)
 - o Diagnosis suggested by classic history, risk factors, unilateral leg swelling, right heart strain on ECG or echo, DVT on ultrasound
 - o Anticoagulation with heparin (requires ability to check PTT), lovenox (expensive but no monitoring required) or Warfarin (requires ability to check INR)
- Pneumothorax/hemothorax (see pneumothorax chapter)
 - o Suspect in any patient with chest trauma or risk factors (tuberculosis, PJP pneumonia, COPD)
 - o Bedside ultrasound very sensitive and specific
 - o Immediate needle decompression for suspected tension pneumothorax (e.g. hypotension, distended neck veins)
- Aortic Dissection
 - o Rare, life-threatening
 - o Suggested by hypertension, enlarged cardiac silhouette on CXR, pericardial effusion, new aortic regurgitation murmur, unequal upper extremity blood pressures
 - o Type A dissections (involving aortic arch) unlikely to survive without cardiac surgery
 - o Type B dissections (below the arch) require aggressive heart rate and blood pressure control. Can also consider calcium channel blockers if available IV.
 - Labetalol 20mg IV over 2 minutes initially, then 40-80mg IV every 10min; total dose not to exceed 300mg
- Pericardial effusion/ Tamponade (See pericardial effusion chapter)
 - o Traumatic (penetrating trauma to chest, deceleration injury) vs. non-traumatic (TB, cancer, uremia)
- Musculoskeletal:
 - o Suggested by history of heavy lifting, pain that is reproducible on palpation
 - o Ibuprofen 600 mg PO every 8 hours, behavior modification
- Psychogenic
 - o Diagnosis of exclusion- not typically made in the emergency setting
 - o Most likely in cases of chronic, unrelenting pain with normal vital signs and normal cardiopulmonary exam

Cardiogenic Shock

Definition: Inadequate end organ perfusion as a result of poor cardiac output.

Causes

- Low contractility
 - Cardiomyopathy
 - Myocarditis
- Poor heart filling
 - Arrhythmias
 - Mitral stenosis
 - Pericardial tamponade
- Other valvular heart disease
 - Examples include acute mitral regurgitation or aortic regurgitation from acute rheumatic fever or endocarditis

Signs and symptoms

- History
 - Depends on etiology; may have slowly progressing or acute symptoms
 - Dyspnea, syncope, weakness, confusion/coma
- Exam
 - Low blood pressure alone should not make the diagnosis. Many patients with chronic heart failure will "live" with systolic pressures in the 80's.
 - Weak or undetectable peripheral pulses
 - Cold extremities, prolonged capillary refill (more than 2 seconds)
 - Skin moist and clammy
 - Altered mental status, confusion, coma
 - Low urine output, anuria
 - Signs of fluid overload: pulmonary edema, peripheral edema, elevated jugular venous distention (JVD)
 - Irregular heartbeat, murmurs
- Bedside tests
 - US
 - IVC: plump or collapsing?
 - EF: low or high?
 - Mitral stenosis present?
 - Pericardial effusion present?
 - If confused or coma -> check glucose immediately

Differential diagnosis

- Other causes of shock
 - Obstructive shock: Pulmonary embolism, tension pneumothorax
 - Septic shock
 - Hypovolemic shock

Investigations

- Labs: Creatinine, electrolytes, FBC for anemia
- Imaging
 - o Bedside US as described above
 - o CXR to look for other causes of hypoxia
 - o ECG if suspect arrhythmia (such as atrial fibrillation with mitral stenosis) or ischemia

Management

- Cardiogenic shock secondary to low ejection fraction or valvular problem other than mitral stenosis (e.g. acute rheumatic fever with mitral regurgitation). These patients are in shock because their heart is not squeezing well (contractility problem).
 - o May start dopamine, Dobutamine, or adrenaline for goal MAP of 65 (or SBP>85, warm extremities and good urine output). See appendix for infusion preparation and rates.
 - Vasopressor infusions should be started at the lowest possible dose and moved up every 10-20min to reach a blood pressure goal of MAP>65 or SBP>100. Once goal is reached, the infusions should be lowered slowly as blood pressure tolerates (do not turn off completely at once).
 - Note that patient probably does NOT need pressors *if they have warm extremities*. Remember that these patients may tolerate low systolic blood pressures in the 80's.
 - o Often have very high afterload (or systemic vascular resistance). This may need to be reduced with Captopril or nitroglycerin once above pressors have been started and blood pressure is raised.
 - o Often very fluid overloaded. They may require positive pressure ventilation (PPV) or intubation to manage pulmonary edema. Be aware that this may further lower their blood pressure, therefore, may need to start pressors prior to or just after intubation.
 - o Often also need aggressive diuresis, but this is difficult in the setting of hypotension.
 - If you have an ultrasound available and are skilled at IVC measurement, use the IVC as a guide. Start with 40mg IV in a Furosemide naive patient. Double the dose if it is not working within 30 minutes.
 - If you don't have an ultrasound available or do not know how to measure IVC, do not give Furosemide until blood pressure is stabilized.
 - o These patients have a very poor prognosis, especially if it is a long-standing cardiomyopathy. Discuss with family and your ICU/ cardiology consultants to help determine appropriate use of resources and when/ if goals of care should be switched to palliation.

Cardiogenic shock secondary to mitral stenosis and rapid heart rate

- o These patients are in shock because their left ventricle is unable to fill adequately during diastole (preload problem).
 - Pressors and diuretics will **not** likely help these patients and could kill them by further increasing heart rate and afterload and decreasing preload.
- o Focus on first correcting arrhythmia. If they are in rapid atrial fibrillation, defibrillate o If defibrillation does not work, give Amiodarone or Digoxin
 - Amiodarone 150 mg over 10 minutes
 - Digoxin 0.5 mg IV
- o Intubate as necessary to manage pulmonary edema. Be careful of diuresing patients as often that will only make their shock worse. o Consider referral for cardiac surgery evaluation.

Heart Failure

Definition: Heart failure is a condition in which the heart is unable to meet the body's demands. In its extreme, it results in cardiogenic shock. According to data from three district hospital outpatient clinics with access to echocardiography, the leading causes are cardiomyopathy (41%), rheumatic heart disease (33%), hypertensive heart disease (8%), and congenital heart disease (2%). Ischemic heart disease as a cause of heart failure is thought to remain relatively uncommon in Rwanda, particularly in more rural settings.

Causes

- Heart failure secondary to high afterload (e.g. flash pulmonary edema)
 - Very hypertensive
- Heart failure secondary to poor forward flow from low contractility (Cardiomyopathy)
 - Often hypotensive or normal blood pressure
 - Can be caused by many things:
 - Viral myocarditis
 - Alcohol
 - Peripartum cardiomyopathy
 - Long-standing aortic or mitral regurgitation
 - Advanced HIV
 - Sepsis
 - Severe anemia
- Heart failure secondary to poor forward flow from valvular disease
 - Acute mitral or aortic regurgitation
 - Will usually have very loud murmurs, pulmonary edema and seemingly normal ejection fraction
 - Can be caused by:
 - Acute rheumatic fever
 - Decompensated rheumatic valvular disease
 - Endocarditis
- Heart failure secondary to poor left ventricular heart filling
 - Mitral stenosis
 - Pericardial disease/ tamponade

Signs and symptoms

- History
 - Patient may carry diagnosis of "cardiopathy" but given lack of cardiologist access in country, unreliable history
 - Ask about dizziness, weakness, dyspnea, orthopnea, edema
 - Palpitations and chest pain not very sensitive or specific
- Exam
 - Possible confusion from shock and/or hypoxia
 - Lungs: Crackles and hypoxia, if left sided failure

- o Heart: Tachycardia, murmurs and irregular heart sounds often found.
- o Abd: May have distension from ascites in right sided failure. o
- Extremities: May be cold, edematous
- Bedside tests
 - o US
 - IVC: plump or collapsing?
 - EF: low or high?
 - Mitral valve: Opening well or not?
 - Pericardial effusion present?

Differential diagnosis

- Pneumonia
- Tuberculosis
- Asthma/ COPD
- Anemia
- Pulmonary embolism
- Renal failure
- Liver failure
- Malnutrition

Investigations

- Labs: Creatinine most important. If creatinine high or diuresing, electrolytes (K and Na) helpful.
- LFTS may be elevated
- Imaging
 - o Chest x-ray to look for other causes of dyspnea
 - o Bedside ultrasound as above. If anything other normal or cardiomyopathy, should be referred for formal echocardiogram (possible candidates for cardiac surgery)

Management: Initial approaches to heart failure the same in all patients. Start with IV line, oxygen, and place patient on monitor. Keep patient in sitting position. Assess ABCs. Severe heart failure may require aggressive airway management with positive pressure ventilation or intubation. Specific therapies will be guided by:

1. Blood pressure (hypotensive, normal or hypertensive)
 2. Ejection fraction
 3. IVC/volume assessment
 4. Presence or absence of mitral stenosis
- Hypertensive heart failure (i.e. Heart failure secondary to high afterload)
 - o Need to rapidly decrease afterload to allow the left side of the heart to empty
 - Nitroglycerin 0.3-0.5 mg SL every 3-5 minutes
 - OR

- Nitroglycerin 50-300 mcg/min IV (drip/pump required)
 - Captopril 25-50 mgSL or PO
 - Hydralazine 20mg-40mg IV/IM; repeat as needed or 10-25mg PO every 6-8hr
 - Caution as may drop blood pressure very quickly and unpredictably
 - Non-invasive ventilation with BIPAP or CPAP very useful. May need to intubate if not able to tolerate non-invasive pressure ventilation..
 - o Patient may or may not be fluid overloaded (check IVC with bedside US)
 - o Often in renal failure -> Check creatinine Heart failure secondary to low contractility (Cardiomyopathy)
 - o If in shock, will need to supplement contractility with inotropes. titrate up to MAP 65 or SBP>85 with warm extremities and good urine output
 - Dobutamine 2-20mcg/kg/min IV
 - Pure inotropy but can decrease blood pressure so may need to use in conjunction with another agent
 - Dopamine 2-20mcg/kg/min IV
 - Adrenaline 0.05-0.1mcg/kg/min
 - o Will often be volume overloaded
 - Diuresis with Furosemide once no longer in shock (when extremities are warm and blood pressure is higher)
 - Decreasing preload can sometimes help contractility if very fluid overloaded.
 - o Has poor prognosis- Counsel family and patient early to decide when appropriate to switch goals of care towards palliation. Heart failure secondary to poor heart filling: Main causes in Rwanda include tamponade and mitral stenosis
 - o Tamponade
 - If large effusion and in shock, perform immediate bedside pericardiocentesis (see pericardial effusion chapter for information on procedure)
 - o Mitral stenosis:
 - Look for and treat rapid atrial fibrillation, including anticoagulation.
 - Patient often fluid-depleted
 - Do NOT give diuretics unless have convincing signs of volume overload (i.e. plump IVC on bedside US)
 - At very high risk for thromboembolism
 - Screen for signs of stroke even if in sinus rhythm
- Heart failure secondary to poor forward flow
- o Often normal to hypotensive

- o Blood pressure support, diuretics and afterload reduction as for patients with cardiomyopathy
- o Need urgent cardiologist review; with surgery many of these patients have a good prognosis.
- o Consider workup and treatment for acute rheumatic fever in ages 5-30 and give empiric IM Benzathine penicillin.
- o Consider endocarditis if febrile, embolic phenomenon and other signs of infection. Draw blood cultures and then start a 3rd generation cephalosporin (see Chapter).

Recommendations

- Heart failure is a common presentation in Rwanda, but very difficult to manage in a resource limited environment. The most useful diagnostic tool is a bedside ultrasound. If one is not immediately available, use blood pressure measurements (very high or very low will have different treatments as above), renal function (high Cr has worse prognosis), diuresis, and palpation of extremities (cold extremities=shock) to guide your management.
- If your patient is not breathing well on his/her own, or you feel his/her presentation is too complicated to manage in the district, transfer to referral hospital immediately. Aggressive management is needed early in order to ensure good outcome for patient.

Hypertensive?

Usually >180/100
EF normal or slightly decreased
May have thick left ventricle

I- Yes

Decrease Afterload:
Nitroglycerin
Captopril (caution if renal failure) PPV +/-
Decrease Preload
Check IVC, may or may not be fluid overloaded

Low Ejection Fraction or Poor Forward Flow because of regurgitation (nl EF + loud murmur)

BP often low or normal
Likely volume overloaded

- Yes

Increase contractility
May need to start dopamine, adrenaline or dobutamine if in shock
Decrease Preload
Furosemide
Decrease Afterload (cautiously if BP can tolerate)
Captopril (Caution if renal failure, but one dose OK)
PPV

Mitral stenosis?

Heart can't fill well
Made worse by tachycardia

I- Yes

Treat rapid atrial fibrillation:
Slow heart rate to increase filling, anticoagulate
Often fluid depleted
Check IVC before giving diuretics
High risk of thromboembolism
Look for sign of stroke even if in sinus

Large pericardial effusion?

Heart can't fill well

I- Yes

Bedside pericardiocentesis if in shock
Removal of small amount of fluid can improve BP

Bradycardia with a Pulse

Definition: Bradycardia is defined as a heart rate less than 60 bpm or less than two standard deviations from normal for children. Bradycardia may reflect a primary cardiac problem or may be a marker of disease in another system.

Causes

- Sinus bradycardia
- Sick sinus syndrome
- Heart block
- Other
 - o Athletic heart: Normal resting heart rates in athletes can be as low as 30's-40's
 - o Medication use or overuse: Beta-blockers and Digoxin can both cause bradycardia
 - o Toxic ingestions: Cholinergic poisoning (i.e. organophosphates) o Hypoxia, hypothermia, hypoglycemia, hyperkalemia, hypothyroid and hypocalcemia are important causes of bradycardia.

Signs and symptoms

- History
 - o Review medications (e.g. beta blockers, calcium channel blockers, Digoxin) or possible toxic exposures (e.g. organophosphates)
 - o Comorbidities such as renal failure (hyperkalemia? common cause of bradycardia), previous heart disease
- Exam
 - o Perform a focused exam to look for signs of end organ damage, heart failure, poor perfusion as a result of bradycardia.
- Bedside tests
 - o ECG
 - Better than the monitor in helping determine rhythm
 - More important for determining long-term treatment/ need for pacemaker
 - o Echocardiogram
 - Not as important, but can be useful to assess left ventricular function, presence of pericardial effusion, large RV, mitral valve opening, and IVC

Investigations

- Labs: Creatinine and electrolytes (K, Ca)
- Repeat ECGs often useful

Management

- Initial management

- o IV, O2, monitor. Assess ABCDs. Remember hypoxia is an important cause of bradycardia, especially in children.
 - o Check a blood glucose as hypoglycemia can cause bradycardia
 - o Check a temperature as hypothermia can cause bradycardia
 - o Look for signs of instability such as hypotension, syncope, heart failure or altered mental status.
 - Asymptomatic bradycardia
 - o Generally does not require any treatment.
 - o If has rhythm that has risk of asystole (2nd degree Mobitz II or complete heart block) consider referral for pacemaker.
 - Symptomatic bradycardia
 - o Atropine 0.5 mg IV x 3 doses
 - o If any concern for renal failure, give calcium gluconate 2 grams IV to treat possible hyperkalemia
 - o If no response, start transcutaneous pacing or pressors
 - Dopamine (2-10mcg/kg/min) OR Adrenaline (2-10mcg/min IV)
 - Transcutaneous pacing
 - Ensure IV, O2, monitor
 - Contraindications: Hypothermia, broken skin where pacing pads would go, prosthetic tricuspid valve
 - Sedate patient with Ketamine (1mg/kg) or diazepam
 - Attach patient to pacing pads one on anterior chest and one to posterior chest
 - Attach patient to ECG leads
 - Choose demand pacing mode
 - Set rate to > 30 bpm above patient's intrinsic rhythm
 - Set current to 100 mA and begin pacing. Increase energy until you have both electrical capture (broad QRS after pacer spike) AND mechanical capture (can feel a femoral pulse with each paced QRS).
 - If not getting capture at a current of 120-130 mA, reposition electrodes and try again.
 - Once have capture, set current 10% above mechanical capture threshold.
 - o If suspect beta blocker overdose, can consider glucagon and calcium.
 - o If calcium channel blocker overdose, can consider calcium, high dose insulin and glucose
- Refer for transvenous pacer

Recommendations

- Don't treat asymptomatic bradycardia
- Look for common causes of bradycardia: hypoxia, hyperkalemia

All cases of symptomatic bradycardia without identified reversible cause need to be referred for transvenous pacer and eventually permanent pacemaker implantation

Tachycardia with a Pulse

Definition: Tachycardia is defined as a heart rate greater than 100 bpm or greater than two standard deviations from normal for children. Tachycardia may reflect a primary cardiac problem or may be a marker of disease in another system.

Causes

- Sinus tachycardia: The rhythm is a marker of a disease and not a disease itself.
- Ventricular tachycardia
 - Monomorphic VT
 - Polymorphic VT - Often torsades
 - Hyperkalemia and TCA overdose can cause wide complex tachycardias
- Atrial fibrillation with rapid ventricular response
 - Can often be precipitated by sepsis or hypovolemia
 - Often have underlying structural heart disease, especially mitral stenosis
- Supraventricular tachycardia (SVT)
 - Many types, often re-entrant at the level of the AV node

Signs and symptoms

- History
 - Usually tachycardia is not patient's presenting complaint. Important to elicit symptoms that may give clue to underlying cause, e.g. sepsis, pulmonary embolism, heart failure, medication/drug use, pain, anxiety
- Exam
 - Physical exam should be guided by history and seek to establish the cause of hemodynamic instability, and rule out common drivers of tachycardia such as infection, hypovolemia, heart failure, pulmonary embolism
- Bedside tests
 - ECG
 - Better than the monitor in helping determine rhythm
 - Follow algorithm as below
 - Echocardiogram
 - Assess left ventricular function, presence of pericardial effusion, large RV, mitral valve opening, and IVC

Differential diagnosis

- If sinus tachycardia, look for underlying abnormality driving tachycardia (e.g. fever, sepsis, hypovolemia, pain, thyroid storm)

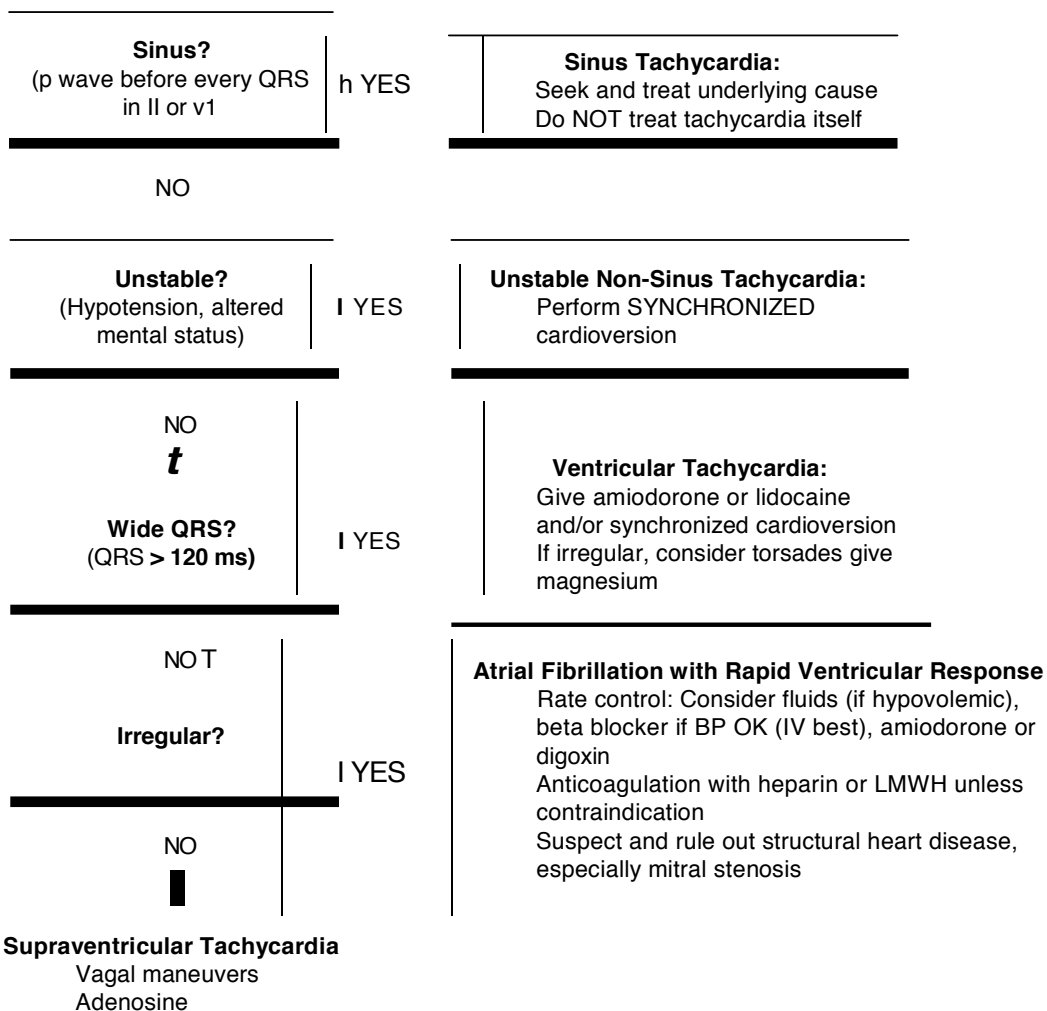
Investigations

- Labs
 - FBC, creatinine, electrolytes helpful in most cases
- Cardiac ultrasound for anyone with non-sinus tachycardia other than simple SVTs
- Repeat ECGs often useful

Management

Initial management

- IV, O₂, monitor. Assess ABCDs.
- On monitor, try to determine if there is a p wave before every QRS complex. If there is, treat as sinus tachycardia. If not, assess whether wide or narrow QRS complex. Follow algorithm below:



- o Seek and treat underlying cause, Do NOT treat tachycardia itself
- o Consider giving fluids, treating pain and/or fever.
- o Cardioversion will not help. Beta blockers almost NEVER indicated.

Unstable non-sinus tachycardia (hypotension, confusion) o

Prepare for immediate synchronized cardioversion

- Ensure IV, O₂, monitor
- Sedate patient with Ketamine (1mg/kg) or diazepam 10 mg IV
- Attach patient to defibrillator pads or place paddles on patient's chest, one in the left mid axillary line and the other at the right, mid-clavicular line, just below the clavicle.
- Choose synch mode
- Choose energy
- Charge
- Make sure no one is touching patient and deliver shock
- o If patient's arrhythmia not terminated, may try escalating shock doses
- o Consider antiarrhythmic according to underlying rhythm

Ventricular Tachycardia

- o If any signs of instability OR no antiarrhythmic available, immediate cardioversion is appropriate (see above) o If irregular and polymorphic, give magnesium 2-4 grams o Consider possibility of hyperkalemia (give calcium) or tricyclic antidepressant overdose (give sodium bicarbonate)
- o If stable, can give trial of antiarrhythmics.
 - Amiodarone 150 mg IV over 10 minutes followed by 1mg/min on pump/drip for 6hrs (360mg)
 - DO NOT give any AV nodal blocking agents (beta blockers, Digoxin, calcium channel blockers)

Atrial Fibrillation with Rapid Ventricular Response

- o If unstable, perform synchronized cardioversion as described above o Rate control: Consider fluids (if hypovolemic), beta blocker if BP is normal (IV best), Amiodarone or Digoxin
 - Atenolol 50-100mg PO 1x/day OR
 - Amiodarone IV dosing as above OR
 - Digoxin 8-12 mcg/kg IV (0.008-0.012 mg/kg) total loading dose: administer 50% initially, then cautiously and slowly give 25% or V* the loading dose every 6-8hr two times OR Digoxin 10-15 mcg/kg PO total loading dose: administer 50% initially, then cautiously and slowly give 25% or % the loading dose every 6-8hr two times OR
 - Diltiazem 15-30 mg IV
- o Anticoagulation with heparin or LMWH unless contraindication

- Patients at very high risk of embolic stroke from clot in left atrium, especially if have mitral stenosis
 - Will need to be discharged on anticoagulation (low molecular weight heparin or Coumadin)
- o Suspect and rule out structural heart disease, especially mitral stenosis

Supraventricular Tachycardia

- o Often re-entrant rhythms within AV node and can be terminated by vagal maneuvers (Valsalva, ice water on face or carotid massage and elevation of the legs) or adenosine, o If responds, reassess patient.
- If asymptomatic and ECG now normal,
 - o may be discharged without further workup o If fails to terminate with above, can try beta-blockers or calcium channel blockers
 - Atenolol 50-100mg PO 1x/day
- o Rarely unstable but if becomes unstable, perform immediate synchronized cardioversion

Pericardial Effusion and Tamponade

Definition: Pericardial effusion is a fluid collection within the pericardial sack. When this fluid collection impairs cardiac filling, it is considered pericardial tamponade.

Causes

- Trauma with a hemopericardium
- Infection (Tuberculosis most common; viruses also can cause)
- Cancer (often metastatic and often bloody)
- Renal failure

Signs and symptoms

- Pericardial effusion can mimic symptoms of pericarditis including chest pain (often pleuritic and positional), palpitations, malaise, weakness and shortness of breath.
- On cardiac monitor, may see low voltage QRS complexes and/ or QRS complexes of changing axis (= Electrical alternans, represents swinging of heart in pericardial fluid)
- Enlarged heart (displaced PMI), muffled heart sounds (fluid collection makes more difficult to hear)
- Tamponade
 - o May present in shock: cold, reduced cap refill, hypotension
 - o May or may not have signs of pulmonary edema
 - o Beck's Triad: Distended neck veins, hypotension, muffled heart sounds. Classic three symptoms, but rarely complete.
 - o Tachycardia
 - o Pulsus paradoxus: Decrease in pulse pressure greater than 10 mmHg with inspiration
- Bedside tests
 - o Ultrasound
 - Look for black stripe (fluid) around the heart. Circumferential effusions causing right atrium and/ or right ventricular collapse during diastole.
 - IVC will be large and non-collapsing

Differential diagnosis

- Other causes of obstructive shock
 - o Pulmonary embolism, tension pneumothorax
- Other causes of shock
 - o Cardiomyopathy, valvular disease, sepsis, hypovolemia.
 - Should be able to differentiate based on physical exam and ultrasound.

Investigations

- Labs: FBC, creatinine. If non-traumatic pleural effusion, send TB tests.
- If pericardiocentesis is performed, send fluid for cell count, protein, acid fast bacilli smear and culture. TB effusions will usually have high protein and leukocyte count with monocyte predominance.
- Bedside ultrasound as above. If have time and concerns about your diagnosis, consider formal echocardiogram.
- CXR: Will show enlarged heart silhouette, usually clear lungs.
- ECG: Tachycardia, electrical alternans (not always present), low voltage or findings consistent with pericarditis (diffuse ST elevations without reciprocal changes, downsloping TP segment, PR segment depression)

Management

- Tamponade
 - Heart cannot fill because of compression by pericardial effusion (preload problem). Must urgently reduce pericardial effusion to allow heart to fill by performing a pericardiocentesis (see Appendix).
- Pericardial effusion without tamponade
 - Management depends on presumed etiology. I.e. if concern for tuberculosis, consider starting empiric TB therapy; if concern for uremic pericardial effusion, consider dialysis, etc.
 - Pericardial effusions with tuberculosis may be helped by steroid therapy, although no good data
 - If effusion large enough to obtain fluid, consider diagnostic pericardiocentesis.
 - If fluid is from malignancy, generally indicator of very poor prognosis.

Recommendations

- Tuberculosis most important and reversible cause of pericardial effusion in our setting.
- Refer any patients in whom causes of pericardial effusion is unclear, patient with acute renal failure and uremic effusion who are candidates for hemodialysis, or who need a formal echocardiogram.

Hypertensive Emergency

Definition

- *Hypertension*: A chronic, usually asymptomatic disease defined as persistently elevated blood pressure > 140/90 in adults.
- *Hypertensive urgency*: An acutely elevated blood pressure *without* evidence of acute end organ damage
- *Hypertensive emergency*: An acutely elevated blood pressure (almost always > 180/120mmHg) with evidence of acute end organ damage:
 - o Cardiac: ischemia, aortic dissection, pulmonary edema
 - o Renal: acute renal insufficiency
 - o CNS: hemorrhagic stroke, encephalopathy

Causes of hypertension

- Cardiovascular
 - o Essential hypertension (most adults)
 - o Coarctation of the aorta (children)
- Renal
 - o Renal failure
 - o Renal artery stenosis
 - o Glomerulonephritis
- Metabolic
 - o Cushing's
 - o Pheochromocytoma
 - o Thyrotoxicosis
- Other
 - o Pain, anxiety
 - o Alcohol withdrawal
 - o Pre-eclampsia/ eclampsia,
 - o Increased intracranial pressure (hemorrhage or stroke)
 - o Drugs/ medications (steroids, cocaine)
 - o Rebound hypertension (Clonidine, B blockers)

Signs and symptoms

- History
 - o Hypertension is usually asymptomatic
 - o Patients with acute, severe elevations of blood pressure causing end organ damage may complain of dyspnea, chest pain, blurred vision, nausea/ vomiting, severe headache, confusion
 - o Headache by itself is *not* a marker of end organ damage. See Chapter on Non-traumatic Headache for guidance on whether a headache needs further investigation
- Exam: Look for signs and symptoms of end organ damage
 - o Neurologic: Altered mental status, focal neurologic deficits, papilledema, reduced visual acuity

- o Cardiac: Acute pulmonary edema, ischemia
- o Be sure that you are measuring blood pressure with an appropriately sized cuff.. A cuff that is too small will result in over-reading blood pressure. A cuff that is too large will result in under-reading blood pressure.
- Bedside tests
 - o Cardiac US: Look for LV function (high or low) and IVC (collapsing in dehydration or full in normal fluid status or volume overload).
 - o Thoracic US: Look for B lines (suggests pulmonary edema)
 - o Fingerstick glycemia if altered mental status or focal neurologic deficits

Investigations

- Labs: Renal function (Cr), urine dipstick (protein in suspected nephrotic syndrome)
- Thyroid function tests (TSH, T3, T4)
- ECG if concerned for ischemia, but not otherwise helpful
- Imaging: Bedside cardiac/ thoracic ultrasound as above . Consider formal echo and renal ultrasound if working up secondary causes of hypertension. Head CT without contrast if concern for intracranial hemorrhage or hypertensive encephalopathy (if any neurological defects on exam, confusion).
- Fundoscopy (for retinopathy)

Management

- Hypertensive Emergency (evidence of end organ damage like stroke, pulmonary edema, renal failure)
 - o Aim to decrease blood pressure (MAP) by 20% within 2 hours (IV Labetalol, Captopril, Nifedipine, IV Hydralazine). Furosemide is not a good agent unless the patient is fluid overloaded. Be careful of rapid drops in blood pressure with Nifedipine and Hydralazine, as this can cause end organ damage.
 - Labetalol 20mg IV over 2 minutes initially, then 40-80mg IV every 10min; total dose not to exceed 300mg (first choice)
 - Hydralazine 20-40mg IV/IM; repeat as needed (second choice)
 - Captopril 12.5-25mg PO; repeat as needed (not to exceed 450mg/day) (third choice)
 - Nifedipine 10mg PO every 8hr (fourth choice)
 - o HTN Emergency with pulmonary edema: Use IV or sublingual nitroglycerin and Captopril (check creatinine before giving more than one dose). Positive pressure ventilation can also help treat pulmonary edema. May use Furosemide if patient appears fluid overloaded
 - o HTN Emergency with acute ischemic stroke: Avoid treating hypertension during acute ischemic stroke unless patient has other indication (CHF, aortic dissection, active ischemia).

- o HTN Emergency with acute hemorrhagic stroke: Consult neurosurgery when available. Target blood pressure is 160/90. Nicardipine is first line agent, but not available in Rwanda. May also use beta-blocker (2nd choice) or Hydralazine (3rd choice)
 - Labetalol 20mg IV over 2 minutes initially, then 40-80mg IV every 10min; total dose not to exceed 300mg
 - Hydralazine 20-40mg IV/IM; repeat as needed
- Chronic, asymptomatic hypertension
 - o There is no evidence that acute management in the ED is beneficial; there is some evidence that it could be harmful.
 - o If patient has stopped their medications, restart them.
 - o If patient is not on any anti-hypertensive medication, you can consider starting them on a first line agent (e.g. hydrochlorothiazide 25 mg daily, Amlodipine 5 -10 mg daily)
 - o Recommend close follow up in OPD for medication titration and any further work up (e.g. creatinine)
- Hypertension caused by anxiety and/ or pain
 - o **VERY common in the emergency department**
 - o If patient has a painful condition, treat pain before treating hypertension

Recommendations

- Elevated blood pressure regardless of severity, if chronic, does *not* represent an emergency and does *not* need to be treated in the emergency department.
- Always consider pain and anxiety as causes of elevated blood pressure
- Refer cases of hypertensive emergency where you suspect intracerebral hemorrhage, acute ischemia or if the patient requires mechanical ventilation to treat pulmonary edema or if patient is deteriorating with available district level treatments.

Infective Endocarditis

Definition: Infection of the endocardium (valves and/ or mural endocardium). Usually caused by bacteria. Risk increased greatly with rheumatic or prosthetic heart valves or with history of congenital heart disease. Other causes of bacteremia (e.g. septic abortion) can seed valve.

Causes

- Rheumatic heart disease is the most important risk factor in sub Saharan Africa
 - Others include hemodialysis, injection drug use, HIV infection.
- Can be caused by bacteremia from any source (e.g. septic abortion, septic joint)
- Viruses, mycobacteria, and fungus can also less commonly cause infective endocarditis
- Non-infective inflammatory endocarditis is a rare complication of some rheumatic diseases and malignancies

Signs and symptoms

- Symptoms can vary greatly from vague constitutional symptoms (persistent fever, malaise, weight loss) to florid sepsis and heart failure. Fever is present in almost all cases.
- Should be considered in anyone with a fever and a murmur or findings suggestive of septic emboli (e.g. brain abscess). More subtle findings include vascular phenomenon (Janeway lesions, splinter hemorrhages, other systemic emboli) and immune phenomenon (splenomegaly, nephritis, Osier nodes, Roth spots)
- Bedside ultrasound should be used to look for clear evidence of vegetation. However, formal echocardiography will be necessary to definitively diagnose.

Differential diagnosis

- Acute rheumatic fever
- Tuberculosis
- Other causes of sepsis

Complications

- Congestive heart failure (most common)
- Embolization (CVA, limb or mesenteric ischemia) (second most common)
- Conduction system involvement: arrhythmias
- CNS abscess
- Mycotic aneurysm
- Glomerulonephritis

Investigations

- Labs: 3 sets of blood cultures from 3 separate sites should ideally be drawn before giving antibiotics. FBC, creatinine, electrolytes.
- Imaging: Formal echocardiogram should be performed to look for vegetations. CT scan of brain if concern for embolic stroke/ brain abscess.
- Diagnostic criteria includes: 1. Two positive blood cultures from 2 separate sites AND 2. Echo showing evidence of vegetation, abscess, etc.

Management

- It is impossible to treat endocarditis unless you consider it in your differential diagnosis! Consider in any patient with a fever and either new murmur or signs of thrombotic emboli (gangrene limb, stroke). Stabilize patient using ABCs, start two IV lines, and start antibiotics.
- Empiric antibiotics should be started immediately and ideally will cover both streptococcus (most common) and staph. Options include:
 - o Ceftriaxone 2g IV 2x/day
 - AND
 - o Gentamycin 1-2.5mg/kg/dose IV 2x/day
 - o Add Cloxacillin 500mg PO 4x/day if concern for staphylococcal infection
 - o Add Vancomycin 1g IV 2x/day if concerned for MRSA (i.e. prosthetic valve, prolonged hospitalization)
- A proportion of patients will present in acute heart failure. Treat according the heart failure algorithms (see heart failure chapter)
- Many patients will require surgical intervention and should be transferred immediately to referral center with cardiology available. Start antibiotics before transfer.

Recommendations

- All patients with suspected endocarditis should be referred to center capable of performing echocardiography and cardiology review.
- Blood cultures are very important for guiding therapy. But if the patient is very sick, do not delay antimicrobial therapy

Syncope

Definition: Syncope is a transient loss of consciousness followed by complete recovery of neurologic function without resuscitative efforts. It is caused by either lack of blood flow to both cerebral hemispheres or to the reticular activating systems. Pre-syncope is transient near loss of consciousness and is treated the same as syncope.

Causes

- Neurally-mediated (reflex)
 - o 25-65% of syncope, excellent prognosis; most common cause o Self-limited bradycardia and/or vasodilation leads to transient hypotension, causing syncope o Usually preceded by sensation of warmth, nausea, tunnel vision, diaphoresis o Associated with situations that activate vagal nerve: emotional distress, painful stimulus, prolonged standing, heat, micturition, defecation, cough/ sneeze, carotid sinus stimulation (in cases of carotid sinus hypersensitivity)
- Neurovascular
 - o Very rare: Requires insufficient blood flow to posterior cerebral circulation or bilateral hemispheres o Vertebrobasilar TIA/ insufficiency, subclavian steal (use of arm causes retrograde flow from posterior circulation), subarachnoid hemorrhage, complex migraine o Most cases would have residual neurologic deficits, and thus not fit definition of true syncope
- Cardiogenic
 - o Caused by insufficient cardiac output, often from arrhythmia. Other causes include obstructive lesions (hypertrophic cardiomyopathy, pericardial tamponade, stenotic valve lesions), very large pulmonary embolism. Rarely caused by ischemia.
 - o Suggested by a history of exertional syncope, syncope while sitting or lying down, palpitations or chest pain or lack of a prodrome
 - o Risk increases with age
- Hypovolemic/ Orthostatic
 - o Acute severe hemorrhage (trauma, GI bleed, ruptured ectopic, ruptured AAA)
 - o Vasodilated states: pregnancy, medications, older patients, alcohol o Suggested by moving from sitting to standing position
- Other
 - o Large pulmonary embolism rare but well documented cause of syncope o Metabolic: hypoglycemia

Signs and symptoms

- History
 - o Ask about situation surrounding syncope- was there valsalva, standing from sitting, PO intake, exertional
 - o Preceding symptoms: Tunnel vision, nausea, lightheadedness, chest pain, palpitations, shortness of breath, severe headache, no prodrome
 - o Event: Witnessed seizure activity, tongue bite, urinary or bowel incontinence, vomiting, head trauma, duration
 - o Post-event: Confusion, headache
 - o History of similar events in self or family, family history of sudden, unexplained death at young age, cardiac history, substance use, last menstrual period, medications or traditional remedies
- Exam
 - o Vital signs should include bilateral upper extremity blood pressures (aortic dissection, subclavian steal will have very different blood pressures in each arm)
 - o Orthostatic vital signs neither sensitive nor specific for identifying cause of syncope
 - o Cardiac: Murmurs, irregular rate
 - o Neurologic: Full neurological exam looking for new deficits, focus particularly on cerebellar exam (ataxia, gait), post-ictal state
 - o Associated injuries from fall
- Bedside tests
 - o ECG to look for arrhythmia, ischemia (very rare cause), delta wave (WPW), large voltage and deep q waves (hypertrophic cardiomyopathy), Brugada pattern, long QT, sinus tachycardia (hypovolemia)
 - o Pregnancy test on ANY woman of childbearing age, regardless of reported last menstrual period
 - o Bedside US: Cardiac function, pericardial effusion, sign of right heart strain or DVT (PE), IVC (hypovolemia)
 - o Bedside glucose

Differential diagnosis

- Seizures (caused by abnormal electrical activity in brain; note, syncope often also associated with jerking motions that can be confused with a seizure. Patients with seizures often have a prolonged post-ictal state that is not seen in syncope)
- Intoxication (do not often return to normal neurologic function after regaining consciousness)
- Hemorrhage

Investigations

- Despite exhaustive testing, many patients will lack clear diagnosis

- Everyone should have an ECG performed to look for signs of dangerous arrhythmia
 - Many young, otherwise healthy patients who are well appearing with normal vital signs and normal ECG can be discharged without further testing.
- Labs: pregnancy, glucose; hematocrit if concerns for blood loss
- Imaging: Head CT not often useful, unless suspecting subarachnoid hemorrhage as cause or if there is significant head trauma associated with the event.
- Obtain formal echo if ECG abnormalities or murmur on exam.
- CT ONLY indicated if patient does not result to baseline neurological status

Management: General goal is to address ABCs, check glucose, and perform ECG. Treat any identified precipitants (e.g. IV fluids for hypovolemia, PO challenge and/or glucose for hypoglycemia)

- Reflex-mediated
 - Most likely diagnosis in young person without comorbidities.
 - If well appearing, normal exam, not exertional in nature, normal ECG, history consistent with reflex mediated syncope, can discharge without further work up
- Cardiogenic
 - Rare cause, but potentially deadly.
 - Obtain formal echo to rule out structural heart problems
 - If ECG or monitor identifies arrhythmia, treat according to arrhythmia protocols
 - Resources to address arrhythmias limited. Consider referral to cardiologist to discuss options.
- Neurogenic
 - MRI can evaluate posterior cerebral circulation problem. However, given lack of resources to address an identified problem, should not be routinely recommended.
 - If concern for TIA, look for embolic source.

Recommendations

- Most syncope in young people is from a benign etiology.
- Head CT is rarely useful in work up of true syncope.
- Consider referral to OPD Internal Medicine/Cardiology for further work up for patients with
 - abnormal ECG
 - history of cardiac disease
 - SBP <90mmHg
 - associated dyspnea
 - old age/comorbidities
 - family history of sudden, unexplained death
 - exertional syncope

Chapter 6

GASTROENTEROLOGY

General Approach to Abdominal Pain

Definition: Any disease process that will cause pain in the abdominal region. The emergency provider must attempt to differentiate a "surgical abdomen" from a non-surgical abdomen.

Causes

(Surgical emergencies are in **bold**)

| Right upper quadrant pain | Left upper quadrant pain | Epigastric pain | Right lower quadrant pain | Left lower quadrant pain |
|--|--|--|--|--|
| GERD/gastritis Acute cholecystitis, cholelithiasis, cholangitis Hepatitis Right lower lobe pneumonia | GERD/gastritis Splenic rupture Myocardial infarction Left lower lobe pneumonia | Pancreatitis GERD/gastritis Peptic ulcer disease Perforated ulcer Angina or myocardial infarction Abdominal Aortic Aneurysm (AAA) Abdominal mass | Appendicitis Pyelonephritis or nephrolithiasis Ovarian torsion Ruptured ectopic Pelvic inflammatory disease (PID) Intussusception Abdominal mass | Sigmoid volvulus Diverticulitis Pyelonephritis or nephrolithiasis Ovarian torsion Ruptured ectopic Pelvic inflammatory disease (PID) Abdominal mass |

* Typhoid may present with non-specific abdominal pain, but usually with fever.

Signs and symptoms

- History
 - All patients with abdominal pain need the following questions asked on history:
 - Onset: rapid or gradual
 - Timing: constant or intermittent pain
 - Quality: sharp, stabbing, electric, cramping
 - Radiation to back, shoulder, pelvis
 - Exacerbating symptoms: worsening with deep breaths, movement, food, urination, menses

- Associated symptoms: fever, nausea, vomiting, anorexia, syncope, chest pain, cough, dysuria, changes in bowel or bladder, gynecourinary symptoms
 - Ask about surgical history, alcohol use, medication use (Chronic Ibuprofen/NSAID use puts patients at higher risk for perforation)
 - Exam
 - Obtain full set of vital signs
 - Look for tachycardia, tachypnea, hypotension, fever
 - Look
 - Hernia, masses, cellulitis, hematoma
 - Distention- ascites or obstruction
 - Jaundice, rash, itching (biliary obstruction)
 - Listen
 - High-pitched bowel sounds- obstruction
 - No bowel sounds- obstruction
 - Palpate
 - Feel for fluid wave (ascites), point tenderness (locate a specific quadrant if possible), masses, rebound/guarding (peritoneal signs), pulsatile mass (aneurysm)

Investigations

- Labs
 - All women of child-bearing age MUST have a pregnancy test
 - FBC if bleeding or infection are suspected
 - Renal function if patient has significant fluid losses or there is a concern for urinary obstruction ○ Liver function tests (AST, ALT, bilirubin) if gallbladder or liver disease are suspected
 - Lactic acid (if available) if mesenteric ischemia or sepsis are suspected ○ Amylase if pancreatitis is suspected (not very sensitive- can be elevated in many clinical situations) ○ Urinalysis if cystitis, pyelonephritis, prostatitis, or nephrolithiasis
- Imaging
 - Ultrasound: pregnancy, ascites/fluid, gall bladder/liver disease, mass ○ Abdominal X-ray: All patients with severe epigastric pain should have upright abdominal XR to look for air-fluid levels (perforation), obstruction ○ CT scan with IV contrast: for diagnosis of abdominal mass, deep space infection/abscess

Recommendations

- All reproductive-age females need a pregnancy test.
 - If test is positive, further evaluation for ectopic versus intrauterine pregnancy is warranted.

Transfer patients with abdominal pain who have peritoneal signs (rebound, guarding), abnormal vital signs despite 2L bolus of fluids (tachycardia, hypotension), or if further imaging is necessary and not available at local facility

Gastrointestinal Bleeding (GIB)

Definition: Upper gastrointestinal bleeding is bleeding proximal to the ligament of Treitz. Lower gastrointestinal bleeding is bleeding distal to the ligament of Treitz.

Causes

- **Upper GIB**
 - Esophagitis, erosive gastritis, duodenitis
 - Esophageal and gastric varices (typically associated with cirrhosis)
 - Peptic ulcer disease
 - Gastric malignancy
 - Mallory Weiss tears
 - Dieulafoy lesions
 - Arteriovenous malformations
- **Lower GIB**
 - Diverticular disease
 - Colitis
 - Arteriovenous malformations
 - Adenomatous polyps
 - Malignancies (rectum, colon)
 - Meckel diverticulum
 - Hemorrhoids (not usually a life-threatening cause of bleeding)

Signs and symptoms

- History
 - Ask about color of blood (bright red typically lower GIB; dark red/black typically upper GIB), duration, and amount
 - Upper GIB
 - Hematemesis (vomiting with black coffee ground appearance) and melena (black stool)
 - Epigastric pain
 - Vomiting and retching followed by hematemesis suggests a Mallory-Weiss tear
 - Lower GIB
 - Hematochezia (bright red or maroon colored bleeding per rectum) sometimes with constipation or diarrhea, tenesmus
 - Ask about symptoms of anemia from blood loss including syncope, weakness, dizziness, chest pain
 - Ask about risk factors including medication use (Ibuprofen, steroids), alcohol abuse, hepatitis, HIV
- Exam
 - Tachycardia—suggests 10% volume loss
 - Postural hypotension or hypotension—suggests 20% volume loss

- o Tachycardia and hypotension associated with cold extremities, oliguria, confusion (hypovolemic shock)—suggests >30% volume loss
- o Jaundice, ascites, gynecomastia, palmar erythema, spider telangiectasias—suggest liver disease
- o Rectal exam with local anal pain, anal fissures, external hemorrhoids

Differential diagnosis

- Epistaxis or oral bleeding
 - o Blood is ingested and patient can present with melena or coffee ground emesis
- Ingestion of iron or bismuth or foods like beets
 - o Can simulate hematochezia

Investigations

- Labs
 - o FBC (be aware that the initial Hct level might be normal in the initial phase of an acute bleeding due to hemoconcentration)
 - Plan to recheck WBC in 6 hours if endoscopy may be delayed
 - o Urea and creatinine to check for pre-renal azotemia (of note, BUN may be disproportionate elevated due to GI resorption of blood)
 - o Liver function tests if possible liver disease
 - o Glycemia
 - o PT.aPTT (if available)
- Imaging: Not typically helpful in upper GI bleeding; CT abdomen/pelvis with contrast may be useful if malignancy is suspected as source of lower GI bleeding
- Other studies: Gastrointestinal endoscopy is diagnostic and can be therapeutic for suspected upper GI bleeding. Colonoscopy is sometimes indicated for suspected lower GI bleeding.

Management of GIB: The general goal is to stabilize the patient until definitive treatment is available. GIB can be a life-threatening emergency. Patients require aggressive, early treatment and often early transfer to referral hospital.

- General Management
 - o Assess ABCs, supplemental oxygen, frequent vital signs (place patient on monitor if available or check BP every 30 minutes) o Place TWO large IV lines (18 gauge or larger)
 - Start 2L IV fluids (NS or RL)
 - o Draw blood for type and cross match
 - o If shock is present **or** there is **NO** improvement in vital signs after 2L of crystalloids, order blood transfusion
 - Initiation of blood transfusion is generally based on active bleeding and failure to improve vital signs after 2L bolus of IV fluids (not on initial Hct alone)

- o If suspicion of liver disease order also fresh frozen plasma and platelets
 - Transfuse for platelets < 50,000 if active bleeding

Upper GIB

- o If unclear diagnosis can place a nasogastric tube to confirm diagnosis and to empty the stomach before endoscopy
 - If bright red blood or clots are found, perform **gentle** gastric lavage with sterile water or saline. Over vigorous suction can produce gastric erosions. There is no added benefit to iced lavage
- o Arrange for endoscopy as early as possible
 - Therapeutic endoscopy, when available, is the treatment of choice for significant upper GI bleeding
- o Transfusion indications
 - pRBCs for Hb<6g/dl OR ongoing bleeding OR unstable vital signs despite 2L fluid resuscitation
 - Platelets for active bleeding with platelets <50,000
 - Fresh frozen plasma (FFP) for INR>1.5
- o Drug therapy
 - Proton pump inhibitors (PPI) are adjunct to endoscopic therapy and reduce re-bleeding rates
 - Omeprazole or Pantoprazole 80mg IV bolus, followed by continuous infusion of 8mg/h IV for 72 hours
 - o Continue oral Omeprazole after 72 hours
 - Somatostatins can also control hemorrhage while waiting for endoscopy or if endoscopy is not available or contraindicated
 - Octreotide 50ug IV bolus, followed by continuous infusion of 50ug/hr
 - Histamine-2 antagonists (Cimetidine) are NOT beneficial in acute upper GIB (Barkun, et al)
 - Antibiotics can prevent infection and risk of re-bleeding
 - Ceftriaxone 1g IV once before endoscopy
- o In profuse upper GI bleeding, patients may require intubation to prevent aspiration of blood

Lower GIB

- o 80% of lower GIB will resolve spontaneously, but anoscopy and colonoscopy can be both diagnostic and therapeutic o

Massive lower GIB is defined as

- Passage of large volume dark blood from rectum
- Hemodynamic instability (low BP, tachycardia) or shock
- Significant drop in Hb (to 6g/dl or less)
- Bleeding requiring transfusion, continuing more than 3 days, or re-bleeding within 1 week

- o Transfusion indications: same as upper GI bleeding above o
- Drug therapy NOT helpful in lower GI bleeding o
- CONSULT surgery for patients who fail to respond to medical and endoscopic therapy

Recommendations

- Remember that an important upper GIB can present with hematochezia in 10-14% of the time
- TWO large IVs, adequate fluid resuscitation, and early blood transfusion if needed are the most important therapy until endoscopy is available
- Consider early transfer to referral hospital as patients with GIB can decompensate quickly. Any patient with following features requires immediate transfer
 - o Initial Hct<30%
 - o Initial systolic blood pressure (SBP)<100mmHg
 - o Red blood in the NG lavage
 - o History of cirrhosis or ascites on exam with active bleeding
 - o History of vomiting red blood

Liver Disorders

Definition: Disorders of the liver are common causes of abdominal pain or illness among patients presenting to the emergency department. Liver disorders are divided into two categories - acute or chronic - depending on the duration of the illness.

Causes

- Chronic liver disorder
 - Cirrhosis
 - Alcoholism
 - Chronic hepatitis
- Acute liver disorder
 - Infection (viral, bacterial, parasitic)
 - Drug Effects and Toxins
 - Biliary Disease
 - Pregnancy

Signs and symptoms

- History
 - Acute Liver Failure: Abdominal pain, fever, nausea, vomiting, anorexia
 - Chronic Liver Failure: Abnormal bleeding, swelling, confusion, muscular atrophy
- Exam
 - Acute Liver Failure
 - Jaundice, icterus
 - Enlarged liver, right upper quadrant tenderness
 - Confusion, asterixis
 - Chronic Liver Failure
 - Jaundice, icterus, palmar erythema, spider angiomas
 - Confusion, asterixis,
 - Ascites, edema, gastrointestinal bleeding, caput medusae
 - Gynecomastia/ testicular atrophy
 - Muscular atrophy

Differential diagnosis

- Viral Hepatitis
- Liver Abscess
- Drug Effect/Poisoning
- Alcoholic Cirrhosis
- Biliary Disease
- Pregnancy

Investigations

- Labs

- o LFTs: Increased serum transaminase
- o Bilirubin: Increased bilirubin reflects the degree of liver damage
- o INR: Prolongation of the PT indicates the severity of the hepatitis
- o FBC: WBC usually normal with a relative lymphocytosis
- o HIV
- Imaging: Abdominal ultrasound typically best mode of imaging to view liver disease; rarely, a CT abdomen/pelvis with IV contrast is needed additionally
- Others
 - o Paracentesis if concern for infection of ascetic fluid
 - o Endoscopy if bleeding with chronic liver disease

Management of Acute Liver Problems

- Viral Hepatitis: Systemic infection affecting the liver, caused by Hepatitis A, B, C and E.
 - o Management:
 - Ensure vital signs are stable and assess ABCs (vomiting and fever can sometimes cause tachycardia or hypotension). Start IV lines and give fluids if patient has clinical signs of dehydration
 - No cure for acute viral hepatitis. Tell patient to rest, avoid alcohol
 - Give anti-emetic if vomiting
 - Metoclopramide 10mg IV every 8hr as needed
 - Confirmed cases of hepatitis B or C will need referral to IM OPD for further management
 - o Complications
 - Acute liver failure
 - Cholestatic hepatitis
 - Aplastic anemia
 - Chronic liver disease and cirrhosis (Hepatitis B and C)
- Liver Abscess: Focal hepatic infection with cavity formation (most due to entamoeba histolytica)
 - o Admit patient, start IV access, give IV fluids and antipyretics
 - o Start treatment with antibiotics
 - Metronidazole 500mg IV every 8hr for 10 days
 - If no improvement in 3-5 days, perform ultrasound guided aspiration of the abscess
 - o Patients should show signs of recovery within 48hr (pain better, fever resolved, no tachycardia or hypotension). If patient is not getting better with IV antibiotics, transfer to referral center for general surgery consult and possible aspiration of abscess

Management of Chronic Liver Complications

Portal hypertension, variceal hemorrhage, hypersplenism, ascites causing shortness of breath, tachypnea

- o Start with TWO large IV lines. These patients are often hypotensive but dehydrated. Do bedside ultrasound of IVC, if available, to assess fluid status. Place Foley catheter to monitor urine output.
 - Restrict the amount of salt in the diet to 2 grams (half tea spoon) per day and fluid to 1.2 liters per day.
 - If renal function is okay and patient is making appropriate urine (at least 0.5cc/kg/hr), start diuretics
 - Furosemide 40-80mg IV 2x/day depending on kidney function
 - MONITOR urine output for response!
 - If urine output is not adequate, consider paracentesis
- o Refractory ascites: It is common to withdraw 2-4 liters of fluid from the abdomen with paracentesis procedure when the ascites is causing painful abdominal distension and/or difficulty breathing.

Gastroesophageal Varices

- o Octreotide (when available) decreases portal vein pressure and has been used to treat variceal bleeding: 25mcg IV bolus followed by infusion 25-50mcg/h
- o Procedures: Upper endoscopy (EGD) with either sclerotherapy or band ligation
- o Propranolol PO 10-80mg 2x/day
- o Transfuse blood for Hb<7 with continued bleeding; transfuse platelets for platelets<50,000 and obvious bleeding or platelets<10,000 and no bleeding
- o If evidence of varices, patient needs immediate transfer to referral center for further management

Hepatic encephalopathy: Any patient with history of liver disease and confusion should be presumed hepatic encephalopathy with treatment started early, but provider should continue to rule out other life-threatening causes of confusion (electrolytes, brain bleeding, renal failure, etc.)

- o Lactulose 30 ml PO 1-2x/day; increase the dose until the patient has 2 - 4 loose stools/day
- o If symptoms of encephalopathy persist or if there is fever, add oral antibiotics
 - Metronidazole 500mg IV every 8hr
- o Typically, patients with end stage liver disease and hepatic encephalopathy that does not resolve with Lactulose have a very poor prognosis. However, it is appropriate to transfer these patients if there is a possibility for another diagnostic cause of confusion (i.e., patient requires head CT)

- Spontaneous bacterial peritonitis (SBP): Any patient with history of liver problems or with obvious ascites on exam, abdominal pain, and fever should be presumed SBP with antibiotics started immediately. Paracentesis should follow for diagnosis.
 - o WBO250 in ascites fluid is diagnostic for SBP. No culture is needed in that case.
 - o Start IV antibiotics immediately
 - Ceftriaxone 1-2g IV 1x/day OR
 - Ciprofloxacin 200mg IV 2x/day
 - o Patients should begin to improve within 48hr of starting IV antibiotics. Transfer patients with continued fever, tachycardia, low blood pressure, or other signs of acute illness not getting better with antibiotics.

Recommendations

- Complications from chronic liver disease can be complicated and life-threatening. Stabilize the patient quickly and treat as above, but transfer early if patient continues to have abnormal vital signs or does not show improvement with treatment at your facility

Biliary Tract Emergencies

Definition

- Cholelithiasis: gallstones
- Cholecystitis:
 - acute cholecystitis—stone lodged in cystic duct
 - acalculous cholecystitis—gallbladder stasis and ischemia in critical illness
- Choledocholithiasis: gallstone in bile duct
- Cholangitis: bile duct obstruction with resultant infection

Causes

- Gallstones
- Bacterial infection
- Parasitic infection
- Critical illness
- Risk factors: female gender, obesity, pregnancy, rapid weight loss

Signs and symptoms

- Right upper quadrant (RUQ) pain, often episodic after eating a heavy meal with radiation to epigastrium, right shoulder or scapula
 - Murphy's sign: RUQ tenderness worse with palpation, causes inspiratory arrest
- Fever
- Nausea/vomiting
- Jaundice if presence or recent passage of stones in the common bile duct
- Charcot's triad: RUQ pain, jaundice, fever/chills

Differential diagnosis

- Cholelithiasis
- Cholecystitis
- Choledocholithiasis
- Ascending Cholangitis

Investigations

- Labs: FBC, LFTs, lipase
- Imaging
 - Right Upper Quadrant Ultrasound (95 - 99% sensitive)
 - Supine position
 - Use low-frequency curvilinear probe positioned in RUQ
 - Key findings:
 - Cholelithiasis: gallstones only
 - Cholecystitis: gallstones with
 - Pericholecystic fluid
 - Gallbladder wall thickening (> 3mm)

- o Sonographic Murphy's sign
- o Common bile duct dilation (> 6-7mm)
- o HIDA scan (80-90% sensitive for acute cholecystitis)
- o CT Scan (60% sensitive) and abdominal X-ray (15% sensitive) can be used but are much less likely to detect abnormalities
 - Abdominal or chest x-ray may show radio-opaque gallstones and can exclude right lower lobe pneumonia or perforated viscus

Management

- Cholelithiasis: Biliary colic with no signs of infection
 - o If patient can eat and drink without vomiting, if their pain is controlled and they don't have a fever, they can go home and consult general surgery in OPD
 - o Gallbladder rest with intake of clear liquids, avoid fatty meals
 - o Acetaminophen for pain
 - o Will likely require cholecystectomy in the future if pain is recurrent

- Cholecystitis: blockage of the cystic duct by gallstone or complete biliary stasis with signs of blockage on ultrasound in patients with severe infection. Patients will typically have severe pain, continued vomiting, and fever.
 - o Pain relief:
 - Moderate: Diclofenac 100 mg IM
 - Severe pain: Morphine 0.1mg/kg IV OR Pethidine 50-100mg IV (both can cause hypotension) or Tramadol 100 mg IV
 - o IV Fluids, no food by mouth
 - Nasogastric aspiration ONLY if persistent vomiting
 - o Antibiotic:
 - First choice:
 - Ceftriaxone IV 2g once a day
AND
 - Metronidazole 500 mg IV 3x/day for 7 days
 - OR Second choice:
 - Ciprofloxacin IV 400mg 2x/day
AND
 - Metronidazole 500 mg IV 3x/day for 7 days
 - OR Third choice:
 - Ampicillin IV 1 g 3x/day for 7 days
AND
 - Gentamycin IV 160mg 1x/day for 5 days
 - o Indications for cholecystectomy:
 - No response to medical therapy
 - Complications such as empyema or perforation
 - Recurrent biliary colic or cholecystitis after the acute attack has settled

- o Transfer to referral hospital for general surgery if unavailable to remove gallbladder at district hospital
- Cholangitis: Life-threatening illness with high mortality rate presents with the same manifestations as cholecystitis PLUS jaundice and fever/chills. May have altered mental status and shock (tachycardia and hypotension)
 - o Remember your ABCs: Start TWO IV lines, run IV fluids. Place foley catheter to monitor urine output. o
 - Pain relief:
 - Moderate: Diclofenac 100 mg IM
 - Severe pain: Morphine 0.1mg/kg IV OR Pethidine 50-100mg IV (both can cause hypotension) or Tramadol 100 mg IV
 - o IV Fluids; no food by mouth
 - Nasogastric aspiration ONLY if persistent vomiting
 - o Antibiotic: As above for cholecystitis
 - If using Ampicillin and Gentamycin, can add Metronidazole if severe
 - o Immediate transfer to referral center for surgical consultation

Recommendations

- Gallstones result in a range of disease from asymptomatic stones to life-threatening cholangitis. Providers must recognize gallbladder infections and treat with appropriate antibiotics. Patients with simple gallstones may see surgery in OPD for definitive management if they don't have fever, their pain is controlled, and they are able to eat and drink without vomiting.
- In general, if patient with gall bladder disease remains hypotensive or tachycardic after appropriate fluid boluses and three days of antibiotics, they should be transferred to referral center for further evaluation and management.

Appendicitis

Definition: Inflammation or infection of the appendix caused by acute obstruction of appendiceal lumen and eventual ischemia of the bowel wall.

Signs and symptoms

- History
 - Classic presentation: peri-umbilical pain shifting to right lower quadrant and intensifying
 - Nausea/vomiting
 - Anorexia (patient is not hungry)
- Exam
 - Tenderness at McBurney's Point (1/3 of the distance from anterior iliac spine to umbilicus)
 - Rovsing's Sign: lower left quadrant palpation induces right lower quadrant pain
 - Obturator Sign: pain on flexion and internal rotation of the right hip
 - Psoas Sign: pain on extension of the right hip
 - Check for peritoneal signs such as rebound tenderness or guarding, which could indicate rupture

Differential diagnosis

- Appendicitis
- Diverticulitis
- Sigmoid volvulus
- Intussusception (children)
- Gastroenteritis
- Pelvic inflammatory disease (women)
- Ovarian cyst or torsion (women)
- Kidney stone

Investigations

- Labs
 - FBC: may see leukocytosis and left shift
 - Urinalysis: nonspecific; may reveal minimal WBC, RBCs and bacteria in minority of patients; important to rule out urinary cause of pain
 - Pregnancy test **must** be checked in female patients
- Imaging
 - Ultrasound (US)
 - Sensitivity 85% and specificity > 90% (dependent on operator experience)
 - May not be able to rule out appendicitis, however
 - Look for non-compressible appendix, 6mm anterior-posterior diameter, presence of appendicolith, peri-appendiceal fluid or mass

- Can also evaluate for adnexal disease in women
 - CT scan with contrast
 - Sensitivity ranging from 96-100%, specificity 94-97%

Management

- Uncomplicated appendicitis (normal vital signs, no peritoneal signs, no abscess formation, no perforation, previously healthy patient)
 - Surgical resection: goal is to remove inflamed appendix prior to perforation
 - Consider surgery when clinical impression and US investigation are highly suspicious for appendicitis
 - CT imaging may be required in some cases to decrease rate of negative appendectomy
 - Pre-operative antibiotics (one dose of same antibiotics used for medical management)
 - In some cases, medical treatment alone can be used:
 - Higher risk of recurrence or complicated appendicitis
 - Not recommended in
 - Cases with fecalith evident on imaging
 - Elderly
 - Immunocompromised
 - Antibiotics
 - Ceftriaxone 2g IV once a day for 5-7 days OR
 - Cefotaxime 1g IV every 8 hours
 - PLUS**
 - Metronidazole 500mg IV every 8 hours for 5-7 days
- Appendicitis with rupture
 - Emergent surgical consultation
 - Place TWO large IVs, start 2L fluid bolus, place patient on monitor or do frequent vital sign checks, place foley catheter
 - Pain control
 - Morphine 0.1mg/kg IV every 4-6hr as needed for pain OR
 - Pethidine 50-100mg IV every 4-6hr as needed for pain
 - Start antibiotics immediately
 - Ceftriaxone 2g IV once a day for 5-7 days OR
 - Cefotaxime 1g IV every 8 hours **PLUS** Metronidazole 500mg IV every 8 hours for 5-7 days

Recommendations

- Appendicitis is a surgical illness. Care must be taken to exclude alternative etiologies of abdominal pain, particularly in women of child-bearing age.
- Elderly patients and children under 2 years old are at elevated risk for rupture
- Start antibiotics and transfer suspected or confirmed cases of appendicitis for surgical management

Gas and Stool Arrest

Definition: Stool and gas arrest from ileus or obstruction

- Intestinal obstruction: Inability to move food and bowel contents normally due to a blockage, either partial or complete
- Ileus: inability to move food and bowel contents normally due to insufficient peristalsis of the intestines

Causes

- Obstruction
 - Adhesions from prior surgeries
 - Extramural obstruction (mass or tumor)
 - Hernia
 - Strictures from chronic inflammation of the bowel
 - Fecal impaction
 - Gallstone
 - Foreign bodies
- Paralytic Ileus
 - Electrolyte abnormalities, including hypokalemia or hypomagnesaemia
 - Injury
 - Decreased motility after anesthesia

Signs and symptoms

- History
 - Previous abdominal trauma or surgeries; history of hernia, inflammatory bowel disease, or malignancy
- Symptoms
 - Vomiting
 - Abdominal pain: often intermittent and colicky, may become constant;
 - Constipation: Progresses to no stool/no passage of gas (though may pass stool or diarrhea early in the disease)
- Exam
 - Vital signs: may present with tachycardia, occasional low-grade fever; may experience hypotension or shock when severe
 - If significant volume depletion: dry mucus membranes, skin tenting, orthostatic vital signs
 - Abdominal tenderness and distention, may have increased bowel sounds at first; then absent bowel sounds

Differential diagnosis

- Mass or tumor
- Fecal impaction
- Volvulus
- Incarcerated hernia

- Perforated ulcer
- Pancreatitis
- Cholecystitis
- Colitis
- Mesenteric ischemia

Investigations

- Labs
 - o FBC: leukocytosis is common but non-specific o Electrolytes and renal function tests if presentation concerning for significant dehydration
- Imaging
 - o All suspected bowel obstructions need an upright abdominal XR
 - Evaluate for free air under diaphragm, which would indicate perforation (and need for IMMEDIATE surgery)
 - Look for distended loops of small bowel (normal small bowel < 3cm), air-fluid levels, and no air in the rectum
 - "String of Pearls" = small bowel almost completely filled with fluid
 - o CT with contrast: Not usually necessary for diagnosis, but will delineate partial from complete obstruction; may detect ischemia

Management

- Bowel Obstruction
 - o ABCs: IV access, IV fluid resuscitation (NS or LR)
 - o Correct electrolyte abnormalities, especially hypokalemia
 - o Pain control with parenteral medications (Tramadol, Morphine, or Pethidine) o Antibiotics if you suspect strangulation or perforation of bowel: must cover gram negative organisms and anaerobes
 - Metronidazole 1 gm IV once, then 500mg IV 4x/day
 - AND
 - Ceftriaxone 2g IV once a day
 - AND
 - Ciprofloxacin 400 mg IV 2x/day
 - o Place nasogastric tube to suction (when available)
 - o Immediate transfer for surgical evaluation
- Ileus:
 - o Conservative Management:
 - IV fluids, NG tube to suction, NPO, pain management

Recommendations

- Patients with stool and gas arrest should have an upright abdominal XR to rule out free air (perforation) and look for possible obstruction. Most XRs will have non-specific bowel gas patterns; therefore a normal XR cannot exclude an obstruction

Suspected or confirmed obstructions require immediate transfer for surgical evaluation. Start IV line, give 2L bolus, place NG tube, and foley catheter and start antibiotics prior to transfer.

Hernias

Definition

- *Reducible hernia*: hernias that can be gently manipulated back through the tissue defect
- *Incarcerated hernia*: when the tissue becomes trapped and there is obstruction of flow of intraluminal contents and impedance of lymph and venous flow
- *Strangulated hernia*: when pressure in the tissue impedes arterial flow and leads to tissue ischemia and death

Causes

- Congenital structural abnormality
- Weakness in body wall
- Increased intra-abdominal pressure (coughing, emesis, pregnancy, ascites, constipation)
- Incisional hernia

Signs and symptoms

- History
 - Pain and swelling localized to region of hernia
 - Persistent pain or generalized abdominal pain and fever may indicate incarceration or strangulation; bowel obstruction may be part of this presentation (nausea, vomiting, absence of stool or flatus)
- Exam
 - To find a hernia if it is not immediately visible, have the patient cough, valsalva, or stand
 - In hernias that contain bowel, bowel sounds may be auscultated at the site of the hernia
 - In strangulated hernias: significant tenderness and erythema at the site, fever, tachycardia, dehydration, toxic appearance

Differential diagnosis

- Pain and swelling
 - Scrotum: testicular torsion, hydrocele/varicocele
 - Inguinal: lymphadenopathy, abscess, aneurysm
- Pain alone:
 - Ovarian torsion
 - Endometriosis
 - Bowel obstruction (usually with nausea/vomiting)
 - Kidney stone
 - Musculoskeletal causes (hip osteoarthritis, bursitis, tendonitis)

Investigations

- Labs: Not useful; typically a clinical diagnosis

- Imaging:
 - o Abdominal XR: if hernia is accompanied by bowel obstruction, may see air-fluid levels, dilated bowel, free abdominal air o Ultrasound: may help differentiate hernia and abdominal wall mass or inguinal from femoral hernia
 - o CT abdomen with contrast: can confirm strangulation and location o *Of note, physical exam should be sufficient to diagnose the majority of hernias*

Management: All hernias should have attempted reduction by provider

- Reduction Procedure
 - o Place patient in Trendelenburg position (head lower than feet) o Place ice or cold pack over hernia o Give IV medications for pain control
 - Tramadol 50-100mg IV once OR
 - Morphine 0.1mg/kg IV once OR
 - Pethidine 50-100mg IV once
 - o After 15-20 minutes of laying with ice in place, gently attempt to push hernia back into place, massaging bowels along the way
 - Surgical consultation if reduction is unsuccessful after 1 -2 attempts as this is concerning for progression to incarceration/strangulation
 - o If successful reduction is achieved, then patient can return for outpatient surgical management (refer to OPD General Surgery)
 - Ask patient to return urgently for recurrent pain, fever or vomiting and to avoid strenuous activity such as lifting, coughing
- Incarcerated or strangulated hernia (provider unable to push hernia back in place or patient has significant pain, vomiting, or unstable vital signs)
 - o Place IV and give 2L bolus IV fluids (NS or LR)
 - o No food by mouth
 - o Bowel decompression with NG tube if recurrent vomiting or likely bowel obstruction o
 - Give analgesia:
 - Tramadol 50-100mg IV once OR
 - Morphine 0.1mg/kg IV once OR
 - Pethidine 50-100mg IV once
 - o Initiate antibiotics
 - Ceftriaxone 2g IV 2x/ day OR
 - Cefotaxime 1g IV 3x/ day
 - PLUS
 - Metronidazole 500mg IV 3x/day
 - o Emergent transfer for surgical evaluation

Recommendations

All patients presenting with hernia pain should have attempted reduction by initial provider.

Symptomatic but reducible hernias can be referred for OPD surgical follow-up

Immediate transfer of patients with

- o Hernias that cannot be reduced by initial provider
- o Incarcerated or strangulated hernia (tachycardia, hypotensive, ill-appearing or toxic patient, peritoneal signs on abdominal exam)
- o Symptomatic but reducible hernias can be referred to outpatient surgical follow-up

Diarrheal Illness

Definition: Increased frequency of bowel movements (> 3/day), often with change in volume and consistency.

- *Acute diarrheal illness:* <14 days in duration
- *Persistent diarrhea:* > 14 days in duration
- *Chronic diarrhea:* > 30 days in duration
- *Inflammatory:* presence of blood or leukocytes in stool
- *Non-inflammatory:* no blood or leukocytes in stool

Causes

- Acute Non-Inflammatory
 - Viral causes (rotavirus, norovirus)
 - Bacterial: toxigenic E coli, pre-formed toxins in food (S. aureus, B. cereus, C. perfringens)
 - Parasitic: Giardia, Cryptosporidium, Cyclospora
 - Cholera (very profuse diarrhea)
- Acute Inflammatory
 - Bacterial dysentery: Salmonella, Shigella, Campylobacter, E. Coli
 - Clostridium difficile (antibiotic-associated diarrhea)
 - Viral causes (CMV in immunocompromised)
 - Parasitic (E histolytica)
- Persistent/Chronic
 - Post-infectious with protozoa
 - Viral: HIV-associated, CMV
 - Non-infectious: inflammatory bowel disease, malabsorption, pancreatic insufficiency

Signs and symptoms

- History
 - History: Sick contacts, HIV status, co-morbid illness, diet changes, travel history
 - Symptoms: Frequency and consistency of stools, duration, presence of blood or mucous, fever, headache, myalgias, skin rash
 - Symptoms depend on etiology

| Type of diarrhea | Location | Volume of diarrhea | Other symptoms? | Fecal blood or WBCs? |
|------------------------|-------------------------------|--------------------|-------------------------|----------------------|
| Acute non-inflammatory | impacts primarily small bowel | Large | Nausea, vomiting | No |
| Acute inflammatory | impacts primarily large bowel | Small | Abdominal cramps, fever | Yes |

- Exam
 - o Do complete set of vital signs looking for fever, tachycardia or hypotension
 - o Dehydration: Dry mucous membranes, decreased skin turgor, sunken eyes, decreased capillary refill, altered mental status
 - o Abdominal tenderness
 - o Blood on rectal exam (perform if reported blood in stool)

Differential diagnosis

- Mesenteric ischemia
- Inflammatory bowel disease: Crohns' disease or ulcerative colitis
- Bowel obstruction
- Diverticulitis
- Appendicitis
- Intussusception

Investigations

Labs: FBC and electrolytes if patient is ill-appearing or reports extensive or chronic diarrhea. Otherwise, not very helpful in the emergency setting. Stool studies should be done if diarrhea is chronic. Imaging: none

Management

- Acute Diarrheal Illness: The goal of management is to provide appropriate fluid resuscitation, determine cause, and initiate specific antimicrobial therapies where appropriate.
 - o Hydration:
 - Oral rehydration is preferred whenever possible. Recommend glass of water after every loose stool. Use Oral Rehydration Therapy (ORS) where available.
 - IV Fluids for severe dehydration, tachycardia, hypotension, or patient unable to drink
 - Adults: initial 2 L bolus, then reassess vital signs
 - o Diet and Hygiene
 - Careful hand washing, proper disposal of fecal matter
 - Health education about food and personal hygiene
 - o Pharmaceutical management depends on cause
 - Acute non-inflammatory:
 - Loperamide 4mg PO once, and then 2mg after each loose stool (maximum 16mg per 24hr period)
 - NOT for patients with bloody diarrhea or immunocompromised patients
 - Acute inflammatory (patient has fever or bloody stool):
 - Avoid Loperamide

- In severe cases use ciprofloxacin 500 mg PO 2x/day for 5 days
- Cholera
 - Ciprofloxacin 1g PO once as a single dose
 - Extremely contagious. Isolate patient immediately and call hospital officials for notification
- Amoebic dysentery
 - Avoid Loperamide
 - Metronidazole 500mg PO 3x/day for 10 days
- Antibiotic-associated diarrhea
 - Stop antibiotics immediately and see if diarrhea resolves
 - If patient continues to have more than 5 stools per day, consider C. diff as possible cause. Send stool culture, if possible. If no stool culture available, start antibiotics
 - Metronidazole 500mg PO 3/day for 10 days

Chronic Diarrheal Illness: Requires referral for further serological testing

Recommendations

- It's important to assess hydration status. Initiate ORS whenever possible, but some patients will require IV fluid hydration.
- Antimotility agents are only for use in non-infectious diarrhea; avoid prolonged use
- Transfer to a referral center if your patient is very ill-appearing and not responding to IV fluids and antibiotics or if they have associated severe abdominal pain or signs of peritonitis

Peptic Ulcer Disease and Perforation

Definition: Peptic ulcer disease results when there is a breakdown in gastric or duodenal mucosa, typically from overproduction of acid and/or breakdown in mucosal defenses. Severe ulcer disease can result in perforation, which can be life-threatening.

Causes

- Peptic Ulcer Disease
 - *Helicobacter pylori* infection
 - Use of non-steroid anti-inflammatory drugs (NSAID)
 - Lifestyle: cigarette use, alcohol consumption, caffeine, stress
 - Critical illness
- Perforation
 - Gastric reflux with ulceration
 - Caustic ingestions
 - Tumor (rare)
 - Violent vomiting (rare)

Signs and symptoms

- History
 - Uncomplicated Ulcer
 - Aching, burning pain localized in epigastrium
 - Can be relieved with food (classically duodenal ulcers) or worsened by food (gastric ulcers)
 - Associated symptoms including nausea and vomiting, bloating, indigestion
 - Perforation
 - Severe epigastric pain, chest pain, back pain
 - Difficulty breathing
- Exam in Perforation
 - Vital sign changes: tachycardia, fever, tachypnea

Differential diagnosis

- Cholecystitis
- Pancreatitis
- Biliary colic
- Aortic dissection
- Abdominal aortic aneurysm

Investigations

- Labs
 - Obtain FBC if concern for bleeding ulcer with hematemesis or melena on rectal exam
- Imaging if concerned for perforation:

- o UPRIGHT chest x-ray may reveal air under the diaphragm •
- Other
- o Endoscopy: best for diagnosis of PUD, but avoided in suspected perforations; can confirm *H. pylori* diagnosis; may also reveal alternate diagnosis

Management: General goal is to ensure patients presenting with epigastric pain do not have perforation. Patients presenting with severe pain should have UPRIGHT chest XR to ensure no free air under the diaphragm.

- Peptic Ulcer Disease without Perforation
 - o Greater than 70% of Rwandans with PUD have non-ulcer dyspepsia. If PUD suspected, counsel patient on non-pharmaceutical treatments like avoiding NSAIDs (ibuprofen), aspirin, stopping tobacco, and no alcohol.
 - o Start trial of Proton Pump Inhibitor (PPI)
 - Omeprazole 20mg PO 2x/day for two weeks
 - If patient feels better, continue medication
 - If patient has continued symptoms or pain, refer to Internal Medicine for endoscopy before initiating H. Pylori treatment
 - o Consider early referral for endoscopy in patients with weight loss, vomiting after eating, dysphagia. These patients need evaluation for malignancy as soon as possible.
- Perforated Ulcer (abnormal vital signs with severe epigastric pain or free air under diaphragm on chest XR)
 - o Immediately start TWO IV lines and give fluids (NS or LR) o Give first dose of IV antibiotics
 - Ceftriaxone 1g IV once AND
 - Metronidazole 500mg IV once
 - o Transfer immediately to referral center for surgical evaluation and repair

Recommendations

- Patients with simple PUD are not considered emergencies, and can be started on trial of PPI with follow up in 2 weeks.
- It is important to rule out perforation in every patient with severe epigastric pain by obtaining an upright chest XR and paying attention to any abnormal vital signs or pain out of proportion to exam. Transfer suspected or confirmed perforations immediately.

Abdominal Mass

Definition: Any abnormal collection of tissue in the abdominal region. Within the Rwandan context, most often a cancer/tumor or infection/abscess.

Causes

- Congenital malformation
- Infection
- Tumor
- Hernia (particularly incarcerated/strangulated)
- Enlarged organ

Signs and symptoms

- History

Characteristics of mass: intermittent versus constant, rapidity of growth, changes in size, associated pain or discomfort Systemic symptoms: anorexia, weight loss, fevers, night sweats, nausea, vomiting, change in bowel habits, missed menses, infections, dysuria, inability to void

Feel for tenderness, erythema, and pulsation Check for presence of bowel sounds, bowel peristalsis Percuss for fluid, check for fluid wave (ascites) Pelvic and rectal exam indicated in some cases

o

o Differential diagnosis by location

Exam

o

o

| Location | Diagnosis |
|----------------------|--|
| Right Upper Quadrant | <ul style="list-style-type: none">• Hepatomegaly o Abscess, hepatitis, tumor •Distended gallbladder o Pancreatic cancer, cholecystitis, carcinoma • Polycystic kidney, renal malignancy |
| Right Lower Quadrant | <ul style="list-style-type: none">• Appendiceal abscess •Intestinal neoplasm • Ovarian mass or malignancy |
| Epigastric | <ul style="list-style-type: none">• Acute gastric distention •Pancreatic pseudocyst •Pancreatic cancer •Abdominal aortic aneurysm |

| | |
|---------------------|---|
| Left Upper Quadrant | <ul style="list-style-type: none">• Splenomegaly• Neoplasm• Polycystic kidney, renal malignancy |
| Left Lower Quadrant | <ul style="list-style-type: none">• Diverticular abscess |

| | |
|-----------------------|--|
| | <ul style="list-style-type: none"> • Ovarian mass or malignancy • Neoplasm |
| Hypo gastric | <ul style="list-style-type: none"> • Urinary retention • Uterine mass or malignancy • Pregnancy |
| Any Quadrant | <ul style="list-style-type: none"> • Tuberculosis • Lymphoma |
| Abdominal Wall Masses | <ul style="list-style-type: none"> • Hernia • Infection • Hematoma |

Investigations

- Labs
 - o Pregnancy test in all women of child-bearing age
 - o FBC if there is concern of infection, anemia, or splenic involvement
 - o LFTs for RUQ pathology
 - o Creatinine to assess renal function
- Imaging
 - o Ultrasound is frequently the most useful initial investigation
 - Can show fluid-filled masses (amoebae, cyst, abscess), gallbladder pathology, pregnancy, distended bladder, appendicitis
 - o Abdominal x-ray only for signs of obstruction, stool and gas arrest
 - o CT abdomen/pelvis with contrast occasionally required to define abdominal mass when ultrasound is non-diagnostic. If suspected malignancy, CT can help to sometimes locate primary location of tumor and help determine if disease is metastatic
 - o Endoscopy sometimes helpful for epigastric masses in patients with inability to take food

Management and recommendations

- Management of abdominal masses depends on the etiology.
- Most cases of abdominal mass can have non-urgent evaluations, with the goal of completing imaging studies and specialty referral within a two-week period.
 - o Longer evaluation time is bad for a patient with an abdominal mass that is a malignancy because metastatic spread is more likely to occur while waiting for test results and referrals. Cancers that are recognized early have much better prognoses as treatments are more feasible.
- Transfer patients with abdominal masses to referral center emergently if they have
 - o Inability to pass stool or urine
 - o Inability to tolerate oral foods
 - o Abnormal vital signs (tachycardia, hypotension)

Chapter 7

RENAL AND GENITOURINARY

Acute Scrotal Pain

Definition: Common reasons for testicular pain include torsion, epididymitis, hydrocele, or varicocele. Testicular torsion is an emergency- surgery can correct the problem and save the testis if done within six hours.

Signs and symptoms

- Timing of onset of pain- if less than six hours, transfer immediately without work up
 - Torsion: sudden onset scrotal, inguinal, or abdominal pain. The pain might be intermittent it is *not* positional in nature (testicular torsion is primarily an ischemic event)
 - Exam: Involved testis is firm, tender with a unilateral absence of the cremasteric reflex
 - Torsion of the appendage of testis: sudden or gradual onset of pain; more common in age 3-12yr; more commonly see localized tenderness in the head of a testis without mass or erythema
- Ask about trauma, sexual activity, penile discharge, dysuria, hematuria
- Ask about vaccination status (mumps can present with orchitis)
 - In orchitis, testicular pain is more gradual and global; epididymitis is normal and spermatic cord is tender but not thickened
- Epididymitis can be sudden or gradual onset pain; can occur any age but more common in post-puberty boys and adults; usually history of painful voiding, discharge, or recent UTI; recent heavy lifting or straining can cause epididymitis
 - Exam: Relief of pain with elevation of the affected testicle (positive Prehn sign)

Differential diagnosis

- **All painful scrotums should be presumed testicular torsion until proven otherwise**
- Torsion of appendage
- Epididymitis (inflammation of the epididymitis on the back side of the testicle)
- Orchitis (inflammation of the testes from mumps, STI, or other infection)
- Hydrocele (fluid collection in the scrotal area)
- Varicocele (dilation of pampiniform venous plexus and the internal spermatic vein)
- Incarcerated hernia
- Carcinoma (gradual onset symptoms, usually not painful)

Investigations

- Physical exam findings

- o Torsion: painful or non-palpable testis that has elevated; typically see swelling of testicle and secondary swelling of scrotum; affected testis usually lies horizontal instead of vertical
- o Torsion of appendage: "blue dot sign" is a small, tender, pea-like structure seen through the scrotal skin
- Labs: Urinalysis, urine cultures, urethral swab if suspecting STI
- Imaging: Immediate Doppler ultrasound looking for blood flow to the testis, if available. If clinical diagnosis is suspicious for torsion and less than 6hr since onset of symptoms, refer immediately for ultrasound and surgical evaluation without delay.

Management: The general goal is to decide whether there is a high likelihood of testicular torsion based on exam and history..

- Testicular torsion
 - o Manual detorsion is successful in 30-70% of patients and **should be attempted before transfer** (see Appendix) o Patients still require transfer for urological review, even if detorsion was successful.
- Hydrocele or Varicocele
 - o Refer to OPD urology for further management; non-emergent
- Torsion of testicular appendage
 - o Self-limiting
 - Reduce activities, NSAIDs like Brufen 800mg PO every 8hr
- Epididymitis
 - o In younger adults, treat for gonorrhea and chlamydia
 - Ceftriaxone 250mg IM once AND
 - Doxycycline 100mg PO 2x/day for 10 days
 - o In older men less likely to have an STI, treat for common UTI pathogens
 - Nitrofurantoin 100mg PO 2x/day for 10 days OR
 - Ciprofloxacin 500mg PO 2x/day for 10 days OR
 - Amoxicillin 500mg PO 2x/day for 10 days

Recommendations

- Testicular torsion is an emergency that requires immediate referral if onset of pain is less than 6hr. If immediate transfer not possible or if arrival to urology will be more than 6hr after onset of pain, attempt manual detorsion.
- Consider testicular torsion in the differential diagnosis of any male presenting with abdominal pain. All males with abdominal pain should have a brief GU exam or at least ask patient about testicular swelling during history.

Hematuria

Definition: Abnormally high number of blood cells in the urine- can be microscopic (urine is still yellow, but RBCs present in urinalysis) or gross (urine is red with blood). The color of urine does NOT correlate with amount of blood lost.

Causes

- Most common causes in adults are : UTI, bladder cancer, calculi and BPH in men >60
- Pseudohematuria: eating beets, porphyria, hemoglobin (hemolytic anemia), myoglobin (rhabdomyolysis), vaginal bleeding, drugs (phenazopyridine, Rifampin)
- Systemic disease: sickle cell, autoimmune (lupus), coagulopathy (hemophilia, other bleeding disorders)
- Renal/Glomerular: post-streptococcal, lupus, hemolytic uremia syndrome (HUS)
- Renal/Non-glomerular: pyelonephritis, infarction, trauma, interstitial nephritis, malignancy
- Post-renal: infection (cystitis, prostatitis, urethritis, calculi, trauma (blunt, catheter placement), malignancy

Signs and symptoms

- Most cases of hematuria are clinically stable. If excessive blood, check vitals for hypotension, tachycardia. Look for fever. Ask about anticoagulants like Warfarin.
- History
 - o Ask about amount, duration, whether this has occurred before. Ask about flank pain (calculi), trauma, fever, back pain or hesitancy (UTI), vomiting (pyelonephritis)
 - o Recent skin or other infections (post-infectious glomerulonephritis)
 - o Transient hematuria can be from sexual activity or menstruation
 - o Vigorous exercise may produce transient hematuria or myoglobinuria
 - o Exposure to schistosomiasis, malaria, TB
 - o Risk factors for urothelial cancer in patients with microscopic hematuria
 - Smoking, age >40, gross hematuria, history of irritative voiding symptoms, occupational exposure to chemicals or dyes (benzenes or amides)
- Exam
 - o Focus on presence of rash (especially in children), fever, flank tenderness, hypertension, edema, palpable abdominal masses. Do rectal exam in older males to evaluate prostate
 - o Glomerular cases are usually painless
 - o Extraglomerular cases usually present as clots in the urine

Differential diagnosis

- See causes above

Investigations

- Labs: FBC to check Hb, electrolytes, renal function, urinalysis (protein, RBC)
- Imaging: If clinically stable, refer for ultrasound of kidneys (renal size, masses, and to rule out obstruction), urine culture (UTI, schistosomiasis, TB), urethral culture (if suspect STI), possible referral for outpatient CT abdomen without contrast (largest stones, renal mass)

Management: General goal is to rule out life threatening bleeding, identify source of blood, treat infections, and refer for proper follow up

- UTI, pyelonephritis, or infected stone: antibiotics
 - Uncomplicated UTI
 - Nitrofurantoin 100mg PO, two tablets 2x/day for 10 days OR
 - Cefuroxime 500mg PO 2x/day for 5 days
 - Encourage high fluid intake
 - Pyelonephritis (UTI with flank pain, fever, vomiting)
 - Admit for IV antibiotics, IV fluids, monitoring
 - Ceftriaxone 1g IV 2x/day until tolerating PO and fever resolved
THEN CHANGE TO PO medications above for seven more days
 - If not getting better, consider unusual UTI
 - TB (sterile pyuria), candiduria, schistosomiasis, gonorrhea, chlamydia
- Urethral catheter for obstruction and to remove clots
 - Irrigate with NS until clots clear
- Refer to OPD Internal Medicine for nephrologist consult if
 - Acute kidney injury
 - Decreased urinary output (oliguria or anuria)
 - Indication for renal biopsy (persistent hematuria, 2+ protein)
 - Underlying cause unclear
- Refer to urology if
 - Gross hematuria
 - Abnormal cytology
 - High risk factors for cancer
 - Cystoscopy needed
 - Imaging showing urological disease

Recommendations

- Determine whether hematuria is microscopic or gross
- Assure patient is hemodynamically stable before sending home
- Check renal function (urea, creatinine) before sending home

Urinary Retention

Definition: Inability to pass urine voluntarily when the bladder is full. It can be painful when acute or painless if chronic.

Causes

- Obstructive
 - BPH (benign prostatic hyperplasia), bladder calculi, bladder neck stenosis, blood clot, cancer, cystocele, iatrogenic (previous catheters), phimosis/paraphimosis, pregnant uterus, prolapsed uterus, rectocele, trauma, urethral obstruction (tumor, inflammation, calculi), urethra stricture (mostly men), cystitis, herpes, prostatitis, STI, TB
- Neuropathic
 - Trauma, mass lesions, infection in the spine
 - Encephalitis, meningitis, stroke, diabetes, multiple sclerosis
- Medications
 - Antidepressants, antipsychotics,

Signs and symptoms

- Dysuria, painful urge to pass urine without output, uncontrolled dribbling of urine through the urethra
- Patients often have significant lower abdominal pain, fullness
- Do full GU exam to look for penile problems like phimosis/paraphimosis

Investigations

- Labs: urinalysis with urine culture, renal function
- Imaging: If bedside ultrasound available, can help verify full bladder; referral for formal ultrasound once retention is relieved

Management: General goal is to catheterize the bladder, preferably by Foley catheter (see Appendix). Suprapubic catheter can be placed if Foley does not pass (see Appendix).

Recommendations

- Suprapubic catheter placement has many potential serious complications such as bowel perforation and bladder rupture. Use an ultrasound, when available, to verify a full bladder and ensure no bowel is present.
- Bleeding after catheter insertion is typically transient, and can be flushed with NS or sterile water.
- Patients with long-standing obstruction are at risk for post-obstructive diuresis as well as post-obstructive renal failure
 - Check renal function in these patients
 - If more than 1L of urine passes after catheterization, monitor patient for signs of hypotension and check renal function.

Instruct patients to return if they develop fever, abdominal pain, catheter blockage or penile pain

Refer to urology OPD for further management once retention has resolved.

Patients with clot retention, significant hematuria, sepsis or possible neurologic cause of urinary retention should be transferred on an emergent or urgent basis, depending on vital signs

Renal Failure- Acute and Chronic

Definition: Decrease of kidney function that can be acute (decline in kidney function over hours to days) or chronic (decline in kidney function over months to years). Typically, patients with acute renal failure have clinical symptoms that require prompt attention while chronic renal failure patients have subacute or chronic symptoms.

Causes

- Acute renal failure
 - Pre-renal (most common cause)
 - Hypovolemia, vomiting/diarrhea, heat loss, burns, decreased cardiac output, sepsis, cirrhosis,
 - Intrinsic renal
 - Acute tubular necrosis, drugs, infections, acute glomerulonephritis, malignant hypertension
 - Post-renal
 - Urethral obstruction, cervical cancer, intra-abdominal tumor, neurogenic bladder
- Chronic renal failure
 - Obstructive
 - Nephrolithiasis, prostatic, congenital
 - Tubulointerstitial
 - Sickle cell, TB
 - Glomerular
 - Diabetic nephropathy, post infectious
 - Hereditary
 - Polycystic kidney disease
 - Vascular
 - Renal arterial disease, hypertensive nephrosclerosis

Signs and symptoms

- Assess ABCs. Start two IV lines in ill-appearing patients and assess oxygen saturation. Consider early Foley catheter placement to monitor urine output.
- For acute renal failure, there are no specific symptoms or signs to diagnose. It is often found on routine labs or during acute illness.
- Renal failure patients may present with uremia- pericardial effusion, coma, seizures, nausea/vomiting, platelet dysfunction. Uremic symptoms more common in chronic renal failure.
- Look for signs of volume overload (acute pulmonary edema is a common presentation of patients with acute renal failure)- hypertension, rales, peripheral edema, JVD
- Ask about urine output and place foley catheter to assess actual output over a 24hr period. Good urine output is at least 0.5cc/kg/hr.

Investigations

- Labs: FBC, electrolytes, calcium, renal function.
 - Potassium is the single more important electrolyte to obtain as hyperkalemia is a life-threatening emergency.
 - Chronic renal failure patients typically have chronic anemia, hypocalcemia.
 - Urea:Cr ratio in pre-renal >20; intrinsic renal 10-15 ratio; post-renal obstructive normal ratio
- Imaging: Ultrasound of kidneys- chronic renal failure typically shows bilateral small kidneys with increased parenchymal echogenicity

Management: Volume overload and hyperkalemia are the most common causes of death in acute renal failure. The goal is to start treatment on each of these conditions while awaiting transfer to referral hospital for dialysis consideration. At the time of publication, Rwanda's health insurance scheme will at times cover six sessions of dialysis if renal failure is deemed to be acute in nature. Typically, insurance will **not** cover chronic dialysis treatments, but patients can pay out of pocket for treatment.

- Volume overload associated with renal failure
 - Check IVC (inferior vena cava) by ultrasound (if available) to see if patient is dehydrated.
 - A significant number of patients will have a pre-renal cause of acute renal failure (vomiting, burns, diarrhea, sepsis).
 - Place TWO IV lines and give 1L fluid bolus, while watching for clinical signs of worsening overload (increased respiratory rate, decreased saturation, development of rales on lung exam)
 - Do NOT give iv fluid if the clinical picture is highly suggestive of pulmonary edema; if this is the case consider the following:
 - Give oxygen as needed to keep saturation above 95%.
 - Morphine 1-2mg IV may help air hunger, but use is controversial
 - Furosemide 40-80mg IV 2-3x/day depending on Cr (the higher Cr, the more Furosemide that is needed)
 - Positive pressure ventilation (at referral hospital only)
 - Consider transfusion of blood in patients with Hb<7
- Hypertension associated with renal failure
 - Nitroglycerin SL or IV is best to control blood pressure. Give 0.4mg SL every 5min on arrival for maximum three doses.
 - Labetalol 20mg IV over 2 minutes initially, then 40-80mg IV every 10min with total dose not exceeding 300mg- can be used in case of extremely high blood pressure and obvious volume overload on exam
 - Captopril 25mg-50mg PO every 8-12 hour

- Hyperkalemia associated with renal failure (see chapter on hyperkalemia for details on dosing)
 - o Calcium gluconate IV o
 - Insulin IV/glucose IV o
 - Salbutamol nebulized o
 - Sodium bicarbonate IV o
 - Furosemide IV o
 - Kayexalate PO

- Indications for acute dialysis
 - o Severe acidosis (pH less than 7)
 - o Electrolyte abnormalities (hyperkalemia and hyponatremia)
 - o Toxic Ingestions (ethylene glycol, methanol, salicylate/aspirin,
 - o Volume overload (acute pulmonary edema)
 - o Uremia

Recommendations

- Sometimes it will be quite difficult to determine if a patient's renal failure is acute or chronic, unless there is a documented history of renal problems in the past.
- Life-threatening complications of renal failure include hyperkalemia and volume overload. These must be recognized quickly and treatment started.
- Transfer any patient that has significant volume overload with or without uncontrolled blood pressure. It is also reasonable to transfer any patient anuria, not responding to fluid bolus. Do not delay treatment of above complications for transfer. Start treatment in the district.

Penile Disorders

Definition: This section covers many penile problems such as trauma, paraphimosis, phimosis, and Fournier's gangrene.

Signs and symptoms

- Assess ABCs, establish IV
- Do full abdominal and inguinal exam. Look at penis, scrotum, and prostate
- Uncircumcised boys and men can develop phimosis and paraphimosis
- Penis examination includes evidence of trauma, bruising, laceration, bleeding from urethra, lesions, or deformity. Retract foreskin in uncircumcised patients and expose glans
- Look for discolored skin, foul odor, crepitus in Fournier's gangrene

Differential diagnosis

- Paraphimosis, penile trauma, priapism, Fournier's gangrene, foreign body, phimosis, balanitis, penile fracture, urethritis, STI

Investigations

- Labs: Urinalysis and then other tests per diagnosis

Management

- Penile trauma
 - If blood at urethral meatus, evaluate for urethral injury with RUG (do not place foley catheter)
 - RUG procedure (retrograde urethrogram- see chapter on pelvic trauma for details)
 - Control hemorrhage with pressure and ice
 - Refer immediately if uncontrolled bleeding
- Paraphimosis: Inability to replace the foreskin back over the glans of the penis, constricting glans and leading to ischemia and necrosis. *This is an emergency.*
 - Control pain (IV morphine, penile block) and reduce edema with compressive dressing, manual pressure, or ice. Sprinkle granulated sugar on prepuce and glans for osmotic reduction of edema
 - Compressive dressing may be wrapped around penis for a few minutes before manual reduction to help with swelling
 - Manual reduction involves gentle, steady pressure on the glans with the tips of the thumbs while applying gentle traction to the foreskin.
 - Emergency dorsal slit to reduce constriction of glans
 - Patient in supine position and cleaned and draped with sterile towels

- Infiltrate lidocaine into the dorsal midline of foreskin just beneath the superficial fascia throughout the course of proposed dorsal slit, starting proximally at the coronal sulcus and proceeding distally to the tip of the foreskin (See photo below)
- After 3-5 minutes, grasp foreskin with forceps to test for anesthesia. If it is not numb, use a dorsal nerve block by injecting at the 10 o'clock and 2 o'clock positions or "ring block" at the base of the penis.
- After anesthesia, advance straight hemostat proximally to the area of the coronal sulcus between the inner layer of the foreskin and the smooth glans of the penis, taking care to avoid injury to the meatus and urethra. Open to tent the skin to ensure proper placement, advance the hemostat to the level of the coronal sulcus and then close it, essentially crushing the foreskin. Leave closed hemostat in place 3-5 min, then remove it and cut the crushed foreskin longitudinally with straight scissors.
- Two absorbable sutures may be placed, beginning proximally at the apex of the dorsal slit and carried distally, to re-approximate the two leaves of the foreskin.
- Definitive elective circumcision should follow dorsal slit.

Fournier's gangrene: necrotizing infection of penis, testicular sac, and perineum. This is a life-threatening infection that spreads rapidly, causes sepsis and death. Crepitus (emphysema) and ecchymosis of the inflamed tissues is a common feature. More commonly seen in patients with diabetes and alcohol abuse patients.

- o Place two large IVs and start NS hydration, pain control with IV morphine
- o Start IV antibiotics immediately
 - Ceftriaxone 1g IV 2x/day OR Cefotaxime 1g IV 3x/day AND
 - Metronidazole 500mg IV 3x/day
- o Transfer immediately to referral hospital for urological/surgical intervention and debridement
- o Have a high index of suspicion in patients who present complaining of any genitalia **pain out of proportion** or extending beyond the confined area of infection

Balantitis: inflammation of the glans with redness and edema
Typically caused by inadequate hygiene and external irritation with subsequent Candida colonization

- o Control glycemia in diabetes patients
- o Clean area with a mild soap, ensuring adequate dryness and antifungal creams

- o Treat infection with topical antibiotics, where available
- **Phimosis:** Inability to retract the penile foreskin; not an emergency unless there is complete obstruction of urine or it turns into paraphimosis. Typically caused by infection, poor hygiene
 - o Consider dorsal slit excision if urine is obstructed
 - o Elective circumcision is preferred if not obstructed
 - o Topical steroid treatment (Betamethasone 0,05% once per day) applied from the tip of the foreskin to the glands corona

Recommendations

- Fournier's gangrene is a life-threatening emergency and should be referred immediately after starting IV antibiotics
- Paraphimosis and phimosis may require dorsal slit if other steps do not reduce swelling or urine is obstructed

Priapism

Definition: A persisting, painful, and abnormal erection of the penis. This is a medical emergency. It can occur without sexual stimulation and does not go away after ejaculation. There is risk of permanent damage and impotence if left untreated for more than four hours.

Causes

- Low-flow: ischemic, more common, more dangerous, painful
 - Sick cell disease, leukemia, idiopathic, spinal trauma (priapism is painless), medications (antidepressant, anti-hypertensives, antipsychotic, chlorpromazine), drugs of abuse (alcohol, cocaine)
 - Aspirated blood from corpora cavernosa is dark red
- High-flow: non-ischemic, less common; most often painless
 - Typically from direct injury to penis
 - Aspirated blood from corpora cavernosa is bright red and well oxygenated

Signs and symptoms

- Persistent, painful erection
- Ask about trauma

Investigations

- Labs: none- clinical diagnosis

Management: Determine whether priapism is low flow or high flow by aspiration.

- High-flow
 - Refer to urology urgently
- Low-flow
 - Establish IV access in patient ◦ Perform penile dorsal block for anesthesia
 - Intra-corporeal phenylephrine (preferred if available) or adrenaline injection:
 - In adults, phenylephrine should be diluted with NS to provide a final concentration of 100-500mcg/ml. Serial doses of 1mL of dilute solution can be given every 5 minutes up to one hour
 - If phenylephrine not available, dilute 0.1mg adrenaline (0.1mL in 1:1000) in 2mL NS; inject into the corpus at either the 10 o'clock position or the 2 o'clock position at the base of the penis. Wait for about 30 min for a response. If unsuccessful, follow next step.
 - Aspirate corpora cavernosum: using sterile technique, insert a small (22g or smaller) needle into one of the corpora cavernosa. Aspirate 20-30mL blood. If the penis remains erect, follow next step.

- o Irrigate with saline or solution of adrenaline (add 1mg of adrenaline to 1L of NS and irrigate with 20-30mL of this solution at a time).
- o Refer to urology as soon as possible
- o Priapism due to sickle cell disease often requires simple blood transfusion

Recommendations

- Priapism is a medical emergency that requires action immediately. Impotence and permanent damage will occur in as little as four hours.
- Treat cases of low-flow priapism in the district *before* transfer, unless it is early in the day, during a weekday, you are close to a referral hospital, *and* urology is immediately available to see patient
- Remember to give IV morphine for pain control
- Sickle cell patients respond to blood transfusion or exchange transfusion when available.

Urolithiasis

Definition: Stones that are found in the kidneys or the ureters. 75% of stones are either calcium oxalate or calcium phosphate.

Causes

- Calcium oxalate (majority)
- Infection stones
- Uric acid

Signs and symptoms

- History
 - Patients often have rapid onset, excruciating pain (severe pain), typically from the back/flank radiating to the groin/front area. Pain can come and go.
 - Blood tinged urine. Ask about fever, vomiting
- Exam
 - Costovertebral tenderness (typically one side only)
 - Normal pelvic exam in women (must rule out pelvic infections)
 - Normal testicular/scrotal exam in men (must rule out torsion)

Differential diagnosis: Any patient over the age of 60 who presents with first-time renal colic, consider other diagnoses BEFORE urolithiasis (very uncommon to have first stone later in life)

- Pyelonephritis
- Appendicitis
- Abdominal or GYN tumors
- Abdominal aortic aneurysm
- Muscle strain or low back injury
- Gallstones
- Testicular or ovarian torsion

Investigations

- Labs
 - Urinalysis is most important test
 - Hematuria in 85% of patients, but it should not be used alone to exclude or confirm the diagnosis of ureterolithiasis
 - Consider FBC for WBC, renal function to ensure no renal failure
 - Test all females of childbearing age for pregnancy when considering renal colic
- Imaging: Abdominal XR will show up to 85% of renal stones; US is good to rule out hydronephrosis, but only shows stone 60% of the time; CT without contrast is 99% sensitive, if available.
- If patient has previous CT that confirms stone, no need to repeat

Management

- Urolithiasis
 - o Main goal is good hydration, pain control, rule out hydronephrosis and renal failure and rule out infection
 - IV NS2L bolus
 - Consider Tramadol for moderate pain
 - Tramadol 50-100mg IV
 - Consider opiate medication if severe pain
 - Morphine 0.1mg/kg IV
 - o If urinalysis confirms leukocytes/nitrites/bacteria, treat with IV antibiotics o Try abdominal XR, but a negative XR does NOT rule out stone (15-40% may not be visible on XR)
 - o If available, perform ultrasound to rule out hydronephrosis o Most patients can be referred for outpatient evaluation with urology. If needed, a CT without contrast is the definitive imaging study to determine stone size and location
 - Stones larger than 5mm typically will NOT pass without urological intervention
 - Discharge with Brufen TID as long as renal function is normal (best pain medication) and ask patient to drink extra water to flush kidneys at home
 - o Admit to district hospital
 - Signs of infection, fever
 - Uncontrolled vomiting
 - Need for repeat IV pain medications (uncontrolled pain)
 - History of diabetes (more prone to renal damage or failure)
 - o Transfer to referral hospital
 - Unstable vital signs despite 2L of fluids IV
 - Confirmed hydronephrosis
 - If unrelieved, irreversible renal damage occurs within 3 weeks with complete obstruction
 - Renal failure (new increase in Cr or anuria)
 - Calculus > 5 mm

Recommendations

- Any older patient presenting with first time flank pain, consider more serious diagnoses other than kidney stone (aneurysm) and refer for definitive imaging
- Patients with stones typically require opiate medication for pain control
- Stones larger than 5mm will not typically pass on their own and will require urgent urology referral

Urinary Tract Infection (UTI) and Pyelonephritis

Definition: Diagnosis requires significant bacteriuria plus clinical signs and symptoms of infection. UTI is very common in women due to the short urethra. Men rarely develop UTIs before the age of 50. UTI is rarely life threatening in its uncomplicated form, however complicated UTIs such as pyelonephritis can cause sepsis.

Types

- Acute cystitis
 - Infection/ inflammation of the bladder and urethra (lower urinary tract)
 - Not systemically ill
- Acute pyelonephritis
 - Infection of the upper urinary tract (ureters, kidneys)
 - Usually have systemic symptoms
- Uncomplicated
 - UTI in an otherwise healthy non-pregnant woman with no urologic abnormalities
 - Causal bacteria:
 - Will depend on location; no great data for Rwanda
 - Escherichia coli: 80 to 90%
 - Klebsiella, Proteus, Enterobacter, Pseudomonas: 5-20%
 - Staph saprophyticus: up to 15% UTIs in young, sexually active women, rarely causes upper tract infections
- Complicated
 - UTI in any other group other than healthy, non-pregnant women
 - Associated with higher morbidity and/ or presence of anatomical abnormalities
 - Bacteria may be different
 - More often pseudomonas or enterococcus

Signs and symptoms

- History
 - Lower Tract Infection
 - Dysuria
 - Increased urinary frequency
 - In young, healthy women, dysuria + frequency -> > 90% chance of UTI
 - Hematuria
 - Urgency
 - Hesitancy
 - Suprapubic discomfort
 - Vaginal discharge makes diagnosis less likely
 - Upper Tract Infection

- Lower tract symptoms PLUS:
 - Back pain
 - Nausea and vomiting
 - Fever
- Exam
 - o Lower tract infections
 - Rarely show abnormal vital signs or signs of systemic toxicity
 - May have suprapubic tenderness
 - Perform pelvic exam on any woman with lower abdominal pain or who has urinary symptoms without a positive urinalysis
 - Perform testicular, prostate and penile exam on any man < 50 with UTI symptoms
 - o Upper tract infections
 - Fever, tachycardia common
 - Uncommonly progresses to septic shock with low blood pressure
 - Often have unilateral costovertebral angle (CVA) tenderness
- Bedside tests
 - o Urine dipstick to look for leukoesterase (suggests presence of white blood cells) and nitrites (suggests presence of bacteria) o
 - o Urine pregnancy test for ALL women of childbearing age

Differential diagnosis

- Women
 - o Sexually transmitted infection (HSV, cervicitis, pelvic inflammatory disease)
 - Especially if recurrent or fails to resolve with UTI treatment
 - o Vaginitis (yeast or gardinella)
 - o Local irritation (soaps, douching, trauma)
- Men
 - o Young men *more likely* to have one of the following diagnoses than to have a UTI
 - Urethrititis
 - Prostatitis
 - Epididymitis
- Nephrolithiasis
- Perinephric abscess
- Schistosomiasis
 - o Especially if hematuria and from endemic area
- Urinary TB

Investigations

- Labs
 - o Urine dipstick or urinalysis for all symptomatic patients

- Can consider treating young women with dysuria and urgency without dipstick IF they can reliably return if symptoms to do resolve
 - Pregnancy test for ALL women of childbearing age
 - Will change treatment
 - Other labs not need routinely unless signs of upper tract infection/ toxicity
 - If signs of upper infection
 - FBC, creatinine useful
- Imaging
 - None for lower tract infections in adults
 - In suspected upper tract infections, consider renal ultrasound to look for evidence of hydronephrosis (might indicate infected nephrolithiasis) or perinephric abscess

Management

- Best antibiotics will vary depending on local resistance patterns. Small surveys in Rwanda suggest very high resistance rates for most commonly available antibiotics. Therefore, if a patient is not improving, consider sending a urine culture with sensitivities and/ or changing antibiotics
- Uncomplicated UTI
 - Lower tract
 - Goal is to prevent progression to upper tract infection
 - Ciprofloxacin 500 mg BID x 3 days
 - Co-trimoxazole 160/800 BID x 3 days
 - Amoxicillin/ clavulanic acid 875 mg PO x 5 days
 - Nitrofurantoin 100 mg TID x 7 days
 - Upper tract
 - Outpatient treatment appropriate if patient is tolerating PO and well appearing
 - Pain control
 - Give above treatments (other than nitrofurantoin) for 14 days
 - Inpatient treatment if signs of severe infection (fever, hypotension, uncontrolled pain) or not tolerating PO
 - IVF for dehydration or sepsis
 - Pain and nausea control
 - Antibiotics
 - Ceftriaxone 1 gram IV BID OR
 - Cefotaxime 1 gram IV TID
 - PLUS
 - Gentamycin 7 mg/kg IV Qday OR
 - Ampicillin 2 grams IV Q6H + Gentamycin 7 mg/kg IV Qday

- Be careful of using Gentamycin in patients in whom creatinine is not known
- Complicated UTI
 - o Same as pyelonephritis regimens, treat 10-14 days
 - o Consider urology referral if concern for concomitant nephrolithiasis, perinephric abscess, or structural urinary tract abnormality
- Pregnancy
 - o Asymptomatic bacteriuria increases risk of miscarriage; treat all women who are pregnant with a positive urinalysis regardless of symptoms
 - Nitrofurantoin x 7 days
 - Amoxicillin/ clavulanic acid 875 mg PO x 5 days

Recommendations

- UTI is an unlikely diagnosis in men < 50
- Consider STI as a common mimic
- Refer patients who may require urologic evaluation or instrumentation. Outpatient referral reasonable for stable patients.

Chapter 8

EYE, EAR, NOSE & THROAT

Pharyngitis and Related Complications

Definition: Inflammation of the mucous membrane lining in the pharynx. Acute pharyngitis may lead to immediate complications including abscess, cellulitis, epiglottitis. Untreated pharyngitis may lead to a later complication of rheumatic fever, which is a leading cause of structural heart disease later in life.

Causes

- Group A beta-hemolytic Streptococcus (GABHS) is most common cause of pharyngitis
- Rhinovirus
- Epstein-Barr virus (EBV)
- HIV
- Mycoplasma pneumonia

Signs and symptoms

- ABCs- assess airway for adequate breathing, talking. Treat tachycardia or hypovolemia with pain control, fever control, and IV fluids
- History
 - Sore throat, fever, headache, swollen nodes at neck, dysphagia
 - Ask about trauma or possible swallowed foreign body
- Exam
 - Patients with deep space neck infections and epiglottitis may be very sick and appear toxic, dehydrated, and have fever. Examine patient for trismus (inability to open mouth), drooling, meningismus, stridor or other signs of severe disease or airway compromise. Severe disease may also present with inability to swallow or lie supine, muffled voice or respiratory distress (use of accessory muscles)
 - Patients with retropharyngeal abscess may hold the head stiff and complain of neck pain. In adults, often extends into mediastinum
 - Patients with peritonsillar abscess may lean to one side
 - Patients with simple pharyngitis will be well appearing, have a clear voice, no difficulty with respirations.

Differential diagnosis

- Acute pharyngitis
- Retropharyngeal abscess
- Peritonsillar cellulitis
- Peritonsillar abscess
- Epiglottitis
- Ludwig's angina
- Foreign body
- Malignancy

Investigations

- Labs: Throat swab. FBC, renal function if toxic appearing and needs admission or transfer
- Imaging: None for simple pharyngitis. Imaging may be needed to diagnose complications of pharyngitis, but do not delay transfer of a sick patient to obtain imaging
 - If toxic appearing or needs ENT referral, the referral hospital may consider *CT with contrast* of neck. Abscess will only appear on CT if IV contrast is given. CT is the image study of choice for diagnosis of peritonsillar, retropharyngeal, and parapharyngeal abscess.
 - Lateral soft tissue airway X-ray: May see enlargement of epiglottis (thumb sign) or ballooning of the hypopharynx (in supraglottitis). May also see absence of a deep, well-defined vallecular air space running parallel to the pharyngotracheal air column that approaches the level of the hyoid bone (vallecula sign) in epiglottitis.

Management:

- The goal of management is to recognize simple throat infections and treat with appropriate antibiotics.
- Antibiotics start to work within 48hrs. Therefore, patients should be told that if they continue to have severe pain or fever after two days, they should return for further examination. These patients should be referred to ENT for further evaluation
- Any ill-appearing patients with fever and throat pain, who continue to have abnormal vital signs (tachycardia, hypotension) after pain control, fever control, and IV fluids after 48hrs of treatment need immediate transfer to referral center.
- Acute pharyngitis- leading cause of rheumatic fever in children in the developing world, which can lead to mitral stenosis and severe cardiomyopathy.
 - If patient has normal vital signs (other than fever), is non-toxic in appearance, and can swallow tablets, can treat with PO antibiotics.
 - Amoxicillin 1000mg PO 3x/day for 7 days OR Penicillin VK 500mg PO 3x/day for 5 days AND
 - Ibuprofen 400mg PO 3x/day for 3-5 days
 - A single dose of PO or IM Dexamethasone in immunocompetent, pediatric and adult patients with moderate to severe pharyngitis has been shown to achieve an earlier onset of pain relief and a shorter duration of pain (Wing, etal).
 - Patient should have resolution of fever within 48hr of starting antibiotics. Their pain should be resolved within a few days. If pain worsening or fever continues, consider alternative diagnosis.

Peritonsillar abscess (PTA)

- o Needle aspiration is the treatment of choice, in addition to either PO or IV antibiotics (antibiotics *without* needle aspiration or I&D typically does not treat PTA). Well-appearing patients can go home with drainage, antibiotics, and pain killer. Drainage of a PTA is a highly specialized procedure and should only be done by trained providers. Complications include puncture of the carotid artery, which could lead to massive hemorrhage. If it cannot be performed locally, transfer to ENT for drainage.
 - Drainage Procedure: With patient sitting upright or slightly hunched forward, insert an 18 gauge needle to the depth of 1cm, aspirating during insertion. Insertion of the needle more than 1cm runs the risk of puncturing the internal carotid artery. Internal carotid artery runs laterally and posterior to the posterior edge of the tonsil.
 - PO antibiotic choice: Amoxicillin/Clavulanic acid 875mg PO BID x 10 days OR Penicillin VK 500mg PO 4x/day for 10 days
AND
 - Metronidazole 500mg PO 3x/day for 10 days OR Clindamycin 150mg PO 4x/day for 10 days (in Penicillin allergic patients)
 - A single dose of IV Dexamethasone steroids reduces pain
 - IV antibiotic choice: same as retropharyngeal abscess

Retropharyngeal abscess

- o More common in children under 3 years old. These patients are ill-appearing, and should prompt immediate transfer to referral center after stabilization with IV fluids, first dose of antibiotics, and supplemental oxygen as needed.
- o Usually diagnosed by CT with IV contrast, but if suspected, start antibiotics, IV hydration, and transfer immediately for ENT referral
 - Clindamycin 600-900mg IV (first choice) OR
 - Cefoxatime 2g 3x/day IV OR
 - Ceftriaxone 2g 2x/day IV
- o Usually requires surgical drainage by ENT

Epiglottitis

- o Patients are very ill-appearing. Often present in a "tri-pod" position-sitting up and forward with obvious difficulty breathing or stridor. They can have a hoarse voice, drooling and sit with a hyper extended neck. Do not ask them to lie down.
- o Keep patient sitting upright in a position of comfort. Immediate transfer to referral center with notification of ENT or A&E doctor prior to arrival. Tell team at referral hospital to be prepared for surgical airway. Treatment begins with supplemental *humidified*

oxygen, IV hydration, and IV antibiotics. Start antibiotics before transferring:

■ Adults:

- Ceftriaxone 2g IV 2x/day OR
- Ampicillin 1g IV every 4 hours
AND
- Gentamycin 3mg/kg/day IV divided in doses every 8hr
IV

■ Pediatrics:

- Ampicillin IV 50-100mg/kg 4x/day for 10 days
AND
- Gentamycin IV 3-5mg/kg 2x/day for 5 days

Epistaxis

Definition: Bleeding from the nose. About 90% of bleeds come from a blood vessel in the anterior part of the nose and can be visualized. Posterior bleeding is less common. Posterior hemorrhage cannot be visualized, tends to be more severe, and these patients need to be seen by ENT immediately. Except in trauma, bleeding is localized to one point on one side of the nose.

Causes

- Most cases are spontaneous and without good cause
- Facial trauma
- Nose picking
- Foreign body, tumors
- Bleeding disorder
- High blood pressure

Signs and symptoms

- Check ABCs
- History: Trauma? History of similar? Bleeding from other body sites (gum bleeding, easy bruising, etc.)?
- Exam
 - Blood typically comes from one side of the nose. Ask patient to blow nose and clear clots in order to visualize bleeding vessel better. Use the brightest light possible

Investigations

- Labs: FBC if bleeding is extensive or patient has other signs of abnormal bleeding
- Nasal endoscopy if available

Management

- Epistaxis with massive hemorrhage
 - Check and stabilize ABCs. Prepare for immediate transfer if airway is at risk. Provide supplemental oxygen if saturation is low, and start IV lines with NS fluids. Transfer immediately to A&E or ENT
 - Consider early transfusion if hypotensive and not responsive to fluids
 - Attempt packing of affected naris before transfer.
- Epistaxis without massive hemorrhage
 - Clean blood clots from the nose
 - Direct pressure applied by pinching the soft fleshy part of the nose for at least 10-20 minutes continuously
 - Have patient bend forward at the waist to prevent blood from entering airway
 - If direct pressure doesn't work, use a light and attempt to locate bleeding vessel (anterior chamber only). Attempt anterior nasal packing:

Apply tetracycline ointment to tip of gauze before packing.

Keep packing in place for two days before removal.

If bleeding continues beyond two days with packing, refer to ENT immediately.

If a patient goes home with nasal packing, they need prophylaxis antibiotics to prevent sinus infection: amoxicillin PO for seven days.

Recommendations

- Most cases of epistaxis are benign and resolve with good pressure to the nasal bridge.
- Take a good history to rule out a bleeding disorder as the cause of epistaxis and send an FBC as a screening test.
- Continued or recurrent bleeding must be transferred for ENT consultation

ENT Mass

Definition: An ENT mass is any abnormal tissue in the nose, pharynx, mouth, or neck region. They can be benign or malignant, but all need prompt referral to ENT for evaluation, biopsy, and treatment.

Causes

- Naso-pharynx tumors
 - Epstein Barr virus (EBV)
 - Congenital
 - Idiopathic (unknown)
- Mouth tumors
 - Parotid tumor
 - Submandibular tumor
 - Tongue tumor
 - Pharyngeal mass/Neck mass

Signs and symptoms

- History
 - Nasal tumor: May have purulent rhinorrhea or repeated nasal infections (gripe), recurrent epistaxis or progressive nasal obstruction and/or snoring
 - Mouth tumor: Patients may have swelling in parotid region or sometimes a lump in the mouth or at the region just below the mandible (jaw). They can complain of pain in the jaw or have persistent pain on swallowing without fever.
- Exam
 - Nasal tumor patients may breathe only through their mouth or have a nasal voice
 - Mouth tumor patients may have facial paralysis if tumor is large, ulcerations may be present inside mouth
 - Look closely inside mouth, under tongue, and inside nose with a bright light.
 - Palpate for large lymph nodes around the neck (signs of possible malignancy)

Differential diagnosis

- Benign tumor
- Malignant tumor
- Goiter

Investigations

- Labs: None needed. Clinical diagnosis

- Imaging: ENT specialists may do fine needle aspiration (FNA), ultrasound, or CT scan for diagnosis. Open biopsy is CONTRAINDICATED and should NEVER be performed by provider other than ENT specialist

Management: The general goal is to recognize abnormal masses and transfer patient as soon as possible for ENT referral. If malignant, these masses need aggressive and early treatment for best outcome. Urgent ENT referral for:

- Unilateral nasal blockage with recurrent epistaxis and purulent rhinorrhea
- Parotid, submandibular, tongue, or neck mass in any patient that doesn't completely resolve with antibiotics.

Ear, Nose Throat Foreign Body

Definition: It is a foreign object inserted into the nose, ear, or throat.

Causes

- Typically self-inflicted by children putting foreign body into their nose or ear or swallowing foreign body. Adults with mental disorders also at risk. Insects may also crawl into the ears during sleep.

Signs and symptoms

- Always start with ABCs, particularly looking for respiratory complaints if swallowed foreign body
 - Listen for stridor (noise coming from the throat), change in voice, new wheezing
- History
 - Adults will say, "there is something in my ear" or have hearing deficit. Children will sometimes just tug at the ear, have bleeding, or hearing deficit. Infants may also present with unexplained crying or fussiness.
- Exam
 - Foreign bodies in nose and ear are clinical diagnosis, but require a good light to examine
 - Foreign body in throat may cause odynophagia, dysphagia
 - Foreign body in the airway may cause stridor
- Bedside tests
 - For foreign body in the throat not visualized, can do chest XR for radio-opaque objects

Differential diagnosis

- Nose
 - Insect/parasite in chronically ill adults
 - Sinusitis, gripe
 - In children you can see food, beads, toys, disk batteries
 - Septal hematoma, polyp, tumor
- Ear
 - Otitis media, otitis externa
 - Wax impaction
 - Tympanic membrane perforation
 - Cholesteatoma
 - Insect in ear
- Throat/Airway
 - Pharyngeal FB
 - Laryngeal FB
 - Esophageal FB
 - Croup
 - Epiglottitis

- o Residual oropharyngeal trauma after spontaneously resolved obstruction

Investigations

- Labs: none- diagnose by clinical history and physical exam
- Imaging: consider XR if swallowed foreign body

Management: General goal depends on equipment available at local hospital. If a good light, otoscope/microscope, and tools like alligator forceps are available, it may be possible to try to remove a foreign body from the nose or the ear. If you don't have proper equipment don't try the extraction as there is a risk of pushing object further in and there is a risk of causing worsening damage. If good equipment is NOT available, transfer to ENT for extraction.

- Insect in ear
 - o Kill insect with mineral oil or other viscous material, irrigate with water at body temperature. Attempt to suction smooth objects like a bean or bead, but insects require alligator forceps under direct visualization
- Foreign body in nose
 - o If object can be visualized with light, can attempt the "Kissing Technique."
 - Blow forcefully into mouth with unaffected nostril occluded. Object will come out of naris/nostril.
 - Attempt only once. If it doesn't work, transfer to ENT for extraction.
 - o If object is smooth like bead or bean, can attempt gentle suction if available
- Esophageal foreign body
 - o Diagnosed by history alone (witness watched child swallow object) or by XR
 - o Immediate transfer to ENT for extraction
- Foreign body in throat/Airway
 - o If patient has shortness of breath or stridor (noise from the throat with regular breathing), needs *immediate* airway maneuvers such as Heimlich maneuver. Prepare for immediately transfer to ENT/A&E for airway protection. Give supplemental oxygen en route.
 - Heimlich maneuver, stomach thrusts, back blows depending on age of patient
 - o If patient has pain after swallowing meat or fish bone, but can drink water or eat food, no need for emergent referral. OPD/ENT follow up is needed.. If unable to swallow water or can't swallow own saliva, needs immediate referral to ENT/A&E.

Chapter 9

NEUROLOGY

Altered Mental Status (AMS) and General Approach to Coma

Definition: Change in neurologic awareness from baseline mental status. It can be acute (occurring within the past few hours or days) or gradual (occurring within the past weeks or months). *Drowsiness or lethargy* is a minor change with slightly decreased wakefulness, but patient is aroused with verbal stimuli or light. *Coma* is a state by which patient cannot be wakened by any stimuli.

Initial approach to assessment and management

- Initial interventions: ABCs, vital signs, IV, immediate bedside glycemia, oxygen saturation
 - Is patient protecting airway (secretions, emesis)? ○ Signs of shock (hypotension, cold extremities, weak pulses, delayed capillary refill.)?
 - Start IV fluid 1L bolus if signs of shock present.
 - All patients with altered mental status need rapid glycemia at triage; give dextrose IV if glycemia is unavailable
- History
 - Ask about recent trauma
 - Onset, evolution, duration?
 - Associated fever, headache, N/V/D, shortness of breath, polyuria?
 - Recent illness, new medications?
 - Exposure to tick/snake/spider?
 - Possible ingestion, intoxication or withdrawal?
- Exam
 - Focused neurological exam
 - Mental status (GCS or AVPU)
 - Eyes: Deviation, nystagmus, pupillary reactivity, cranial nerves, motor (tone, symmetry)
 - Focused exam for etiology: hematoma, laceration, signs of head trauma? Fever, hypotension, rash (septic shock)? Respiratory difficulty (hypoxemia)? Abdomen (pregnant with HELLP or eclampsia)? Skin infections (bedsores, rashes)? Smell of ketosis (fruity breathe) or rapid shallow breathing (DKA)?
 - Unilateral weakness (sign of CVA)?

Differential diagnosis: Several mnemonics can help to remember extensive differential diagnosis list. AEIOU-TIPS is just one of them.

- A: alcohol (ethanol, methanol, thiamine deficiency/Wernicke's encephalopathy)
- E: epilepsy and endocrine (continuous seizure, post-ictal state, hyponatremia, hypernatremia, hypercalcemia, hypoglycemia, DKA, hypothyroidism, thyrotoxicosis, hepatic encephalopathy)
- I: insulin (hyperglycemia or hypoglycemia)

- O: overdose and oxygen (organophosphate poisoning, opiate overdose, hypoxemia)
- U: uremia (renal failure)
- T: trauma and toxins (subarachnoid hemorrhage, subdural, epidural, cerebral contusion, diffuse cerebral edema, carbon monoxide,,)
- I: infection (meningitis, intracranial abscess, sepsis, cerebral malaria, encephalitis)
- P: psychiatric (should be a diagnosis of exclusion)
- S: stroke, shock, space occupying lesion (hypertensive bleeds, ischemic stroke, sepsis, tumors)

Investigations

- Labs
 - o FBC, electrolytes, renal function, HIV status, glucose, malaria, liver and thyroid function tests, in some cases.
 - o Cerebral spine fluid analysis if concern for infection.
- Imaging
 - o Brain CT (the majority of brain CTs for altered mental status and trauma presenting to the ER or hospital should be **WITHOUT IV** contrast; IV contrast is reserved for patients with known HIV positive serology or known space occupying lesion).

Management: The management varies depending on etiology of altered mental state. Patients presenting to district hospitals with altered mental status and **STABLE** vital signs should have a minimum work up to determine the cause (electrolytes, FBC, malaria test, HIV test). If patient has **UNSTABLE** vital signs, district hospitals should give oxygen, start IV fluids, give dextrose if needed, place foley catheter, start antibiotics if concern for sepsis, and consider transfer to referral hospital within 24hrs if no improvement for further work up and management.

Acute Stroke

Definition: A stroke is the acute loss of neurological function due to interruption of blood supply to the brain. Most strokes will present with a new focal neurologic deficit, such as unilateral weakness. However, both more severe presentations such as coma and more subtle presentations such as dizziness can be caused by a stroke. Transient ischemic attack (TIA) is a brief episode of neurologic dysfunction caused by focal brain, spinal cord or retinal ischemia *without* acute infarction that resolves on its own. People that present with a TIA have a high risk of actual stroke within the next several days.

Causes

- Ischemia
 - Embolic
 - Thrombotic
- Hemorrhage
 - Parenchymal
 - Subarachnoid

Signs and symptoms

- Note that the clinical history and exam are NOT always very accurate in discriminating among different stroke types (ischemic vs. hemorrhagic)
- Ask about time of onset (last time seen normal), rapidity of onset, and neurological deficits (any difficulty moving extremities, speaking, seeing? Any confusion, dizziness, or difficulty walking?), and functional baseline (does the patient walk and talk normally?)
- Ask about vomiting, headache or neck pain (more common in hemorrhagic stroke)
- Ask about HIV status, history of fever (concern for infection that is either mimicking or causing stroke)
- Ask about other embolic events like gangrene to toes (concern for endocarditis)
- Is there a history of similar symptoms, trauma, or cardiovascular problems (structural heart disease, atrial fibrillation, hypertension)?
- Perform detailed neurologic exam on every patient!
 - Cranial nerves, motor and sensation in all four limbs, cerebellum (finger to nose), speech, gait and vision (deficits in visual fields or gaze paralysis)
 - GCS
 - Consider using a stroke scale as way to gauge severity and evolution of symptoms
- Bedside tests
 - All patients need immediate finger stick glucose
 - ECG if available and if suspect atrial fibrillation (heart rate irregularly irregular)

- o Consider bedside echocardiogram if concern for mitral stenosis, endocarditis or low ejection fraction contributing to embolic stroke
- o Assess patient's ability to swallow without choking

Differential diagnosis

- Hypoglycemia (only metabolic problem that can cause focal deficits)
- Todd's paralysis (paralysis following a seizure)
- Tumor or infectious space occupying lesion
- Infections
 - o Neurocysticercosis, cerebral malaria, herpes simplex virus and tuberculosis can cause cerebral infarcts or parenchymal hemorrhages
- Metabolic
 - o Hyponatremia, uremia, poisoning
- Trauma
- Complex migraine
- Syncope (transient loss of consciousness followed by complete neurologic recovery; almost never caused by a stroke or TIA)

Investigations

- Labs: glycemia, creatinine, electrolytes; FBC to look for signs of hematologic causes of stroke (TTP, bleeding from thrombocytopenia, leukemia).
- Imaging:
 - o Consider referral for head CT only for patients with suspected stroke if it is likely to change the management.
 - o Patients who are older (>65), without history of trauma and have clear stroke syndromes, can probably be managed just as well at district hospitals without advanced imaging.
 - o MRI is a test that should be considered in young patients where the diagnosis of the stroke is not clear based on CT imaging and others causes of focal neurological deficit should be excluded (e.g. tumor or infection).
 - o All patients with stroke *who are candidates for anticoagulation* should have an ECG and echocardiogram to look for structural heart disease and/ or atrial fibrillation as a source of embolic stroke.

General management: Then general goal in management of all strokes includes consideration for airway protection, aspiration risk, blood pressure control, and immediate physiotherapy.

- Airway Protection: Some patients with severe strokes will present with GCS<8, which is typically an indication for intubation. However, the long-term prognosis in a patient in coma from severe stroke, whether ischemic or hemorrhagic, is quite low. Carefully consider both prognosis and availability of ICU beds and intubate only if you feel patient has a significant chance of recovery AND an ICU bed is available.
- Blood pressure: Do not treat high blood pressure unless it is >200/110

- o **If BP >200/110**, then lower it slowly and do not lower beyond **160/90**.
- Prevent aspiration and infection
 - o Prevent aspiration pneumonia by assessing swallowing in all stroke patients upon arrival
 - Sit patient upright and watch as patient takes a sip of water.
 - Note any choking, dribbling or coughing.
 - Patients who have difficulty with swallowing may benefit from nasogastric feeding.
 - o Immobile patients should be turned frequently (every 2-4hr) to prevent bedsores.
 - o Avoid prolonged use of urinary catheters. o Aggressively treat fever. o Early mobilization and physiotherapy provide the best chances for regaining function.

Specific management

- Ischemic stroke
 - o Thrombolytics are not currently recommended in our setting for ischemic stroke for the following reasons:
 - In order to cause more good than harm, these drugs must be used early, generally within 3-5 hours of stroke onset, which in almost all cases will be impossible to achieve. Even within this accepted time window, the value of thrombolysis for acute stroke continues to be debated.
 - The most readily available thrombolytic, Streptokinase, has not been proven to be effective for this purpose. Only lysis with tPA should be considered.
 - o Blood pressure should not be lowered in the acute setting unless it is extremely high (>220/120).
 - Lowering blood pressure too quickly can cause worsening infarct (ischemic penumbra) due to cerebral auto regulation.
 - After a month, antihypertensives may be started to slowly bring the blood pressure down to a normal range. Good agents that have been studied for this indication include hydrochlorothiazide and long acting Nifedipine.
 - o Aspirin **160-300** mg is recommended early for ischemic stroke. o Statins have modest efficacy in preventing secondary stroke
 - Studies from sub-Saharan Africa suggest that there is probably less atherosclerotic disease than in countries where these studies were done and therefore the benefit is likely to be even lower.
 - Generally safe and could be prescribed if it is affordable for the patient.

- o Ischemic stroke due to embolism (cardiac source such as atrial fibrillation/rheumatic valve)
 - Start anticoagulation (Warfarin or low molecular weight heparin) between 1 week and 1 month following stroke.
- Hemorrhagic stroke
 - o Intracerebral hemorrhage: goals are to prevent expansion of hematoma and to maintain cerebral perfusion pressure.
 - Goal blood pressure is not well defined, but 160/90 mmHg is a reasonable target. If SBP >200 or MAP >150 mmHg, consider lowering more slowly over hours to prevent drop in cerebral perfusion pressure.
 - If possible, use IV antihypertensive agents such as Labetalol, Nicardipine, Esmolol, Enalapril, Hydralazine, or nitroglycerin. (Requires frequent blood pressure monitoring at least every 15 minutes)
 - Treat pain (blood hurts!) and this can help with blood pressure control.
 - Avoid drugs that can increase likelihood of bleeding such as aspirin or Diclofenac.
 - Most spontaneous intracranial hemorrhages will not be candidates for neurosurgical intervention. However, if available, consult neurosurgery to evaluate if there is a role hematoma evacuation or ventriculostomy for ICP reduction.
 - Mannitol is unlikely to be beneficial in patients in whom neurosurgery is not indicated
 - o Subarachnoid hemorrhage
 - See subarachnoid hemorrhage chapter
- Transient Ischemic Attack (TIA)
 - o Patients with suspected TIA should be treated as an impending stroke and emphasis should be on prevention. o Search out embolic cause of TIA with echocardiogram and ECG to rule out structural heart disease and atrial fibrillation o Patients should be discharged with a plan to control blood pressure and blood sugar. o Consider prescribing low dose daily aspirin and a statin although the benefit is marginal.

Recommendations

- Stroke in Rwanda appears to have a different risk factor profile and likely a different pathophysiology from those in more industrialized countries. Stroke guidelines from these settings may therefore not be as appropriate for application in Rwanda.

Consider keeping older patients with clear stroke syndromes and no history of trauma at district hospital rather than transferring for CT scan, as this test is unlikely to change management or outcome. Therapeutics such as aspirin, statins, or thrombolytics (for ischemic strokes) or neurosurgery (for hemorrhagic strokes) are not likely to be very effective in these cases. Rather, focus on good early stroke care with prevention of aspiration, fever control and early physiotherapy.

Young patients or those with an unclear presentations or history should be referred to referral center for advanced imaging and further workup.

Non-traumatic Headache

Definition: Pain in the head that can be classified as acute and singular (first headache), acute recurrent, or chronic in nature. The main goal is to appropriately select patients for emergency investigation (with brain CT) and to offer pain relief to those with a benign, reversible cause of headache with a good follow up plan.

Causes

- Primary headache
 - Migraine
 - Tension headache
- Secondary headache
 - Vascular
 - Subarachnoid hemorrhage
 - Epidural hematoma
 - Subdural hematoma
 - Stroke
 - Intraparenchymal hemorrhage
 - Venous sinus thrombosis
 - Temporal arteritis
 - CNS Infection
 - Meningitis
 - Encephalitis
 - Cerebral abscess
 - Tumor
 - Toxicity
 - Carbon Monoxide (CO) poisoning
 - Preeclampsia
 - Hypertensive Emergency

Signs and symptoms

- History
 - General history includes onset, headache location (unilateral is typically migraine, occipitotemporal leads to higher suspicion for intracranial pathology), associated symptoms (syncope, confusion, neck pain, visual disturbance, fever), remote or recent trauma history, toxic exposures (indoor cooking- carbon monoxide), possible HIV or malignancy, history of hypertension
 - History should include any "red flags" (warning signs that there is a serious etiology behind the headache)
 - Sudden onset (time from onset to maximal pain is seconds), especially if it begins during exertion (coughing, defecation, etc.), worst headache of life -> SAH
 - Positional in nature (worse with laying down or bending forward) -> space occupying lesion

- First headache in life and age over 50 -> consider space occupying lesion, bleeding
 - Fever, neck stiffness, change in neurological status -> meningitis or abscess
 - History of malignancy, weight loss, possible TB, HIV -> space occupying lesion or infection
 - Post partum or currently pregnant -> Preeclampsia
- Exam
 - o All patients needs full set of vital signs looking for high blood pressure, low saturation o
 - Complete full neurological exam
 - Strength in all four extremities
 - Vision and visual field examination
 - Sensation in all four extremities
 - Coordination (finger to nose, gait, Rhomberg test)
 - Cranial nerves

Investigations

- Labs
 - o FBC to rule out anemia, thrombocytopenia (patients with platelets less than 10,000 are at high risk of intracranial bleeding); malaria smear, urine pregnancy test
- Imaging
 - o CT without contrast is typically adequate to exclude a critical space occupying lesion and is the best test to diagnose subarachnoid hemorrhage
 - o CT with contrast is typically indicated in patients with known history of HIV, high suspicion of space occupying lesion (first time *focal* seizure, history suggestive of increased intracranial pressure)
 - Performing CT with contrast on every patient with headache increases time, expense and risk of adverse effects
- Lumbar puncture (LP) if recent fever, HIV (suspected meningitis) or high suspicion of subarachnoid hemorrhage (SAH) when CT scan findings are normal
 - o CT scan should be done before lumbar puncture if there is suspected increased intracranial pressure.
 - There is currently no consensus as to when a CT is absolutely indicated before LP. Some would argue that patients with a normal consciousness (GCS=15) and normal neurological exam do NOT need a CT before an LP, even if there is a history of HIV.
 - If there is altered mental status (GCS<14) or a focal neurological finding on exam (unilateral weakness, gaze paralysis, facial droop, etc.), then do a CT before LP.

Management: The general goal is to determine who needs a CT scan and on what time basis (immediate, OPD, or no indication) and to offer pain control for primary causes of headache.

- Who to CT?
 - Patients with any of the "red flag" symptoms/signs, as described above, should be transferred or admitted for immediate CT brain.
 - Patients with recurrent headaches or headache for many weeks/months *without* any of the "red flag" symptoms can be referred for an outpatient CT and then given follow up with OPD for review.
 - Patients with suspicion of primary headache (tension, migraine), with a normal neurological exam and no history of immunocompromise or cancer do not need a CT. They can be treated and discharged home with OPD follow up. If symptoms change or worsen, tell the patient to return to the hospital for evaluation.
- Tension headache: typically bilateral, non-pulsating, not worsened by exertion, not associated with nausea and vomiting
 - Typically better with Paracetamol or NSAIDs. Encourage patient to drink plenty of water, as dehydration can play a role. Talk about stressors at home, alcohol use.
 - Refer to OPD for follow up after prescribing pain control to ensure headache is better
- Migraine headache: typically slow in onset (gradually worsens over hours to days), lasts from 4-72 hours, unilateral, pulsating, worsened by physical activity; may see nausea/vomiting and photophobia; may also note visual auras (dark spots, flashing lights)
 - No clear consensus on the best therapy for migraine. ○ Within Rwanda, two possibilities from randomized controlled ED-based trials exist:
 - 1L NS (IV fluids) AND
 - Metoclopramide 10mg IV once AND
 - Tramadol 50-100mg IV once
 - OR
 - 1L NS (IV fluids) AND
 - Dexamethasone 20mg IV once AND
 - Tramadol 50-100mg IV once
 - Refer to OPD for follow up after prescribing pain control to ensure headache is better
- Non traumatic bleeds or intracranial processes: subarachnoid hemorrhage, subdural hematoma, space occupying lesion, epidural hematoma
 - Consider the patient's age and prognosis as you consult neurosurgery. If patient is older than 50, has metastatic disease, multiple comorbidities, or has a very low GCS, consider palliative care in the district hospital

- o If patient is young, otherwise healthy and tumor is only medical condition, consider immediate transfer for further evaluation and treatment
- Carbon monoxide poisoning
 - o Supplemental O₂ by NRB

Recommendations

- The key to deciding whether a patient with nontraumatic headache needs emergent brain CT is in a good history and complete physical exam (including detailed neurological exam).
- Refer patients for immediate brain CT when they have one of the "red flags" in their history or an abnormal neurological exam. Other patients can be referred for an outpatient brain CT and OPD follow up. Suspected primary headaches and be treated and discharged without consideration for brain CT.

Seizure

Definition: Uncontrolled shaking in the body from excessive and disorderly neuronal discharge in the cerebral cortex. *Epilepsy* is a condition of unprovoked seizures. Some seizures are partial or focal, while others are generalized or "whole body." *Post-ictal state* refers to the time after the seizure finishes, when a patient can be comatose or confused. *Status epilepticus* is defined as a seizure that lasts 5-10 minutes or two seizures without full recovery between them. If a seizure lasts more than 30 minutes, the body can no longer regulate homeostasis- blood pressure drops and acidosis builds, sometimes resulting in neuronal damage.

Initial approach to assessment and management

- Initial interventions include assessing ABCs, vital signs, IV access, and rapid glycemia check
 - Airway: risk of emesis, aspiration
 - Breathing: aspiration or hypoxemia
 - Circulation: signs of shock?
- History:
 - Onset, progression, duration
 - Responsive during event (during partial seizures, patient may be responsive; during tonic clonic or generalized seizures, patient is not responsive)?
 - Ask family to describe movements- are they bilateral or focal (happening in only one part of the body)?
 - History of previous seizure?
 - Drug use? INH use? Possible ingestion?
 - Immunosuppression? Recent fever or illness? Recent trauma?
- Exam:
 - General exam, including full neurological exam
 - Evidence of ingestion? Suspicious odors?
 - Evidence of trauma?
 - Focal deficit during seizure (gaze preference, unilateral shaking)?
 - Fever or signs of shock (cold extremities, weak pulses)?

Differential diagnosis

- Fever or immunosuppression: meningitis or other CNS infection, cerebral malaria, toxoplasmosis, neurocysticercosis
- Ingestion or toxicity: Tricyclic antidepressant overdose, INH overdose, Theophylline overdose, organophosphate overdose, Phenytoin overdose alcohol withdrawal (usually 24-72 hours after last drink)
- Trauma: head injury
- History of epilepsy: factors lowering seizure threshold (infection, insomnia, puberty), missed dose of seizure medication, progressive disease (need for

- new medication), undiagnosed space-occupying lesion (no previous brain imaging), undiagnosed metabolic or thyroid disease
- Refractory seizures: electrolyte disturbance (hyponatremia), toxin exposure (especially INH), venous sinus thrombosis
 - Behavior change or focal neurological signs: encephalitis (HSV), space occupying lesion, HIV/AIDS with toxoplasmosis, vasculitis (SLE)
 - Vomiting and/or diarrhea with seizures: hypoglycemia, electrolyte imbalance, GI infection with associated Shigella toxin, DKA, organophosphate poisoning
 - Other seizure-mimicking etiologies: syncope (patient will NOT be confused after a syncopal event, there is no tongue biting or urinary incontinence in a syncopal event), migraine with an aura, hypoglycemia (all seizure patients need immediate glycemia), tetanus, psychogenic event (this is a diagnosis of exclusion and should NOT be assumed until a full work up, including head CT and possibly lumbar puncture has been completed)

Investigations

- Labs
 - o FBC, electrolytes, renal function, malaria, HIV, urinalysis, lumbar puncture (possibly after brain CT)
- Imaging
 - o Chest XR if concern for infection
 - o Brain CT without contrast if concern for trauma, space occupying lesion, or cause of seizure is unknown. o If patient has known HIV, order CT brain with contrast for better evaluation of infection or possible abscess. o Patients with first time seizure disorder should have a brain CT as a part of their work up, but this can be done as outpatient or OPD clinic if patient is stable and has returned to normal baseline mentation.

Management: General goal is to stop the seizures as soon as possible to prevent permanent brain damage and aspiration. Once seizures are under control, patient should return to normal mental baseline between 1-8 hours. If a patient does not return to baseline mental status, he needs further evaluation for underlying causes, including CT..

General management of seizing patient

- Place patient in lateral position. Do NOT put anything in patient's mouth to stop tongue biting
- Place patient on oxygen mask
- Do immediate bedside glycemia. Give IV Dextrose if glycemia measurement is not available.
- Start treatment of seizure immediately without waiting for results of special investigations
- Pharmacologic treatment (first line)

- o If IV line:
 - Diazepam, 10-20mg IV, not faster than 2mg/minute OR
 - Clonazepam 1mg IV every 5min until seizure stops (max dose 4mg)
THEN
 - Phenytoin 20mg/kg IV diluted in NS administered not faster than 50mg/minute preferably with cardiac monitoring (NOTE: IV Phenytoin can cause cardiac abnormality. If arrhythmias occur, stop infusion and start again more slowly)- loading dose
- o If no IV line:
 - Diazepam 10-20mg IM (takes longer to work and less reliable)
THEN
 - Phenytoin 20mg/kg PO OR Phenobarbital 20mg/kg PO loading doses
- If seizures continue despite above measures, use
 - o Phenobarbital loading dose 20mg/kg IV at rate of 50-75 mg/min. If no response, repeat at 5-10mg/kg IV. Maintenance dose 1-5mg/kg/day orally. Can cause respiratory depression so be prepared to intubate.
- If seizure continues after 30 minutes despite above measures, then
 - o Intubate and ventilate patient
 - o Start thiopental sodium 2-4mg/kg IV, followed by 50mg boluses every 2-3 minutes to control seizures. Maintenance dose 1-5mg/kg/hour. Watch for hypotension. Once seizures are controlled for 24hr, wean off thiopental by decreasing the dose by 1mg/kg every 12hr.
- Maintenance therapy once seizures are controlled
 - o Phenytoin 100mg IV every 8hr OR 300mg PO every night

Recommendations

- Every patient actively seizing needs immediately bedside glycemia on arrival. Give IV Dextrose if no glycemia measurement available.
- Actively seizing patient should be turned on their side to prevent aspiration, and give IV or IM medications as soon as possible to stop the seizures.
- Any patient that doesn't return to normal mental status after their seizures (within 12 hours) should be transferred to a referral center for further evaluation.

Subarachnoid Hemorrhage (SAH)

Definition: Bleeding into the subarachnoid space.

Causes

- Traumatic
- Spontaneous
 - Rupture of aneurysm, usually congenital

Signs and symptoms

- Initial interventions: Check ABCs, start IV line, place on cardiac monitor if available, check glycemia if altered, oxygen saturation
- History:
 - Spontaneous SAH typically presents with **sudden severe headache** often described as worst headache of life. Reaches maximal intensity within minutes (rather than a gradual onset).
 - Often presents with nausea, vomiting, syncope, confusion, and diplopia.
 - Risk factors include age greater than 30 years old (rare before 30yo), HTN, smoking history, family history, alcohol or stimulant abuse, female gender, and connective tissue disorder (Marfan's)
- Exam:
 - Full neurological exam looking for focal findings

Differential diagnosis

- CNS infection (meningitis, abscess)
- Severe primary headache (migraine, tension)
- Space occupying lesion
- Stroke
- Hypertensive encephalopathy

Investigations

- Labs: Regular labs will NOT diagnose SAH. If admitting for altered mental status/coma, can order FBC, electrolytes, renal function, malaria, HIV.
- Imaging: CT brain to diagnose SAH is not a good study if the bleeding is very small, but is useful if bleeding is large. CT brain is better the earlier it is done (more useful in first several hours of headache and less useful if many days have gone by). While CT brain with IV contrast is a superior study at detecting a bleeding vessel, most patients with an undifferentiated headache should receive CT without contrast as first study.
- Lumbar puncture is better at detecting SAH compared to CT. Send two tubes of CSF fluid. Evaluate for increase in the number of RBCs in the second tube compared to the first tube. Can also see xanthochromia (yellowing of CSF after fluid is spun).

Management

- Subarachnoid hemorrhage
 - Keep head of bed elevated to 30 degrees
 - Blood pressure control to keep systolic BP <160mmHg or diastolic BP <100mmHg or MAP<110mmHg
 - First line medication: labetalol 20mg IV over 2 minutes initially, then 40-80mg IV every 10 min until blood pressure is lowered by 25% or at a goal of 160mmHg; total dose NOT to exceed 300mg
 - Second line medication: Hydralazine 20-40mg IV/IM; repeat every 30 min as needed until target BP reached
 - Nicardipine 5mg/hr IV by slow infusion (50mL/hr) initially; may be increased by 2.5mg/hr every 15minutes; not to exceed 15mg/hr
 - Nitroprusside 0.25-0.3mcg/kg/min IV infusion; may increase by 0.5mcg/kg/min every few minutes to target BP
 - Prevent cerebral vasospasm with calcium channel blockers
 - Nimodipine 60mg PO every 4hr for 21 days; begin therapy within 96 hours of SAH
 - OR
 - Nicardipine IV (see above for dose)
 - Seizure control with benzodiazepine
 - Diazepam 10-20mg IV as needed for seizure control
 - Transfer to referral hospital for neurosurgical review. Patients may present with GCS<8, which is normally an indication for intubation. However, if CT brain result is available, discuss intubation with neurosurgery consultant and consider ICU bed availability. Most cases of severe SAH with low GCS are conservative management only in a district hospital; therefore intubation may not be the best course for the patient.

Chapter 10

HEMATOLOGY

Anemia

Definition: A decrease in the number of circulating red blood cells (RBCs) in the body as well as a decrease in the capacity of the blood to carry oxygen to the body's tissues. Anemia is not a disease within itself. It is necessary to search for the underlying cause of anemia.

- **Normal values:** >13g/dl men, >12g/dl women, >11g/dl pregnant women, >11g/dl children, >9.5g/dl age 2-6 months, >13.5g/dl neonates

Causes and differential diagnosis

- Increased red blood cell destruction
 - o Infections (malaria, syphilis, parasites)
 - o Thyroid disease
 - o Cancer (leukemia, lymphoma)
 - o Hypersplenism
 - o Thalassemia
 - o Medications (anti-retroviral agents)
- Decreased red blood cell production
 - o Iron deficiency
 - o Chronic conditions (diabetes, liver failure, renal failure)
 - o Lead poisoning
 - o Folic acid or Vitamin B12 deficiency
 - o Viral infections (HIV)
- Blood loss
 - o Trauma (chest .abdomen ,femur .environment .pelvis)
 - o Hemoptysis
 - o GI tract (upper and lower GI bleeding)
 - o Obs and Gynecologic (vaginal bleeding, placenta previa, abruption
.....
)

Signs and symptoms

- History
 - o Ask about any blood loss (menstrual, GI tract) o Ask about symptoms of anemia including chest pain, dizziness, shortness of breath
- Exam
 - o Acute blood loss will cause hypovolemia, tachycardia, and hypotension
 - Consider menstrual or GI tract blood loss
 - o Anemia secondary to chronic blood loss will cause progressive fatigue, malaise, weakness.
 - Vital signs may be normal
 - o Pale conjunctiva, palms, and soles (signs of low Hb) o Hypoxia, crackles on lung auscultation, tachycardia, tachypnea, edema of hands or feet (signs of heart failure)

- o Jaundice (hemolysis), splenomegaly (thalassemia), petechiae, purpura (bleeding disorder)

Investigations

- Labs: FBC, peripheral smear, coagulation factors, reticulocyte count
 - o If available, send peripheral blood smear BEFORE transfusion in order for hematologist to accurately investigate cause of anemia

Management

- Blood transfusion (1 unit of blood will raise hemoglobin by approximately 1g/dl)
 - o Transfuse packed RBC for
 - Acute, severe anemia with low blood pressure or severe tachycardia (trauma, massive bleeding during surgery)
 - Hemoglobin <5g/dl in patients with chronic anemia but feeling well (consider chronic anemia in patients with normal vital signs)
 - Hemoglobin <6g/dl in patients with heart failure, severe chronic anemia with fatigue or intolerance, or anemia in late pregnancy who is not responsive to folic acid and iron
 - Hemoglobin <7g/dl in acute anemia (acute GI or GU blood loss) with ongoing bleeding
 - Pale conjunctiva alone is NEVER a reason to do transfusion
- Treatment of iron deficiency
 - o Ferrous sulphate 200mg PO TID with meals for six months
 - OR
 - o Ferrous fumarate 200mg PO TID with meals for six months

Recommendations

- Try to differentiate acute versus chronic anemia by a good history and looking at vital signs. Chronic anemia rarely needs transfusion unless hemoglobin <5g/dl.
- Immediate transfer to referral center for patients with ongoing, active blood loss or abnormal vital signs
 - o Patients with active upper GI bleeding should be referred early as they can decompensate and die quickly if the bleeding is not controlled
- Referral to OPD appropriate for patients with chronic anemia with normal vital signs

Transfusion Reactions and Complications

Definition: A transfusion reaction is any complication that can arise during or after receiving a blood transfusion. The most common reaction, simple febrile reaction, is not life-threatening, but needs to be recognized early. Other reactions are more rare, but have a very high mortality rate (acute hemolysis and transfusion-related acute lung injury), and must be recognized and treated immediately.

Causes:

- Simple febrile reaction
 - Caused by antibodies that accumulate in the stored blood
 - Most common, but not dangerous if noted and treated early
- Acute hemolysis
 - Most often clerical error (wrong blood type given to patient)
 - High mortality rate and most common cause of transfusion-related death
- Transfusion-related acute lung injury (TRALI)
 - A non-cardiogenic pulmonary edema (equivalent to an adult respiratory distress syndrome) caused by antibodies in donor reacting with patient's WBCs
 - High mortality rate and second most common cause of transfusion-related death
- Anaphylaxis
 - Patient is allergic to IgA, which is present in transfused blood (unable to predict which patients are allergic)
- Sepsis
 - Occurs when a contaminated blood product is given to a patient (more common in platelet transfusion because they are stored at room temperature)
- Delayed hemolysis
 - Caused by reactivation of antibodies to minor RBC antigen systems

Signs and Symptoms

- Simple febrile reaction
 - Isolated fever during transfusion **without** more serious signs of vomiting, back pain, hypotension, or evidence of hemolysis
- Acute hemolysis
 - Acute renal failure, DIC, mucocutaneous bleeding cardiovascular collapse
 - Patients experience sudden onset fever, chills, low back pain, vomiting, tachycardia, hypotension, itching, shortness of breath
 - Symptoms typically begin within one hour of starting transfusion, but may occur later
- Transfusion-related acute lung injury (TRALI)

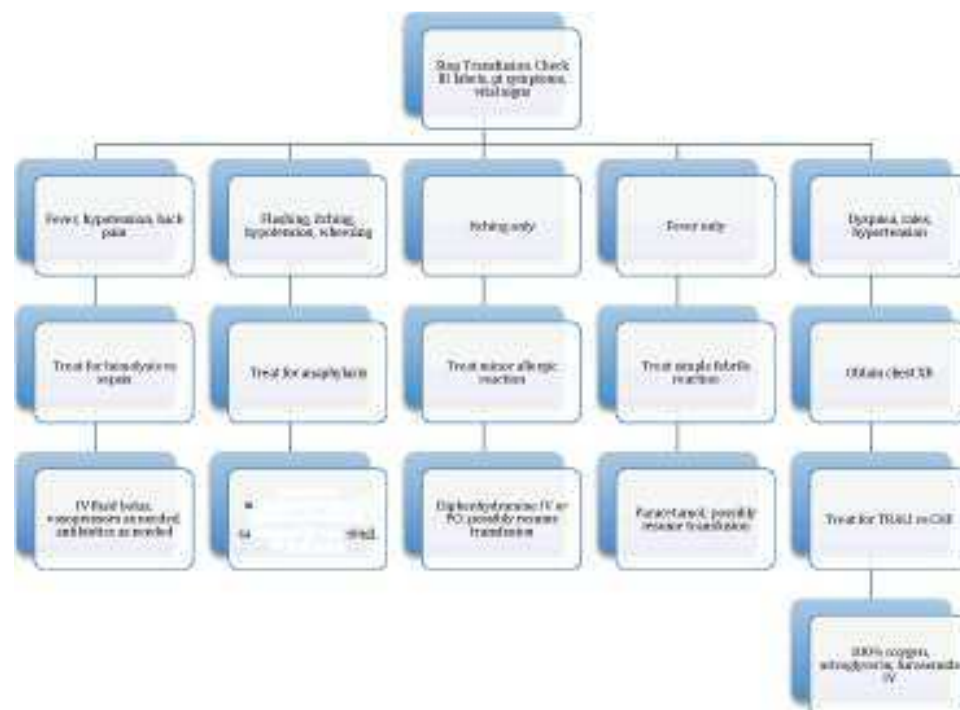
- o Acute, progressive dyspnea and rales that develop after a period **no longer** than 6 hours following a blood transfusion
- o Must differentiate TRALI from congestive heart failure by patient history and chest XR (TRALI chest XR will show diffuse interstitial edema **WITHOUT** cardiomegaly) Flat neck veins is a good sign that helps differential of these two conditions
- Acute congestive heart failure (CHF)
 - o Acute, progressive dyspnea and rales that develop over minutes or hours, during or soon after a blood transfusion .Distended neck veins are present.
 - o Must differentiate congestive heart failure from TRALI by patient history and chest XR (CHF chest XR will show diffuse interstitial edema **WITH** cardiomegaly)
- Anaphylaxis
 - o Sudden flushing, pruritus, laryngospasm, bronchospasm, hypotension
- Sepsis
 - o Fever, chills, hypotension
- Delayed hemolysis
 - o Presents less severe and less dramatic than acute hemolytic reaction days or weeks after a transfusion
 - o Low-grade hemolysis and progressively worsening anemia o Progression to renal failure a possibility, but rare. Typically self-limiting

Differential diagnosis:

- Acute, severe reactions
 - o Acute hemolysis
 - o Anaphylaxis
 - o Septic
 - o Transfusion-related acute lung injury
 - o Congestive heart failure
- Acute, minor reactions
 - o Simple fever o Allergic
- Delayed reactions
 - o Delayed hemolysis o Graft-versus-host disease
 - o Infections: Hepatitis, HIV, Cytomegalovirus, Epstein-Barr virus, syphilis, malaria, toxoplasmosis, Trypanosomiasis, Cytomegalovirus)

Investigations

- Labs: blood and urine cultures if signs of sepsis
- Imaging: CXR for rales, wheezing, dyspnea



Clinical algorithm for suspected transfusion reaction. Image adapted from Harwood-Nuss' *Clinical Practice of Emergency Medicine, 4th Edition*

Management

- Simple febrile reaction
 - o Paracetamol 500mg PO every 4hr as needed for fever
 - o Consider resuming transfusion if no vomiting, back pain, hypotension
- Acute hemolysis
 - o IV fluid bolus
 - o Vasopressors to support blood pressure
 - Dopamine 10-20ug/kg/min to keep SBP>120 or MAP>65 o
 - o Consider Furosemide 40-60mg IV x 1 dose
- TRALI or CHF
 - o Obtain chest XR to differentiate the two processes
 - o Nitroglycerin 0.4mg sub lingual (if available]
 - o Furosemide 40-80mg IV once to start diuresis
- Anaphylaxis
 - o Adrenaline 0.1mg IV every 20min for upper airway edema, active wheezing, hypotension (put 1 ampule of 1 mg/ml adrenaline into a 10cc syringe with 9 ml NS to make 0.1mg per 1ml]
 - o Dexamethasone 1mg/kg IV once OR Methylprednisolone 125mg IV once
 - o Diphenhydramine 50mg IV once
 - o Salbutamol 5mg nebulized (if wheezing]
 - o IV fluid bolus

- Minor allergic reaction
 - Diphenhydramine 50mg PO/IV/IM every 6hr to prevent itching
 - Consider resuming transfusion if no vomiting, back pain, hypotension

Recommendations

- There are risks involved in everything we do, including a "simple" blood transfusion. Ensure the patient really needs the transfusion and that the benefits outweigh the risks.
 - Explain to the patient the basic risks of a blood transfusion and obtain consent before giving blood.
- Two health providers need to agree that the correct blood is being given to the correct patient.
- There is no supported recommendation as to how fast to run blood in, but it should be **no longer than four hours**. Generally speaking, you can transfuse a unit of blood over 2hr (faster if it is a trauma patient or someone who is severely ill).
- Monitor a patient regularly during blood transfusion for signs and symptoms of a reaction and treat accordingly.

Chapter 11

INFECTIOUS DISEASE

Sepsis and Septic Shock

Definitions

- **SIRS** (*systemic inflammatory response syndrome*): the presence of two or more of the following clinical indicators:
 1. a temperature over 38C (100.4F) or below 36C (96.8F),
 2. a heart rate over 90 beats per minute,
 3. a respiratory rate over 20 breaths per minute (or a $\text{paCO}_2 < 32\text{mmHg}$),
 4. a white blood cell count over 12,000/uL or less than 4,000/uL
- Typically caused by infection, though other causes (such as thyroid storm, trauma, blood product reactions) can also explain these vital sign changes.
- **Sepsis**: SIRS + documented or suspected source of infection
- **Severe Sepsis**: Sepsis + evidence of inadequate perfusion such as decreased urine output or altered mental status
- **Septic Shock**: Sepsis + refractory hypotension (in spite of adequate fluid resuscitation)
- **Bacteremia**: The presence of bacteria in the blood, which may lead to a clinical presentation of SIRS, sepsis, or septic shock

Causes

SIRS presentations can have non-infectious causes. However, by definition, all sepsis presentations are related to infection. Likely organisms include:

- E. coli
- Pneumococcus
- S. aureus
- Meningococcus
- Group A beta-hemolytic streptococcus

Signs and symptoms

- History
 - o Use pre hospital personnel, patient, family, and friends to get best possible history about when symptoms started. Ask about any antibiotic use or traditional medicine use prior to arrival. If there is a transfer sheet from another facility, find out what antibiotic was given and how many doses
- Exam
 - o Obtain full set of vital signs, including saturation and temperature. Cold extremities are important clinical sign of shock (lack of perfusion to extremities)
 - o Early symptoms of sepsis/shock include
 - Hyperthermia (Fever, chills, rigors) or hypothermia
 - Tachycardia
 - Wide pulse pressure
 - Tachypnea

- Mental status change
 - Organs that are typically damaged from shock
 - Pulmonary function
 - Acute respiratory distress syndrome (ARDS)
 - Renal insufficiency
 - Oliguria, urinary sediment
 - Hepatic dysfunction
 - Jaundice
 - Coagulation abnormalities (DIC)
 - Increased bleeding
- Bedside test: Immediate glycemia check

Differential diagnosis

- Hypovolemic shock (GI bleed, major trauma)
- Cardiogenic shock (massive myocardial infarction)
- Anaphylactic shock (allergic reaction to foods, insect bites, drug reactions)

Investigations

- Labs: FBC (look for neutropenia), electrolyte, liver function tests, renal function, urinalysis, blood cultures if febrile, malaria test, HIV test. If available, coagulation factors (low in DIC) and lactic acid (value >4 predicts bad mortality) are invaluable to monitor septic patients
- Imaging: Chest XR
- Consider bedside ultrasound for IVC measurement for fluid status
 - Collapsing IVC indicates patient is dehydrated and would benefit from more fluids

Management: Early antibiotics and adequate resuscitation are the essential aspects of care.

- As always, start with ABCs. Reposition and open airway, if needed. Give supplemental oxygen. Patients with SIRS criteria at triage need TWO large IVs and a 2L bolus within one hour of arrival to health facility. Do bedside glycemia check. Consider early foley catheter placement to monitor urine output. If patient with fever on arrival and signs of sepsis, start antibiotics immediately.
- Fluid resuscitation
 - Place TWO large IVs (18g or larger)
 - Start NS or LR (LR is better for large volume resuscitation) ○ Start with 2L bolus run as quickly as possible (may have to squeeze bottle)
 - Continue fluids as long as the patient shows improvement in their hemodynamics.

Skin and Soft Tissue Infections

Definition: Skin and soft tissue infections (SSTI) range from mild, self-limiting disease to life-threatening infections. A variety of pathogens can cause infection, and severity of disease often depends on the host's underlying immune status. Simple skin infections occasionally spread into deeper tissue layers and cause more serious local infection or systemic illness. The most serious SSTI is necrotizing fasciitis which is a rapidly spreading bacterial infection within the deeper tissues and fascial planes.

Causes

- of SSTI
 - Abscess
 - Cellulitis
 - Erysipelas
 - Necrotizing Infection
 - Candidiasis
- Risk Factors
 - Trauma
 - Foreign body
 - Immunocompromise (elderly, diabetic, alcoholic)
 - Pre-existing wounds
- Organisms
 - Staphylococcus aureus
 - Anaerobes
 - Vibrio species
 - Haemophilus influenza
 - Streptococcal Species (group A and non-group A)
 - Eikenella corrodens
 - Pasteurella multocida
 - Pseudomonas

Signs and symptoms

- History and exam
 - Local skin infection shows warmth, redness, pain/tenderness, edema
 - Systemic or severe infection shows pain out of proportion (hurts more than it should), emphysema under the skin, pain with passive movement, regional lymphadenopathy, fevers/chills. If signs of systemic illness and pain out of proportion with exam findings, necrotizing fasciitis is likely.
- Bedside tests
 - Bedside ultrasound can be used to detect fluid pockets in abscesses that are suitable for drainage.

Differential diagnosis

- Septic arthritis
- Drug rash
- Steven Johnsons Syndrome
- DVT
- Allergic reaction
- Erythema migrans
- Neoplasm
- Allergic reaction
- Insect bite

Investigations

- Labs
 - None typically needed for simple skin infection or abscess. Send FBC or blood culture if fever present or patient is ill-appearing
- Imaging
 - Plain radiographs can be used to detect gas (necrotizing infection), foreign body, bone extension (osteomyelitis)
 - Ultrasound of soft tissue can be used to identify abscess
- Other tests
 - Skin marking
 - Mark boundaries of skin infection with pen in order to make it clear on re-evaluation whether cellulitis is responding to treatment
 - Expansion of infection in minutes to a hours suggests life threatening necrotizing infection and is a surgical emergency

Management

- Cellulitis (Non-purulent SSTI)
 - Simple cellulitis (small area of infection, no fever, no signs of systemic illness, no HIV)
 - Mark boundaries of erythema with skin marker. Tell patient to return if expanding outside the markings after 24hr of antibiotics
 - Oral antibiotics
 - Penicillin VK OR
 - Doxycycline OR
 - Clindamycin
 - Moderate cellulitis (larger infection, failed PO antibiotics, history of HIV or DM, fever)
 - Mark boundaries of erythema with skin marker for in hospital monitoring
 - Rule out necrotizing process
 - IV Antibiotics
 - Cephalosporin, OR
 - Doxycycline, OR

- Clindamycin
- o Severe cellulitis (involves GU area, patient ill appearing with hypotension or tachycardia, emphysema under skin, rapidly progressing)
 - Place TWO large IVs and Foley catheter for urine output. Treat patient as septic. Give 2L bolus IV fluids (NS or LR), start antibiotics immediately.
 - Emergent transfer for surgical evaluation: rule out a necrotizing process
 - Immediate treatment with IV antibiotics:
 - Cefotaxime 1g IV every 8hr OR Ceftriaxone 1g IV every 12hr AND
 - Metronidazole 500mg IV every 8hr

Purulent SSTI Infection (abscess)

- o Mild (no fever, no surrounding area of redness, isolated abscess, no HIV)
 - Incision and drainage ONLY
 - Antibiotics *not* indicated
 - Culture not indicated
 - Give patient instructions to wash wound area with soap and water twice a day and keep covered with clean gauze
 - Return to health center in 24-48hr for wound check
- o Moderate (some redness surrounding abscess, immunocompromised)
 - Incision and drainage
 - Oral antibiotics
 - TMP-SMX PO OR
 - Doxycycline PO
 - Give patient instructions to wash wound area with soap and water twice a day and keep covered with clean gauze
 - Return to health center in 24hr for wound check
- o Severe (fever, tachycardia, hypotension, large abscess, multiple abscesses, immunocompromised, failed PO antibiotics)
 - Place TWO large IVs and Foley catheter for urine output. Treat patient as septic. Give 2L IV fluids, place Foley catheter
 - Incision and drainage with culture and sensitivities, if available
 - IV fluid bolus AND IV antibiotics:
 - Cefotaxime 1g IV every 8hr OR Ceftriaxone 1g IV every 12hr AND
 - Clindamycin (IV preferred, but PO acceptable)
 - Transfer to referral center if patient remains with unstable vital signs after 24hr of IV antibiotic treatment and IV fluids

Necrotizing fasciitis

- o ABCs: these patients will often be in shock and will need aggressive fluid resuscitation
- o Antibiotics: should be started within 1 hour of presentation and must cover gram positives, gram negatives and anaerobes.
 - Augmentin AND Ciprofloxacin AND Metronidazole OR
 - PCN AND Gentamycin AND Metronidazole
- o Early and aggressive surgical exploration is essential for definitive treatment; this is a surgical emergency so patients must be transferred to a facility to surgical service.

Recommendations

- Simple cellulitis should be marked with a pen so patient or provider can monitor if redness extends beyond border despite antibiotics.
- Simple abscesses only need drainage (no antibiotics necessary)
- Patients with cellulitis or abscess that have abnormal vital signs or are ill appearing need aggressive treatment with TWO large IVs, catheter placement, and constant monitoring. Infections should start to heal within 48hr of IV antibiotic administration. If a patient is not getting better with IV antibiotics, transfer for more specialized care.
- Any cellulitis in the GU area should be considered severe and transferred for evaluation by surgery, particularly in patients with diabetes or HIV.

Chapter 12

ENDOCRINE/METABOLIC

Hyperglycemia Disorders (DKA, HHS)

Definitions

- Hyperglycemia: A fasting glucose greater than 111 mg/dl (6.16 mmol/L) or random glucose greater than 200 mg/dl (11.11 mmol/L).
- Diabetic Ketoacidosis (DKA): Hyperglycemic state (glycemia >250 mg/dL) associated with anion gap acidosis (pH <7.25 and HCO₃⁻ <18 mEq/L) with ketosis (ketones in urine or blood)
- Hyperosmolar hyperglycemic Syndrome (HHS): Hyperglycemia (glycemia > 600 mg/dL or 33.33 mmol/L) associated with hyperosmolarity (> 320 mOsm/kg) and altered mental status. These patients do **not** have significant ketoacidosis.

Causes

- Newly diagnosed or poorly controlled diabetes mellitus
- Acute disease: CVA, infection, seizure
- Medications

Signs and symptoms

- History
 - Ask about diabetes history, whether on oral pills or insulin, and whether patient has been taking medication appropriately (or ran out of drugs or missed doses), dietary compliance, and any recent changes to medication regimen. This will help determine if medication change or noncompliance is the cause of hyperglycemic state
 - DKA patients can have altered mental status, confusion, polyuria, polydipsia, vomiting
 - HHS patients are typically ill-appearing with confusion
- Exam
 - Patients with simple hyperglycemia are usually well-appearing with normal vital signs. They have no vomiting, no fast breathing, and no abdominal pain
 - Patients with DKA can either be ill-appearing or relatively well-appearing. They will often have vomiting, fast breathing, fruity breath, confusion, and vomiting. Vital signs often include tachycardia, tachypnea, and possible hypotension
 - Patients with HHS are always ill-appearing and usually quite confused, in a coma state. They are always very dehydrated with dry mucous membranes.

Investigations

- Labs
 - Bedside glycemia upon arrival in any patient with confusion, coma, or history of diabetes with polyuria, polydipsia, or abnormal vital signs

- o Any patient with glycemia >250 needs ketones checked to ensure no DKA (urine ketones or blood ketones).
- o FBC, renal function, electrolytes (potassium is single more important electrolyte to obtain)
- o Malaria test, HIV, urinalysis to look for source of infection in DKA and HHS patients
- o If available, venous blood gas (VBG) or arterial blood gas (ABG) and bicarbonate level will be helpful in diagnosis and treatment goals for DKA patients
- o If available, serum osmolarity >320mOsm/kg seen in HHS patients
- Imaging
 - o Chest XR in any patient with DKA or HHS to look for cause of infection

Management: General goal is to quickly determine if patients with hyperglycemia have DKA or HHS as treatment and prognosis varies greatly.

- **Hyperglycemia without complications** (glycemia high, but negative ketones, no vomiting, normal vital signs)
 - o Determine the cause first as that will guide treatment
 - Medication non-compliance, normal vital signs
 - Restart oral medications or insulin, give guidance on diet, follow up in clinic in one week to recheck glycemia
 - Can give IV fluids at facility, but will only reduce glycemia for the next 1-2 hours. Medication is the key to treatment
 - Taking medication as prescribed but glycemia still high
 - If on oral medications, start on insulin. These patient typically should be admitted overnight for glycemia monitoring to ensure correct insulin dose is started. Patient must be taught how to give self injections. Offer nutrition counseling. Follow up in one week to check glycemia
 - If on insulin and taking appropriately, increase dose as needed. Typically no need to admit. Can follow up in clinic in one week for glycemia check
 - Taking medication, but has new symptoms of infection, fever, cough, etc.
 - Continue medication, look for source of infection with labs and imaging. Likely admit if patient is well-appearing.
- **Diabetic Ketoacidosis** (high glycemia, positive ketones, low bicarbonate, low pH)
 - o These patients are quite sick and have high mortality if not treated aggressively and appropriately. Start TWO large IV lines, give supplemental oxygen as needed, start with 2L fluid bolus (NS or LR)

immediately, place Foley catheter for close urine output monitoring, keep on monitor to watch vital signs or check vital signs ever 30 minutes

- o Correct fluid losses first: Average fluid deficit is 4L on DKA patient, but can be as high as 6L. Must check renal function (Cr) and/or make sure patient is making urine (reason for Foley catheter) before giving entire fluid bolus. Give at least 2L fluid within one hour of arrival *before* starting insulin therapy
 - After fluid bolus of 2-4L (run in as fast as possible), continue NS at 125cc/hr while starting insulin infusion
- o Correct hyperglycemia next: Best therapy is insulin infusion
 - Regular insulin on infusion pump at 0.1u/kg/hr (first choice)
 - Fast acting insulin 0.1u/kg every 2hr subcutaneous (second choice)
 - Patient remains on insulin infusion until anion gap closes or ketones disappear from urine/blood. Sometimes the infusion therapy does NOT stop when the glycemia drops below 250. You must check for continued ketones regularly before stopping insulin therapy.
 - If glycemia <250, but ketones remain, start D5NS fluids along with insulin infusion
- o Correct electrolyte problems: Monitor potassium, magnesium, sodium
 - Potassium: Patients with DKA typically have LOW potassium (total body potassium low although lab value may be normal or high). When you give insulin, the potassium will drop even lower. Therefore, must check potassium and supplement during insulin infusion
 - If K > 6 mEq/L, do not give potassium
 - If 4.5 <K <6 mEq/L, give 10mEq/hour potassium mixed with patient's fluids
 - If K <3.5, stop insulin therapy, replace potassium until it is 4.5; then restart insulin therapy
 - Magnesium: If available, check magnesium and replace to goal of 2
 - Sodium: Patients with hyperglycemia have *falsely elevated* sodium levels.
 - True sodium level = lab measured Na + (0.016)x(serum glycemia-100). If true sodium level is elevated (>145), change fluids from NS to 1/2NS
- o Reason for DKA: Infection is a common cause of DKA (along with medication non-compliance). Look for source of infection, start antibiotics early.

- o Patients with DKA have a very high mortality and require a level of care comparable to an intensive care unit. Transfer any patient with DKA whose vital signs are not improving within 24hr.
- **Hyperosmolar Hyperglycemic Syndrome:** (very high glycemia, negative ketones, high serum osmolarity)
 - o Correct fluid deficit: HHS patients have typical fluid deficit of 6-10L (much more compared to DKA). Start with 2L bolus, but make sure patient urinating and check renal function before proceeding with remainder of fluid bolus. Continue to run at least 4L as fast as possible. Then run remainder in about 500cc/hr.
 - o Correct glycemia: HHS patients sometimes respond to IV fluids alone, but insulin infusion should be started at same dose with same guidelines as patients with DKA. See above
 - o Correct electrolytes: HHS patients have similar electrolyte disturbances as DKA patients. See management above
 - o It is difficult to differentiate DKA from HHS, especially if serum osmolarity, bicarbonate, and ketone testing is not available. Give plenty of fluids in each case, monitor urine output, electrolytes, and do glycemia checks every 2hr while on insulin therapy. Transfer patients with suspected HHS if vital signs are not improving within 24hr.

Recommendations

- It is crucial to differentiate simple hyperglycemia (minimal treatment needed) from DKA and HHS (both life threatening processes with high mortality). Check ketones when possible in any patient with high glycemia. If no ketones available, but patient has tachycardia, tachypnea, vomiting, or hypotension, presume DKA and treat aggressively as described above.
- Remember to monitor electrolytes in all patients in insulin infusion as described above. Even when lab potassium is near normal, patients are actually hypokalemic and need repletion.
- Most DKA or HHS patients require ICU level care. Transfer early- typically any patient who continues to have tachycardia, hypotension, tachypnea, or confusion after 24hr of aggressive treatment.
- All DKA and HHS patients need TWO large IVs, Foley catheter placement, and frequent vital sign checks.

Hypokalemia

Definition: Hypokalemia is when the serum potassium is < 3.5 mEq/L. Moderate hypokalemia is below 3.0 mEq/L, and severe hypokalemia is below <2.5 mEq/L

Causes

- Nutritional deficiencies
- Renal losses
- Diuretic use (Furosemide/Lasix)
- Vomiting/diarrhea
- Chronic alcohol use
- Theophylline use

Signs and symptoms

- History
 - Most patients with mild hypokalemia are asymptomatic
 - Moderate hypokalemic patients may have muscle cramping, generalized weakness, paresthesia
- Exam
 - Most patients have a normal physical exam

Investigation

- Labs
 - Check magnesium, if available, and other electrolytes along with potassium; check renal function
- Imaging
 - None

Management

- Replacement of potassium can be done orally or through an IV
 - Expect an increase of about 0.1 mEq/L for every 10 mEq of PO or IV potassium chloride given
- Patient with mild hypokalemia or asymptomatic moderate hypokalemia who can tolerate orals can be treated with foods rich in potassium (banana) or PO potassium chloride (40 mEq) if available
- Patients who are symptomatic or who have severe hypokalemia should be treated with IV potassium chloride (10 mEq/hr IV)
 - Do not run potassium in any faster than 10mEq/hr IV! Going more quickly can burn the vein or cause arrhythmias of the heart. Put patient on monitor, if possible, when giving IV potassium
- Patients who have low magnesium need to have magnesium replaced prior to potassium repletion.
 - Magnesium sulfate 2 gm IV over 30 min
- Once patients are stable, identify and treat the underlying cause.

Recommendations

- Mild to moderate uncomplicated hypokalemia can be discharged home with IM OPD follow up in 2 weeks.
- Symptomatic patients and patients with $K^+ < 2.5$ should be admitted to the hospital, with cardiac monitoring where possible.

Hyperkalemia

Definition: Serum potassium >5.0 mEq/L.

Causes

- Renal failure (chronic or acute)- most common cause
- Rhabdomyolysis
- Potassium-sparing diuretics (Spironolactone)
- Digitalis toxicity
- Tissue necrosis (ischemic bowel, tumor lysis syndrome)
- Lab error (common to see falsely elevated potassium if blood sits in tube for a long time before going on to machine)

Signs and symptoms

- History
 - Most patients are asymptomatic, but can have weakness, paresthesia, nausea, vomiting, diarrhea
- Exam
 - Typically a normal exam

Investigation

- Lab
 - In addition to seeing high potassium, check renal function for high BUN/Cr, and FBC (anemia common in chronic kidney disease, but not always)
- Other tests
 - EKG is important in patients with $K > 5.5$. It varies, but certain EKG changes are expected at various levels of hyperkalemia.
 - $K^+ 6.5 - 7.5$ mEq/L: Prolonged PR interval, short QT interval, and peaked T waves
 - $K^+ 7.5 - 8.0$ mEq/L: Flattening of P wave, QRS widening
 - $K^+ 10.0$ mEq/L and above: QRS complex degradation into a sinusoidal pattern and PEA arrest (death)

Management: The definitive treatment for hyperkalemia is to treat the underlying cause. There are three goals of treatment with different types of medications working for varying reasons.

The goals of treatment are to 1) stabilize cardiac membrane, 2) cause an intercellular shift of K^+ , and 3) remove K^+ from the body. Put patient on cardiac monitor, if available.

- Interventions working in seconds (stabilize cardiac membrane): Only needed in patients with ECG changes (as above) or $K > 6.6$
 - Calcium Gluconate: Give 2 ampules IV. Works within 1-3 min by stabilizing membranes. Lasts 30-50 min.

- Interventions working in minutes (shift K into cells): Give to any patient with $K > 5.5$
 - Salbutamol: Give as nebulized treatment—30 mg with 5 ml of saline nebulized over 15 min. Works within 15-30 min by shifting K^+ into cells. Lasts 2-4 hours.
 - Insulin with Glucose: Give dextrose 50% 1 ampule or 5% 500cc bolus with insulin. If the patient has $glc < 200$ mg/dl, give 2 ampules of dextrose. Check finger stick 20-30 min later. Works within 30 min by shifting K^+ into cells. Lasts 4-6 hours.
 - Furosemide: Give 40-80mg IV. Has variable onset of action and duration. Reduces total body K^+ .
- Interventions working in hours (the only interventions to actually remove K from the body)
 - Kayexalate: Give 30-60g PO. Works within 1-2 hours by increasing GI excretion of K^+ .
 - Hemodialysis: Works within minutes of initiation by direct removal of K^+ from the extracellular space.
- Dialysis should be considered in patients with hyperkalemia and renal failure. This is the ONLY long-term cure. Transfer to referral center for dialysis consideration any patient with hyperkalemia and renal failure.

Recommendations

- Asymptomatic patients with $K^+ < 6.0$, without EKG changes, and with normal renal function can be discharged home with IM OPD follow up in 2 weeks
- Patients with $K > 5.5$ should have EKG when available
- Patients with $K > 6$ with EKG changes or patients with $K > 7$ regardless of EKG, need calcium gluconate treatment, along with the other listed treatments, and immediately referral for dialysis.

Hypernatremia

Definition: Hypernatremia: serum sodium concentration above 145 mEq/L; all hypernatremic patients have deficit of free water relative to sodium
Severe hypernatremia: serum sodium greater than 158 mEq/L

Causes

- Decrease in total body water
 - Inability to obtain or swallow water (old person not drinking)
- Excessive sodium
 - GI
 - Vomiting, diarrhea, intestinal fistula
 - Renal loss
 - Central diabetes insipidus
 - Hypercalcemia
 - Sickle cell disease
 - Multiple myeloma
 - Sarcoidosis
 - Drugs/Medications
 - Alcohol, Lithium, Phenytoin
 - Skin loss
 - Burns, sweating

Signs and symptoms

- Symptoms progress depending on severity of disease
 - Restless, agitated-> tremulous, ataxic->hyper-reflexic, twitching->seizures, death
- Patient most commonly presents as coma or confusion
 - Patients will often be old, bed-bound, and not taking oral food or water at home

Investigations

- Labs: Immediate bedside glycemia in any patient with confusion or coma. Check serum electrolytes, renal function, FBC. If available, urine studies for urine osmolality and urine sodium may be useful

Management

- The main treatment is volume repletion, first with NS or lactated Ringer's solution (LR).
- **Correcting the sodium too quickly can lead to cerebral edema.**
 - Sodium correction should not exceed 10-15mEq/L per day! ◦ Check serum sodium TWICE after fluids are started (at six hours, then twelve hours) to ensure sodium is not falling too quickly.

Recommendations

- All patients with acute hypernatremia should be admitted to the hospital.
- Patients with chronic hypernatremia who are symptomatic (agitated, confused, tremors) should be admitted to the hospital.

Hyponatremia

Definition

- Hyponatremia: serum sodium less than 135 mEq/L
- Severe hyponatremia: serum sodium less than 125 mEq/L

Causes

- Hyperglycemia (most common)
- Renal failure
- Alcoholism
- Obstructive jaundice
- Multiple myeloma
- Diuretic use
- Diarrhea/vomiting
- Burns
- Excessive sweating
- Malnutrition
- CHF
- Cirrhosis
- Pregnancy

Signs and symptoms

- History
 - Most patients are asymptomatic, particularly if they have a serum sodium over 130 mEq/L.
 - When patients are symptomatic, the severity of symptoms typically depends on the severity of hyponatremia and the time frame in which the hyponatremia develops (the faster onset, the more symptomatic)
 - Symptoms of hyponatremia include headache, muscle cramping, nausea/vomiting, confusion
 - Severely hyponatremic patients can present with seizures

Investigations

- Labs
 - Bedside glycemia should be done on all patients presenting with coma, confusion, seizure
 - Renal function, liver function tests, other electrolytes in addition to sodium
 - Serum osmolality, if available, will help guide reason for hyponatremia
 - Urine studies like osmolality, creatinine, and urine sodium are helpful, if available

Management: True management of hyponatremia begins with calculating volume status of patient (hypovolemic, hypervolemic, or euvolemic), measured osmolalities and plasma osmolalities. Those equations are beyond the scope of these introductory guidelines and osmolalities are not often available. The following management guidelines are based on clinical symptoms. Recognize that correcting the sodium too fast will lead to severe brain damage and irreversible neurological deficits. Therefore, it is crucial that you correct sodium slowly and that you check blood samples for sodium levels at least every 2hr while treating with NS.

- Severe Hyponatremia (presents with seizure and serum $\text{Na} < 115 \text{mEq/L}$)
 - o Treat with 3% NS (where available) at 25-100mL/hr until seizures stop
 - o Recheck Na immediately after giving 3% NS
 - o Maximum sodium increase is 1-2mEq/L per hour
- Moderate hyponatremia (presents with signs of cerebral edema like lethargy, confusion, delirium and serum $\text{Na} < 120 \text{mEq/L}$)
 - o Treat with a NS bolus at a rate of about 1-2 ml/kg/hr for 1-2 hours or until symptoms have improved.
 - o Re-check sodium level after 2 hrs of NS infusion
 - o Maximum sodium increase should be 0.5-1mEq/L per hour
- Mild hyponatremia (presents with mild symptoms, no confusion, and $\text{Na} > 120 \text{mEq/L}$). Treatment depends on estimated body fluid status.
 - o Euvolemic patients: use free water restriction
 - o Hypovolemic patients (recent GI losses, hyperglycemia, etc.): use normal saline
 - o Hypervolemic patients (CHF, etc.): restrict water and salt to correct their hyponatremia; diuretics can also be used.

Recommendations

- Patients with asymptomatic hyponatremia with a sodium $> 120 \text{mEq/L}$ can be treated with free water restriction for 24hr and then gentle NS infusion, only if needed.
- Only patients presenting with seizures need to be treated with rapid boluses of 3% NS or regular NS.
- In general, do not correct sodium too quickly, as it will lead to permanent brain damage.
- Transfer any patient who has severe symptoms like coma or seizure and is not improving with sodium correction as described above.

Chapter 13

ENVIRONMENTAL

Burns

Definition: Damage to the integumentary system (skin) caused by exposure to temperature extremes, chemicals, radiation or electrical current.

Causes

- Thermal
- Chemicals
- Radiation
- Electrical Current

Signs and symptoms

- History
 - Important features include time since burn (hours, days?), cause of burn (fire, electrical?), and whether traditional medicine or home remedy was used on burn prior to arrival
 - Burns at higher risk for poor outcomes include
 - Delayed presentation (>3 days since burn) and/or prior use of traditional medicine before presentation
 - >10% BSA in children and >15% BSA in adults
 - Burns involving perineum or flexures
 - Electrical burns
- Exam
 - Assess ABCs
 - Look for airway involvement (black soot in nares, stridor, hoarse voice)
 - Full set of vitals including saturation
 - Calculate % total body surface area (BSA) burned
 - Superficial (1st degree) burns are NOT included in the BSA
 - Assess the percentage of body surface area (BSA) that is burned using the "rule of nines" or estimate the area of the back of the patient's hand is approximately 1% BSA. Note that rule of nines for a child with burn is slightly different (head is 18%, legs are 14% each)
 - Head: 9%
 - Front chest: 18%
 - Back: 18%
 - Arm: 9% each
 - Leg: 18% each
 - Depth of burn (see chart below)
 - Involvement of critical areas (face, hands, genitals, feet, major limbs)
 - Muscle compartment involvement (firm, painful)
 - Highest risk of compartment syndrome with circumferential burns and burns at calf/lower leg and forearm

- o Weight needed to calculate fluid resuscitation

Depth of burn estimation

| | Superficial (1st Degree) | Partial Thickness | Partial Thickness | Full Thickness (3rd Degree) |
|-------------------|--|------------------------------|------------------------------|---|
| | | Superficial | Deep | |
| Depth | Epidermis | Superficial dermis | Most dermis | All of dermis |
| Appearance | Red | Pale/Dark pink, moist | White, waxy/dry | White/dark brown, dry/leathery |
| Blisters | No | Small blisters | No blisters | None |
| Cap refill | Normal | Sluggish | Reduced | None |
| Sensation | Normal/painful | Normal/painful | Reduced | None |

Investigations

- Labs: Isolated superficial burns do not need any investigations. Adults with partial thickness burns > 15% BSA require FBC, renal studies
 - o Children with >10% BSA require bedside glycemia, type and cross for possible transfusion if ill-appearing in addition to above studies
- Investigations: Consider full trauma survey in electrical burns, including XRs, urinalysis for possible rhabdomyolysis

Management: General goal is to remove burned clothing, keep patient warm, assess full burn area, and start appropriate stabilization before determining if patient requires transfer to burn center or higher level of care.

- Initial stabilization:
 - o ABCs: Assess airway carefully. Look for soot in the nose and mouth, mucosal lesions, swelling of the neck, wheezing, changes in voice, difficulty swallowing, drooling, circumferential burns to the neck or chest, tachypnea, or hypoxia.
 - o Early intubation is required in patients with inhalation injury or burn to mouth/airway. Transfer immediately if necessary.
 - o Start supplemental oxygen at highest level possible for any desaturation or sign of smoke inhalation
 - o Start large IV (or two IV lines if patient appears in shock)
 - o Urinary catheter for high risk burns (See above list)
- Fluid resuscitation (see Appendix)
 - o Parkland formula AND maintenance fluids for pediatrics
 $4\text{mL} \times (\text{Patient's weight in kg}) \times (\% \text{BSA})$

Pain relief: Burns are extremely painful and require opiates for pain control, particularly during any dressing changes.

- o Morphine 0.1mg/kg IM/IV every 2-4hr as needed
- o Pethidine 1mg/kg IV every 3-6hr as needed
- o Tramadol 0.1-0.2mg/kg (kids) or 100mg (adults) IV every 4-6hr as needed
- o Paracetamol (only for use in healing burns)

Dressing changes: Infection and sepsis are major sources of mortality in burn patients. Regular dressing changes are necessary, but are extremely painful and require either conscious sedation with Ketamine (extensive burns) or opiate pain control (small burn area)

- o After initial presentation, remove any burned clothing and cover patient in clean sheet until burns can be dressed appropriately
- o Wash burn area thoroughly with sterile water or normal saline
 - If blister is intact, do not break open blister
 - If blister is open, de-roof blister and clean area of skin underneath
- o Cover clean burn area with light coat of honey (if antibiotic ointment unavailable) or Flamazine or other topical antibiotic
 - Do not cover burn area with dry dressing!
- o Cover burns with sterile gauze and bandage
- o Dressing changes AT LEAST every other day
 - Infected burns need daily or twice daily dressing changes

Medications for dressing changes

- o Conscious sedation: Ketamine 1.5mg/kg IV once
- o Pain control: morphine 0.1mg/kg IV just before dressing change

All burns need updated tetanus Antibiotics: Should NOT be prescribed routinely. Consider antibiotics for

- o Signs of shock (hypotension, delayed cap refill, no urine output, fever)
- o Delayed presentation (>3 days since burn)
- o >10% BSA in kids or >15% BSA in adults
- o Burns involving perineum or flexures
 - Cloxacillin 1g IV every 8hr (adults) or 100mg/kg IV every 8hr (children) for 5-7 days
 - If starting antibiotics, send malaria smear and blood cultures FIRST

Children have higher nutritional requirements. Begin feeding orally as soon as possible. Place NG tube if not eating after 24hr and obtain nutrition consultation if available. Increase feeds by 1-2 extra feedings/day for every 5% TBSA burn, including high calorie foods like sosoma porridge and peanut butter. Remember to check finger stick glucose in children early as they often develop hypoglycemia and add D5 % NS maintenance fluids. Electrical burns have additional possible complications

- o Dysrhythmias (typically asystole or ventricular fibrillation) will occur at scene

- o Nerve and deep muscle injury common following contact with voltages over 400 volts
 - Fluid resuscitation more important
 - Foley catheter to ensure output of at least 1cc/kg/hr
 - Urinalysis for myoglobin/blood/darkening of urine
 - o Neurologic impairment frequent
 - Consider brain CT for associated agitation, confusion, coma, seizures
 - Do full trauma survey to assess for spinal cord injury
 - o Cutaneous burns from high voltage contact appear as gray to yellow depressed area on body o High risk for compartment syndrome
 - o All patients with electrical injury should be transferred to burn center
- Patients with circumferential burns need to have the distal perfusion assessed.
- o Patients with compromised perfusion should have an escharotomy performed in the district BEFORE transfer to referral center o Full thickness circumferential burns of the torso may require escharotomy to allow normal respiration o Escharotomy is a limb saving procedure

Recommendations: Practitioners need to consider their facility's capability to care for burn patients and transfer as needed.

- Patients with minor burns can be managed as an outpatient with or without daily checks to a local health center:
 - o < 5% TSBA partial thickness burn in healthy, well appearing adults o <5% TSBA in healthy, well appearing children without prior evidence of malnutrition
 - o No involvement of joints, face, perineum o Patient must be reliable for close follow up and/or live near to a health center
- Patients with moderate burns should be admitted in a district level hospital:
 - o 15-20% TBSA in healthy, well appearing adults
 - o **10-15%** TBSA in healthy, well appearing children without prior evidence of malnutrition o No involvement of joints, face, perineum o No evidence of airway compromise or inhalation injury o Vital signs stabilized after initial fluid bolus o No fever or signs of infection
- Patients with severe burns should be stabilized (open airway, supplemental oxygen as needed, IV line placement, fluid bolus, foley catheter placed) and then transferred to burn center
 - o >20% TBSA in adults o >15% TBSA in children

- o Full thickness burns in any age
- o Burns involving hands, face, feet, or perineum
- o Burns crossing major joints
- o Circumferential burns of an extremity
- o Burns with inhalation injury
- o All electrical burns
- o Burns complicated by fracture or other trauma

Mammalian Bites

Definition: Breaking of the skin due to human or animal teeth

Causes

- Accidental by animal or human
- Intentional by human

Signs and symptoms

- History
 - Ask when bite occurred
- Exam
 - Breakage of the skin with or without bleeding
 - Typically a puncture wound rather than a laceration
 - Examine for possible fracture beneath bite if other trauma involved

Investigations

- Labs: none needed
- Imaging: Consider XR of the hand if concern for associated broken bones

Management: General goal is good irrigation of wound, exploration for associated injuries (tendon, nerve damage, underlying fractures), and appropriate wound management

- Irrigation
 - All wounds due to a bite must be thoroughly irrigated. This should be done with a large volume of water or NS (at least 1L or more depending on size) under high pressure (may be from a sink faucet). This water does not need to be sterile.
- Laceration repair
 - General indications for suturing in mammal bites
 - Location is face or scalp
 - Bite occurred less than 6 hour prior to arrival
 - Wound is simple without devitalized or ragged tissue edges
 - No underlying fracture
 - Patient is not immunocompromised (no HIV)
 - While controversy exists, in general indications for delayed primary closure (do NOT suture)
 - Cat or human bites
 - Livestock (cows, donkey, pig, monkey) bites
 - Deep puncture wounds
 - Hand or foot wounds
 - Bites in patients with HIV
 - Infected wounds
 - Wounds older than 6 hours

- Wounds with associated or underlying fracture
 - Delayed primary closure: After irrigation and edge debridement, cover wound in moist, clean cloth/gauze. Patient to return to nearest health facility DAILY for dressing changes and wound checks to ensure no infection occurs
 - Debridement of devitalized tissue is necessary
- Antibiotic therapy
 - Amoxicillin-clavulanate (Augmentin) 875mg PO 2x/day for 5 days OR 500mg PO 3x/day for 5 days (first choice)
 - OR
 - Trimethoprim-sulfamethoxazole (TMP-SMZ) PO BID for 5 days AND o Clindamycin 150-300mg PO every 6-8hr for 5 days
- Update tetanus as needed
- Infected closed fist injuries or open fractures need transfer to referral hospital for orthopedic consultation and IV antibiotics
- Specific mammalian bites: in addition to guidelines above, add
 - Bat, monkey, dog bites
 - Rabies vaccine/immunoglobulin
 - Monkey bites
 - Higher rate of herpes B virus transmission
 - Acyclovir PO for 10 days
- Human bites
 - Debridement of devitalized tissue is necessary during/after irrigation

Recommendations

- Thorough irrigation can prevent most infections from bites. Do NOT suture every bite. Follow guidelines above.
- High-risk bites need daily wound checks by a healthcare provider to ensure no infection/complications. Simple bites also need daily dressing changes, but can be done by patient at home with clean water (doesn't need to be sterile) and clean dressings.
- Transfer any bites that appear infected, any open fractures (evidenced by fracture on XR and bite overlying skin)

Snake Bites

Definition: Estimates of snake bites in Rwanda are lacking, as there is little current research on the topic. A paper from 2008 estimated between 1300-2400 snake bites per year in Rwanda with between 43-328 deaths as a result.

- **Important points to remember:**

- o Do not send family to retrieve snake.
- o If brought in with patient, remember that dead snakes can still bite (with venom!).
- o Up to 70% of snake bites from venomous snakes are "dry" (have no venom)

Causes: There are three main types of snakes thought to be in Rwanda

- *Elapidae* (smooth scales, round pupils, short fixed fangs)
 - o Cobras and mambas with neurotoxin venom
- *Viperidae* (long, hinged fangs, triangle-shaped head; elliptical shaped pupils)
 - o Pit vipers and adders with cytotoxic venom
- *Colubridae* (rear fanged, "boomslang" or tree snake with hemotoxic venom)

Signs and symptoms

- Ask for description of snake if possible
- Cytotoxic venom (pit vipers)
 - o Local edema, bleeding, necrosis, evidence of compartment syndrome
 - o Hemorrhage or bruising
 - o Decreased urine output, dark urine (rhabdomyolysis), muscle pain
 - o Hypotension, heart arrhythmias
- Neurotoxic venom (elapid bites; often delayed presentation with minimum symptoms)
 - o Descending paralysis (can impede respiratory function)
 - o Tremors, salivation, dysarthria, diplopia, ptosis, seizures
- Hemotoxic venom ("boomslang")
 - o Decreased clotting time, bleeding

Investigations

- Measure limb circumference above and below the bite. Mark the border of the edema/erythema and reassess both measurements every 30minutes.
 - o This is the most important way to know if the bite is getting worse or not
- Labs: FBC, electrolytes, renal, urinalysis, PT/PTT (if available)
 - o Clotting test after snake bite
 - Take 2ml of blood and place in clean test tube. Leave undisturbed for 20min, then turn over. If blood flows out, then coagulopathy has occurred. If blood stays still, then patient has normal coagulopathy.
- Imaging: none

- Check for compartment pressures (pain, firmness, swelling are clinical signs of compartment syndrome)

Management: Goal of acute management is to prevent systemic envenomation

- Immobilize affected limb immediately.
 - Wrap entire limb tightly with a compression dressing (NOT a tourniquet!).
 - How tight is tight?
 - Applied properly, a finger may be easily placed between the band and the skin
 - Do NOT disturb bite site- no sucking, biting, or cutting of bite site ◦ Ask patient to lay back and relax and stay immobilized as much as possible.
- Medical care
 - Tetanus booster if needed
 - Antibiotics if sign of infection or necrosis
 - IV fluids (NS or LR) for hypotension, dark urine, tachycardia
 - Debride necrotic tissue as necessary, but avoid fasciotomy unless clotting test (see above) is normal ◦

If signs of compartment syndrome

 - Elevate limb, administer Mannitol 1-2g/kg over 30min while giving antibiotics. Try to reserve fasciotomy if clotting test is positive.
 - Indication for antivenom is rapid spreading of edema/redness, compartment syndrome, systemic toxicity

Recommendations

- There are many misunderstandings about snake bites. Follow the management guidelines closely- immobilize limb, elevate, do not place a tourniquet, but instead a "tight" compression dressing
- Transfer to the closest facility that has antivenom if there is any signs of rapidly spreading wounds
- Transfer to a referral center with surgical capabilities if there is concern for impending compartment syndrome, but fasciotomy should be done *before* transfer, if provider has training in the procedure, to save limb.

Drowning

Definition: A process resulting in a primary respiratory impairment from submersion/immersion in a liquid medium.

Causes

- Accidental submersion
- Suicide attempt
- Forced submersion

Signs and symptoms

- History
 - Ask about timing of event (how many hours ago did it occur?) and whether there was associated trauma (head first diving or assault)
- Exam
 - Start with ABCs and a complete set of vital signs, including saturation and body temperature
 - Other possible symptoms may include shortness of breath, change in voice, chest pain, confusion/coma, seizure
 - Lung exam may show rales, rhonchi, wheeze, retractions
 - Do full trauma survey for possible associated injuries, paying close attention to possible c-spine injuries

Investigations

- Labs: none unless patient requires intubation and admission
- Imaging: Chest XR is indicated in patients with saturation <95% or GCS<13. Other imaging based on associated trauma

Management: General goal is to assess ABCs, determine if other trauma work up is necessary and treat patients based on oxygen saturation and GCS on arrival.

- GCS>13 and saturation >95% with normal lung exam
 - Patients do not require labs or imaging. Safe to observe in the department for six hours. If asymptomatic, safe to discharge home to return only if fever, mental status change or pulmonary symptoms occur
 - If patient develops oxygen requirement during observation or has new lung exam findings, admit and treat with supplemental oxygen
- GCS<13 or saturation<95% with abnormal lung exam
 - Give patient the highest flow oxygen available. If saturation does not improve, transfer to referral center for intubation and positive pressure ventilation. Intubation indicated for GCS<8 or inability to oxygenate well.
 - Do FBC, electrolytes, renal function, and chest XR
 - Treat for aspiration pneumonia

- Metronidazole 500mg IV every 8hr o Do full trauma work up to evaluate for other injuries

Recommendations

- Patients with GCS >13, and O₂ sat >95% should be observed for 6 hours. If they remain asymptomatic, with a normal physical exam and saturation >95%, they can be discharged home.
- Patients with saturation <95% or GCS <13 should be admitted and treated aggressively.
- Patients requiring supplemental oxygen or intubation should be transferred to a referral center.

Chapter 14

TOXICOLOGY

General Approach to Toxidromes

Definition: Exposure to toxic substances can occur through various routes: ingestion, inhalation, injection, dermal exposure, or mucosal exposure. Identification of the specific substance(s) involved in a poisoning can frequently assist clinical management, but is not always possible in actual practice. Recognizing symptom patterns, known as toxidromes, may help direct general management of the patient even when the exact agent responsible for poisoning remains unknown. Specific antidotes for some toxins exist, but their availability is often limited. Good supportive care is critical to managing many toxic exposures

Causes

- Exposure to a sufficient amount of any substance is toxic, even those substances required for survival.
- Exposures may be accidental or intentional
- Common toxic exposures include: medications, illicit drugs, agricultural or industrial chemicals, gas and smoke, environmental

Signs and symptoms

- Many poisonings can be grouped into broad categories termed "toxidromes" by the consistent clinical signs and symptoms that they exhibit. Familiarity with these toxidromes can greatly facilitate clinical care by alerting the medical provider to the probable cause of the patient's findings. Timely examination of the patient's vital signs like blood pressure (BP), pulse/heart rate (P), respiratory rate (RR), and temperature (T) are critical. Accurate assessment of mental status (MS), pupil size, presence or absence of bowel sounds (peristalsis), and skin (whether diaphoresis is present) is crucial to determining whether a given ingestion fits a particular toxidrome. Toxidromes include: anti-cholinergic, cholinergic, opioid, sympathomimetic and sedative-hypnotic.

| TOXIDROME | BP | p | RR | T | Mental Status | PS | BS | Diaphoresis | Other |
|-------------------|----|---|----------|---|-----------------------|----|----|-------------|---|
| Anti-cholinergic | | T | | T | Delirium/ confusion | T | 1 | 1 | Mucous membranes dry, skin flushed, urinary retention |
| Cholinergic | | | Nml or t | | Normal or depressed | | T | T | Salivation, lacrimation, urination, diarrhea, bronchorrhea, fasciculations, paralysis |
| Opioid | 1 | 1 | 1 | 1 | Depressed/sleepy | 1 | 1 | | |
| Sympatho-mimetic | T | T | T | T | agitated | T | | T | Tremor, seizures |
| Sedative Hypnotic | 1 | 1 | 1 | | Depressed or agitated | | 1 | | |

BP Blood Pressure; P Pulse; RR Respiratory Rate; T Temperature; BS Bowel Sounds; Nml Normal; PS Pupil Size

- History
 - If possible, determine the specific agent involved. Ideally have the container of the involved substance brought immediately for inspection. Photographs of container labels from the family can be extremely helpful.]
 - Inquire about type of work (farming, industry)
 - Dietary habits
 - Medical history include previous psychiatric issues, current medications, and use of traditional medicines
- Exam
 - Toxidrome directed exam as above
 - Examine patient for evidence of trauma or signs of chronic illness
 - Look for clues of specific poisonings:
 - Fruity odor (organophosphates),
 - Cutaneous/skin injury (caustics)
 - Puncture wounds (snakes, self injection)
- Bedside tests
 - Glycemia - must be checked immediately on all patients with an altered level of consciousness or focal neurologic findings
 - ECG - look for QT prolongation, Digoxin effect, QRS widening, RSR' morphology in lead AVR (suggestive of tricyclic anti-depressants like Amitriptyline)

Differential diagnosis

- Infection
- Trauma
- Endocrine
- Rheumatologic
- Withdrawal
- Stroke
- Psychiatric
- Environmental

Investigations

- Labs: Basics include electrolytes (sodium, potassium, chloride, bicarbonate), renal function. Consider also FBC, liver function tests (AST/ALT), urinalysis, pregnancy test. If available, quantitative testing for certain substances can guide therapy (Acetaminophen/Paracetamol, Dioxin, lead, iron, Lithium).
- Imaging: If there is a question of poisoning, but event was not witnessed (cannot be confirmed personally) and patient is very confused, has high blood pressure, or is in coma, then a brain CT without contrast is appropriate to rule out other diagnoses (trauma, CVA, space occupying lesion).

Management: Varies depending on substance that was ingested, but as this is often unknown or unverified, focus on stabilizing the patient and offering supportive care.

Limiting the extent of exposure can be critical:

- o Remove exposed clothing, wash contaminated body surfaces
- o Health providers and EMS must protect themselves from exposure

Assess and stabilize ABCs. Check glycemia at bedside immediately upon arrival

- o Reposition patient to keep airway patent; intubate if necessary
- o Give supplemental oxygen if needed
- o Start IV lines and NS fluid
- o IV dextrose if hypoglycemic
- o Place foley catheter to assess urine output

Gastric lavage only if potentially life threatening ingestion and patient presents LESS THAN 2 hours after ingestion. Contraindicated in caustic ingestion. Contraindicated in patients without the ability to swallow on their own (low GCS or coma) unless NG tube placed.

- o Activated charcoal
 - Dose 1 gm/kg PO once
 - Reduces absorption of many ingested toxins
 - Ineffective for: caustics, alcohols, hydrocarbons, iron, lithium
 - Pulmonary aspiration is a major risk in lethargic/confused patients

Increase rate of elimination if possible: if appropriate dialysis, dieresis with Furosemide

Seizure control

- o Diazepam 5 -10 mg IV. May repeat in 5 minutes in no response.
- o If benzodiazepine refractory seizures consider B6 (Pyridoxine) if Isoniazid ingestion is possible.

| Toxidrome | Treatment Considerations |
|------------------|--|
| Anticholinergic | ABCs, supportive care Hypotension - IV normal saline Hypoglycemia - IV dextrose Hyperthermia - evaporative cooling Agitation/seizures - IV benzodiazepines Decrease absorption - Activated charcoal (if clinically appropriate). Consider Physostigmine (see below in Antidotes). |
| Cholinergic | ABCs, supportive care Hypotension - IV normal saline, IV dobutamine Atropine -1 mg IV then 2-4 mg every 15 minutes until bronchial and oral secretions dry. Obidoxime - 250 mg IV or IM 5 minutes after first Atropine dose. If good response then continue 750mg/24hrs Agitation/seizures - IV benzodiazepines |

| | |
|---|---|
| Opioid (Morphine, Fentanyl, Pethidine) | ABCs, supportive care Naloxone 0.4-2.0 mg IV. May require repeat dosing depending on opiate ingested. Titrate to adequate respiration not mental status. |
| Sympathomimetic (cocaine, etc.) | ABCs, supportive care Hypotension - IV normal saline Hypoglycemia - IV dextrose Hyperthermia - evaporative cooling Agitation/seizures - IV benzodiazepines Decrease absorption - Activated charcoal (if clinically appropriate) No Beta Blockers |
| Sedative Hypnotic (diazepam, etc.) | ABCs, supportive care Avoid Flumazenil |

Antidotes and treatments for specific ingestions (see references for further specifics on management recommendations):

- **Acetaminophen**
 - N-Acetylcysteine (NAC) -
 - IV - 150mg/kg in 200 ml 5% dextrose over 60 minutes (max 15 g) then 50 mg/kg in 500 ml 5% dextrose over 4 hours (max 5 g) then 100 mg/kg in 1000 ml 5% dextrose over 16 hours (max 10 g).
 - Oral -140 mg/kg then 70 mg/kg every 4 hours for a total of 17 doses.
- **Anticholinergics**
 - Physostigmine -
 - If benzodiazepines are insufficient for agitated delirium; 0.5-2.0 mg slowly IV (adults). 0.02 mg/kg in children (max 0.5 mg). May repeat in 20-30 minutes. May cause dysrhythmias.
- **Beta Blockers**
 - Glucagon
 - 0.05-0.15 mg/kg IV bolus. May repeat or start infusion at 0.05-0.15 mg/kg/hr.
- **Calcium Channel Blockers**
 - Calcium Chloride or Calcium Gluconate
 - 1 g slow IV push.
 - Glucagon
 - 0.05-0.15 mg/kg IV bolus. May repeat or start infusion at 0.05-0.15 mg/kg/hr.
 - IV Insulin: Only in severe cases of refractory hypotension or bradycardia

- 1 unit/ kg bolus followed by 1-10 u/kg/hr. Titrate to blood pressure. Monitor serum potassium and blood glucose every 30 minutes (if possible) until stabilized. Dextrose infusions to maintain glycemia at normal levels.
- **Carbon Monoxide**
 - Oxygen
 - Treat with the highest concentration of oxygen available for at least 6-8 hours. Consider co-intoxication with cyanide.
- **Cholinesterase Inhibitors**
 - Obidoxime
 - 250 mg IV or IM 5 minutes after first Atropine dose. If good response then continue 750mg/24 hrs.
- **Cyanide**
 - Hydroxycobalamin
 - 5 g IV over 15 minutes. May be repeated once.
- **Digoxin**
 - Digoxin Immune FAB
 - If Digoxin level available calculate:
 - number of vials = serum dig level x body weight/100
 - If no level available: empirically dose with 5 vials.
- **Ethylene glycol/Methanol**
 - Fomepizole
 - 15 mg/kg IV bolus then 10mg/kg every 12 hours.
 - Ethanol
 - Oral: 0.8-1.0 ml/kg of 95% ethanol loading dose, then 0.15 ml/kg/hr
- **Iron**
 - Desferoxamine
 - Indications: serum level >54 umol/L and moderate to severe toxicity. Infuse 15mg/kg/hr to maximum dose of 80 mg/kg.
- **Isoniazid**
 - Pyridoxine
 - Indication: Ingestion of > 80 mg/kg
 - Give Pyridoxine dose equal to Isoniazid ingested (gram for gram). If unknown amount of ingestion, start with 5 g and repeat until seizures controlled.
- **Methemoglobinemia**
 - Methylene Blue
 - 1-2 mg/kg IV over 5 minutes (0.1-0.2 ml/kg of 1% solution). May repeat in 1 hour.
- **Oral Sulfonylurea**
 - Octreotide acetate
 - 50-100 meg SC every 12 hours for dextrose refractory hypoglycemia
 - 1mcg/kg (child).

- **Warfarin**
 - Phytonadione (Vitamin K)
 - Management must be individualized
 - Elevation of INR may take several days to develop after ingestion
 - See algorithm
 - http://poisoncontrol.utah.edu/healthpros/utox/toxtoday/VolII_lss4.pdf

Recommendations

- Excellent supportive care is crucial to caring for all intoxications. Obtain the best history of the exposure as possible. Ask family for photos of substance ingested.
 - History is often limited or unavailable in patients presenting confused or in coma. Keep a broad differential and consider other possibilities (electrolyte imbalance, CVA, bleeding) if poisoning cannot be verified
- Activated charcoal is only indicated in patients who present within 2 hours of ingestion and who are able to swallow without risk of aspiration.
- Consider if the patient fits a well known toxidrome and treat accordingly
- Refer any patient
 - Abnormal vital signs, not resolved with supplemental oxygen and IV fluids
 - GCS<13 whether poisoning is confirmed or not (patient will need brain CT)
 - GCS<10 and will require intubation and ventilation with specialized care

Alcohol Withdrawal Syndrome

Definition: Chronic ingestion of alcohol can lead to physical dependence. Stopping alcohol use for any reason can cause an acute withdrawal syndrome. Delirium Tremens is the most severe manifestation of alcohol withdrawal syndrome and can be fatal.

Causes

- Abruptly stopping alcohol consumption

Signs and symptoms

- Assess ABCs initially, record saturation, and do temperature on all patients. Do immediate glycemia at bedside.
- History
 - o Ask patient or family how much they drink on a typical day, what type of alcohol they consume (beer, liquor?) o Most important historical question: when did the patient have their last drink (hours, days?).
 - This helps provider to anticipate symptoms of withdrawal (see below)
 - o Ask about possible trauma, recent illness, previous episodes of same
- Exam
 - o Alcohol intoxication presents very different than alcohol withdrawal. Intoxication may include extreme happiness (euphoria) or agitation and combativeness. Central nervous system depression often occurs including slurred speech, ataxia, and nystagmus and can eventually lead to coma and respiratory depression. Can often cause low glycemia
 - o Alcohol withdrawal typically presents with some combination of symptoms including
 - Tremulousness (tachycardia, hypertension, hyperthermia, tremor, diaphoresis)
 - Occurs as early as 6 hours after the last drink and up to 48 hours after last drink
 - Hallucinations (visual or auditory)
 - Occurs within a few hours after last drink
 - Alcohol withdrawal seizures
 - Peak time for seizure is within 24 hours after last drink
 - Delirium tremens (includes all above symptoms of withdrawal plus delirium/confusion)
 - Occurs within 24-96 hours after last drink and has typical duration of 3-7 days
 - Patients with delirium tremens have a mortality as high as 15-20%
- Bedside tests

- o Immediate glycemia in all patients with suspected ingestion, withdrawal, or in coma

Differential diagnosis: The differential diagnosis for tremor, seizures, hallucinations, or confusion is very broad. Even if a patient has a reported history of chronic alcohol abuse, must consider all possible diagnoses, especially if timeline of stopping alcohol doesn't fit with clinical picture.

- Infections (meningitis, encephalitis, sepsis)
- Metabolic (hypoglycemia, hypoxia, hypothyroidism, hypocalcemia, hepatic failure, uremia)
- Structural (head trauma, CNS hemorrhage, space occupying lesion, CVA)
- Other intoxications (organophosphate poisoning, anticholinergics, Amitriptyline, lithium, Phenytoin, Isoniazid)

Investigations

- Labs: Bedside glycemia upon arrival, electrolytes, renal function, liver function tests, FBC, malaria test
- Imaging: Consider chest XR if possibility of aspiration (low saturation, high respiratory rate, crackles on lung exam). Consider brain CT without contrast if possible other cause of coma/confusion. Chronic alcohol drinkers are at high risk for trauma.

Management

- Alcohol withdrawal
 - o Check glycemia immediately and treat with IV dextrose if less than 60mg/dL
 - o Thiamine (vitamin B1) 100mg IV once
 - o NS 2L bolus initially (even if patient has high blood pressure)
 - o Place foley catheter to monitor urine output
 - o Treat seizures with benzodiazepines
 - Diazepam 5-10 mg IV every 5-10 minutes until agitation controlled. May increase to 20mg every 15 minutes for refractory seizures
 - Do not exceed 1000mg over 24hr period
 - Monitor for respiratory depression
 - Phenobarbital 100-200 mg IV as needed to control agitation
 - Monitor for respiratory depression and low blood pressure. Typically will require intubation for airway protection
 - o Consider intubation if GCS<8, patient at risk for aspiration, or if patient requires a large amount of sedative to control seizure
 - o Transfer to referral hospital for abnormal vital signs despite adequate fluid resuscitation, continued seizures despite benzodiazepines, low GCS and need for brain CT

Recommendations

- Alcohol intoxication is NOT the same as alcohol withdrawal. Use patient's physical exam and clinical signs and history to decide what diagnosis you are treating.
- Alcohol withdrawal has a high fatality rate if not treated aggressively and appropriately.
- Keep a broad differential diagnosis in patients presenting confused or in coma, even if they have a history of alcohol. Transfer for brain CT and higher level of care if history is unclear or patient is not recovering with IV fluids and benzodiazepines.

Chapter 15

OBSTETRICS AND GYNECOLOGY

Vaginal bleeding

Definition: When a female presents with vaginal bleeding, the very first step is determine if she is pregnant or not pregnant. Work up and treatment varies greatly depending on this test result. **All women of childbearing age MUST have a pregnancy test in the ER upon admission.**

- Abnormal uterine bleeding (AUB) is any bleeding that occurs before menarche, after menopause, or any bleeding outside the normal menses time.
- Bleeding in early pregnancy is common and can indicate anything from a normal pregnancy to a life threatening ectopic pregnancy. Many women who present with vaginal bleeding do not know they're pregnant.

Signs and symptoms

- If pregnant, patients are at high risk of hypovolemic shock, severe anemia, or sepsis. Assess ABCs, start two large IV lines, NS, and monitor closely.
- If not pregnant, vaginal bleeding is rarely a life-threatening disease unless severely anemic. Ask about sexual assault, recent trauma, and history of irregular bleeding from other parts of the body.
- Ask about last menstrual period, current pregnancy progression, prenatal care, associated symptoms like abdominal pain, fever, syncope
- Exam includes detailed abdominal exam (check for surgical abdomen) and pelvic exam
 - Must note on pelvic exam if internal os is open or closed, whether there are clots in the vaginal vault (POC: products of conception), adnexal mass, uterine or adnexal tenderness, laceration or tears

Causes and differential diagnosis

- Non-pregnant vaginal bleeding
 - Pre-menarche
 - Trauma, sexual abuse, foreign body, infection
 - Pre-menopausal
 - Pregnancy, infection, cervical cancer, liver disease, polycystic ovarian syndrome, clotting disorder, hormonal imbalance
 - Post-menopausal
 - Cervical cancer, endometrial cancer, uterine infection, fibroids, atrophy of vaginal/uterine tissue, systemic disease
- Pregnant with vaginal bleeding
 - Ectopic pregnancy
 - Recent induced abortion or complications
 - Spontaneous abortion: inevitable (bleeding with open internal os), incomplete (open os, POC visualized), or complete (closed os, fetus and placental material fully expelled)
 - Septic abortion- fever and abdominal pain

- o Threatening abortion: bleeding and closed internal os; US shows IUP; risk of completed abortion 35-50%
- o Blighted ovum: gestational sac present but absence of the embryo

Investigations

- All women of child bearing age with vaginal bleeding OR abdominal pain MUST have a pregnancy test on arrival.
- Labs: Urine pregnancy test, FBC, type and cross, Rh factor, beta-HCG (when available)
- Imaging
 - o Bedside US for free fluid and possible hemorrhage
 - o Pelvic US with positive pregnancy test (transvaginal preferred, but transabdominal acceptable)
 - IUP: intrauterine double gestational sac (suggestive but not confirmatory); gestational sac plus fetal pole, yolk sack or cardiac activity
 - Ectopic pregnancy: pregnancy outside the uterus, ectopic fetal pole or heart activity. Can have a pseudo gestational sac
 - Suggestive of ectopic: moderate free fluid or adnexal mass without IUP
 - Indeterminate: empty uterus, nonspecific fluid, single gestational sac/pseudosac
 - o Pelvic US with negative pregnancy test
 - Fibroids

Management: General goal is adequate resuscitation if unstable (IV fluids and blood products), urgent surgical intervention if needed, anti-D immunoglobulin if Rh-negative and pregnant (50ug in first trimester, 300ug after first trimester), analgesia

Differential and management for pregnant patients with vaginal bleeding:

- Ectopic
 - o Consult OB immediately
 - o Fluid resuscitate with two large-bore (18g or larger) IV and NS
 - o Laparotomy for unstable vital signs, peritoneal signs, evidence of rupture
 - o Medical management with Methotrexate may be considered ONLY with OB consultation and the following US signs:
 - Definite ectopic by US, tubal mass <3.5cm, no fetal cardiac activity, no evidence of rupture, minimal pain, hCG<5,000
 - o See OB/GYN Ministry of Health guidelines for further details on medical management of ectopic
- Missed abortion or blighted ovum
 - o Consult OB/GYN Ministry of Health guidelines for Misoprostol instructions and dosing

- o Discuss any unstable patients with OB and transfer for further management
- Inevitable or incomplete abortion
 - o If stable, discuss options with patient
 - Expectant management (same as threatened abortion) OR
 - Medical management
 - Misoprostol 400mcg-800mcg (2-4 tablets) every 6hr per os
 - Tell patient to expect diarrhea, pain due to uterine contraction, and increase in temperature due to high doses (will usually settle without treatment)
 - o If unstable, correct shock with IV fluids and blood transfusion and transfer for surgical management
- Spontaneous abortion
 - o Transfuse as needed if Hb<7 and heavy bleeding continues
 - o Gently remove any fetal tissue visualized in the cervical os o
 - If febrile, start antibiotics
 - Ceftriaxone 1gm IV or Cefotaxime 1gm IV AND Metronidazole 500mgIV
 - OR
 - Ampicillin 2gm IV AND Gentamicin 2mg/kg IV AND Metronidazole 500mg IV
 - o Transfer for OB consult if prolonged bleeding, fever, or unstable vitals
- Threatened abortion
 - o Close follow up with OB or district hospital; review weekly until symptoms resolve

Management for non-pregnant patients with vaginal bleeding

- If actively bleeding with tachycardia and low blood pressure, stabilize with two large IVs, type and cross, and refer for GYN consultation immediately
- If stable, start oral contraceptive pill, iron replacement, and follow up GYN OPD

Recommendations

- All women of child bearing age require a pregnancy test on arrival
- Transfer any patient with unstable vital signs that have not improved with 2L IV fluids.
- Transfer any patient with ruptured ectopic, falling hematocrit, severe pain, or fever.

Management of the Sexual Assault Patient

Definition: Sexual violence is the verbal, physical, or emotional abuse of a person. It includes rape, attempted rape, sexual harassment, and touching. It can happen to men and women, but women are more often the victims. The abuser can be a stranger, a family member, or a spouse. Rwanda's Ministry of Health has recognized this problem and sought to address it through a Gender Monitoring Office and implementation of a national strategic plan to reduce the number of gender-based violence cases.

Signs and symptoms

- Record what happened in patient's own words. Your job is NOT to judge the patient. Nor are you supposed to decide if the patient is being truthful. In your notes, put the date and time of the assault, number of assailants, type of assault. Ask about physical injuries, date of last menstrual cycle, and if patient is on contraception.
- Perform exam in a considerate manner. Be careful not to force or pressure the patient.
 - Perform head to toe exam to identify and describe any injuries (location, size, type, shape)
 - Genital exam to describe any lesions or injuries, including location of injuries. Evaluate other sites like lips and breasts for possible injury
- Collect any evidence per local laws. Be sure to wear gloves during entire exam.

Investigations

- Labs: HIV, urine pregnancy test, hepatitis B, STI testing if available
- Imaging: none

Management

- The general goal is to identify injuries, record patient history, and to make sure patient has a safe place to go (either assailant was arrested by police or patient has family or friends).
- If patient has not already contacted the police, offer to contact for him/her. If the patient does not want to contact the police that is their choice.
- If there is a One Stop Center in your district, refer immediately for disease prophylaxis and psychological treatment. If you are not near to a One Stop Center, offer the following drugs as prophylaxis against STIs.
- Prophylaxis
 - Consider giving a 28 day course of HIV prophylaxis if assault occurred less than 72hr prior to arrival.
 - The sooner prophylaxis is started, the better
 - Consider Hepatitis B vaccination if not already vaccinated (500UI immunoglobulin + vaccine).

- o Consider tetanus vaccine or booster if open wound present.
- **Prophylaxis drugs for children**
 - o Penicillin benzathine 500 IU IM x 1 (syphilis)
 - o Cefixime 8mg/kg PO x 1 (gonorrhea)
 - o Erythromycin 12.5mg/kg PO 4x/day for 7 days (chlamydia)
 - o Metronidazole 5mg/kg PO 3x/day for 7 days (trichomonas and BV)
- **Prophylaxis drugs for pregnant women**
 - o Penicillin benzathine 2.4 million IU IM x 1 (syphilis)
 - o Ceftriaxone 250mg IM x 1 (gonorrhea)
 - o Erythromycin 500mg PO 4x/day for 7 days (chlamydia)
 - o Metronidazole 2g PO once ONLY after first trimester (trichomonas and BV)
- **Prophylaxis drugs for adults**
 - o Penicillin benzathine 2.4 million IU IM x 1 (syphilis)
 - o Ceftriaxone 250mg IM x 1 OR ciprofloxacin 500mg PO x 1 (gonorrhea)
 - o Doxycycline 100mg PO 2x/day for 7 days (chlamydia)
 - o Metronidazole 2g PO once (trichomonas and BV)

Recommendations

- As a physician, your role is to identify sexual assault in your patients.
- Validate the patient's experience and let them know it's not their fault
- Document the patient's experience in their own words.
- Assess risk and help plan for the patient's safety upon leaving the hospital.
- Refer all patients to a local One Stop Center, when possible.

Chapter 16

MUSCULOSKELETAL

Low Back Pain- When Is It an Emergency?

Definition: Pain/discomfort in the lumbar and sacral region; a common condition affecting up to 90% of adults. Most episodes resolve without intervention within six weeks.

Causes

- Musculoskeletal
- Infections
- Cancer/tumor
- Hematoma
- Vascular
- Trauma

Signs and symptoms

- There are many symptoms that should alert the physician to a possibly serious cause of back pain
 - o Pain lasting greater than six weeks despite analgesic treatment
 - o Age less than 18 or over 50
 - o History of trauma
 - o Neurological complaints with back pain (paresthesia, anesthesia, weakness, gait disturbance)
 - o Unable to control bowel or bladder
 - o Pain in the night
 - o Fever, chills, night sweats, weight loss
 - o History of any type of cancer (breast, lung, kidney, prostate, myeloma, lymphoma, and sarcoma are at highest risk to metastasize to the spine)
- On physical exam, the physician must palpate each vertebrae individually to see where the pain is located. Concerning signs include
 - o Fever
 - o Patient can't lay still because pain is severe
 - o Point tenderness on a vertebrae
 - o Decreased motricity or sensibility in any extremity
 - o Decreased range of motion
- In patients over 50 years old, palpate the abdomen for an abdominal mass or pulsatile aorta consistent with aortic aneurysm
- Perform rectal exam in any patient with neurological complaints. Loss of rectal tone is a serious red flag that should alert you to do imaging
- Urinary retention is the most consistent finding in cauda equina. Ask the patient to urinate everything out of their bladder. Then use an ultrasound to see if urine is left over in the bladder. If you don't have an ultrasound, you can place a foley catheter AFTER the patient has told you that they completely emptied their bladder. If there is a large amount of urine left in

the bladder, despite patient's attempt to empty bladder fully, it should raise concern for urinary retention and cauda equina.

Differential diagnosis

- Musculoskeletal
- Disc herniation
- Spinal Infections
 - Vertebral osteomyelitis
 - Spinal epidural abscess
 - TB in the spine (Pott's disease)
- Severe compression syndromes
 - Spinal stenosis
 - Cauda equina compression
 - Hematoma

Investigations

- Labs: If possible infection or tumor, FBC, urinalysis and creatinine
- Imaging: Consider XR of spine if pain is severe, recent trauma, age less than 18 or above 50, or there are any concerning signs and symptoms as listed above.
 - Definitive transfer for CT/MRI for neurological symptoms, systemic fever, night sweats, weight loss (TB or other infection), or abnormal XR findings

Management

- Musculoskeletal Pain
 - If the patient has no serious signs of illness as described above and a normal exam, it is reasonable to send them home with ibuprofen (preferable) or Paracetamol (if patient elderly or has history of PUD) asking them to avoid strenuous lifting, but resume normal activities (don't lay down all day). Refer to physio if available.
 - Ask patient to return in 4 weeks if pain is persistent or sooner if it gets worse or they develop any weakness, numbness, or new symptoms
 - Brufen 600mg PO 3x/day for 5 days (lower dose in patients with renal disease or diabetes)
- Spinal infections
 - Stabilize patient by starting IV line, IV fluids, necessary antibiotics, fever control, insertion of Foley catheter
 - Cefotaxime 2gm 3x/day IV OR Ceftriaxone 2g 2x/day IV
 - AND
 - Cloxacillin 500mg PO 4x/day
 - AND
 - Metronidazole 500mg IV 3x/day
 - Refer immediately for further imaging, specialist consultation
- Cancer or tumors in the spine
 - Most are treated with steroids.

- If patient has equivocal signs of compression and you are unsure if a tumor or cancer is compressing on the spine, then give low dose of Dexamethasone
 - Dexamethasone 10mg IV once and transfer
- If patient has definitive signs of compression with neurological findings (partial or complete paraplegia, anesthesia to the GU/rectal area, incontinence or poor rectal tone), then give a high dose of steroids
 - Dexamethasone 10mg IV once and transfer
- Transfer immediately for further imaging and specialist consultation

Recommendations

- Patients presenting with low back pain require a full neurological exam including motricity in each of the four limbs, sensibility in each of the limbs, reflexes, gait testing, and assessing rectal tone
- Be aware of the "red flags" listed above that clue the physician into the possibility of a more serious cause of pain

Chapter 17

VASCULAR

Unilateral Leg Swelling- DVT, Arterial Clot

Definition: Obstruction of venous blood flow by a clot.

Risk factors

- Bed rest >48-72h
- Age > 50 years old
- Immobilization of the hip and knee (recent fracture and plaster application)
- Major surgery in the previous 4 weeks
- Malignancy (diagnosed or suspected)
- Pregnancy (highest risk after C section delivery)
- Oral Contraceptives
- Nephrotic syndrome

Signs and symptoms

- History
 - Patient typically presents with unilateral leg swelling (bilateral DVTs are very, very rare). Ask about risk factors listed above.
- Exam
 - Extremity pain, swelling or cramping, sometimes redness
 - A difference of 2 cm or more between right and left leg circumference
 - Feel for a distal pulse at the foot and make sure extremity is warm with good capillary refill
 - Arterial clots present similarly to venous clots, but with arterial clots, leg will be cold with poor capillary refill and absent pulse.
 - Diagnosis of arterial clot is surgical emergency and needs immediate transfer
- Bedside tests
 - Venous ultrasound.

Differential diagnosis

- Cellulitis
- Ruptured Baker cyst
- Acute occlusion of an artery
- Lymph obstruction

Investigations

- Labs
 - If going to Warfarin or Lovenox, need renal function (Cr, urea) to ensure no kidney failure. Coagulation factors (PT, PTT) are helpful, when available.
 - If young female with new DVT, do urine pregnancy test as pregnant patients are at high risk for clots.
- Imaging

- o Venous ultrasound with Doppler flow

Management

- Deep venous thrombosis
 - o Elevate affected limb to level of the heart to reduce swelling
 - o Remove constrictive clothing, cast or dressing
 - o Treat with anticoagulant. There are two choices. Currently, Enoxaparin seems to be the best choice in Rwanda. Anticoagulation must be taken daily for at least three months. In patients with recurrent clots or pulmonary embolism (see PE chapter) anticoagulation will be at least six months.
 - Enoxaparin (Lovenox): 1.5mg/kg Subcutaneous (SC) once a day
 - Benefit: once a day dosing, no need to monitor drug levels in body, low side effect profile
 - Difficulties: Requires daily injection, expensive for some families
 - Warfarin (Coumadin): Start at 5mg PO at night. Monitor INR levels regularly and increase or decrease dose to maintain INR of 2-3.
 - Benefit: PO medication (no injection necessary)
 - Difficulties: Requires regular INR blood level checks, currently available at limited hospitals/facilities, extremely dangerous drug if levels get too high (causes intracranial hemorrhage or life-threatening GI bleeding), interacts with several medications and foods
- Acute arterial occlusion (Limb is cold, with extreme pain, pulseless)
 - o Start anticoagulation immediately (Enoxaparin preferred). Transfer immediately to referral center.
 - o If the period of ischemia is more than 6 hours, irreversible damage might occur and amputation likely
- Acute cellulitis (warm, tender, and red limb with negative Doppler ultrasound)
 - o Elevate limb to reduce swelling
 - o Give analgesia (Paracetamol, ibuprofen, Tramadol, depending on level of pain)
 - o Start antibiotics. See chapter on soft tissue infections (cellulitis) for details.

Recommendations

- Remember to feel the swollen extremity for warmth, good capillary refill, and good distal pulses. An arterial clot presents very similarly to venous clot, but will result in amputation of limb if not recognized and treated aggressively.

Do not use Warfarin as an anticoagulant if there is no possibility to frequent INR testing.

Refer patients with suspected arterial clot or patients with suspected DVT and pulmonary embolism (associated chest pain, shortness of breath, hypotension, hypoxemia). Patients with an isolated DVT can be treated at the district level and sent to OPD Internal Medicine for review on a non-urgent basis.

APPENDIX

Procedural Sedation and Analgesia (PSA)

Definition: Technique of administering sedative or dissociative agents with or without analgesics to induce a state where the patient can tolerate painful or unpleasant procedures while maintaining cardio respiratory function. General anesthesia is to be avoided.

Indications

- A painful procedure that requires emergent management and can be done safely without general anesthesia
- Completion of the procedure will often result in a more comfortable and stable patient
- Common examples of procedures include cardioversion, dislocated joint reduction, fracture reduction and splinting, abscess drainage, and chest drain insertion.

Contraindications

- Procedure requires general anesthesia
- Patient has significant co-morbid illness where the risk of procedural sedation in the emergency room outweighs the benefits of the procedure (severe lung disease, hypoxic on room air, problems with sedation medication in the past, etc.)
- There is insufficient monitoring equipment
- Two skilled providers are not available

Pre-procedure

- AMPLE history including co-morbidities, allergies, anesthetic history and last solid and liquid intake
- Assess airway and cardio respiratory status for possible difficulty
- Obtain consent for procedure
 - Discuss risk of hypoxia, aspiration, respiratory arrest, allergic reaction
 - Ketamine can result in a temporary frightening emergence reaction
 - Alternatives include regional block, analgesia, or general anesthesia
- Assemble equipment, personnel and establish patient on monitor, pulse oximetry and ideally, capnography
- Consider medication selection based on projected length of procedure, ideal sedation levels and need for analgesic
- Painful procedures require the addition of analgesia (e.g. IV Fentanyl or morphine) in addition to sedation
- Ketamine is often an excellent choice:
 - Has analgesic and dissociative properties
 - Maintains airway reflexes

Choose the Right Medication for the Procedure

- The provider **MUST** understand the properties of each medication in order to choose the best option and to understand what to do if something goes wrong during the procedure

| Medication | Dose | Onset | Duration | Adverse Reaction | Reversal Agent |
|-------------------|--|------------------------------------|--|---|--|
| Propofol | 0.5mg/kg IV to start, then bolus 0.1-0.25mg/kg IV as needed for sedation | 60 seconds | 5-10 minutes | Severe hypotension, cannot give to patient with egg allergy, unused medication MUST be discarded after first use; causes burning at site of injection (warn patient) | NONE! Be prepared with IV fluid bolus for hypotension |
| Ketamine | 1-1.5mg/kg IV OR 4mg/kg IM (IV preferred) | IV: 60 seconds IM: 5-15 minutes | IV: 10-15 minutes IM: 20-30 minutes | Emergence reaction (pt wakes up violent, screaming, and agitated), laryngospasm (rare, but life threatening) | NONE! 5mg IV Diazepam can help with emergence reaction; MUST have bag valve mask available to bag patient in case of laryngospasm |

The Procedure

- Set patient up on monitor, pulse oximetry, and capnography (if available)
- Have two ED providers fully present
- Ensure IV is running well
- Ensure oxygen and suction sources are operational
- Explain procedure to patient
- Administer medications
 - Propofol 0.5mg/kg IV initially and bolus of 0.1-0.25mg/kg IV OR
 - Ketamine initial dose of 1 mg/kg IV then 0.25mg/IV as needed
 - AND
 - Fentanyl 50-150mcg IV if analgesic needed

- Check the depth of anesthesia every 1-3mins (shake patient to see if they are sleeping)
- Perform procedure when anesthesia is appropriate
- Continue to monitor patient for adverse events once procedure complete

The post procedure period is when patients are at most risk for an adverse event

Post Procedure Care

- Sit patient up
- Continue to monitor until vital signs are normal, patient is alert, and can walk unassisted

Disposition

- Discharge when alert, can walk, and can tolerating oral intake and is in the care of a responsible adult
- Instruct not to drive or operate dangerous machinery for 12 hours

Required Equipment

- Oxygen source
- Cardiac monitoring
- Pulse oximetry
- Capon graphs (if available)
- IV line(s)
- Any material required for the actual procedure; casting supplies, suture, blades, drains, slings....
- Reversal agents depending on which medication you use
- Advanced airway management supplies (ambu-bag, other airway devices, if available)
- At least 2 ED care providers
- Medications for sedation

Recommendations

- There is no reason to perform painful procedures on patients without appropriate medication, and sometimes PSA in necessary. Procedural sedation, when done well, is very safe for patients. However, if performed by unskilled providers, it can be life threatening.
 - Providers must be knowledgeable about all medication options AND side effects BEFORE starting a procedure.
- Anticipate bad reactions BEFORE they happen and have the necessary equipment and medications ready to treat the patient.
- Perform a consent on all patients BEFORE starting the procedure.

Fluid Management

- Parkland formula: **4mL x (Patient's weight in kg) x (%BSA)**

Example: 75 kg patient with 20% partial thickness burn:
 $4\text{mL} \times 75 \times 20 = 6000 \text{ ml}$

- o Half of this should be administered in the first 8 hours from the time of burn; the second half should be administered in the following 16 hours
 - o There is little/no research on how to manage fluids in patients who present more than 24hr after burn. Therefore, use clinical judgment.
 - o If patient has tachycardia, delayed cap refill, or hypotension, start with IV fluid bolus at 2L for adults or 20ml/kg in children and reassess
 - o Place foley catheter to monitor urine output
 - o Target urine output 1ml/kg/hr
 - o Children with >10% BSA burn have high fluid requirements
 - o Estimate with Parkland formula for fluid resuscitation AND, for children, add maintenance fluids (D5) using the 4:2:1 formula.
- Maintenance Fluids in Pediatric Patients: **"4,2,1 Rule"**
 - o Give 4mls/kg/hr for first 10kg of body weight, 2mls/kg/hr for next 10 kg of body weight and 1ml/kg/hr for any additional kgs
 - o Example: Fluids for a 40kg child would be
 - $4\text{mL} \times 10\text{kg} + 2\text{mL} \times 10\text{kg} + 1\text{mL} \times 20\text{kg} = 40+20+20 = 80\text{mLs/hr}$

Assessment of Mental Status

Coma Score (GCS): Best score is 15; worst score is 3

- o Eyes
 - Open spontaneously: 4
 - Open only to verbal command: 3
 - Open to pain: 2
 - No eye opening: 1
- o Motor
 - Obeys commands: 6
 - Localizes pain: 5
 - Withdrawal from pain: 4
 - Flexion to pain: 3
 - Extension to pain: 2
 - No motor response at all: 1
- o Verbal
 - Oriented, speaks well: 5
 - Confused, but talking: 4
 - Talks some, but inappropriate words: 3
 - Incomprehensible sounds/mumbling: 2
 - No verbal response: 1
 - Intubated: 1

AVPU Scale: Favored in pediatric patients- has four possible outcomes. Best is A; worst is U.

| AVPU Scale | |
|------------|--|
| A | Alert |
| V | Responds to voice (equal GCS 13) to approximately |
| P | Responds to pain (equal GCS 8) to approximately |
| U | Unresponsive |

Vasopressors

Dopamine: 5-20 mcg/kg/min

Mix 200mg vial into 500ml of NS (concentration of 400mcg/ml)

| | | | | | | | | | |
|-----------|------|-----|------|-----|------|------|------|------|------|
| mcg/min | 75 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 400 |
| Drops/min | 3.75 | 5 | 6.25 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 |
| mcg/min | 600 | 700 | 800 | 900 | 1000 | 1250 | 1500 | 1750 | 2000 |
| Drops/min | 30 | 35 | 40 | 45 | 50 | 62.5 | 75 | 87.5 | 100 |

Adrenaline: 0.05-0.5 mcg/kg/min

Mix 1mg vial into 500ml of NS (concentration of 2mcg/ml)

| | | | | | | | | | |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| mcg/min | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Drops/min | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| mcg/min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Drops/min | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |

Charts adapted from AFEM Handbook of Emergency Medicine, pg 963

Dobutamine: 1-20 mcg/kg/min

Mix 200mg in 500mL NS (concentration 400mcg/mL)

| | | | | | | | | | |
|-----------|------|-----|------|-----|------|------|------|------|------|
| mcg/min | 75 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 400 |
| Drops/min | 3.75 | 5 | 6.25 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 |
| mcg/min | 600 | 700 | 800 | 900 | 1000 | 1250 | 1500 | 1750 | 2000 |
| Drops/min | 30 | 35 | 40 | 45 | 50 | 62.5 | 75 | 87.5 | 100 |

Charts adapted from AFEM Handbook of Emergency Medicine, pg 963

Pain Medications and Dosing

Mild Pain

■ **Paracetamol**

- Adult or >50 kg: 1g every 6h (max 4g/day)
- Pediatric or <50kg : 15mg/kg EVERY 6h (max 60mg/kg/day)
- Advantages: Reduces fever, Safe at correct dosing, Reduces Inflammation
- Contraindication:: Hepatic impairment

■ **Ibuprofen**

- Adult: 400mg every 6h
- Pediatric >3yrs and < 40kg : 10mg/kg every 8h
- Contraindications: renal failure, allergy to aspirin/NSAIDs

Moderate Pain

■ **Tramadol**

- Adult: 50-100 mg every 4-6h (max 400mg/day)
- Pediatric >4yrs : 1-2mg/kg Q4-6hrs
- Contraindications: seizure disorder (decreases seizure threshold)

Severe Pain

■ **Morphine**

- Adult: 0.1- 0.2mg/kg IM/IV every 2-4hr as needed
- Pediatric: 0.1-0.2 mg/kg IV/IM Q4-6hrs
- Contraindications: hypotension, concern for hypoventilation

■ **Pethidine**

- Adult: 1mg/kg IV every 3-6hr as needed
- Pediatric: 1mg/kg IM/SC q3-4hr as needed
- Contraindications: hypoventilation, concern for hypoventilation, seizure disorder, cardiac arrhythmias

■ **Fentanyl**

- Adult: 1mcg/kg IV every 1-3hr as needed
- Pediatric: 1mcg/kg IV every 1-3hr as needed
- Contraindications: concern for hypoventilation

Logroll Technique

In-line immobilization to be used in trauma patients that are at risk for spinal injuries. Requires at least 4 providers: 3 for movement of the patient and one for examination of the patient's back. Maintain logroll precautions until spine injuries have been ruled-out.



Procedures

Retrograde Urethrogram

Indications: the presence of blood at the urethral meatus after blunt or penetrating trauma in the setting of trauma to rule out urethral injury
Contraindication: patient allergic to radiopaque contrast
Procedure:

- Place just the tip of a Foley catheter into the penis (do not advance completely to the bladder as this could worsen urethral injury)
- Gently inject 20-30mL of contrast into the urethra
- Obtain a pelvic XR
- Normal urethrograms show contrast following the urethra into a normal appearing bladder
- Extravasation of contrast confirms a urethral disruption

Tube Thoracostomy (Chest Tube)

Indications: pneumothorax, hemothorax, pleural effusion

Contraindication: skin infection over the insertion site, coagulopathy

Procedure:

- Consider procedural sedation with Ketamine if deemed safe and appropriate as this is a painful procedure
- Place patient supine with arm abducted above head
- Chest tube insertion site is 4th or 5th intercostal space, along anterior axillary line
- Sterilize and drape area. Wear sterile gloves.
- Using a syringe and needle with local anesthetic such as Lidocaine, anesthetize subcutaneously **over** (just above) the chosen rib, then anesthetize deeper towards the rib; guide the needle above the rib while aspirating until air bubbles are withdrawn into syringe; anesthetize in and around the pleura. Use approximately 7mL of Lidocaine.
- Make a 2-3 cm incision with a sterile scalpel/blade parallel to the chosen rib
- Bluntly dissect through the intercostal muscles with a curved clamp towards the rib, then **above** the rib, until the pleura has been pierced
- Spread the clamp, then replace it with a finger; sweep in a complete circle with your finger inside the inner chest wall to clear out any adhesions
- Load the chest tube (24-36 Fr) onto a curved clamp, and use the clamp to guide it into the intrathoracic space along your finger that is in the puncture site. *Note: it is very important that you do not remove your finger before the tube goes in. If you remove your finger, you will lose the "track" and risk placing tube into a space other than the lung!*
- Guide the chest tube in an apical and posterior direction until all drainage holes are in the intrathoracic space

- Secure the chest tube with a horizontal mattress suture to pull the sides of the incision tight around the chest tube, and tie the loose ends around the chest tube to keep it from sliding.
- Apply an occlusive dressing over the chest tube site
- Ideally, connect the chest tube to suction with a water seal, such as a pleural-evac system (available at pharmacies in Kigali, but expensive). If this is not available, connect chest tube to Heimlich valve and/or create a water seal using a sterile saline bottle.
- Confirm placement with a chest X-ray

Pericardiocentesis

Indications: the presence of life-threatening hemodynamic changes in a patient with suspected cardiac tamponade

Contraindication: in the hemodynamically unstable patient, no absolute contraindications exist to performing pericardiocentesis.

Procedure:

- Consider giving 1L NS bolus to increase right-sided filling pressure, while preparing for pericardiocentesis
- Consider sedation with Ketamine or diazepam
- Prep and drape subxiphoid/ parasternal area in sterile fashion
- Prepare equipment. You may use a spinal needle or, if available, a central line kit, which will allow for the placement of a catheter over a wire and continued drainage of the effusion (leaving a draining catheter in place, is preferable).
- Infiltrate local anesthesia
- Position patient in semi-recumbent position at 45°
- If ultrasound-guided (preferred):
 - Find the largest pocket of fluid (in subxiphoid, parasternal or apical probe position) and use this to guide needle.
 - Try to enter your needle in plane with the ultrasound probe so that you can visualize the needle tip at all times. Aspirate as you advance. Never advance the needle without having a view of the needle tip.
 - If placing a catheter over a wire, inject agitated saline to first confirm needle position.
- If no ultrasound available (blind):
 - Insert the needle to the immediate left of the xiphoid
 - Advance the needle towards the left shoulder at 15-30° angle aspirating as you go. May feel a "pop" when you enter the pericardium.
 - Aspirate fluid. Small amount should improve vital signs.
 - Remove needle and dress puncture wound

Manual Detorsion of the Testes

Indications: strong suspicion of testicular torsion

Contraindication: suspicion for other causes of testicular pain or if the duration of torsion is more than 6 hours

Procedure:

- Patient supine with physician at patient's right side
- Patient is in "frog leg" lithotomy position for best access to GU area
- Inform patient that this is a painful maneuver. Consider light sedation with Diazepam 10mg IV once
- Manual detorsion is a twisting of the testis in a medial to lateral direction (like you are opening a book). The patient's right testis is detorsed in a counterclockwise direction while the left is detorsed in a clockwise direction.
- Rotate affected testis 180 degrees and kept in that position.
- If initial rotation increases the pain, try to rotate in an opposite direction. One to three turns is appropriate.
- Stop detorsion when anatomy appears normal again or pain is relieved.

Foley Catheter Placement

Indications: urinary retention, monitoring of urine output, among many others

Contraindication: suspicion of urethral injury or obstruction

Procedure:

- Preliminary washing of hands; wearing mask recommended
- Place patient supine with legs slightly apart (male) or apart with knees flexed (female)
- Clean genital area with antiseptic solution
- Put on sterile gloves and drape sterile cover over area, keeping genitals exposed
- Check foley catheter balloon by introducing 5mL water into balloon then deflating
- Lubricate sterile catheter with water-soluble lubricant

Women:

- Separate the labia with the thumb and index finger of your non-dominant hand and identify the urethral meatus
- Gently advance lubricated catheter through the meatus until urine appears in the tube (remember the female urethra is short, about 4cm)
- Inflate balloon with 5-10mL saline and pull catheter back gently until you meet resistance
- Connect catheter to collecting bag. Use tape to secure tubing to patient's inner thigh.

Men:

- Hold penis with your non-dominant hand upright, away from scrotum
- Hold catheter firmly with your dominant hand and gently pass well lubricated catheter through external urethral meatus. Advance catheter until urine comes through the tube.
- Inflate balloon with 5-10mL saline and pull catheter back gently until you meet resistance
- Connect catheter to collecting bag. Use tape to secure tubing to patient's inner thigh.

- If catheterization produces gross blood, deflate de balloon, remove the catheter and do not attempt reinsertion because a false passage (through the penile soft tissue instead of the urethra) may have been produced
- Urgent urology consultation

Suprapubic Catheter Placement

Indications: inability to pass foley catheter, suspicion of urethral injury

Contraindication: coagulopathy, prior lower abdominal or pelvic surgery

Procedure:

Equipment

- Sterile gloves, drapes, gauze
- Antiseptic solution
- Local anesthetic
- 10mL syringe
- 18g and 25g spinal needle
- scalpel
- percutaneous suprapubic catheter set or trochanter set
- sterile urine collection bag
- skin tape
- bedside ultrasound, when available, to ensure passage into bladder

Procedure:

- Palpate distended bladder and mark insertion site at the midline, two fingers (4-5cm) above pubic symphysis. If available, use the US to verify bladder location and ensure no loops of bowel are between abdominal wall and bladder
- Apply antiseptic solution and use sterile drapes over area, keeping open insertion site
- Inject local anesthetic (lidocaine) with smallest gauge needle available. After injecting a small wheel of anesthesia to the skin, gently advance the needle, aspirating along the way until urine comes into the syringe. This will ensure the bladder is full with urine and also help you to determine the depth at which you must insert the trochanter.
- Using the scalpel, make a 4mm stab incision at the insertion site. Stab only the skin. Do NOT cut through to the rectus sheath
- Insert percutaneous instrument that is available (most likely trochanter set), using your non-dominant hand on the lower abdomen to stabilize the unit. Insert very slowly and stop as soon as urine flows.
- Pass catheter through hole of trochanter until urine flows through tubing. Withdraw trochanter needle
- Connect to collection bag.
- Undrape patient and apply dressing around the insertion site.

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