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Dear readers,

This handbook is a student-driven initiative developed in order to help you succeed on your emergency medicine rotation. It provides concise approaches to key patient presentations you will encounter in the emergency department. This guide has been peer-reviewed by staff physicians to make sure evidence is up-to-date and accurate. Based out of Ottawa, our hope is that this resource will benefit clerkship students and help bridge the emergency medicine knowledge gap from pre-clerkship to clinical practice.

Sincerely,

Omar Anjum, BSc, MD Candidate (2018)
Author and Editor

**How to use this Guide**

Topics are subdivided according to **background**, **assessment**, **investigations**, and **management**.

| Background | This section provides common definitions, pathophysiology, etiology or risk factors for certain conditions. Differential diagnoses are also discussed (“Symptoms Approach” section). |
| Assessment | Common historical and physical exam features are mentioned here. Diagnostic criteria or techniques/methods used to aid in diagnosis may also be noted. |
| Investigations | Relevant labs, radiological evaluation and adjunctive tests are mentioned for consideration of diagnostic workup. |
| Management | General and disease-specific management approaches are discussed. Disposition and discharge criteria may also be noted. |

Key references: Used for further reading. Some sources are provided because they are deemed useful to a reader seeking additional information.
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Resuscitation
Airway

Decision to Intubate
Failure to maintain or protect airway (ie. low GCS, airway trauma)
Failure to ventilate/oxygenate (ie. low or declining SpO\textsubscript{2}, rising pCO\textsubscript{2})
Anticipatory (ie. trauma, overdose, inhalation injury, AECOPD, CHFe)

Assessment

<table>
<thead>
<tr>
<th>Difficult bag-valve mask ventilation “BOOTS”</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = Beard; O = Obese; O = Older; T = Toothless; S = Snores/Stridor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Difficult intubation “LEMON”</th>
</tr>
</thead>
<tbody>
<tr>
<td>L = Look for gestalt signs</td>
</tr>
<tr>
<td>E = Evaluate the 3-3-2 rule: 3 fingers mouth opening, 3 fingers hyo-mental distance, 2 fingers from thyroid cartilage to floor of mouth</td>
</tr>
<tr>
<td>M = Mallampati score</td>
</tr>
<tr>
<td>O = Obstruction or Obesity</td>
</tr>
<tr>
<td>N = Neck mobility (ie. ankylosing spondylitis, rheumatoid arthritis)</td>
</tr>
</tbody>
</table>

Airway techniques

<table>
<thead>
<tr>
<th>Temporizing Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chin lift/jaw thrust, BVM, suctioning, nasal airway, oral airway, LMA</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Definitive Airway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orotracheal/nasotracheal intubation, surgical airway (percutaneous or open cric)</td>
</tr>
</tbody>
</table>

Airway methods

<table>
<thead>
<tr>
<th>Rapid Sequence Intubation (RSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind nasotracheal intubation</td>
</tr>
<tr>
<td>Awake oral intubation</td>
</tr>
<tr>
<td>Oral intubation without any agents (ie. “crash” airway)</td>
</tr>
</tbody>
</table>

Rapid Sequence Intubation (6Ps)

<table>
<thead>
<tr>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare equipment and medications</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Pre-oxygenation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% O\textsubscript{2} x3 mins OR ask pt to take deep breaths on 100% O\textsubscript{2}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-treatment (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive airways: +/- lidocaine 1.5mg/kg</td>
</tr>
<tr>
<td>Cardiovascular disease: fentanyl 3mcg/kg</td>
</tr>
<tr>
<td>Increased ICP: fentanyl 3mcg/kg</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Paralysis with induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration of sedative (ie. ketamine, propofol, etomidate) followed by muscle relaxant if indicated (ie. succinylcholine or rocuronium)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Place tube with proof</th>
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</thead>
<tbody>
<tr>
<td>Intubate patient and confirm tube placement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-intubation management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CXR, ongoing analgesia and sedation, ongoing resuscitation</td>
</tr>
</tbody>
</table>

# Breathing

## Definitions

**Acute respiratory failure** = \( pO_2 < 50\text{mmHg} +/- pCO_2 > 45\text{mmHg} \)

**Type 1** = respiratory failure without hypercapnia

- Diffusion problem: pneumonia, ARDS
- V/Q mismatch: PE
- Shunt
- Low ambient FiO\(_2\): high altitude
- Alveolar hypoventilation

**Type 2a** = respiratory failure with hypercapnia, normal lungs

- Disorder of respiratory control: overdose, brainstem lesion, CNS disease
- Neuromuscular disorders: muscular dystrophy, GBS, Myasthenia Gravis, ALS
- Anatomic: trauma, ankylosing spondylitis, kyphosis/severe scoliosis

**Type 2b** = respiratory failure with hypercapnia, abnormal lungs

- Increased airway resistance: AECOPD, asthma exacerbation
- Decreased gas exchange: scarring, IPF

## Assessment

<table>
<thead>
<tr>
<th>Look</th>
<th>Listen</th>
<th>Feel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental status, color, chest wall movement, accessory muscle use</td>
<td>Auscultate for breath sounds Signs of obstruction Air entering or escaping</td>
<td>Tracheal deviation, crepitus, flail segments, chest wounds</td>
</tr>
</tbody>
</table>

## Investigations

**Labs**: CBC, electrolytes, cardiac enzymes +/- D-dimer, VBG  
**Tests**: Chest X-ray +/- Chest CT

## Management of breathing

**Spontaneously breathing patient**

- Nasal prongs  
- Face mask, Non-rebreather face mask

**Temporizing measures for inadequate ventilation**

- Bag-valve mask +/- nasal airway  
- High flow nasal oxygenation (ie. Mastech)  
- CPAP/BiPAP: acute exacerbations of CHF, COPD, asthma

**Definitive measures for inability to maintain/protection airway**

- Oro-tracheal intubation  
- Surgical airway

**Additional modalities**

- Needle thoracostomy for tension pneumothorax  
- Tube thoracostomy to drain pleural effusions or hemothoraces, and to treat pneumothoraces

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**Causes of shock**

<table>
<thead>
<tr>
<th>Hypovolemic shock</th>
<th>Hemorrhage</th>
<th>GI losses</th>
<th>Third spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstructive shock (intra-thoracic)</td>
<td>Pulmonary embolism</td>
<td>Cardiac tamponade</td>
<td>Tension pneumothorax</td>
</tr>
<tr>
<td>Distributive shock (vasodilation)</td>
<td>Septic shock</td>
<td>Anaphylactic shock</td>
<td>Neurogenic shock</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>ACS</td>
<td>Cardiomyopathy</td>
<td></td>
</tr>
</tbody>
</table>

**Assessment**

<table>
<thead>
<tr>
<th>Rosen’s empirical criteria for circulatory shock (&gt;4/6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ill appearance or AMS</td>
</tr>
<tr>
<td>RR &gt; 20 or paCO₂ &lt;32</td>
</tr>
<tr>
<td>Urine Output &lt; 0.5mL/kg/hr</td>
</tr>
</tbody>
</table>

**Investigations**

**Labs:** CBC, electrolytes, BUN, Cr, LFTs, TnI, VBG, lactate  
**Tests:** CXR, ECG, POCUS - RUSH exam (cardiac, IVC, lungs, aorta)

**Management**

**Hemorrhagic hypovolemic shock**
- Control hemorrhage (tourniquets, direct compression, pelvic binders)  
- Aggressive fluids (IV warm crystalloids), blood product transfusion (1:1:1 pRBCs:platelets:FFP)

**Obstructive shock**
- Tension pneumothorax: needle decompression then chest tube  
- Cardiac tamponade: IV crystalloids, pericardiocentesis  
- PE: IV crystalloid, inotropes, thrombolysis

**Anaphylactic shock**
- Epinephrine IM, IV crystalloids, antihistamines, corticosteroids

**Septic shock**
- Broad-spectrum antibiotics, IV crystalloids +/- norepinephrine  
- **Goals:** Urine Output >0.5mL/kg/h, CVP 8-12mmHg, MAP >65mmHg, ScvO₂ >70%, lactate clearance

**Cardiogenic shock**
- Maintain MAP > 65 with fluid boluses to optimize preload  
- Norepinephrine 5mcg/min, dobutamine 2.5 mcg/kg/min,  
- Treat underlying cause: cath lab, ECMO support, heart transplant

**Cellular Toxins**
- Antidotes for various toxins (see toxicology)

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Trauma Resuscitation

**Primary Survey**

<table>
<thead>
<tr>
<th>1 Airway</th>
<th>3 Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess patency of airway, look for obstruction (blood, emesis, teeth, foreign body), ensure C-spine precautions, RSI</td>
<td>Assess LOC, signs of shock (HR, BP, skin color, urine output, base deficits) Estimate degree of hemorrhagic shock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 Breathing</th>
<th>4 Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expose chest, assess breathing, auscultate for breath sounds Rule out tension pneumothorax</td>
<td>GCS assessment Neurological evaluation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5 Exposure/Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully expose patient, logroll patient to inspect for injuries, spine tenderness and rectal exam for high-riding prostate and tone. Keep patient warm and dry to prevent hypothermia</td>
</tr>
</tbody>
</table>

**Secondary Survey**

Full physical exam: head and neck, chest, abdomen, MSK, neuro
SAMPLE history, collateral history
FAST exam: subxiphoid pericardial window, perisplenic, hepatorenal (Morison’s pouch), pelvic/retrovesical

**Investigations**

Bloodwork: CBC, lytes, BUN, Cr, glucose, lactate, INR/PTT, fibrinogen, B-hCG, tox bloodwork (EtOH, ASA, APAP), T+C, U/A
Labs: Full portable X-rays (spine, chest, pelvis) CT - for stable patients; unstable patients may require urgent OR

**Management**

**Resuscitation parts**

Blood component ratios: 1 pRBCs: 1 FFP: 1 platelets Tranexamic acid: 1g IV over 10 minutes then 1g IV over 8 hours

**Head trauma**

Seizure management, treat suspected raised ICP, neurosurgical intervention for severe head injury/bleeds

**Spinal cord trauma**

Immobilize, treat neurogenic shock, consult spine service

**Chest trauma**

Airway management, thoracotomy for blunt vs. penetrating trauma as per EAST guidelines, surgical intervention for life-threatening pulmonary, diaphragmatic, esophageal, aortic, myocardial injuries

**Abdominal trauma**

Laparotomy for hemodynamically unstable and hollow organ injuries

**Orthopedic injuries**

Reduce and immobilize when possible, adequate analgesia, consult ortho

**The Deadly Triad**

Coagulopathy Hypothermia Acidosis

Symptoms Approach
Syncope

**Definition:** sudden and transient loss of consciousness with loss of postural tone accompanied by a rapid return to baseline

**Pathophysiology:** dysfunction of both cerebral hemispheres or the brainstem (reticular activating system), usually from hypo-perfusion

### Differential Diagnosis

#### Cardiac
- Rhythm disturbances: dysrhythmias, pacemaker issues
- Structural: outflow obstruction (aortic stenosis, HOCM), MI
- Other CV diseases: dissection, cardiomyopathy, PE

#### Non-Cardiac
- **Reflex (neurally mediated)**
  - Vasovagal: sensory or emotional reactions
  - Orthostatic: postural related, volume depletion
  - Situational: coughing, straining
  - Carotid sinus pressure: shaving
  - Subclavian steal: arm exercises

- **Medications**
  - CCBs, B-blockers, digoxin, insulin
  - QT prolonging meds
  - Drugs of abuse

- **Focal CNS hypoperfusion**
  - Hypoxia, epilepsy, dysfunctional brainstem

### Assessment

**History:** syncope character (ask about exertion!), cardiac risk factors, comorbidities, medication/drug use, family history, orthostatic symptoms

Rule out seizure/stroke/head injury

**Physical:** cardiac exam (murmurs, rate), CNS exam

### Investigations

**Labs:** CBC, glucose, lytes, extended lytes, BUN/Cr, CK/Tnl, B-hCG

<table>
<thead>
<tr>
<th>ECG intervals</th>
<th>ECG rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short PR: WPW</td>
<td>Tachydyshrhythmias: SVT, Afib, Vtach, Vfib</td>
</tr>
<tr>
<td>Long PR: conduction blocks</td>
<td>Bradyarrhythmias: AV conduction blocks, sinus node dysfunction</td>
</tr>
<tr>
<td>Deep QRS: HOCM</td>
<td></td>
</tr>
<tr>
<td>Wide QRS: BBB, Vtach, WPW</td>
<td></td>
</tr>
<tr>
<td>QT intervals: Congenital QT syndrome</td>
<td></td>
</tr>
</tbody>
</table>

### Management

**General**
- ABCs, monitors, oxygen, IV access

**Cardiogenic syncope**
- Consult cardiology for workup, pacemaker consideration

**Non-cardiogenic syncope**
- Benign causes or low-risk syncope: discharge with GP follow-up
- Consider outpatient cardiac workup

**Risk stratification prediction rules**
- Canadian Syncope Risk Score

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Altered Mental Status

**Definition:** decrease in LOC caused by either diffuse CNS dysfunction (toxic/metabolic causes) or primary CNS disease

### Differential Diagnosis

#### Drugs
- Abuse: Opiates, benzodiazepines, alcohol, illicit drugs
- Accidental: Carbon monoxide, cyanide
- Prescribed: Beta-blockers, TCAs, ASA, acetaminophen, digoxin
- Withdrawal: Benzodiazepines, EtOH, SSRIs

#### Infection
- CNS: meningitis, encephalitis, cerebral abscess
- Systemic: sepsis, UTI, pneumonia, skin/soft tissue, bone/joint, intraabdominal, iatrogenic (indwelling lines or catheter), bacteremia

#### Metabolic
- Kidneys: electrolyte imbalance, renal failure, uremia
- Liver: hepatic encephalopathy
- Thyroid: hyper or hypothyroid
- Pancreas: hypoglycemia, DKA, HHS

#### Structural
- Bleeds: ICH, epidural hematoma, subdural hematoma, SAH
- Brain: Stroke, seizures, surgical lesions, hydrocephalus
- Cardiac: ACS, dissection, arrhythmias, shock

### Assessment

**History:** Collateral from family/friends/EMS, onset and progression, preceding events, past medical history, medications, history of trauma, comparison to baseline

**Physical:** ABCs, primary survey, vital signs including temp and glucose, rapid neurological exam (GCS and focal neurological deficits)

### Investigations

**Labs:** CBC, lytes, glucose, BUN, Cr, LFTs, INR/PTT, serum osmolality, VBG, troponin, urinalysis, drug levels.

**Tests:** ECG, CXR, CT head

### Management

**General**
- Monitors, oxygen, vitals, IV access

**Treatment**
- Treat underlying cause, universal antidotes (dextrose, oxygen, naloxone, thiamine), broad-spectrum Abx, warm/cool, BP control

**Disposition**
- Consider admission for working up underlying cause

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Headache

Common Types

Migraine: POUND (pulsatile, onset 4-72hrs, unilateral, N/V, disabling intensity), photophobia/phonophobia, chronic, recurrent, +/- aura
Cluster: unilateral sudden sharp retro-orbital pain, <3hours usually at night, pseudo-Horner’s symptoms, precipitated by alcohol/smoking
Tension: tight band-like pain, tense neck/scalp muscles, precipitated by stress or lack of sleep

Differential Diagnosis

<table>
<thead>
<tr>
<th>Intra-cranial</th>
<th>Extra-cranial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bleed:</strong> epidural, subdural, subarachnoid, intracerebral hemorrhage</td>
<td>Acute angle closure glaucoma</td>
</tr>
<tr>
<td><strong>Infection:</strong> meningitis, encephalitis, brain abscess</td>
<td>Temporal arteritis</td>
</tr>
<tr>
<td><strong>Increased ICP:</strong> mass, cerebral venous sinus thrombosis</td>
<td>Carotid artery dissection</td>
</tr>
</tbody>
</table>

Assessment

History: Red flags (sudden onset, thunderclap, exertional onset, meningismus, fever, neurological deficit, AMS), symptoms of increased ICP (persistent vomiting, headache worse lying down and in AM)
Physical: vitals, detailed neuro exam (cranial nerves, gait, coordination, motor/sensory, reflexes), neck for meningeal irritation, eye exam (slit lamp, IOP), temporal artery tenderness

Investigations

Neuroimaging to rule out deadly causes. Most benign headaches do NOT need further investigation. Refer to Ottawa SAH Rule.
LP: if CT head negative (>6h from onset) but suspicion of SAH
ESR/CRP: if suspect temporal arteritis

Management

<table>
<thead>
<tr>
<th>Common benign headache regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fluids:</strong> No clear evidence, but consider in dehydrated patient</td>
</tr>
<tr>
<td><strong>Antidopaminergic agent:</strong> Metoclopramide 10mg IV</td>
</tr>
<tr>
<td><strong>Analgesic:</strong> Acetaminophen 1g po</td>
</tr>
<tr>
<td><strong>NSAIDs:</strong> Ketorolac 15-30mg IV or Ibuprofen 600mg po</td>
</tr>
<tr>
<td><strong>Steroids:</strong> Dexamethasone 10mg po/IV (rebound migraine prophylaxis)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-traditional uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen, sumatriptan, verapamil - used for cluster headaches</td>
</tr>
<tr>
<td>Magnesium, lidocaine, propofol, ketamine - for refractory headaches,</td>
</tr>
<tr>
<td>emerging evidence</td>
</tr>
<tr>
<td>Nerve blocks: limited efficacy</td>
</tr>
</tbody>
</table>

Shortness of Breath

Definitions
Tachypnea: RR > 18 in adults
Hyperpnea: high minute ventilation to meet metabolic demands
Orthopnea: dyspnea lying flat
Paroxysmal Nocturnal Dyspnea: sudden dyspnea at night

Differential Diagnosis

<table>
<thead>
<tr>
<th>Pulmonary</th>
<th>Cardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway obstruction</td>
<td>Pulmonary edema</td>
</tr>
<tr>
<td>Respiratory failure (refer to Type 1 vs Type 2 in “Breathing” section)</td>
<td>Myocardial infarction</td>
</tr>
<tr>
<td>Anaphylaxis</td>
<td>Cardiac tamponade</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>Pericardial effusion</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
<td>Arrhythmias</td>
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<table>
<thead>
<tr>
<th>Toxic-metabolic</th>
<th>Neuro-endocrine</th>
</tr>
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<tbody>
<tr>
<td>Toxin ingestion (organophosphates, CO poisoning)</td>
<td>Thyrotoxicosis</td>
</tr>
<tr>
<td>Sepsis</td>
<td>Guillain-Barre syndrome</td>
</tr>
<tr>
<td>DKA</td>
<td>Amyotrophic lateral sclerosis</td>
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<tr>
<td></td>
<td>Multiple sclerosis</td>
</tr>
</tbody>
</table>

Assessment

History: OPQRST, recent travel, trauma, PE risk factors (Well’s criteria, PERC rule), sick contacts
Physical: appearance, signs of respiratory distress, cardiac/resp exam

Investigations

Blood work: CBC, lytes, BUN/Cr, VBG, cardiac enzymes +/- D-dimer
Tests: ECG, bedside U/S, CXR (portable if unstable)

Management

<table>
<thead>
<tr>
<th>General</th>
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<tbody>
<tr>
<td>Monitors, oxygen, vitals, IV access, ABCs</td>
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<table>
<thead>
<tr>
<th>Intubate</th>
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<tbody>
<tr>
<td>If not protecting airway or significant respiratory distress</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Empiric treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma: ATLS guidelines</td>
</tr>
<tr>
<td>Anaphylaxis: epinephrine, antihistamines, steroids, fluids</td>
</tr>
<tr>
<td>Cardiac causes: see various cardiac sections below</td>
</tr>
<tr>
<td>Asthma/COPD: oxygen, bronchodilators, corticosteroids +/- antibiotics</td>
</tr>
<tr>
<td>Infection: antibiotics, consider broad-spectrum if septic</td>
</tr>
</tbody>
</table>

Chest Pain

Differential Diagnosis

<table>
<thead>
<tr>
<th>Deadly Six (PET MAC)</th>
<th>Cardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary embolism</td>
<td>Pericarditis</td>
</tr>
<tr>
<td>Esophageal rupture/mediastinitis</td>
<td>Myocarditis</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
<td>Endocarditis</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td></td>
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<tr>
<td>Aortic dissection</td>
<td></td>
</tr>
<tr>
<td>Cardiac tamponade</td>
<td></td>
</tr>
<tr>
<td>Pericarditis</td>
<td></td>
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<tr>
<td>Myocarditis</td>
<td></td>
</tr>
<tr>
<td>Endocarditis</td>
<td></td>
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<tr>
<td>Respiratory</td>
<td>GI</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>Esophagus - Mallory-Weiss tear,</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>esophageal spasm</td>
</tr>
<tr>
<td>Acute chest syndrome (sickle cell)</td>
<td>Stomach - GERD, dyspepsia/PUD</td>
</tr>
<tr>
<td>Lung or mediastinal mass</td>
<td>Pancreas - pancreatitis</td>
</tr>
<tr>
<td></td>
<td>Gallbladder - biliary colic,</td>
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<tr>
<td></td>
<td>cholecystitis, cholangitis</td>
</tr>
<tr>
<td>Respiration</td>
<td></td>
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<tr>
<td>MSK</td>
<td>Other</td>
</tr>
<tr>
<td>Intramuscular pain</td>
<td>Panic attack</td>
</tr>
<tr>
<td>Rib pathology</td>
<td>Herpes Zoster</td>
</tr>
</tbody>
</table>

Assessment

History: character of pain, cardiac risk factors (see HEART score), PE risk factors (see PERC rule), recent trauma, neuro symptoms

Physical: appearance, cardiac exam, resp exam, neuro screen, vitals + pulse deficits

Investigations

Tests: ECG, CXR +/- CTPA
Labs: CBC, lytes, abdo panel, CK/TnI +/- D-dimer

Management

<table>
<thead>
<tr>
<th>General</th>
<th>ABCs, monitors, oxygen, vitals, IV access, equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS</td>
<td>ASA, nitro (avoid in RV infarct), clopidogrel/ticagrelor, LMWH, code STEMI (PCI vs. thrombolysis)</td>
</tr>
<tr>
<td>PE</td>
<td>Anticoagulation +/- thrombolysis for massive PE</td>
</tr>
<tr>
<td>Esophageal rupture</td>
<td>Urgent thoracics consult, IV antibiotics, NPO, further imaging</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
<td>Needle decompression (2nd ICS at MCL) then chest tube (4th or 5th ICS)</td>
</tr>
<tr>
<td>Tamponade</td>
<td>Pericardiocentesis</td>
</tr>
<tr>
<td>Dissection</td>
<td>Urgent vascular consult, reduce BP and HR with IV labetalol, surgery vs. medical management</td>
</tr>
<tr>
<td>Disposition</td>
<td>Diagnosis and risk stratification dependent</td>
</tr>
</tbody>
</table>

# Chest Pain Risk Stratification

## HEART score

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients ≥21 years old presenting with symptoms suggestive of ACS</td>
<td>New STEMI &gt;1mm or other new ECG changes, hypotension, life expectancy &lt; 1 years, noncardiac medical/surgical/psychiatric illness</td>
</tr>
</tbody>
</table>

### H = History
0 = slightly suspicious
+1 = moderately suspicious
+2 = highly suspicious

### E = ECG
0 = normal
+1 = No ST depression but LBBB, LVH, repolarization changes
+2 = ST depression/elevation not due to LBBB, LVH, or digoxin

### A = Age
0 = age < 45
+1 = age 45 - 64
+2 = age ≥ 65

### R = Risk factors
Risk factors = HTN, hypercholesterolemia, DM, obesity (BMI > 30), smoking (current, or smoking cessation ≤ 3 months), positive FHx (parent/sibling with CVD < 65yo), atherosclerotic disease (prior MI, PCI/CABG, CVA/TIA, or PVD)
0 = No known risk factors
+1 = 1-2 risk factors
+2 = ≥3 risk factors or history of atherosclerotic disease

### T = Troponin (initial)
0 = initial troponin ≤ normal limit
1 = initial troponin 1-2X normal limit
2 = initial troponin >2X normal limit

### Interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>Risk of MACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>0.9 - 1.7%</td>
</tr>
<tr>
<td>4-6</td>
<td>12-16.6%</td>
</tr>
<tr>
<td>≥ 7</td>
<td>50-65%</td>
</tr>
</tbody>
</table>

Use the HEART Pathway (HEART score + delta TnI) to further lower risk of MACE (not prospectively validated but 1% risk of MACE in retrospective data)

## PERC Rule

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients where pre-test probability of PE is considered to be low-risk (&lt; 15%)</td>
<td>Moderate to high risk for PE</td>
</tr>
</tbody>
</table>

Patients can be safely ruled out and do not require further workup if no criteria are positive:

- Age ≥ 50, HR ≥ 100, SaO₂ < 95% on room air, unilateral leg swelling, hemoptysis, recent surgery or trauma (<4 weeks ago), prior PE or DVT, hormone use (OCPs, hormone replacement, estrogen)

### Key References:
## Abdominal Pain

### Differential Diagnosis

<table>
<thead>
<tr>
<th>RUQ</th>
<th>Epigastrium</th>
<th>LUQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis</td>
<td>Gastritis/PUD</td>
<td>Pancreatitis*</td>
</tr>
<tr>
<td>Biliary colic</td>
<td>Dyspepsia/Duodenitis</td>
<td>Gastritis</td>
</tr>
<tr>
<td>Cholecystitis/Cholangitis*</td>
<td>Pancreatitis*</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>Pancreatitis*</td>
<td>Cardiac - ACS*</td>
<td>Pleural effusion PE*</td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleural effusion PE*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Flank</td>
<td>Umbilicus</td>
<td>Left Flank</td>
</tr>
<tr>
<td>Colitis</td>
<td>Colitis</td>
<td>Colitis</td>
</tr>
<tr>
<td>Perforation*</td>
<td>Perforation*</td>
<td>Perforation*</td>
</tr>
<tr>
<td>Obstruction*</td>
<td>Obstruction*</td>
<td>Obstruction*</td>
</tr>
<tr>
<td>Renal colic</td>
<td>Aortic dissection*</td>
<td>Renal colic</td>
</tr>
<tr>
<td>Pyelonephritis AAA*</td>
<td>AAA*</td>
<td>Pyelonephritis AAA*</td>
</tr>
<tr>
<td>Hypogastric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appendicitis</td>
<td>UTI (Cystitis)</td>
<td>Diverticulitis*</td>
</tr>
<tr>
<td>Ectopic pregnancy*</td>
<td>Renal colic</td>
<td>Ectopic pregnancy*</td>
</tr>
<tr>
<td>PID, TOA</td>
<td>Obstruction</td>
<td>PID, TOA</td>
</tr>
<tr>
<td>Testicular torsion, epididymitis, orchitis</td>
<td></td>
<td>Testicular torsion, epididymitis, orchitis</td>
</tr>
<tr>
<td>Ovarian torsion</td>
<td></td>
<td>Ovarian torsion</td>
</tr>
<tr>
<td>Renal colic</td>
<td></td>
<td>Renal colic</td>
</tr>
</tbody>
</table>

### Can’t-miss Diagnoses

<table>
<thead>
<tr>
<th>Can’t-miss Diagnoses</th>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruptured ectopic</td>
<td>Hx of STI/PID, recent IUD, previous ectopic, smoking, fallopian tube surgery, tubal ligation</td>
</tr>
<tr>
<td>Ruptured AAA</td>
<td>Elderly, hx HTN/DM, smoking, trauma hx</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>Alcohol use, biliary pathology</td>
</tr>
<tr>
<td>Cholangitis</td>
<td>Charcot’s Triad: fever, RUQ pain, jaundice</td>
</tr>
<tr>
<td>Mesenteric ischemia</td>
<td>Elderly, CAD, CHF, dehydration, infection</td>
</tr>
<tr>
<td>Obstruction</td>
<td>Operative or malignant history, elderly</td>
</tr>
<tr>
<td>Perforated viscus</td>
<td>Risk factors for diverticulitis or PUD, malignancy or instrumentation (ie. colonoscopy)</td>
</tr>
<tr>
<td>Comp. diverticulitis</td>
<td>Elderly, low-fibre diet, Western population</td>
</tr>
</tbody>
</table>

### Assessment

**History:** OPQRST, associated symptoms (N/V, fever, chills, bowel movement, urinary symptoms, pelvic discharge/bleeding)

**Physical:** abdominal exam +/- pelvic exam, cardiac/resp exam

### Investigations

**Labs:** CBC, lytes, BUN/Cr, LFTs, lipase, lactate, B-hCG +/- CK/TnI

**Tests:** ECG, CXR, bedside US as indicated

**Formal abdo U/S (biliary pathology, ectopic, AAA) +/- CT abdo/pelvis**

### Management

ABCs, NPO, analgesics, anti-emetics, consult surgery as needed

---

**Key References:** Rosen’s Emergency Medicine: Concepts and Clinical Practice - 8th ed, 2014; Chapter 27.
Pelvic Pain

Differential Diagnosis

<table>
<thead>
<tr>
<th>Gynecological</th>
<th>Urinary tract</th>
<th>Urological</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ovaries:</strong> Ruptured cyst, abscess, torsion</td>
<td>Urolithiasis</td>
<td>Testicular torsion</td>
<td>Sexual or physical abuse</td>
</tr>
<tr>
<td><strong>Fallopian tubes:</strong> Salpingitis, tubal abscess, hydrosalpinx</td>
<td>Pyelonephritis</td>
<td>Prostatitis</td>
<td></td>
</tr>
<tr>
<td><strong>Uterus:</strong> PID, endometriosis, fibroids</td>
<td>Cystitis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pregnancy related (1st trimester):</strong> Ectopic pregnancy, threatened abortion, ovarian hyperstimulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pregnancy related (2nd-3rd trimester):</strong> Placental abruption, round ligament pain, Braxton-Hicks contractions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other:</strong> Bartholin abscess</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assessment

**History:** OPQRST, associated symptoms (vaginal bleeding, discharge, dyspareunia, bowel or bladder symptoms), pregnancy and sexual history

**Physical:** vitals, abdominal exam

Pelvic exam (assess cervical motion tenderness, adnexal tenderness)

Speculum exam (look for discharge, blood, take samples as needed)

**Investigations:**

**Labs:** CBC, lytes, BUN/Cr, b-hCG, +/- vaginal and cervical swabs

**Tests:** Bedside U/S - rule out ectopic, free fluid assessment

Formal abdo/pelvic ultrasound

Management

**General**

ABCs, IV access, analgesia, antiemetics, +/- admit and consult

**Ovarian cyst**

Uncomplicated: analgesia with follow-up

Hemoperitoneum or hemodynamically unstable: surgery

**Ovarian torsion/Testicular torsion**

Surgical detorsion or removal

**PID**

**Severe infection:** admit with IV antibiotics (cefotixin 2g IV q6h IV + doxycycline 100mg IV q12h x24hrs then switch to po)

**Mild-moderate infection:** Ceftriaxone 250mg IM x 1 + doxycycline 100 po BID x 14 days

# Back Pain

## Deadly Differential Diagnosis

<table>
<thead>
<tr>
<th>Spinal</th>
<th>Vascular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cauda equina and spinal cord compression:</td>
<td>Aortic Dissection</td>
</tr>
<tr>
<td>Spinal metastasis</td>
<td>Ruptured AAA</td>
</tr>
<tr>
<td>Epidural abscess/hematoma</td>
<td>Pulmonary Embolism</td>
</tr>
<tr>
<td>Disc herniation</td>
<td>Myocardial Infarction</td>
</tr>
<tr>
<td>Spinal fracture with subluxation</td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td></td>
</tr>
<tr>
<td>Vertebral osteomyelitis</td>
<td></td>
</tr>
<tr>
<td>Transverse myelitis</td>
<td></td>
</tr>
</tbody>
</table>

## Assessment

**History:** focus on red flags, fracture history, cancer risk, infection risk

Red flags (BACK PAIN): bowel/bladder dysfunction, anesthesia (saddle), constitutional symptoms (night pain, weight loss, fever/chills), chronic disease, paresthesias, age >50, IVDU/infection, neurological deficits

**Physical:** vitals + pulse deficits, inspect skin for infection/trauma, abdo exam for AAA, cardiac exam (aortic murmur), MSK lower back exam, neuro exam (lower extremity, reflexes, rectal tone), post void residual

## Investigations

**Bloodwork:** usually not indicated unless suspected infection (CBC, ESR, CRP)

**Bedside U/S:** rule out AAA, look for bladder distention post-void

**PVR:** cauda equina syndrome (PVR >200cc has sensitivity of 90% for CES)

## Management

<table>
<thead>
<tr>
<th>Cauda equina syndrome</th>
<th>Urgent MRI, spine consult, analgesia, IV dexamethasone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic dissection</td>
<td>Immediate specialist consultation, IV labetalol to control HR and BP</td>
</tr>
<tr>
<td>Ruptured AAA</td>
<td>Fluid resuscitation, immediate OR if unstable</td>
</tr>
<tr>
<td>Epidural abscess or vertebral osteomyelitis</td>
<td>MRI to definitively diagnose +/- bone scan (osteomyelitis), broad spectrum antibiotics, orthopedics consult</td>
</tr>
<tr>
<td>MSK back pain</td>
<td>Analgesia (WHO pain ladder)</td>
</tr>
<tr>
<td></td>
<td>Multidisciplinary approach with GP follow-up</td>
</tr>
</tbody>
</table>

## Key References:
Medical Emergencies
Anaphylaxis

Definition: Life-threatening immune hypersensitivity systemic reaction leading to histamine release, vascular permeability and vasodilation.

Common triggers: Foods (egg, nuts, milk, fruits), meds (antibiotics, NSAIDs), insect bites, local anesthetics, occupational allergens, aeroallergens.

Differential Diagnosis: Shock (of any etiology), angioedema, flush syndrome, asthma exacerbation, red man syndrome.

Diagnostic criteria:

<table>
<thead>
<tr>
<th>Acute onset (minutes to hours) + ANY of the following three:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement of skin +/- mucosa WITH EITHER respiratory difficulty or low BP</td>
</tr>
<tr>
<td>Exposure to likely allergen with 2/4 signs:</td>
</tr>
<tr>
<td><strong>Skin-mucosal involvement</strong> (urticarial, angioedema, flushing, pruritus)</td>
</tr>
<tr>
<td><strong>Respiratory difficulties</strong> (dyspnea, wheezing, stridor, hypoxemia, rhinitis)</td>
</tr>
<tr>
<td><strong>Low BP</strong> (hypotonia, syncope, pre-syncope, headache, collapse)</td>
</tr>
<tr>
<td><strong>GI symptoms</strong> (abdo pain, cramps, N/V)</td>
</tr>
<tr>
<td>Low BP after exposure to known allergen</td>
</tr>
</tbody>
</table>

Assessment

**General:** TREAT FIRST, ABCs, monitors, oxygen, vitals, IV access.
Appearance, respiratory distress, visualize swelling (lips, tongue, mucous membrane).

**History:** exposure to any known or likely allergen, co-morbidities, recent medication use, family history, atopy.

Management

**General management**

If need to protect airway: ketamine as induction agent.

Epinephrine: 0.3-0.5 mg IM (1:1000 conc.) to anterolateral thigh q5-10 mins.

Antihistamines: Benadryl 50mg IV/PO, Ranitidine 50mg IV/150mg PO.

Steroids: Methylprednisolone 125mg IV/prednisone 50mg po.

Fluids: 0.5 – 1 L NS bolus.

**Refractory hypotension**

Epinephrine drip 1-10ug/min IV (titrate to desired effect).
Consider norepinephrine 0.05 – 0.5ug/kg/min.

**Patients with beta-blockers**

IF epinephrine unsuccessful, glucagon 1-5mg IV over 5-10 mins followed by 5-15ug/min infusion.

**Disposition**

May discharge as early as 2 hours if stable. Arrange follow-up with GP in 24-48 hrs to watch for biphasic reaction.
Education to avoid allergen, consider allergy testing, Epi-pen prescription.

**Meds at discharge:** Benadryl 50mg po OD, Ranitidine 150mg po OD and prednisone 50mg po OD x3 days.

Asthma

Definition: chronic inflammatory airway disease with recurrent reversible episodes of bronchospasm and variable airflow obstruction

Triggers: URTIs, environmental allergens, smoking, exercise

Classification (CAEP/CTS Asthma Severity):

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Arrest/Fatal</td>
</tr>
<tr>
<td>Appearance: altered mental status, cyanotic, decreased resp. effort</td>
</tr>
<tr>
<td>Vitals: low HR, high RR, low O₂ sat &lt;90% despite oxygen</td>
</tr>
<tr>
<td>Exam: Silent chest - consider preparing for intubation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
</tr>
<tr>
<td>Appearance: agitated, diaphoretic, labored respirations, difficulty speaking</td>
</tr>
<tr>
<td>Vitals: high HR, high BP, O₂ sat 90-95%</td>
</tr>
<tr>
<td>Exam: worsening resp. distress, exp/insp. wheezing, FEV1 &lt;40% predicted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Appearance: SOB at rest, cough, congestion, nocturnal symptoms</td>
</tr>
<tr>
<td>Vitals: O₂ sat &gt;95%</td>
</tr>
<tr>
<td>Exam: exp. wheezing, FEV1 40-60% predicted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
</tr>
<tr>
<td>Appearance: SOBOE, chest tightness</td>
</tr>
<tr>
<td>Vitals: O₂ sat &gt;95%</td>
</tr>
<tr>
<td>Exam: exp. wheezing, FEV1 &gt;60% predicted</td>
</tr>
</tbody>
</table>

Assessment

History: triggers, recent infection, thorough asthma hx including prior exacerbations, hospitalizations + interventions/ICU stays, family history

Good asthma control: daytime symptoms <2/week, no activity limitation, no nocturnal symptom, rescue puffer <2/week, normal PFT

Physical: vitals, sign of distress, accessory muscle use, respiratory exam

Investigations: CXR, ECG +/- VBG, +/- PEFR (to estimate FEV1), bloodwork (CBC - infection, lytes - potassium)

Management

Treat exacerbation (“0.5 - 5 - 50”)

Atrovent 0.5mg nebulized OR 4-8 puffs via MDI+spacer q20mins x 3
Ventolin 5mg nebulized OR 4-8 puffs via MDI+spacer q20mins x 3
Prednisone 50mg oral

NOTE: MDIs are superior to nebs, however if patient too tachypneic use nebs

Severe asthma

MgSO₄ 2g IV over 30 mins
Epinephrine 0.3mg IM then 5mcg/min IV infusion
Ketamine 1mg/kg (in conjunction with BiPAP)

Respiratory failure

Consider NiPPV first (BiPAP)
Intubate (LAST RESORT): ketamine 1mg/kg IV + succinylcholine 1.5mg/kg IV
Involve ICU early

### Chronic Obstructive Pulmonary Disease

**Risk factors:** smoking (#1), occupational dust, chemical exposure

**Triggers of AECOPD:** viral URTI, pneumonia, environmental allergens or pollutants, smoking, CHF, PE, MI

### Assessment

**Cardinal symptoms:** ↑ SOB ↑ sputum production ↑ sputum purulence

**Key elements on history:** duration of symptoms, severity of airflow limitation, number of previous episodes (total/hospitalizations), comorbidities, premorbid functional status, present treatment regimen, previous use of mechanical ventilation, use of home oxygen

**Clinical signs of severity:** rapid shallow pursed-lip breathing, use of accessory muscles, paradoxical chest wall movements, worsening or new onset central cyanosis, peripheral edema, hemodynamic instability, decreased LOC or confusion, decreased O₂ sat

### Investigations

**Labs:** CBC, electrolytes, VBG

**Tests:** CXR, ECG, pulse oximetry

### Management

#### Oxygen

- Venturi masks (high-flow devices) preferred over nasal prongs
- **Target SaO₂:** >88% Goal PaO₂ = 60-65 mmHg

#### Bronchodilators

- **SABA:** salbutamol 2.5-5mg via nebulizer or 4-8 puffs via MDI with spacer q15mins x3 prn
- **Anticholinergic:** Ipratropium bromide 500mcg via nebulizer or 4-8 puffs q15mins x3 prn

#### Systemic corticosteroids

- Oral is equivalent to IV in most exacerbations
- Oral prednisone 40-60mg for 5-10 days
- IV methylprednisolone 125 mg BID-QID (for severe exacerbations or not responding to oral steroids)

#### Antibiotics

- **Indication:** ≥2 of: inc sputum production 2) inc sputum purulence 3) inc SOB
- **Simple exacerbation:** amoxicillin, 2nd/3rd gen cephalosporin, macrolide, doxycycline or TMP/SMX
- **Complicated exacerbation:** fluoroquinolone or amoxicillin/clavulanate

#### Ventilation

- NIPPV such as CPAP or BiPAP (consider in respiratory acidosis, severe dyspnea or distress)

#### Intubation

- For life-threatening exacerbations, failed NIPPV, altered LOC, severe hypoxemia, cardiovascular instability, respiratory or cardiac arrest

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**Myocardial Infarction**

**Definition:** evidence of myocardial ischemia on the spectrum of ACS (unstable angina, NSTEMI and STEMI). Diagnosed by cardiac marker abnormalities and one of: ECG changes, HPI consistent with ACS.

| **Stable Angina** | Transient episodic chest discomfort secondary to myocardial ischemia. Precipitated by exertion or emotion, lasts < 15 mins, relieved by rest or nitro. |
| **Unstable Angina** | Angina with minimal exertion or at rest, new-onset angina, angina post MI/PCI/CABG, worsening change from baseline anginal symptoms, increased duration of pain or threshold, or decreased response of typically effective angina medications. |
| **NSTEMI** | Infarction without ST elevation. |
| **STEMI** | Infarction with ST elevation: ≥1mm STE in 2 contiguous leads. For V1 - V3 leads: >1.5 mm for females; >2.5 mm for males under 40; >2mm for males over 40 |

**Assessment**

**History:** character of pain, associated symptoms (diaphoresis, radiating pain, vomiting, and exertional pain have highest LRs for AMI)

**Classic risk factors:** male, smoking, diabetes, HTN, FHx, dyslipidemia

**Atypical features in:** women, elderly, diabetics, non-Caucasians, dementia

**Complications of AMI:** arrhythmias, cardiogenic shock, papillary muscle rupture, pericarditis, stroke

**Physical:** vitals, cardiac exam, resp exam, pulses, signs of complications

**Investigations:** ECG (ST-T changes, new BBB, pathological Q waves), CXR

**Labs:** CBC, lytes, cardiac enzymes

**Management**

**General**

ABCs, monitors, oxygen, vitals, IV access

**Pain control:** NTG (avoid for RV infarcts) or morphine if resistant to NTG

**ACEi, B-blockers, statins**

No role for ED use. ACEi + statins should be started within 24-48hrs of presentation.

**Antiplatelet therapy**

ASA 325 mg chewed

Clopidogrel 300mg po OR ticagrelor 180mg po (if going for primary PCI)

**Antithrombotic therapy**

Primary PCI: UFH 4000 units (max) then 12 U/kg/hr

Fibrinolytics: enoxaparin or fondaparinux IV bolus then sc dose daily

**Goals**

Primary PCI: within 90 mins of hospital arrival

Lytics: <12 hours of symptoms OR cannot get to PCI centre within 120 mins, given within 30 mins of hospital arrival

**Key References:** Rosen’s Emergency Medicine: Concepts and Clinical Practice - 8th ed, 2014; Chapter 78. Circulation 2013; 127:00-00.
Congestive Heart Failure

**Etiology:** CAD, HTN, valve abnormalities, cardiomyopathy, infarction, pericardial disease, myocarditis, cardiac tamponade, metabolic disorders (ie. hypothyroidism), toxins, congenital

**Precipitants of CHF exacerbation**

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemia, dysrhythmias, mechanical complications (ie. papillary muscle rupture)</td>
<td>Forgot meds, negative inotropes (CCB, b-blocker), NSAIDs, steroids</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High cardiac output</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia, infection, pregnancy, hyperthyroidism</td>
<td>Lifestyle (high salt intake), renal failure, PE, HTN</td>
</tr>
</tbody>
</table>

**Assessment**

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Left-sided:</strong> SOB, orthopnea, PND, nocturia, fatigue, altered mental status, syncope, angina, pulmonary congestion (cough, wheeze)</td>
<td><strong>General:</strong> Tachypnea, tachycardia, hypertension, hypotension, weak pulses</td>
</tr>
<tr>
<td><strong>Right-sided:</strong> fatigue, abdominal distension, swelling, weight gain</td>
<td><strong>Left-sided:</strong> hypoxia, crackles, wheezes, S3 or S4</td>
</tr>
<tr>
<td><strong>Right-sided:</strong></td>
<td><strong>Right-sided:</strong> pitting edema, JVP elevation, hepatomegaly, ascites</td>
</tr>
</tbody>
</table>

**Investigations**

**Labs:** CBC, electrolytes, AST, ALT, BUN, Cr, Troponin, BNP (or NT-proBNP)

**Tests:** CXR, ECG, POCUS (systolic function, pulmonary edema)

**Management**

**General**

ABCs, monitors, 100% O₂ non-rebreather facemask, vitals, IV access, position upright, +/- Foley catheter, treat precipitating factor

Morphine 1-2 mg IV prn

**First line**

Nitroglycerin 0.4mg sl q5min (if sBP>100) +/- topical nitroglycerin patch (0.2-0.8mg/h)

Furosemide: generally double home dose

**Second line**

Double furosemide dose

Nitroglycerin infusion (start at 10 mcg/min and titrate)

If hypotensive (sBP<90): norepinephrine 2-12 mcg/min or dobutamine 2.5mcg/kg/min

---

Cardiac Dysrhythmias

**Causes:** Enhanced automaticity: MI, drugs, toxins, lyte imbalances
Triggered activity: Torsades de Pointes, post-MI reperfusion
Re-entry: VT and SVT

**Main classifications**

<table>
<thead>
<tr>
<th>Bradydysrhythmias and AV conduction blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1° = prolonged PR interval</td>
</tr>
<tr>
<td>2° (Mobitz I) = gradual PR interval prolongation then QRS drop</td>
</tr>
<tr>
<td>2° (Mobitz II) = PR interval constant with QRS drop</td>
</tr>
<tr>
<td>3° = P wave and QRS complex unrelated, PP and RR intervals constant</td>
</tr>
</tbody>
</table>

**Supraventricular tachydysrhythmias (narrow QRS)**

<table>
<thead>
<tr>
<th>Regular rhythm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial: sinus tachycardia, atrial tachycardia, atrial flutter</td>
</tr>
<tr>
<td>AV: SVT (AVNRT &gt; AVRT), junctional tachycardia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Irregular rhythm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial: atrial fibrillation, multifocal atrial tachycardia, SVT w/ aberrancy</td>
</tr>
</tbody>
</table>

**Ventricular tachydysrhythmias (wide QRS)**

| Regular rhythm: Ventricular tachycardia, SVT with aberrancy |
| Irregular rhythm: Ventricular fibrillation, polymorphic VT, Afib with WPW |

**Assessment**

**Unstable patient:** altered mental status, respiratory distress, hypotension, syncope, chest pain with AMI, signs of CHF, shock

**Stable patient:** light-headedness, SOBOE, palpitations, mild anxiety

**Management**

**General:** Monitors, oxygen, continuous monitoring, IV access

**Initial approach:** ABCs, treat symptomatic and unstable patients immediately

**ACLS Guidelines (for unstable patients)**

<table>
<thead>
<tr>
<th>Bradycardia algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine 0.5mg IV bolus q3-5mins x 6</td>
</tr>
<tr>
<td>+/- infusions: dopamine 2-10 mcg/kg/min OR epi 2-10 mcg/min</td>
</tr>
<tr>
<td>If ineffective: transcutaneous pacing, prepare for IV pacing</td>
</tr>
<tr>
<td>Type II 2° AV block OR 3° AV block: transcutaneous pacing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tachycardia algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronized cardioversion (with premedication)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atrial fibrillation/Atrial flutter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronized cardioversion (higher risk of stroke if rhythm &gt;48hrs and patient not anticoagulated)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VF/pVT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock-CPR: shock cycles, epinephrine 1mg IV q3-5mins, consider amiodarone 300mg IV bolus with 2nd dose 150mg IV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PEA/Asystole</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR, airway support, IV access, epinephrine 1mg IV q3-5mins</td>
</tr>
</tbody>
</table>

*See detailed ACLS algorithms in a separate section

Vascular Emergencies

Ruptured AAA

Risk factors: FHx, HTN, PVD/CAD, DM, connective tissue disease, smoking

<table>
<thead>
<tr>
<th>AAA &lt; 5 cm</th>
<th>AAA 5 cm - 7 cm</th>
<th>AAA &gt; 7 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3% risk of rupture/yr</td>
<td>10% risk of rupture/yr</td>
<td>20% risk of rupture/yr</td>
</tr>
</tbody>
</table>

Assessment

Classic Triad: acute onset back/abdo/flank pain + hypotension (with or without syncope) + pulsatile abdominal mass

Other presentations: syncope, UGIB/LGIB, high output CHF, ureteral colic, bowel obstruction symptoms

Tests: POCUS to detect AAA (>3cm), ECG, CT (for stable patient)

Management

General
- ABCs, monitors, oxygen, vitals, IV access
- STAT vascular surgery consult

Resuscitation
- IV crystalloids, blood - aim for systolic BP 90 - 100 mmHg
- Massive transfusion protocol

Urgent surgical intervention
- Open surgery with graft replacement or endovascular aneurysm repair

Post-op Complications
- Infection - graft contamination or hematogenous seeding
- Ischemia - SC ischemia, CVA, visceral ischemia
- Aortoenteric fistula - commonly present as GI bleeding
- Endo Leak - blood flow outside of the graft lumen

Acute Arterial Occlusion

Definition: acute embolus or arterial thrombosis, true emergency as irreversible damage can occur within 6-8 hours

Risk factors: atherosclerosis, MI with LV thrombus, AFib, valve stenosis, stent/grafts

Assessment

History (6Ps): pain, paresthesia, pallor, polar, pulselessness, paralysis (late finding)

Tests: Doppler probe to leg with proximal BP cuff - perfusion pressure <50mmHg, ABI < 0.5

Management

- STAT vascular surgery consult
- Immediate heparinization with 5000 IU bolus
- Revascularization vs. CT angiogram (depends on if emboli from Afib vs. secondary to PVD)

Deep Vein Thrombosis and Pulmonary Embolism

Risk Factors: venous stasis (surgery or trauma), vessel injury (surgery or trauma), hypercoagulability (inherited thrombophilia, active malignancy, estrogen, prior PE/DVT)

Assessment

<table>
<thead>
<tr>
<th>Modified Wells Criteria for DVT</th>
<th>Wells Criteria for PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Active cancer</td>
<td>3 Signs + symptoms of DVT</td>
</tr>
<tr>
<td>1 Paralysis, paresis or recent</td>
<td>3 PE = #1 diagnosis</td>
</tr>
<tr>
<td>immobilization of lower limb</td>
<td>1.5 HR &gt; 100</td>
</tr>
<tr>
<td>1 Bedridden &gt; 3 days or major</td>
<td>1.5 Immobilization &gt; 3 days OR</td>
</tr>
<tr>
<td>surgery in last 12 weeks</td>
<td>surgery in last 4 weeks</td>
</tr>
<tr>
<td>1 Tenderness along DV system</td>
<td>1.5 Hx DVT/PE</td>
</tr>
<tr>
<td>1 Entire leg swollen</td>
<td>1 Hemoptysis</td>
</tr>
<tr>
<td>1 Calf swelling 3 cm &gt; asymp.</td>
<td>1 Active cancer</td>
</tr>
<tr>
<td>side</td>
<td></td>
</tr>
<tr>
<td>1 Pitting edema in symptomatic</td>
<td></td>
</tr>
<tr>
<td>leg</td>
<td></td>
</tr>
<tr>
<td>1 Superficial non-varicose veins</td>
<td></td>
</tr>
<tr>
<td>1 Previous DVT</td>
<td></td>
</tr>
<tr>
<td>-2 Alternative diagnosis</td>
<td></td>
</tr>
</tbody>
</table>

Results:
DVT unlikely = score ≤ 1
DVT likely = score ≥ 2

How to interpret results from Wells Criteria

DVT unlikely
Order D-Dimer: if negative = no DVT
If positive = obtain leg Doppler
DVT likely
Obtain leg Doppler

Non-high risk
Order D-Dimer: if negative = no PE
If positive = obtain CTPA
High risk
Obtain CTPA

PERC Rule

Apply to patient where diagnosis of PE is being considered, but patient is deemed low-risk.
If PERC negative AND clinician’s pre-test probability is <15%, there is <2% chance of PE.

PERC negative if: Age<50, HR<100, SpO2<95%, no hemoptysis, no estrogen use, no history of surgery/trauma, no prior PE/DVT, no present signs of DVT

Management

DVT
LMWH (warfarin bridge required) or fondaparinux
Heparin infusion for patients with renal impairment
Transition to oral anticoagulation x3-12 months

PE
Similar treatment as DVT
tPA reserved for massive PE, cardiac arrest, extensive clot burden

Gastrointestinal Bleeding

**Risk Factors:** medications (NSAIDs, anticoagulants), excessive vomiting, bleeding disorders, malignancy, alcohol use, ulcer history, H. pylori

**Differential Diagnosis**

### Upper GI bleed (proximal to Ligament of Treitz)
- Peptic ulcer disease (gastric > duodenal)
- Gastritis/esophagitis
- Esophageal varices
- Mallory-Weiss tears
- Gastric cancer

### Lower GI bleed (distal to Ligament of Treitz)
- Colitis (inflammatory, infectious, ischemic)
- Anorectal pathology (hemorrhoids, fissures, proctitis)
- Angiodysplasia
- Diverticulosis
- Malignancy

**Assessment**

**History:** blood quantity/quality, symptoms of anemia (fatigue, SOB, chest pain), Hx liver disease, medication review, smoking/EtOH, bleeding disorders, constitutional symptoms

Beware mimics: Pepto-Bismol, iron ingestion can cause dark stools

**UGIB:** hematemesis, coffee ground emesis, melena, BRBPR if brisk UGIB

**LGIB:** hematochezia, BRBPR

**Physical:** ABCs, vitals, inspect nasal-oral cavity, abdominal exam, DRE

**Investigations**

**Labs:** CBC, lytes, INR/PTT, BUN/Cr, lactate, VBG, T+S/T+C

**Tests:** ECG, CXR +/- CT if indicated for LGIB

**Management**

**General**
- ABCs, monitors, oxygen, vitals, 2 large bore IVs, GI consult
- Intubate early if suspect unprotected airway or risk of aspiration
- Transfusion threshold: Hb < 70, Plt < 50, or hemodynamically unstable or with active bleeding

**UGI Bleed**
- Pantoloc 80mg IV bolus then 8mg/h infusion
- Octreotide 50mcg IV bolus then 50mcg/h infusion - for suspected variceal bleeding
- Ceftriaxone 2g IV: for suspected variceal bleeds, prevention of SBP
- Tranexamic acid: hemodynamically unstable patients (no clear evidence)
- Balloon tamponade: crashing GI bleeding patient

**LGI Bleed**
- NPO, IV fluids, manage underlying etiology (ie. Abx, steroids)
- Colonoscopy to evaluate cause of bleeding

**Key References:** Rosen’s Emergency Medicine: Concepts and Clinical Practice - 8th ed, 2014; Chapter 30.
# TIA and Stroke

## Definition

<table>
<thead>
<tr>
<th>ACA stroke</th>
<th>MCA stroke</th>
<th>PICA stroke (Wallenberg syndrome)</th>
<th>TIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg &gt; face/arm contralateral motor + sensory deficits</td>
<td>Face/arm &gt; leg contralateral motor + sensory deficits</td>
<td>Pain/temperature loss on contralateral side + ipsilateral face</td>
<td>Transient episode of neuro dysfunction without acute infarction</td>
</tr>
<tr>
<td>Bowel and bladder incontinence</td>
<td>Contralateral hemianopia; gaze preference towards lesion</td>
<td>Ipsilateral Horner’s-like syndrome</td>
<td></td>
</tr>
<tr>
<td>Impaired judgement/insight</td>
<td>Aphasia (dominant) or neglect (non-dominant)</td>
<td>4D’s: dysphagia, diplopia, dysarthria, dysphonia</td>
<td></td>
</tr>
</tbody>
</table>

## Assessment

**History:** time of onset (usually abrupt, maximal), LOC (usually normal, non-significant decrease), focal symptoms, headache (pain more suggestive of hemorrhagic stroke or dissection)

Stroke mimics: seizure, migraine, syncope, metabolic derangements, sepsis, tumor, conversion disorder, Todd’s paralysis

**Physical Exam:** Vitals, neuro (NIHSS scale), look for comorbidities

**CV:** dissection, arrhythmias, valvular pathology

**Labs:** CBC, lytes, extended lytes, glucose, BUN, Cr, INR, PTT

**Neuroimaging:** acute stroke (CT/CTA immediately), low-risk TIAs (plain non-contrast CT head), high-risk TIAs (CTA head/neck)

## Management

### General

ABCs, monitors, oxygen, vitals, IV access +/- intubation (severe strokes)

BP control: lower if HTN severe (>220/120), BP < 185/110 if giving tPA

Consult neurology, admission to stroke unit

### Antiplatelet therapy

TIA - start ASA

TIA on ASA - dual antiplatelet therapy x 21 days

Acute stroke - don’t give acutely, start ASA daily once discharged

### Thrombolytics

Alteplase given within 4.5 hours (ideal = 90 minutes)

+/- Intra-arterial thrombectomy by IR (within 6 hours)

### TIA management

Risk stratification, early CT angio of carotids +/- endarterectomy

### Stroke prevention

Primary: stratify based on CHADS$_2$ (stroke), ABCD$_2$ (TIA), Rx ASA or DOACs

Secondary: oral anticoagulation started 1-2 weeks post stroke

## Key References:

Diabetic Emergencies

**Definitions**

<table>
<thead>
<tr>
<th>DKA</th>
<th>HHS</th>
</tr>
</thead>
</table>
| Predominantly Type 1 DM  
Insulin deficiency + stressor → counter-regulatory hormone excess → inc lipolysis (ketoacidosis) and osmotic diuresis (dehydration)  
**Serum glucose:** > 16 mmol/L  
**Other labs:** HCO₃ < 15 pH < 7.3  
**Onset:** hours to days  
**Features:** moderate dehydration, acidosis, often young |
| Predominantly Type 2 DM  
Relative insulin deficiency + stressor → counter-regulatory hormone excess → osmotic diuresis (dehydration)  
**Serum glucose:** > 30 mmol/L  
**Onset:** days to weeks  
**Features:** severe dehydration, hyper-osmolality, often elderly with AMS |

**Assessment**

**History:** N/V, abdominal pain, polyuria/polydipsia, weakness, anorexia  
**Physical Exam:** rapid, deep breathing (Kussmaul) respirations  
Tachycardia, ileus, acetone breath

**Investigations**

**Labs:** glucose, urine/serum ketones, beta-hydroxybutyrate, CBC, lytes, extended lytes, glucose, BUN, Cr +/- cultures, cardiac enzymes (if indicated)

**Management**

**Fluid resuscitation**

NS 1-2 L over 1 hours  
Change to D5½NS when BG < 16

**Insulin**

Short acting insulin Regular  
Infusion of 0.1 U/kg/h (goal = lower BG by 4-5)  
**Once gap closed:** continue infusion x 1hr but overlap + switch to sc insulin

**Electrolyte replacement**

**Potassium**  
K < 3.3 mmol/L: hold insulin and give 40 mmol/L KCl  
K 3.3 - 5 mmol/L: give 20-30 mmol/L KCl  
K > 5 mmol/L: recheck K in 1-2 hours

**Phosphate**  
Low phosphate can be replaced if severe levels or metabolic disturbances (muscle weakness, paralysis, rhabdomyolysis)  
**Sodium:** Pseudohyponatremia common due to dilutional decrease

**Disposition**

**Admission if:** first time presentation, co-morbidities, unable to close gap, iatrogenic complications (ARDS, cerebral edema, fluid overload), or DKA/HHS due to stressors listed above (ie. need to manage MI or sepsis in hospital)  
**Education:** diet, insulin administration, fluid replacement

Sepsis

Definitions

Old Definitions (2012)

<table>
<thead>
<tr>
<th>s</th>
<th>SIRS</th>
<th>2 or more of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt; 36 or &gt; 38.3</td>
<td>HR &gt; 90</td>
<td>RR &gt; 20 or CO2 &lt; 32</td>
</tr>
<tr>
<td>Sepsis</td>
<td>SIRS criteria + documented or suspected infection</td>
<td></td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>Sepsis + end-organ dysfunction (high lactate, elevated Cr, low UOP, hepatic/marrow dysfunction)</td>
<td></td>
</tr>
<tr>
<td>Septic shock</td>
<td>Severe sepsis + tissue hypoperfusion despite fluid resuscitation</td>
<td></td>
</tr>
</tbody>
</table>

New Definitions (2016)

| Sepsis | Life threatening organ dysfunction caused by dysregulated response to infection |

Assessment

History: associated symptoms, full review of systems, co-morbidities

Physical Exam: vitals, volume status, look for a focus

Investigations

Full septic workup: CBC, lytes, extended lytes, BUN/Cr, LFTs, lactate, INR/PTT, blood/urine C+S, ECG, CXR

RUSH exam: heart (PSL, 4 chamber), IVC view, Morrison’s and splenorenal views, bladder window, aorta, pneumothorax

Management

General

Monitors, oxygen, vitals, 2 large bore IVs

3-hour recommendation (2016): draw lactate, IVF, early antibiotics, send cultures

6-hour recommendation (2016): repeat lactate, fluid assessment, maintain MAP > 65

Resuscitation

Fluids: 1-2L NS IV bolus initially, then guided by clinical reassessment

Vaspressors: if not fluid responsive, norepinephrine 2-12 mcg/min

Steroids: if refractory to fluids + pressors, hydrocortisone 100mg IV

Antibiotics

Empiric treatment: Pip-Tazo 3.375g IV + Vancomycin 1g-1.5g IV

Meningitic doses: Ceftriaxone 2g IV + Vancomycin 2g IV + dexamethasone 10mg IV +/- Acyclovir 1g IV (for HSV encephalitis)

Early goal-directed therapy

Not recommended anymore but first two targets important:

*MAP >65 mmHg

*UOP > 0.5 cc/kg/hr

CVP 8-12 mmHg, SvcO₂ > 70%, HCT > 30%

Disposition

Admission to medicine for source control +/- ICU

# Electrolyte Disturbances

**History:** review of systems, neurologic symptoms (headache, lethargy, weakness, muscle cramps, dec LOC, personality changes), co-morbidities, infection, intake + losses, past history of electrolyte disturbances

## Hyperkalemia: [K] > 5.5 mmol/L

**Causes**
- Pseudohyperkalemia (#1), chronic renal failure, acute acidosis, medications* (ACEi, NSAIDs, K-sparing diuretics, digoxin, septral), cell death (rhabdo, burn/crush injuries, hemolysis, TLS)

**ECG changes**
- Peaked T waves → PR prolongation → loss of P waves → widened QRS → sine wave

**Management**
- **Protect:** 1 amp CaCl or 3 amps Ca gluconate (*if ECG changes noted*)
- **Shift:** 1-2 amps D50W + 10 U R insulin, albuterol nebs +/- bicarbonate (if acidotic)
- **Excrete:** fluids, Lasix, PEG3350 +/- dialysis if critical K or unable to excrete

## Hypokalemia: [K] < 3.5 mmol/L

**Causes**
- Renal losses (diuretics), non-rerenal losses (vomiting, diarrhea), metabolic alkalosis

**ECG changes**
- Loss of T waves → U waves → prolonged QT → TdP, VTach, Vfib

**Management**
- **Replace:** KCl 10-20 mmol/hr IV or KCl 40-60 mmol po q2-4hrs
- **HypoMg:** MgSO4 500mg/h IV to ensure K being driven into cells

## Hyponatremia: [Na] < 135 mmol/L

**Causes**
- Hypo-osmolar most common - hypervolemic (CHF, cirrhosis, nephrotic syndrome), euvoletic (SIADH), hypovolemic (adrenal insufficiency, vomiting, diuretics)

**Management**
- Known acute (<24-48h) [Na]<120 or symptomatic (dec LOC, focal neurological symptoms): max Na 8mmol/L in 24 h to prevent central pontine myelinolysis
- **Dose option:** IV 3% saline 100cc IV over 10 mins (if seizing)

## Hypercalcemia: [Ca] > 2.6 (corrected for albumin)

**Causes**
- Malignancy (breast, lung, kidney), hyperPTH, granulomatous diseases, medications (thiazides, Li, estrogen, vitamin A/D toxicity)

**ECG changes**
- Short QT, ST elevation, bradyarrhythmias, AV block

**Management**
- Bolus NS until normal perfusion, then infusion to 200cc/hr with goal of UOP 2L/day. Lasix to promote diuresis, bisphosphonates and calcitonin.

---

## Peripheral causes

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benign Paroxysmal Positional Vertigo (BPPV)</strong></td>
<td>Short lived, positional, associated with nausea/vomiting No auditory symptoms (tinnitus or hearing loss)</td>
</tr>
<tr>
<td><strong>Vestibular neuronitis</strong></td>
<td>Sudden and severe vertigo, increasing intensity over hours, symptoms subside over days to weeks. Exposure to infection or toxins. No auditory symptoms</td>
</tr>
<tr>
<td><strong>Labyrinthitis</strong></td>
<td>Positional, co-existing ENT infection, +/- febrile/toxic appearance Auditory symptoms: mild to severe hearing loss</td>
</tr>
<tr>
<td><strong>Meniere’s disease</strong></td>
<td>Recurrent episodes of sudden severe rotational vertigo, N/V, lasts hours. Auditory symptoms: tinnitus, hearing loss</td>
</tr>
</tbody>
</table>

## Central causes: cerebellar hemorrhage, PICA stroke, head trauma, vertebrobasilar migraine, Multiple sclerosis, temporal lobe epilepsy

### Assessment

**Peripheral:** sudden severe onset lasting seconds-minutes, horizontal/rotary nystagmus, worsened by position, auditory findings, NO neurological findings  

**Central:** gradual onset, weeks to months, vertical nystagmus, may have neurological findings, NO auditory findings

**Acute vestibular syndrome:** acute onset + ONGOING vertigo >24hrs, N/V  

**Physical exam:** gait/coordination, neuro exam, Dix-Hallpike (pc BPPV) or Roll Test (hc BPPV), HINTS exam (IF patient has AVS)

**Dix-Hallpike test (diagnose posterior-canal BPPV)**

Head turned 45° to one side while patient sitting. Patient moved to supine position with head hanging over edge of bed. Observe for nystagmus. Repeat with patient looking 45° in other direction.

**Roll test (diagnose horizontal-canal BPPV)**

Patient initially supine, head on bed. Turn head 90° to one side, observe for nystagmus. Repeat by straightening head and turning in the other direction.

**HINTS exam (patients with AVS to differentiate vestibular neuronitis vs. posterior stroke)**

- **Head Impulse:** corrective saccade as examiner turns head to affected side is normal (ie. it is a peripheral cause)  
- **Nystagmus:** vertical or down-beating nystagmus is abnormal (ie. central)  
- **Test of Skew:** Any corrective eye re-alignment on cover-uncover is abnormal

### Management

**Peripheral**

Epley’s Manouver for BPPV, betahistine for Meniere’s, Abx/steroids for vestibular neuronitis or labyrinthitis

**Central**

neuroimaging required, neuro consult + stroke management

---

ENT Emergencies

Epistaxis

Causes: trauma (nasal, digital, facial), URI, allergies, low humidity, polyps, foreign body, idiopathic causes (familial), systemic causes (atherosclerosis, anticoagulation, pregnancy, coagulopathies, diabetes, liver disease)

Assessment: visualize nares + oropharynx for active bleeding

Labs: CBC, INR/PTT +/- cross+type

Management

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>ABCs, vitals, volume assessment</td>
</tr>
<tr>
<td>Initial step</td>
<td>Compress cartilaginous part of nose x 20mins</td>
</tr>
<tr>
<td>Next step</td>
<td>Compress x 20 mins with lidocaine/epinephrine-soaked pledget +/- Silver nitrate if able to identify site +/- Consider TXA intranasally or IV</td>
</tr>
<tr>
<td><strong>Anterior bleeds (90% Kesselbach’s plexus)</strong></td>
<td>Anterior packing: nasal tampon, rhino rockets or Vaseline gauze pack</td>
</tr>
<tr>
<td></td>
<td>Apply anterior pack to active side first, if ineffective, pack both nares</td>
</tr>
<tr>
<td><strong>Posterior bleeds</strong></td>
<td>Epistat or foley catheter. Apply traction once inserted. Keflex x 5d course or until pack removal to prevent TSS</td>
</tr>
</tbody>
</table>

Pharyngitis

Etiology: viruses (rhinovirus, adenovirus), bacterial (Group A Strep)

Assessment

History: odynophagia, URI symptoms, complications are rare (ie. rheumatic fever)

Physical Exam: vitals, ABCs, red flags

Can’t Miss Diagnoses

- Peritonsillar abscess: muffled voice, uvular deviation
- Retropharyngeal abscess: drooling, airway compromise
- Tracheitis: may be confused with croup, stridor, labored breathing
- Epiglottitis: fever, stridor, rapidly progressive swelling

Modified Centor Criteria

<table>
<thead>
<tr>
<th>Age</th>
<th>Tonsillar exudates = +1</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-14 years old = +1</td>
<td>Tender anterior cervical lymph nodes = +1</td>
</tr>
<tr>
<td>15-44 years old = 0</td>
<td>Temp &gt;38°C = +1</td>
</tr>
<tr>
<td>&gt;44 years old = -1</td>
<td>Absent cough = +1</td>
</tr>
</tbody>
</table>

Management: fluids, antipyretics, single dose dexamethasone may reduce pain/duration.

Antibiotics reduce symptoms by 16 hours. They do NOT reduce incidence of suppurative complications.

Key References: Rosen’s Emergency Medicine: Concepts and Clinical Practice - 8\textsuperscript{th} ed, 2014; Chapter 23+72.
Renal Colic

Risk factors: hereditary (RTA, G6PD deficiency, cystinuria, oxaluria), lifestyle (minimal fluid intake, excess vitamin C, oxalation, purines, calcium), meds (loop diuretics, acetazolamide, topiramate), medical conditions (UTI, IBD, gout, DM, hypercalcemia), obesity

Assessment

History: unilateral flank pain +/- radiating to groin, “writhing” in pain, N/V, trigonal irritation (frequency, urgency)

Physical Exam: vitals (fever, HR, RR), abdominal exam, CVA tenderness

Investigations: CBC, urinalysis, B-hCG (females)

CT

Vast majority do NOT need CT imaging

Relative indications: first presentation of renal colic, elderly patients, suspicion of a serious alternative diagnosis

Ultrasound

Most helpful in detecting hydronephrosis (98% sensitivity)

KUB

Plain X-rays are neither sensitive or specific for detection of renal stones. KUB may be used to follow stone progression.

Management

General

IV NS if clinically dehydrated

N/V

Zofran 4-8mg IV

Analgesia

Morphine 2mg IV + ketorolac 30mg IM/IV or Naproxen 500mg po

MET

Tamsulosin 0.4mg po OD x 3 weeks (large stone >4mm or distal stones)

Disposition

can be safely discharge with appropriate GP/urology follow-up

Urology consult

intractable pain, infected stone, compromised renal function (single kidney, transplanted kidney, bilateral obstruction)

UTI and Pyelonephritis

Causes: E. coli (85%), Klebsiella, Proteus, Saprophyticus

Assessment

History: UTI (frequency, urgency, dysuria, hematuria), pyelo (fever/chills, flank pain, N/V), associated vaginitis/cervicitis symptoms, sexual history

Investigations: Urine dipstick, urine R+M, urine C+S +/- CBC, BUN/Cr

Management

Uncomplicated UTI

Septran DS po BID x 3 days

Macrobid 100mg BID x 5 days

If suspected STI: Levofoxacin 500mg po daily x 1 week + CTX 250mg IM x 1

Complicated UTI/Uncomplicated Pyelonephritis

Ciprofloxacin 500mg po BID or Septra DS po BID x 10-14 days

Consider US/CT imaging for complicated UTI

Complicated Pyelonephritis

Ceftriaxone 1g IV q24h

Environmental Emergencies

**Hypothermia (T < 35°C)**

**Causes:** inc heat loss (EtOH, environmental), dec thermogenesis (hypothyroidism, hypoglycemia, adrenal insufficiencies), impaired thermogenesis (toxins, CNS lesions, SC injury)

**Risk factors:** low SES, age extremes, drug OD, psych co-morbidities

**Assessment**

- **Mild (32°C - 35°C):** excitation response (↑HR/BP/RR, +shivering)
- **Moderate (28°C - 32°C):** physiologic slowing, NO shivering, AMS, ataxia
- **Severe (24°C - 28°C):** dysrhythmias (brady>slow Afib>Vfib>asystole), irritable myocardium (avoid invasive heart procedures), fixed/dilated pupils

**Investigations**

- **Labs:** CBC, lytes, BUN/Cr, VBG, lactate, INR/PTT, glucose
- **Tests:** ECG (Osborne waves), pCXR (aspiration pneumonia, pulmonary edema)

**Management**

<table>
<thead>
<tr>
<th>General</th>
<th>Cardiac arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors, O₂, IV access, vitals + rectal or foley temp, remove wet clothes</td>
<td>Focus on rewarming</td>
</tr>
<tr>
<td>Ensure NO pulse x 1 min then ACLS protocol (can try 1-3 shocks for Vfib)</td>
<td>Passive rewarming (T &gt; 32°C)</td>
</tr>
<tr>
<td>Cover patients with insulating blanket, let body generate heat</td>
<td>Active rewarming (T &lt; 32°C)</td>
</tr>
<tr>
<td>Warming blankets, radiant heat, place extremities in 45°C water</td>
<td>Warming blankets, radiant heat, place extremities in 45°C water</td>
</tr>
<tr>
<td>Non-invasive: warm IVF (42°C), warm O₂</td>
<td>Non-invasive: warm IVF (42°C), warm O₂</td>
</tr>
<tr>
<td>Invasive: heated irrigation (pleural, stomach, peritoneal, bladder), dialysis, ECMO</td>
<td>Invasive: heated irrigation (pleural, stomach, peritoneal, bladder), dialysis, ECMO</td>
</tr>
</tbody>
</table>

**Heat Stroke (T > 40.5°C)**

*differentiated by heat exhaustion by AMS/elevated LFTs*

**Classic/non-exertional:** elderly, heat waves, indoors with no AC

**Exertional:** young athletes, runners

**Assessment**

- **Classic:** dry/hot skin, not always dehydrated, HIGHER mortality
- **Exertional:** diaphoretic skin, profound dehydration, more morbidities (liver failure, renal failure, DIC, lactic acidosis)

**Management**

<table>
<thead>
<tr>
<th>General</th>
<th>Treat symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors, cooled IV fluids, rapid evaporative cooling</td>
<td>Shivering: midazolam 2mg IV</td>
</tr>
<tr>
<td>Antipyretics NOT effective (as not a hypothalamus problem, can also make DIC/liver failure worse)</td>
<td>Rhabdomyolysis: IVF, Lasix, NaHCO₃</td>
</tr>
<tr>
<td></td>
<td>Seizures: Lorazepam 2mg IV</td>
</tr>
<tr>
<td></td>
<td>Hyperkalemia: protect, shift, eliminate</td>
</tr>
</tbody>
</table>

Common Fractures

Assessment

History: mechanism of injury, associated neurological symptoms, blood loss
Exam: ABCs +vitals, look + feel, active and passive ROM, neurovascular status, assess bleeding/open fractures, complications of compartment syndrome, examine joint above and below fracture
Investigations: radiographs as clinically indicated, use decision rules for ankle/foot/knee to guide your assessment

General Management
Provide adequate analgesia with foundation (Tylenol + Advil) and opioids
Reduce and immobilize as appropriate. Repeat imaging and neurovascular status post reduction.
Appropriate ortho/plaster clinic follow-up

Upper Limb
Colle’s fracture: FOOSH. Distal radial fracture with dorsal displacement.
Exam: “dinner fork deformity”
Management: reduction to restore radial length and correct dorsal angulation

Scaphoid fracture: 15-40yo with FOOSH. High complication rate (5-40% with AVN/non-union).
Exam: limited wrist/thumb ROM, snuff box tenderness, axial loading of 1st MC, pain to scaphoid tubercle volarly
Management: thumb spica splint for suspected fractures (even if negative XR) x 6-12 weeks, repeat imaging in 10 days.

Proximal humeral fracture: high energy trauma (young), FOOSH (elderly).
Management: minimally displaced (closed reduction with sling immobilization), anatomic neck fractures or displaced (ORIF)

Boxer’s fracture: blow on distal-dorsal aspect of closed fist. Angulation of neck of 5th metacarpal into palm.
Management: Closed reduction if angulation >40°. If stable, ulnar gutter splint for 4-6 weeks.

Lower Limb
Management: non-operative (Non-WB BK cast), operative (most of Weber Type B/all Type C)

Management: Non-WB BK cast x 6 weeks.

Hip fracture: direct force to hip, fall (elderly), rotational force
Exam: shortened and externally rotated leg, painful ROM
Management: based on Garden classification. Elderly usually get hemi-/total hip arthroplasty. Young adults get ORIF.

# Toxicology

## Differential Diagnosis

### “Hot and Crazy” (DIMES)
- Drug-related: sympathomimetics (cocaine, amphetamines, caffeine, PCP, ketamine), anticholinergics, ASA, SS/NMS/MH, EtOH withdrawal
- Infection: meningitis, encephalitis, sepsis
- Metabolic: hypoglycemia, uremia, electrolytes, thyrotoxicosis, pheo
- Environmental: heat stroke
- Structural: ICH

### “Low and Slow” (ABCDO)
- ADHD tablets (clonidine)
- Beta-blockers
- Calcium-channel blockers
- Digoxin
- Opiates/Organophosphates

## Common Toxidromes

### Anticholinergics
- **Vitals:** hyperthermia, tachycardia
- **Signs:** mydriasis, dry skin
- **Symptoms:** agitation, hallucination, constipation, urinary retention
- “dry as a bone, red as a beet, blind as a bat, mad as a hatter, hot as a hare”

### Antidepressants
- Antidepressants

### Antihistamines
- Antihistamines

### Antipsychotics
- Antipsychotics

### Antispasmodics
- Antispasmodics

### Atropine
- Atropine

### Carbamazepine
- Carbamazepine

### Cholinergics
- **Vitals:** hypotension, bradycardia
- **Signs:** miosis, diaphoresis, seizures
- **Symptoms:** urination, bronchospasm, vomiting, diarrhea

### Organophosphates
- Organophosphates

### Nerve gas
- Nerve gas

### Mushroom
- Mushroom

### Anticholinesterase
- Anticholinesterase

### Sympathomimetics
- **Vitals:** hyperthermia, tachycardia, HTN
- **Signs:** mydriasis, diaphoresis, seizures
- **Symptoms:** agitation, anxiety

### Amphetamines
- Amphetamines

### Cocaine
- Cocaine

### LSD
- LSD

### Ephedrine
- Ephedrine

### Sedative/Hypnotics
- **Vitals:** hypothermia, hypotension, bradypnea
- **Signs:** respiratory depression, miosis (opioids), altered LOC

### EtOH, BZDs, GHB
- EtOH, BZDs, GHB

### Opioids (morphine, heroin, fentanyl)
- Opioids (morphine, heroin, fentanyl)

### Barbiturates
- Barbiturates

## Basic Approach (ABCDE)

<table>
<thead>
<tr>
<th>Airway</th>
<th>Intubate early if impending airway compromise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathing</td>
<td>Think metabolic derangements if low RR</td>
</tr>
<tr>
<td>Circulation</td>
<td>Ensure patient is well perfused</td>
</tr>
<tr>
<td>Detect and correct</td>
<td>Consider universal antidotes (dextrose, oxygen, naloxone, thiamine), correct vitals, correct signs (ie. seizure), consider decontamination/enhanced elimination</td>
</tr>
<tr>
<td>Emergency antidotes</td>
<td>Specific antidotes and treatments</td>
</tr>
</tbody>
</table>
Drugs and Dosages

**Analgesia**
Acetaminophen 325mg or 500mg tablets (max 4g daily)
Ibuprofen 200mg tablets (max 2400mg daily)
Naproxen 250mg tablets (max 1250mg daily)
Morphine 0.1-0.2mg/kg (max 15mg IV q4h)

**Procedural sedation**
Propofol 0.25-1mg/kg IV
Ketamine 1mg/kg (often used in conjunction with propofol)
Fentanyl 0.5-1 mcg/kg IV
Midazolam 50mcg/kg IV (often used in conjunction with fentanyl)

**Antiemetics**
Dimenhydrinate 50-100mg PO/PR/IM/IV (max 400mg daily)
Ondansetron 4-8mg PO/IV (max 16mg daily)
Haldol 0.5-2mg PO/IV

**Anaphylaxis**
Epinephrine 0.3mL (1:1000) IM anterolateral thigh
Diphenhydramine 50mg IV
Ranitidine 50mg IV
Methylprednisolone 125mg IV
Glucagon 1mg IV/IM

**Anxiolytics/Anticonvulsants**
Lorazepam 0.5-2mg po/IM/IV q6h or 4mg IV q5min (status epilepticus)
Phenytoin 20mg/kg IV at 25-50 mg/min (call neuro)
Phenobarbital 20mg/kg IV at 50mg/min (call neuro)

**ACLS drugs**
Adenosine 6mg IV rapid push over 3 seconds, repeat at 12mg IV
Amiodarone 150mg over 10 mins x2, infusion 1mg/min x 6hrs then 0.5mg/min x 18hrs
Atropine 0.5-1mg IV push (max 0.04mg/kg or 3mg)
Diltiazem 0.25mg/kg slow IV push over 2 mins
Epinephrine 1mg IV q3-5mins (no max)
Epinephrine drip 2-10mcg/min
Dopamine drip 2-10mcg/min
Lidocaine 1 mg/kg (max dose 3mg/kg)
Magnesium 1-2g IV push
Procainamide 20-30mg/min (max 17mg/kg) then 1-4mg/min infusion
Sodium bicarb 1mEq/kg IV, repeat at half dose in 10 mins
## Clinical Decision Rules

### Ottawa Ankle Rules

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult patient (has ALSO been validated in pediatrics), any mechanism of blunt ankle injury</td>
<td>Age &lt; 18, pregnant, isolated skin injury, injury older than 10 days, reassessment of same injury</td>
</tr>
</tbody>
</table>

**Ankle X-ray only required if**

- Bony tenderness at posterior edge/tip of lateral OR medial malleolus OR inability to take 4 complete steps in ED

**Foot XR only required if**

- Bony tenderness at base of 5th MT OR navicular OR inability to take 4 complete steps in ED

### Ottawa Knee Rules

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult patient, blunt knee injury, “knee” = patella, head/neck of fibula, proximal 8cm of tibia and distal 8cm of femur</td>
<td>Age &lt; 18, pregnant, isolated skin injury, injury older than 7 days, return for reassessment, AMS, paraplegic, multi-trauma</td>
</tr>
</tbody>
</table>

**Knee X-ray only required if**

- Age > 55 OR isolated patellar tenderness OR fibular head tenderness OR inability to flex 90° C OR inability to take 4 complete steps in ED

### Canadian CT Head Rule for Minor Head Injury

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head injury resulting in witnessed LOC/disorientation or definite amnesia; initial ED GCS &gt; 13; injury within 24hrs</td>
<td>Minimal head injury, obvious penetrating skull injury, acute neurological deficits, unstable vital signs assoc. with major trauma, seizure prior to ED assessment, bleeding disorder, pregnant</td>
</tr>
</tbody>
</table>

**High risk criteria (for neurological intervention)**

- GCS < 15 at 2hrs after injury, suspected open or depressed skull fracture, signs of basal skull fracture, vomiting > 2 episodes, age > 65

**Medium risk criteria (for brain injury on CT)**

- Amnesia before impact >30 mins, dangerous mechanism

### Ottawa SAH Rule

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert patients &gt;15yo, new severe atraumatic headache, max intensity within 1 hour</td>
<td>New neurological deficits, prior aneurysm, prior SAH, known brain tumors, chronic recurrent headaches (&gt;3 headaches of same character/intensity for &gt;6 months)</td>
</tr>
</tbody>
</table>

**CT is indicated if any criteria are present**

- Neck pain/stiffness, witnessed LOC, age > 40, onset during exertion, thunderclap headache, limited neck flexion on examination

---

### Canadian Syncope Risk Score

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 16, present to ED with syncope within 24 hours</td>
<td>Prolonged (&gt;5min) LOC, AMS, witnessed seizure, major trauma, intoxication, language barrier, head trauma</td>
</tr>
</tbody>
</table>

**Clinical Evaluation**

| -1 Vasovagal predisposition | +2 Elevated TnI |
| +1 Hx heart disease | +1 QRS axis < -30° or > 100° |
| +2 sBP < 90 or sBP > 180 | +1 QRS > 130ms |
| +2 Corrected QT > 480ms |  |

**Interpretation**

Total score = -3 to 11
Score of 0 = 1.9% risk of serious adverse event within 30d
Score of 11 = 83.6% risk of serious adverse event within 30d

### Ottawa Heart Failure Risk Scale

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 50, symptoms consistent with CHF (acute SOB, fluid retention, underlying cardiac abnormality) and/or response to diuretics</td>
<td>O₂ &lt; 85%, HR &gt; 120, sBP &lt; 90, confusion, ischemic chest pain, acute STEMI on ECG, prognosis of weeks (due to chronic disease), arrival from LTC</td>
</tr>
</tbody>
</table>

**Initial Assessment**

| +1 Hx of stroke or TIA | +2 STEMI on ECG |
| +2 Hx of intubation for respiratory distress | +1 BUN > 12mmol/L |
| +2 HR > 110 on ED arrival | +2 HCO₃ > 35mmol/L |
| +1 SaO₂ < 90% on EMS or ED arrival | +2 Elevated TnI |
|  | +1 ProBNP > 5mcg/L |

**Walk Test**

| +1 SaO₂ < 90%, HR > 110 during 3-min walk test, or too ill to walk |

**Interpretation**

Total score = 0 to 15
Score of 0 = 2.8% risk of serious adverse event within 14d
Score of 9 = 89% risk of serious adverse event within 14d

### Ottawa TIA Risk Score

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 18, ED diagnosis of TIA</td>
<td>Confirmed stroke, decreased LOC, presentation &gt; 7 days following onset of most recent TIA</td>
</tr>
</tbody>
</table>

**Clinical Findings**

+2 First TIA (in lifetime)
+2 Symptoms > 10 min
+2 History of carotid stenosis
+3 Already on antiplatelet therapy
+1 History of gait disturbance
+1 History of unilateral weakness
-3 History of vertigo
+3 Initial triage diastolic BP > 110 mmHg
+1 Dysarthria or aphasia (history of examination)
+2 Afib on ECG
+1 New or old infarction on CT
+2 Platelet count > 400
+3 Glucose > 15

**Interpretation**

Total score = -3 to 14
Score of 0 = 0.04% risk of stroke within 7d
Score of 14 = 27.6% risk of stroke within 7d

---

Key References:

- CMAJ 2016; 188(12):E289-298
- AEM 2017; 24(3):316-327
- Stroke 2014; 45(1):92-100
**Electrical Cardioversion**

### Indications

- Paroxysmal SVT
- Atrial fibrillation/Atrial flutter
- Ventricular Tachycardia

### Pre-medication

- Midazolam 1-5mg +/- fentanyl 50-200mcg
- Propofol 50-150mg IV
- Ketamine 0.25-1.5mg/kg IV
- Etomidate 20mg IV

### Synchronized Cardioversion

- pSVT/Aflutter: 150J biphasic or 300J monophasic
- Vtach/Afib: 200J biphasic or 360J monophasic

---

**Atrial Fibrillation or Atrial Flutter**

### General

Assess ABCs if stable, monitors, $O_2$, vitals, IV access, ECG

### Unstable

- Chest pain, SOB, LOC, low BP, CHF, AMI

### Cardioversion (200J biphasic or 360J monophasic)

#### Stable

1. Rate control if HR>120

#### Narrow complex:

- Diltiazem 20mg IV or Verapamil 2.5-5mg IV or Metoprolol 5mg IV or Amiodarone 150mg over 10 mins or Digoxin 0.5mg IV

#### Wide complex (WPW or BBB):

- Procainamide 30mg/min to 17mg/kg or Amiodarone 150mg over 10mins

#### 2 Rhythm control

- Afib < 48 hours: electrical cardioversion or pharmacological cardioversion (procainamide, amiodarone)
- Afib > 48 hours: anticoagulate x 3 weeks prior to and 4 weeks after cardioversion. Alternatively long-term rate control with beta-blockers or CCB

---

**Ventricular Fibrillation/Pulseless Ventricular Tachycardia**

### General

Intubate, ventilation, early IV/IO access to administer medications

Treat reversible causes: hypovolemia, hypoxia, acidosis, hyper/hypokalemia, hypothermia, toxins, ischemia

### Shock-CPR-Shock Cycles

1. Shock first (200J biphasic or 360J monophasic)
   - If defibrillator not immediately available start CPR then shock ASAP
   - High quality CPR for 2 min
     - Push hard (2-2.4 inches) and fast (100-120/min), complete chest recoil, minimize interruptions, avoid excessive ventilations (10/min), change compressors q2min, monitor end-tidal $CO_2$
   - 3 Shock

### Drugs provided during CPR

- **Epinephrine**: 1mg IV q3-5min
- **Amiodarone**: 300mg IV bolus (preferred), 150mg IV (2nd dose)
- **Lidocaine** for refractory VF: 1.5mg/kg IV q3-5min (max 3mg/kg)
- **Magnesium sulfate** for polymorphic VT: 2g IV
### Wide Complex Tachycardia (85-95% = VT)

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess ABCs if stable, monitors, O₂, vitals, IV access, ECG, CXR</td>
</tr>
<tr>
<td><strong>Unstable</strong></td>
</tr>
<tr>
<td>Prepare for synchronized cardioversion (200J biphasic or 360J monophasic)</td>
</tr>
<tr>
<td>Consider premedication</td>
</tr>
<tr>
<td><strong>Stable</strong></td>
</tr>
<tr>
<td>Procainamide: 20-50mg/min (max 17mg/kg)</td>
</tr>
<tr>
<td>Amiodarone: 150mg over 10 mins (repeat x2 PRN)</td>
</tr>
<tr>
<td>Magnesium sulfate for polymorphic VT: 2g IV</td>
</tr>
<tr>
<td><em>Avoid multiple antidysrhythmics sequentially (to prevent proarrhythmogenic effects). If one fails, go to electrical cardioversion.</em></td>
</tr>
</tbody>
</table>

### Paroxysmal Supraventricular Tachycardia (AVnRT, AVRT)

<table>
<thead>
<tr>
<th>Unstable</th>
<th>Chest pain, SOB, LOC, low BP, CHF, AMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronized cardioversion (150J biphasic or 300J monophasic)</td>
<td></td>
</tr>
<tr>
<td>Consider premedication</td>
<td></td>
</tr>
<tr>
<td><strong>Stable</strong></td>
<td></td>
</tr>
<tr>
<td>Vagal manoeuvres</td>
<td></td>
</tr>
<tr>
<td>Adenosine: 6mg IV over 3 secs (1st dose), 12mg IV (2nd dose)</td>
<td></td>
</tr>
<tr>
<td>Diltiazem: 20mg IV over 2 min (1st dose), 25mg IV (2nd dose)</td>
<td></td>
</tr>
<tr>
<td>Metoprolol: 5mg IV (max 15mg)</td>
<td></td>
</tr>
<tr>
<td>Verapamil: 2.5-5mg IV over 2 min, repeat 5-10mg in 10 mins</td>
<td></td>
</tr>
</tbody>
</table>

### Pulseless Electrical Activity or Asystole

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubate, ventilation, early IV/IO access to administer medications, POCUS</td>
</tr>
<tr>
<td><strong>Management</strong></td>
</tr>
<tr>
<td>1 Ongoing CPR</td>
</tr>
<tr>
<td>2 Treat reversible causes: 5Hs (hypovolemia, hypoxia, hydrogen acidosis, hyper/hypokalemia, hypothermia) and 5Ts (toxins, tamponade, tension pneumothorax, thrombosis - coronary, thrombosis - pulmonary)</td>
</tr>
<tr>
<td>3 Epinephrine 1mg IV q3-5mins</td>
</tr>
</tbody>
</table>

### Bradycardia (HR < 60)

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCs, monitors, O₂, vitals, IV access</td>
</tr>
<tr>
<td><strong>Unstable</strong></td>
</tr>
<tr>
<td>Atropine 0.5mg q3-5min (max 3mg) - Not effective for 3° heart block</td>
</tr>
<tr>
<td>Transcutaneous pacing → Transvenous pacing</td>
</tr>
<tr>
<td>Consider infusions: Dopamine 2-10mcg/kg/min OR Epinephrine 2-10mcg/min</td>
</tr>
<tr>
<td><strong>Stable</strong></td>
</tr>
<tr>
<td>1° AV block or Type I 2° AV block: Observe</td>
</tr>
<tr>
<td>Type II 2° AV block or 3° AV block: transcutaneous pacing → transvenous pacing</td>
</tr>
</tbody>
</table>