OTTAWA

Ottawa Handbook of Emergency Medicine

Second Edition

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Preface

Introduction

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 ensure 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
Author and Editor

How to Use this Guide

Topics are subdivided according to **background**, **assessment**, **investigations**, and **management**. 🔍 indicates there are images.

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 (e.g. low GCS, airway trauma)
Failure to ventilate/oxygenate (e.g. low or declining SpO_2, rising pCO_2)
Anticipatory (e.g. trauma, overdose, inhalation injury, anaphylaxis, inc. WOB)

Assessment

Difficult Bag-Valve Mask Ventilation "BOOTS"
B = Beard; **O** = Obese; **O** = Older; **T** = Toothless; **S** = Snores/Stridor
Difficult Intubation
Look for gestalt signs. Evaluate the 3-3-2 rule. Check for signs of obstruction, swelling, trauma. Assess neck mobility. **Upper lip bite test:** Concern if patient cannot bite past vermillion border
Difficult Supraglottic Device "RODS"
R = **R**estricted mouth opening; **O** = **O**bstruction, **O**bese **D** = **D**isrupted or **D**istorted anatomy; **S** = **S**tiff lung or cervical **S**pine

Airway Techniques

Temporizing Measures
Chin lift/jaw thrust, BVM, suctioning, nasal airway, oral airway, LMA
Definitive Airway
Orotracheal/nasotracheal intubation, surgical airway (percutaneous or open cric)

Airway Methods

-Rapid Sequence Intubation (RSI)
-Awake oral intubation
-Oral intubation without any agents (ie. "crash" airway)

Rescue Airways

-LMA
-Cricothyroidotomy

Rapid Sequence Intubation (6Ps)

Preparation
Prepare equipment and medications, use checklist if available
Pre-Oxygenation
100% FiO_2, employ PEEP valve to improve recruitment
Pre-Treatment (Optional)
Increased ICP: fentanyl 3mcg/kg Hypotension: fluids/vasopressors (infusion or push-dose) Acidosis: bicarb (controversial), consider maintaining spontaneous respiration Anxiolysis: midazolam 2-4mg
Positioning
Sniffing position, ramped position if obese, adjust bed height
Paralysis with Induction
Administration of sedative (i.e. ketamine, propofol, etomidate) followed by muscle relaxant if indicated (i.e. succinylcholine or rocuronium)
Place Tube with Proof
Intubate patient and confirm tube placement (continuous waveform EtCO2)
Post-Intubation Management
Post-intubation analgesia, ongoing sedation, ventilator management, further resuscitation.

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 1. Emergency Medicine Journal 2005; 22(2): 99-102.

Breathing

Definitions

Acute respiratory failure = pO_2 <50mmHg +/- pCO_2 >45mmHg
Hypoxic Respiratory Failure
Diffusion problem: pneumonia, ARDS V/Q mismatch: PE, Asthma, COPD Shunt Low ambient FiO_2: high altitude Alveolar hypoventilation
Hypercarbic Respiratory Failure, 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
Hypercarbic Respiratory Failure, Abnormal Lungs
Increased airway resistance: AECOPD, asthma exacerbation Decreased gas exchange: scarring, IPF

Assessment

Look	Listen	Feel
Mental status, colour, chest wall movement, accessory muscle use Paradoxical abdominal movement	Auscultate for breath sounds Signs of obstruction Air entering or escaping Wheeze and stridor	Tracheal deviation, crepitus, flail segments, chest wounds

Investigations

Labs: CBC, electrolytes, cardiac enzymes +/- D-dimer +/- BNP, VBG
Tests: POCUS, CXR +/- CT Chest

Management of Breathing

Spontaneously Breathing Patient
Nasal prongs Face mask, Non-rebreather face mask High flow nasal oxygenation (ie. MaxTech)
Temporizing Measures for Inadequate Ventilation
Bag-valve mask +/- nasal airway CPAP/BiPAP: acute exacerbations of CHF, COPD, asthma
Definitive Measures for Inability to Maintain/Protect Airway
Oro-tracheal intubation Surgical airway
Additional Modalities
Needle or finger thoracostomy for tension pneumothorax Chest tube to drain pleural effusion/hemothorax/pneumothorax

Key References: Journal of Critical Care 2016; 34: 111-115. Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 2.

Circulation

Causes of Shock

Hypovolemic Shock	Hemorrhage GI losses	Third spacing Dehydration Overdiuresis
Obstructive Shock (Intra-Thoracic)	Pulmonary embolism Cardiac tamponade Tension pneumothorax	Valvular dysfunction Congenital heart disease Air embolism
Distributive Shock (Vasodilation)	Septic shock Anaphylactic shock Neurogenic shock	Drug overdose Adrenal crisis
Cardiogenic Shock	ACS Cardiomyopathy	Cardiac structural damage Dysrhythmias

Assessment

Clinical symptoms and signs suggestive of shock	
Vitals: ↑HR, ↓BP, ↑RR	High initial lactate
Urine Output <0.5mL/kg/hr	Skin mottling
Capillary refill time > 3 secs	Altered mental status

Investigations

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

Management

Perfusion Goals
Urine Output >0.5mL/kg/h, MAP >65mmHg, improved mentation, improved cap refill time, lactate clearance (poor evidence)
Hemorrhagic Hypovolemic Shock: fill the tank
Control hemorrhage (tourniquets, direct compression, pelvic binders) Fluids until blood available, blood product transfusion (1:1:1 of pRBCs:platelets:FFP)
Obstructive Shock: alleviate obstruction
Tension pneumothorax: needle decompression then chest tube Cardiac tamponade: IV crystalloids, pericardiocentesis PE: IV crystalloid, inotropes, thrombolysis
Distributive Shock: source control, squeeze the pipes
Anaphylaxis: Epinephrine IM, IV crystalloids, antihistamines, corticosteroids Sepsis: Broad-spectrum antibiotics, IV crystalloids +/- norepinephrine
Cardiogenic Shock: support forward flow
Norepinephrine 5mcg/min, dobutamine 2.5 mcg/kg/min Treat underlying cause: cath lab, mechanical circulatory support (IABP, Impella, VAD, ECMO), heart transplant
Cellular Toxins
Antidotes for various toxins (see toxicology)

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 6.

Trauma Resuscitation

Primary Survey

1. Airway	3. Circulation
Assess patency of airway, look for obstruction (blood, emesis, teeth, foreign body), ensure C-spine precautions, airway management	Assess LOC, signs of shock (HR, BP, skin color, urine output, base deficits), sources of bleeding (external, chest, abdomen, pelvis, femur)
2. Breathing	**4. Disability**
Expose chest, assess breathing, auscultate for breath sounds, rule out tension pneumothorax	GCS assessment Neurological evaluation
5. Exposure/Environment	
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	
Adjuncts	
eFAST Exam: subxiphoid pericardial window, perisplenic, hepatorenal, pelvic/retrovesical, bilateral anterior lung **Portable X-ray:** chest, pelvis, grossly deformed limbs **ECG:** evaluate for dysrhythmias	

Investigations

Bloodwork: CBC, lytes, BUN, Cr, glucose, lactate, INR/PTT, fibrinogen, B-hCG, tox bloodwork, T+C, U/A
Imaging: CT (selective vs. pan-scan) - for stable patients; unstable patients may require emergent OR

Trauma Triad of Death
Coagulopathy Hypothermia Acidosis

Management

General Resuscitation
Immediate hemorrhage control (Stop the Bleed) Blood transfusion: balanced resuscitation to avoid dilutional coagulopathy Tranexamic acid: 1g IV over 10 minutes then 1g IV over 8 hours Consider permissive hypotension
Head Trauma
Seizure management/prophylaxis, treat suspected raised ICP, neurosurgical intervention for severe head injury/bleeds
Spinal Cord Trauma
Complete immobilization, treat neurogenic shock, consult spine service
Chest Trauma
Airway management, bedside resuscitative thoracotomy in arrest, surgery for life-threatening lung, diaphragmatic, esophageal, aortic, myocardial injuries
Abdominal Trauma
Laparotomy for hemodynamically unstable and hollow organ injuries
Orthopedic Injuries
Reduce and immobilize when possible, irrigate open fractures, assess for neurovascular and skin compromise, adequate analgesia, consult ortho

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 36. ATLS Manual, ACS – 9th ed, 2012.

Symptoms Approach

Syncope

Definition: sudden and transient loss of consciousness and 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 Exam: cardiac exam (murmurs, rate), CNS exam

Investigations

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

ECG intervals	ECG rates
Short PR: WPW Long PR: conduction blocks Deep QRS: HOCM Wide QRS: BBB, Vtach, WPW QT intervals: Long QT syndromes	Tachydysrhythmias: SVT, Afib, Vtach, Vfib Bradyarrhythmias: AV conduction blocks, sinus node dysfunction

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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 15. CMAJ 2011; 183(15): 1694-1695. CMAJ 2016; 188(12): E298.

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 Exam: 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, toxicology panel

Tests: ECG, CXR, CT head

Management

General
Monitors, oxygen, vitals, IV access Airway management for declining GCS and inability to protect airway
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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 16.

Headache

Common Types

Migraine: **POUND** (**p**ulsatile, **o**nset 4-72hrs, **u**nilateral, **N**/V, **d**isabling intensity), photophobia/phonophobia, chronic, recurrent, +/- aura
Cluster: unilateral sudden sharp retro-orbital pain, <3 hours 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

Intra-cranial	Extra-cranial
Bleed: epidural, subdural, subarachnoid, intracerebral hemorrhage **Infection:** meningitis, encephalitis, brain abscess **Increased ICP:** mass, cerebral venous sinus thrombosis	Acute angle closure glaucoma Temporal arteritis Carotid artery dissection CO Poisoning Pregnancy-related headaches

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 Exam: 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

Common Benign Headache Regimen
Fluids: No clear evidence but consider in dehydrated patient **Antidopaminergic:** Metoclopramide 10mg IV **Antihistamine:** Diphenhydramine 25mg IV **Analgesic:** Acetaminophen 1g PO **NSAIDs:** Ketorolac 15-30mg IV or Ibuprofen 600mg PO **Steroids:** Dexamethasone 10mg PO/IV (rebound migraine prophylaxis)
Non-Traditional Uses
Cluster Headaches: oxygen, sumatriptan, verapamil **Refractory Headaches:** magnesium, lidocaine, propofol, ketamine, valproate **Nerve Blocks:** greater occipital nerve, sphenopalatine block, trigger points

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 20. Headache 2016; 56: 911-940.

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

Pulmonary	Cardiac
Airway obstruction Respiratory failure (refer to Type 1 vs Type 2 in "Breathing" section) Anaphylaxis Pulmonary embolism Tension pneumothorax	Pulmonary edema Myocardial infarction Cardiac tamponade Pericardial effusion Arrhythmias
Toxic-metabolic	**Neuro-endocrine**
Toxin ingestion (organophosphates, CO poisoning) Sepsis Acidosis (DKA, lactic, etc.)	Thyrotoxicosis Guillain-Barre syndrome Amyotrophic lateral sclerosis Multiple sclerosis

Assessment

History: OPQRST, recent travel, trauma, PE risk factors (Wells Criteria, PERC rule), sick contacts
Physical Exam: appearance, signs of respiratory distress, cardiac/resp exam

Investigations

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

Management

General
Monitors, oxygen, vitals, IV access, ABCs
Intubate
If not protecting airway or significant respiratory distress
Empiric Treatment
Trauma: ATLS guidelines **Anaphylaxis:** epinephrine, antihistamines, steroids, fluids **Cardiac causes:** see various cardiac sections below **Asthma/COPD:** oxygen, bronchodilators, corticosteroids +/- antibiotics **Infection:** antibiotics, consider broad-spectrum if septic

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 25.

Chest Pain

Differential Diagnosis

Deadly Six (PET MAC)	Cardiac
Pulmonary embolism **E**sophageal rupture/mediastinitis **T**ension pneumothorax **M**yocardial infarction **A**ortic dissection **C**ardiac tamponade	Pericarditis Myocarditis Endocarditis
Respiratory	**GI**
Pneumonia Pleural effusion Acute chest syndrome (sickle cell) Lung or mediastinal mass	**Esophagus** – Mallory-Weiss tear, esophageal spasm **Stomach** – GERD, dyspepsia/PUD **Pancreas** - pancreatitis **Gallbladder** - biliary colic, cholecystitis, cholangitis
MSK	**Other**
Intramuscular pain Rib pathology	Panic attack Herpes Zoster

Assessment

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

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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 26.

Chest Pain Risk Stratification

HEART Score

Inclusion Criteria	Exclusion Criteria
Patients ≥21 years old presenting with symptoms suggestive of ACS	New STEMI >1mm or other new ECG changes, hypotension, life expectancy <1 year, noncardiac medical/surgical/psychiatric illness

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	
Scores 0-3: 0.9 – 1.7% risk of MACE Score 4-6: 12-16.6% risk of MACE Score ≥7: 50-65% risk of MACE	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

Inclusion Criteria	Exclusion Criteria
Patients where pre-test probability of PE is considered to be low-risk (<15%)	Moderate to high risk for PE

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

Age ≥50, HR ≥100, SaO_2 <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: Neth Heart J. 2008; 16(6): 191-6. J Thromb Haemost 2008; 6(5): 772-80.

Abdominal Pain

Differential Diagnosis

RUQ	Epigastrium	LUQ
Hepatitis Biliary colic Cholecystitis/Cholangitis* Pancreatitis* Pneumonia Pleural effusion PE*	Gastritis Dyspepsia/PUD Duodenitis Pancreatitis* Cardiac – ACS*	Pancreatitis* Gastritis Pneumonia Pleural effusion PE*
Right Flank	**Umbilicus**	**Left Flank**
Colitis Perforation* Obstruction* Renal colic Pyelonephritis AAA*	Colitis Perforation* Obstruction* Aortic dissection* AAA* Early appendicitis	Colitis Perforation* Obstruction* Renal colic Pyelonephritis AAA*
RLQ	**Hypogastric**	**LLQ**
Appendicitis Ectopic pregnancy* PID, TOA Testicular torsion, epididymitis, orchitis Ovarian torsion Renal colic	UTI (Cystitis) Renal colic Obstruction	Diverticulitis* Ectopic pregnancy* PID, TOA Testicular torsion, epididymitis, orchitis Ovarian torsion Renal colic

Can't-Miss Diagnoses*	Risk Factors
Ruptured Ectopic	Hx of STI/PID, recent IUD, previous ectopic, smoking, fallopian tube surgery, tubal ligation
Ruptured AAA	Elderly, hx HTN/DM, smoking, trauma hx
Pancreatitis	Alcohol use, biliary pathology
Cholangitis	Charcot's Triad: fever, RUQ pain, jaundice
Mesenteric Ischemia	Elderly, CAD, CHF, dehydration, infection
Obstruction	Operative or malignant history, elderly
Perforated Viscus	Risk factors for diverticulitis or PUD, malignancy or instrumentation (i.e. colonoscopy)
Comp. Diverticulitis	Elderly, low-fibre diet, Western population

Assessment

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

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

Investigations

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

Tests: ECG, CXR, POCUS

Radiology performed 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

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

Assessment

History: OPQRST, associated symptoms (vaginal bleeding, discharge, dyspareunia, bowel or bladder symptoms), pregnancy and sexual history
Physical Exam: 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: PoCUS – 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 (cefoxitin 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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 33.

Back Pain

Deadly Differential Diagnosis

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

Assessment

History: fracture history, cancer risk, infection risk, steroid use, **red flags** (**BACK PAIN**): **B**owel/Bladder dysfunction, **A**nesthesia (saddle), **C**onstitutional symptoms (night pain, weight loss, fever/chills), **C**hronic disease, **P**aresthesias, **A**ge >50, **I**VDU/infection, **N**eurological 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

Cauda Equina Syndrome
Urgent MRI, spine consult, analgesia, IV dexamethasone
Aortic Dissection
Immediate specialist consultation, IV labetalol to control HR and BP
Ruptured AAA
Blood resuscitation, immediate OR if unstable
Epidural Abscess or Vertebral Osteomyelitis
MRI to definitively diagnose +/- bone scan (osteomyelitis), broad spectrum antibiotics, orthopedics consult
MSK Back Pain
Analgesia: Acetaminophen, NSAIDs Multidisciplinary approach with GP follow-up

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 35.

Selected 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 (vancomycin)

Diagnostic Criteria:

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

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. 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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 109. The World Allergy Organization Journal 2011; 4(2): 13-37.

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):

Respiratory Arrest/Fatal
Appearance: altered mental status, cyanotic, decreased resp. effort Vitals: low HR, high RR, low O_2 sat <90% despite oxygen Exam: Silent chest – consider preparing for advanced airway intervention
Severe
Appearance: agitated, diaphoretic, labored respirations, difficulty speaking Vitals: high HR, high BP, O_2 sat 90-95% Exam: worsening resp. distress, exp/insp. wheezing, FEV1 <40% predicted
Moderate
Appearance: SOB at rest, cough, congestion, nocturnal symptoms Vitals: O_2 sat >95% Exam: exp. wheezing, FEV1 40-60% predicted
Mild
Appearance: SOBOE, chest tightness Vitals: O_2 sat >95% Exam: exp. wheezing, FEV1 >60% predicted

Assessment

History: triggers, recent infection, thorough asthma hx including prior exacerbations, hospitalizations + interventions/ICU stays, family history
Asthma Control Criteria: daytime symptoms <4/week, no exercise limitation, no absenteeism, no nocturnal symptoms, rescue puffer <4/week, normal PFT, exacerbations mild/infrequent
Physical Exam: 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")
Ipratropium bromide 0.5mg neb OR 4-8 puffs via MDI+spacer q20mins x 3 Salbutamol 5mg neb OR 4-8 puffs via MDI+spacer q20mins x 3 Prednisone 50mg oral **NOTE:** MDIs are superior to nebs unless patient too tachypneic to use MDI
Severe Asthma
$MgSO_4$ 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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 73. CMAJ 1996; 155(1): 25-37.

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), co-morbidities, 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 O_2 sat

Investigations

Labs: CBC, electrolytes, VBG, lactate
Tests: CXR, ECG, pulse oximetry

Management

Oxygen
Venturi masks (high-flow devices) preferred over nasal prongs **Target SaO_2: >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: 1) ↑ sputum production 2) ↑ sputum purulence 3) ↑ 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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 74. Am J Respir Crit Care Med 2013; 187(4):347-365.

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 or 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 angina, increased duration of pain or threshold, or decreased response of previously effective angina meds
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 Exam: 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
Atorvastatin 80 mg PO in STEMI. Do NOT delay transfer to cath lab for statin No role for initiating ACEi or B-blocker in the ED ACEi, B-blocker + statins likely to be initiated during hospital admission (<24-48 hrs from time 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 (i.e. hypothyroidism), toxins, congenital

Precipitants of CHF exacerbation

Cardiac	Medications
Ischemia, dysrhythmias, mechanical complications (i.e. papillary muscle rupture)	Forgot meds, negative inotropes (CCB, b-blocker), NSAIDs, steroids
High Cardiac Output	**Other**
Anemia, infection, pregnancy, hyperthyroidism	Lifestyle (high salt intake), renal failure, PE, HTN

Assessment

Symptoms	Signs
Left-sided: SOB, PND, fatigue, orthopnea, angina, syncope, altered mental status, cough + wheeze (pulmonary congestion) **Right-sided:** fatigue, abdominal distension, leg swelling, weight gain, nocturia	**General:** Tachypnea, tachycardia, hypertension, hypotension, weak pulses **Left-sided:** hypoxia, crackles, wheezes, S3 or S4 **Right-sided:** pitting edema, JVP elevation, hepatomegaly, ascites

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% O_2 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: double home dose, 20 mg IV if furosemide naive
Second-line
Double furosemide dose Nitroglycerin infusion if acute distress (start 10 mcg/min and titrate) If hypotensive (sBP<90): norepinephrine 2-12 mcg/min or dobutamine 2.5mcg/kg/min

Key References: Canadian Journal Cardiology 2007; 23(1): 21-45. Circulation 2009; 119: 1977-2016. Journal of Cardiac Failure 2010; 16(6): e134-156

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

Bradydysrhythmias and AV Conduction Clocks
1^0 = prolonged PR interval 2^0 **(Mobitz I)** = gradual PR interval prolongation then QRS drop 2^0 **(Mobitz II)** = PR interval constant with QRS drop 3^0 = P wave and QRS complex unrelated, PP and RR intervals constant
Supraventricular Tachydysrhythmias (narrow QRS)
Regular rhythm Atrial: sinus tachycardia, atrial tachycardia, atrial flutter AV: SVT (AVNRT > AVRT), junctional tachycardia **Irregular rhythm** Atrial: atrial fibrillation, multifocal atrial tachycardia, SVT w/ aberrancy
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)

Bradycardia Algorithm
Atropine 0.5mg IV bolus q3-5mins x 6 +/- infusions: dopamine 2-10 mcg/kg/min OR epi 2-10 mcg/min If ineffective: transcutaneous pacing, prepare for IV pacing Type II 2^0 AV block OR 3^0 AV block: transcutaneous pacing
Tachycardia Algorithm
Synchronized cardioversion (with premedication)
Atrial Fibrillation/Atrial Flutter
Synchronized cardioversion (higher risk of stroke if rhythm >48hrs and patient not anticoagulated)
VF/pVT
Shock-CPR-pulse rhythm check cycles, epinephrine 1mg IV q3-5mins, consider amiodarone 300mg IV bolus with 2nd dose 150mg IV
PEA/Asystole
CPR, airway support, IV access, epinephrine 1mg IV q3-5mins

*See detailed **ACLS algorithms** in a separate section

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 6. Heart & Stroke Foundation: ACLS provider manual – 2015.

Vascular Emergencies

Ruptured AAA

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

AAA <5cm	AAA 5cm - 7cm	AAA >7cm
0.3% risk of rupture/yr	10% risk of rupture/yr	20% risk of rupture/yr

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, neurological 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 – 100mmHg 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** - Spinal cord ischemia, CVA, visceral ischemia, erectile dysfunction **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): **p**ain, **p**aresthesia, **p**allor, **p**olar (cold), **p**ulselessness, **p**aralysis (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)

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 86+87. NEJM 2012; 366(23): 2198-2206. *BMJ* 2000; 320: 854-857.

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

Modified Wells Criteria for DVT	Wells Criteria for PE
+1 Active cancer **+1** Paralysis, paresis, or recent immobilization of lower limb **+1** Bedridden >3 days or major surgery in last 12 weeks **+1** Tenderness along DV system **+1** Entire leg swollen **+1** Calf swelling 3cm > asymp. side **+1** Pitting edema in symptomatic leg **+1** Superficial non-varicose veins **+1** Previous DVT **-2** Alternative diagnosis **Results:** DVT unlikely = score ≤1 DVT likely = score ≥2	**+3** Signs + symptoms of DVT **+3** PE = #1 diagnosis **+1.5** HR >100 **+1.5** Immobilization >3 days OR surgery in last 4 weeks **+1.5** Hx DVT/PE **+1** Hemoptysis **+1** Active cancer **Results:** Non-high risk = 0-4 points High risk = >4 points
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, 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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 88. J Thromb Haemost 2008; 6:772-80. NEJM 2003; 349(13):1227-35.

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 Exam: 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 (i.e. Abx, steroids) Colonoscopy to evaluate cause of bleeding

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 30.

Stroke

Definition

ACA stroke
Leg > face/arm contralateral motor + sensory deficits Bowel and bladder incontinence Impaired judgement/insight
MCA stroke
Face/arm > leg contralateral motor + sensory deficits Contralateral hemianopia; gaze preference towards lesion Aphasia (dominant) or neglect (non-dominant)
PICA stroke (Wallenberg syndrome)
Pain/temperature loss on contralateral side + ipsilateral face Ipsilateral Horner's-like syndrome 4D's: dysphagia, diplopia, dysarthria, dysphonia

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)

Investigations

Labs: CBC, lytes, extended lytes, glucose, BUN, Cr, INR, PTT
ECG: rule out Afib
Neuroimaging: acute stroke protocol (CT/CTA immediately)

Management

General
ABCs, monitors, oxygen, vitals, IV access +/- intubation (declining GCS, evolving symptoms, or presumed hemorrhagic transformation) BP control: lower if HTN severe (>220/120), BP < 185/110 if giving tPA **Consult neurology,** admission to stroke unit
Antiplatelet Therapy
Don't give acutely, start ASA daily once discharged
Stroke time windows
tPA < 4.5 hours Endovascular therapy < 6 hours Consideration of endovascular therapy (in consultation with stroke team) upto 12 hours
Stroke Prevention
Primary: stratify based on $CHADS_2$ (stroke risk with Afib), Ottawa TIA Risk Score, Rx ASA or DOACs Secondary: oral anticoagulation started 1-2 weeks post stroke

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 101. NEJM 1995; 333:1581-1588. AMJ Neuroradiol 2001; 22:1534-1542.

Transient Ischemic Attack

Definitions

TIA Definition (Canadian Stroke Best Practices)
A brief episode of neurological dysfunction caused by focal brain, spinal cord or retinal ischemia without imaging evidence of acute infarction, typically resolving within one hour.
Very High-risk TIA
Symptom onset **within 48 hours** Motor or speech disturbance Sensory loss, vision loss Posterior circulation stroke: diplopia, dysarthria, dysphagia, ataxia
High-risk TIA
Symptom onset **between 48 hours and 2 weeks** Motor or speech disturbance
Moderate-risk TIAs
Symptom onset **between 48 hours and 2 weeks** Sensory loss, vision loss Posterior circulation stroke: binocular diplopia, dysarthria, dysphagia, ataxia
Low-risk TIAs
Symptom onset **greater than 2 weeks**

Assessment

History: time of onset, differentiate between motor, speech and vision disturbances

Physical Exam: vitals, neurological exam, look for functional comorbidities, CV exam (dissection, arrhythmias, valvular pathology)

Investigations

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

ECG: rule out Afib

Neuroimaging: very high to high-risk TIAs (CTA head/neck), low to moderate-risk TIAs (non-contrast CT head)

Management

General
ABCs, monitors, oxygen, vitals, IV access +/- intubation (declining GCS, evolving symptoms, or hemorrhagic transformation)
High-risk TIA features
Loading dose: Clopidogrel 300mg PO + ASA 160mg PO Dual antiplatelet therapy: Clopidogrel 75mg PO daily + ASA 81mg PO daily Monotherapy (after 21 days): ASA 81mg PO daily
Low-risk TIA features
ASA 81mg PO daily
Disposition
Stroke clinic follow-up within 3 weeks Risk stratification: $CHADS_2$ (stroke risk with Afib), Ottawa TIA Risk Score Outpatient carotid dopplers or CT angiogram +/- endarterectomy

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 101. Canadian Stroke Best Practices, 2018. Stroke 2018; 49:2278-2279.

Diabetic Emergencies

Definitions

DKA	HHS
Predominantly Type 1 DM Insulin deficiency + stressor → counter-regulatory hormone excess → ↑ lipolysis (ketoacidosis) and osmotic diuresis (dehydration) **Serum glucose:** >16 mmol/L **Other labs:** HCO3<15, pH <7.3 **Onset:** hours to days **Features:** dehydration, 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
Stressor (7 Is): infection, infarction, intoxication, insulin (dose changed/missed), incision (surgery), initial (diagnosis), impregnated	

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, VBG, lactate +/- cultures, B-HCG, 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 (i.e. need to manage MI or sepsis in hospital)
Education: diet, insulin administration, fluid replacement

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 118.

Sepsis

Definitions

Sepsis	
Life threatening organ dysfunction caused by a dysregulated host response to infection with a SOFA score ≥ 2	
Septic Shock	
Vasopressor requirement to maintain a MAP ≥ 65 Serum lactate ≥ 2mmol/L in the absence of hypovolemia	
Clinical tools to aid in sepsis recognition	
SIRS	2 or more of: T <36 or >38.3 | HR >90 | RR >20 or CO2 <32 | WBC <4 or >12
qSOFA	2 or more of: GCS < 15 | RR ≥ 22 | sBP < 100

Assessment

History: associated symptoms, full review of systems, co-morbidities
Physical Exam: vitals, volume status, look for a focus (respiratory, urine, abdomen, skin, blood, brain), permanent lines

Investigations

Full Septic Workup: CBC, lytes, extended lytes, BUN/Cr, LFTs, VBG, lactate, INR/PTT, blood C+S, 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 Early antibiotics (within 1 hour), crystalloids (RL > NS) Endpoints: MAP > 65, capillary refill time, lactate clearance, urine output
Resuscitation
Crystalloids: Ringer's Lactate for patients with hypotension or lactate ≥ 4 **Vasopressors:** norepinephrine 5-10 mcg/min (if not fluid responsive), vasopressin 0.04 U/min (if moderate doses of NE being used) **Steroids:** if refractory to fluids + pressors, or on chronic steroids
Antibiotics
Empiric treatment: Pip-Tazo 3.375g IV +/- Vancomycin 1g-1.5g IV Respiratory: Ceftriaxone 2g IV + Azithromycin 500mg IV Urinary: Ceftriaxone 2g IV + Tobramycin 3-5mg/kg (single dose) Meningitic doses: Ceftriaxone 2g IV + Vancomycin 2g IV + dexamethasone 10mg IV +/- Acyclovir 1g IV (for HSV encephalitis)
Disposition
Admission to medicine +/- ICU (if requiring vasopressors or intubated)

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 6. NEJM 2001; 345(19): 1368-77. JAMA 2016; 315(8): 801-10. Crit Care Med 2017; 45(3): 486-552. JAMA 2019; 321(7): 654-664. AJRCCM 2019; 199(9): 1097-1105.

Electrolyte Disturbances

History: review of systems, neurologic symptoms (headache, lethargy, weakness, muscle cramps, ↓ LOC, personality changes, seizures), 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, septra), 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-renal 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: $MgSO_4$ 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), euvolemic (SIADH), hypovolemic (adrenal insufficiency, vomiting, diarrhea, diuretics, poor PO fluid intake)
Management
Known acute (<24-48h) [Na]<120 or symptomatic (↓ 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, multiple myeloma), hyperPTH, granulomatous diseases, meds (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.

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 117.

ENT Emergencies - Vertigo

Important Causes

Benign Paroxysmal Positional Vertigo (BPPV)
Short lived (20-30 secs) vertigo brought on by lying down, turning over or getting out of bed. Resolves when still. **No spontaneous nystagmus.**
Vestibular Neuritis
Hours or days of constant severe vertigo, worse with head movements. Difficult with gait. **Spontaneous or gaze evoked nystagmus** in first few days. Resolves over a few weeks.
Posterior Circulation Stroke
Can present similar to vestibular neuritis. May have focal paresthesia, weakness, headache or neck pain, and deadly Ds (dysarthria, diplopia, dysmetria, dysphonia, dysphagia).
Vestibular Migraine
Often under-diagnosed. Multiple episodes of dizziness lasting minutes to days. History of migraines. Half of the episodes have either typical migraine headache, and/or associated photophobia/phonophobia.

Other less common causes: Meniere's, multiple sclerosis, labyrinthitis, other central causes (cerebellar hemorrhage, PICA stroke, head trauma)

Assessment

Positional testing (Dix-Hallpike or Roll Test): if short episodes initiated with head movement and without spontaneous or gaze evoked nystagmus.
HINTS exam: if constant vertigo and nystagmus present.
Central cause: neuro exam, gait and coordination exam

Dix-Hallpike Test (diagnose posterior-canal BPPV)
Head turned 45^0 to one side while patient sitting. Patient moved to supine position with head hanging over edge of bed. Observe for vertical upward or rotatory nystagmus. Repeat with patient looking 45^0 in other direction.
Roll Test (diagnose horizontal-canal BPPV)
Patient initially supine, head on bed. Turn head 90^0 to one side, observe for horizontal nystagmus. Both sides will show horizontal nystagmus.
HINTS Exam (differentiate vestibular neuritis vs. posterior stroke)
Must have all three to be diagnosed vestibular neuritis: **Head Impulse:** corrective saccade as examiner turns head away from direction of spontaneous nystagmus **Nystagmus:** unidirectional horizontal/rotatory nystagmus **Test of Skew:** No vertical or slanted eye movements on cover-uncover test

Management

Peripheral
Epley's Maneuver for PC BPPV, Gufoni for HC BPPV. Consider steroids for vestibular neuritis (evidence poor)
Central
Neuroimaging, neuro consult +/- stroke management

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 19.

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

General
ABCs, vitals, volume assessment **Initial step:** compress cartilaginous part of nose x 20 mins **Next step:** compress with lidocaine/epinephrine/decongestant-soaked pledget +/- topical TXA +/- Silver nitrate if able to identify site
Anterior Bleeds (90% Kesselbach's plexus)
Anterior packing: nasal tampon, rhino rockets or Vaseline gauze pack Apply anterior pack to active side first, if ineffective, pack both nares
Posterior Bleeds
Epistat or Foley catheter. Apply traction once inserted. Keflex x 5d course or until pack removal to prevent TSS

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	
Age 3-14 years old = **+1** 15-44 years old = **0** >44 years old = **-1**	**Tonsillar exudates = +1** **Tender anterior cervical lymph nodes = +1** **Temp >38^{0}C = +1** **Absent cough = +1**

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 - 8th ed, 2014; Chapter 23+72.

Urological Emergencies

Renal Colic

Risk Factors: hereditary (RTA, G6PD deficiency, cystinuria, oxaluria), lifestyle (minimal fluid intake, excess vit 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, complicated 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 nor 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 6mg IV + ketorolac 30mg IM/IV or Naproxen 500mg PO
MET	Tamsulosin 0.4mg PO OD x3 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
Septra DS PO BID x 3 days Macrobid 100mg BID x 5 days If suspected STI: Levofloxacin 500mg po daily x 1 week + CTX 250mg IM x1
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

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 99. NEJM 2014; 371(12):1100-10. Cochrane DB Syst Rev 2014;4:CD008509

Environmental Emergencies

Hypothermia (T < 35^{0}C)

Causes: ↑ heat loss (EtOH, environmental), ↓ 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 (32^0 – 35^{0}C): excitation response (↑ HR/BP/RR, +shivering)

Moderate (28^0 – 32^{0}C): physiologic slowing, NO shivering, AMS, ataxia

Severe (24^0 – 28^{0}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

General
Monitors, O_2, IV access, vitals + rectal, esophageal or Foley temp Remove wet clothes
Cardiac Arrest
Focus on rewarming Ensure NO pulse x 1 min then ACLS protocol (can try 1-3 shocks for Vfib)
Passive Rewarming (T> 32^{0}C)
Cover patients with insulating blanket, let body generate heat
Active Rewarming (T< 32^{0}C)
Warming blankets, radiant heat, place extremities in 45^{0}C water Non-invasive: warm IVF (42^{0}C), warm O_2 Invasive: heated irrigation (pleural, stomach, peritoneal, bladder), dialysis, ECMO

Heat Stroke (T >40.5^{0}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

General	
Monitors, cooled IV fluids, rapid evaporative cooling Antipyretics NOT effective (as not a hypothalamus problem, can also make DIC/liver failure worse)	
Treat Symptoms	
Shivering: midazolam 2mg IV	**Rhabdomyolysis:** IVF, Lasix, NaHCO3
Seizures: Lorazepam 2mg IV	**Hyperkalemia:** protect, shift, eliminate

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 138+139.

Orthopedic Injuries – Upper Limb

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, skin tenting, complications of compartment syndrome, examine joint above and below fracture
Investigations: radiographs as clinically indicated

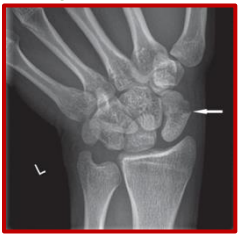
Upper Limb

Distal Radius Fracture: FOOSH. Several fracture patterns. Colle's fracture is most common (distal radial fracture with dorsal displacement, volar apex angulation, and is extra-articular).
Exam: "dinner fork deformity" if dorsally angulated as in Colle's fracture.
Management: hematoma block, reduction to restore radial length and correct dorsal angulation. Success of reduction depends on several factors (intra- vs. extra-articular, comminution, quality of cast mold)

Colle's Fracture

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.

Scaphoid Fracture



Proximal Humeral Fracture: high energy trauma (young), FOOSH (elderly). Neer classification to determine 1/2/3/4 part fracture. Separate part if displaced > 1cm or >45^0 angulation.
Management: minimally displaced (sling or cuff-and-collar immobilization), displaced GT or 2/3/4 part in younger patients (ORIF)

Proximal Humeral Fracture

Boxer's Fracture: blow on distal-dorsal aspect of closed fist. Volar angulation of neck of 5th metacarpal into palm.
Management: closed reduction if angulation >40^0. If stable, ulnar gutter splint for 4-6 weeks.

Boxer's Fracture

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 44, 45, 51, 58.

Orthopedic Injuries – Lower Limb

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, skin tenting, complications of compartment syndrome, examine joint above and below fracture

Investigations: radiographs as clinically indicated, use decision rules for ankle/foot/knee to guide assessment

Lower Limb

Ankle Fracture: inversion/eversion injury. Risk-stratification based on Weber's classification.

Weber A: below syndesmosis – typically stable

Weber B: at level of syndesmosis – can be unstable

Weber C: above level of syndesmosis – always unstable

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

Weber A Fracture

Jones Fracture: Stress injury. Midshaft 5th MT fracture (greater than 15mm from proximal end of 5th MT). High incidence of non-union.

Management: non-WB BK cast x 6 weeks.

Pseudo-Jones Fracture: Traumatic injury. Proximal tubercle of 5th MT (less than 15mm from proximal end of 5th MT). Non-union is uncommon.

Management: protective weight bearing in stiff soled shoe or boot.

Jones Fracture

Hip Fracture: fall (elderly), direct force to hip, rotational force.

Garden I: incomplete, valgus impacted

Garden II: complete, non-displaced

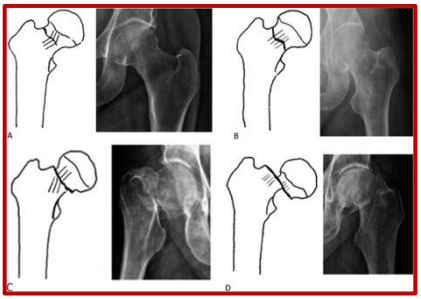
Garden III: complete, partially displaced

Garden IV: complete, fully displaced

Exam: shortened/abducted/externally rotated leg, painful ROM

Management: Elderly may get hemi or total hip arthroplasty. Young adults get ORIF.

Garden Classification



Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 51+58. Clin Orthop Relat Res. 2018 Feb; 476(2): 441–445.

Toxicological Emergencies

Differential Diagnosis

"Hot and Crazy" (DIMES)
Drug-related: sympathomimetics (cocaine, amphetamines, caffeine, PCP, ketamine), anticholinergics, ASA, SS/NMS/MH, EtOH withdrawal **I**nfection: meningitis, encephalitis, sepsis **M**etabolic: hypoglycemia, uremia, electrolytes, thyrotoxicosis, pheo **E**nvironmental: heat stroke **S**tructural: ICH
"Low and Slow" (ABCDO)
ADHD tablets (clonidine) **B**eta-blockers **C**alcium-channel blockers **D**igoxin **O**piates/**O**rganophosphates

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 Antihistamines Antipsychotics Antispasmodics Atropine Carbamazepine
Cholinergics	
Vitals: hypotension, bradycardia **Signs:** miosis, diaphoresis, seizures **Symptoms:** urination, bronchospasm, vomiting, diarrhea	Organophosphates Nerve gas Mushroom Anticholinesterase
Sympathomimetics	
Vitals: hyperthermia, tachycardia, HTN **Signs:** mydriasis, diaphoresis, seizures **Symptoms:** agitation, anxiety	Amphetamines Cocaine LSD Ephedrine
Sedative/Hypnotics	
Vitals: hypothermia, hypotension, bradypnea **Signs:** respiratory depression, miosis (opioids), altered LOC	EtOH, BZDs, GHB Opioids (morphine, heroin, fentanyl) Barbiturates

Basic Approach (ABCDE)

Airway	Intubate early if impending airway compromise
Breathing	Think metabolic derangements if low RR
Circulation	Ensure patient is well perfused
Detect and Correct	Consider universal antidotes (dextrose, oxygen, naloxone, thiamine), correct vitals, correct signs (i.e. seizure), consider decontamination/enhanced elimination
Emergency Antidotes	Specific antidotes and treatments

Pain Management

General Approach: patient-centred, target specific pain syndromes, and use non-pharmacological and pharmacological approaches.

Non-opioid analgesics

Acetaminophen	
First line foundational analgesia Use in combination with NSAIDs to improve efficacy	Tylenol 975mg PO
NSAIDs	
Ibuprofen and Naproxen: best safety profile and least side effects **Ketorolac:** helpful in acute painful condition **Topical NSAID preparations:** added analgesia for acute MSK and joint pain If prescribing NSAIDs, consider concomitant PPI therapy in patients with higher risk of GI bleeds.	Ibuprofen 400mg – 800mg PO Naproxen 500mg PO Ketorolac 10mg – 30mg IM/IV
Ketamine	
Sub-dissociative doses provide effective analgesia Administer over 20 minutes to minimize risk of emergence reaction	Ketamine 0.1-0.3mg/kg IV Over 20 mins
Regional and local nerve blocks	
Useful in lacerations, acute fractures requiring reduction or operation, and headaches (ie. occipital neuralgia)	Lidocaine + Epi Max 7mg/kg Lidocaine – Epi Max 5mg/kg Bupivacaine Max 2.5-3mg/kg

Opioid analgesics

Morphine	
Pros: less abuse potential, palliative care pain, cancer pain, dosing range well known Cons: active metabolites may accumulate in renal insufficiency	PO: 0.5mg/kg IV/SC: 0.1mg/kg
Hydromorphone	
Pros: easier titration, more equipotent, better tolerated in renal insufficiency Cons: initial dosing range unclear, more side effects	PO: 1-2mg IV/SC: 0.5-1mg
Fentanyl	
Pros: most effective for acute pain (fractures, trauma) Cons: abuse potential, overdose potential, long half life	IV/SC: 25-50mcg

Gabapentinoids

Pregabalin and Gabapentin	
Ideal for neuropathic pain	Pregabalin: 50mg PO TID upto 300mg/day Gabapentin: 300mg PO TID upto 2400mg/day

Key References: Rosen's Emergency Medicine: Concepts and Clinical Practice – 8th ed, 2014; Chapter 3. 2017 Canadian Guideline for Opioids for Chronic Non-Cancer Pain. Source: http://nationalpaincentre.mcmaster.ca/guidelines.html

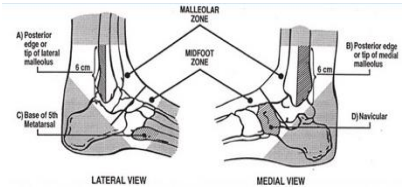
Clinical Decision Rules

Canadian CT Head Rule for Minor Head Injury

Inclusion Criteria	Exclusion Criteria
Head injury resulting in witnessed LOC/disorientation or definite amnesia; initial ED GCS > 13; injury within 24hrs	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
High Risk Criteria (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 Ankle Rules

Inclusion Criteria
Adult patient (ALSO been validated in pediatrics), any mechanism of blunt ankle injury
Exclusion Criteria
Age <18, pregnant, isolated skin injury, injury >10 days, reassessment of same injury



Ankle X-ray only required if
Bony tenderness at A OR B OR inability to take 4 complete steps in ED
Foot XR only required if
bony tenderness at C OR D OR inability to take 4 complete steps in ED

Ottawa Knee Rules

Inclusion Criteria	Exclusion Criteria
Adult patient, blunt knee injury, “knee” = patella, head/neck of fibula, proximal 8cm of tibia and distal 8cm of femur	Age <18, pregnant, isolated skin injury, injury older than 7 days, return for reassessment, AMS, paraplegic, multi-trauma
Knee X-ray only required if	
Age > 55 OR isolated patellar tenderness OR fibular head tenderness OR inability to flex 90^0C OR inability to take 4 complete steps in ED	

Ottawa SAH Rule

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

Key References: BMJ 2010; 341:c5204. Ann Emerg Med 1992; 21(4):384-390. Ann Emerg Med 1995; 26(4):405-413. Lancet 2001; 357(9266):1391-6.

Risk Stratification Scales

Canadian Syncope Risk Score

Inclusion Criteria	Exclusion Criteria	
Age >16, present to ED with syncope within 24 hours	Prolonged (>5min) LOC, AMS, witnessed seizure, major trauma, intoxication, language barrier, head trauma	
Clinical Evaluation	**Investigations**	**ED Diagnosis**
-1 Vasovagal predisposition **+1** Hx heart disease **+2** sBP<90 or sBP>180	**+2** Elevated TnI **+1** QRS axis <-30^0 or >100^0 **+1** QRS >130ms **+2** Corrected QT>480ms	**-2** Vasovagal syncope **+2** Cardiac syncope
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

Inclusion Criteria	Exclusion Criteria	
Age >50, symptoms consistent with CHFe (acute SOB, fluid retention, underlying cardiac abnormality) and/or response to diuretics	O_2 <85%, HR>120, sBP<90, confusion, ischemic chest pain, acute STEMI on ECG, prognosis of weeks (due to chronic disease), arrival from LTC	
Initial Assessment	**Investigations**	**Walk Test**
+1 Hx of stroke or TIA **+2** Hx of intubation for respiratory distress **+2** HR > 110 on ED arrival **+1** SaO_2 < 90% on EMS or ED arrival	**+2** New ischemic changes on ECG **+1** BUN>12mmol/L **+2** HCO_3>35mmol/L **+2** Elevated TnI **+1** ProBNP>5mcg/L	**+1** SaO_2<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

Inclusion Criteria	Exclusion Criteria	
Age>18, ED diagnosis of TIA	Confirmed stroke, decreased LOC, presentation >7days following onset of most recent TIA	
Clinical Findings		**Investigations**
+2 First TIA (in lifetime) **+2** Symptoms >10min **+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.

Advanced Cardiac Life Support

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: cardioversion if non-valvular Afib, not anticoagulated AND CHADS-65 0-1. If CHADS-65 > 1 then needs cardioversion within 12 hours. **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 **2.** 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

Advanced Cardiac Life Support

Wide Complex Tachycardia (85-95% = VT)

General	
Assess ABCs if stable, monitors, O_2, vitals, IV access, ECG, CXR	
Unstable	**Chest pain, SOB, LOC, low BP, CHF, AMI**
Prepare for synchronized cardioversion (200J biphasic or 360J monophasic) Consider premedication	
Stable	**Consider cardioversion as meds (only revert VT 30% of the time)**
Procainamide: 20-50mg/min (max 17mg/kg) **Amiodarone:** 150mg over 10 mins (repeat x2 PRN) **Magnesium sulfate** for polymorphic VT: 2g IV *Avoid multiple antidysrhythmics sequentially (to prevent proarrhythmogenic effects). If one fails, go to electrical cardioversion.	

Paroxysmal Supraventricular Tachycardia (AVnRT, AVRT)

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

Pulseless Electrical Activity or Asystole

General
Intubate, ventilation, early IV/IO access to administer medications, PoCUS
Management
1. Ongoing CPR **2.** Treat reversible causes: **5Hs** (**h**ypovolemia, **h**ypoxia, **h**ydrogen acidosis, **h**yper/hypokalemia, **h**ypothermia) and **5Ts** (**t**oxins, **t**amponade, **t**ension pneumothorax, **t**hrombosis – coronary, **t**hrombosis – pulmonary) **3.** Epinephrine 1mg IV q3-5mins

Bradycardia (HR <60)

General	
ABCs, monitors, O_2, vitals, IV access	
Unstable	**Chest pain, SOB, LOC, low BP, CHF, AMI**
Atropine 0.5mg q3-5min (max 3mg) – Not effective for 3^0 heart block Transcutaneous pacing → Transvenous pacing Consider infusions: Dopamine 2-10mcg/kg/min OR Epinephrine 2-10mcg/min	
Stable	
1^0 AV block or Type I 2^0 AV block: Observe Type II 2^0 AV block or 3^0 AV block: transcutaneous pacing → transvenous pacing	

Point of Care Ultrasound

Definitions

Hyperechoic: object is more echogenic (ie. brighter) than surrounding tissue
Hypoechoic: object is less echogenic (ie. less bright) than surrounding tissue
Isoechoic: object has same echogenicity than surrounding tissue
Anechoic: object has absence of echoes within it
Near field: area closer to probe **Far field:** area farther from probe

Recommended Probe Selection

	Abdo	Cardiac	Lung	Gyne	Soft Tissue	MSK
Curvilinear	+	-	+	+	-	-
Phased Array	+	+	+	-	-	-
Linear	-	-	+	-	+	+
Intracavitary	-	-	-	+	-	-

Ultrasound Artifacts

Acoustic shadowing: shadow distal to reflective surface (ie. bone, gallstone)
Acoustic enhancement: posterior enhancement due to transmission through a fluid filled structure
Edge artifact: refraction of U/S waves due to two different propagation speeds
Reverberation artifact: sound bouncing between highly reflective surfaces and probe (ie. metal needle)

Cardiac

Clinical questions: Is there a pericardial effusion? Is there cardiac activity? Is the LV function reduced? Is there RV strain?
Exam:

Parasternal long axis: assess LV function
Fractional shortening < 30 % indicates reduced LV function Assessed by the difference in LV diameter between end diastole and systole. **E-point septal separation > 7mm** indicates reduced LV function Assessed by looking at the septal slap between anterior mitral valve leaflet and septum. **Fractional shortening ~ 100% or EPSS ~ 0mm** indicates hyperdynamic LV Can be seen when ventricles are "kissing" or empty
Parasternal short axis: assess LV function, some indication of RV function
Fractional shortening < 30% indicates reduced LV function **RV larger than LV or "D-shaped" LV** may indicate RV pressure overload
Apical 4 chamber view: assess RV function
RV = LV or RV > LV suggests right heart strain
Subxiphoid view: assess pericardial effusion
Anechoic area first appearing between pericardium and RV, can expand to encompass all 4 chambers

AAA

Clinical questions: Is there an abdominal aneurysm?
Exam: Transverse view using curvilinear probe, max AP diameter > 3 cm may indicate AAA. Does not necessarily provide information of whether it is ruptured or not.

Key References: Boyd, Jeremy S., et al. "EMERGENCY ULTRASOUND." *The Atlas of Emergency Medicine, 4e* Eds. Kevin J. Knoop, et al. New York, NY: McGraw-Hill.

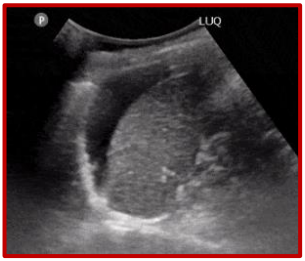
Point of Care Ultrasound

eFAST

Clinical questions: Is there evidence of pneumothorax or free fluid in the abdomen?

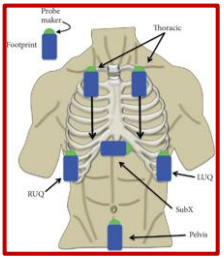
Exam: Curvilinear probe to look at RUQ, LUQ, and suprapubic areas. Free fluid will appear anechoic, collects early near the caudal edge of liver (RUQ).
Right and left thorax views using cardiac or curvilinear probe. Absence of lung sliding in pneumothorax.

Positive LUQ



Positive RUQ

eFAST Views



Lung

Clinical questions: Is there pneumothorax? Is there hemothorax or pleural effusion?

Exam: Curvilinear probe along mid axillary line at the level of diaphragm

Mirror sign – interface between liquid and air-filled thorax will create a highly reflective surface for sound. Absent mirror sign in fluid-filled thorax (ie. in hemothorax or pleural effusion).

Spine sign – visualized when anechoic or hypoechoic fluid is present in the pleural space.

Lung sliding - shimmering appearance of pleura, "ants marching on a log". Absent lung sliding may indicate pneumothorax.

Spine Sign

First Trimester

Clinical questions: Is there an intrauterine pregnancy?

Exam: Curvilinear probe along midline sagittal view

Diagnosis of IUP on POCUS
Confirm **bladder-uterine juxtaposition** to identify the uterus
Gestational sac within the uterus Circular anechoic intrauterine area surrounded by thickened echogenic rim
Yolk sac OR fetal pole visualized within the gestational sac Yolk sac is circular structure with hypoechoic centre within the gestational sac Fetal pole is a small mass at the margin of yolk sac present between 5-6wks
Myometrial mantle >8mm Uterine tissue surrounding gestational sac

Key References: Boyd, Jeremy S., et al. "EMERGENCY ULTRASOUND." *The Atlas of Emergency Medicine, 4e* Eds. Kevin J. Knoop, et al. New York, NY: McGraw-Hill.