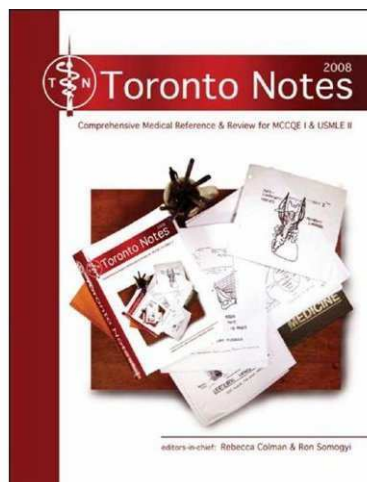


TORONTO NOTES

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Emergency Medicine



UNPROTECTED COPY

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Initial Patient Assessment and Management



1. Rapid Primary Survey (RPS)

- Airway maintenance with cervical spine (C-spine) control
 - Breathing and ventilation
 - Circulation (pulses, hemorrhage control)
 - Disability (neurological status)
 - Exposure (complete) and Environment (temperature control)
 - restart sequence from beginning if patient deteriorates
- IMPORTANT:** always watch for signs of shock while doing primary survey (see Table 1)



Approach to the Critically Ill Patient

1. Rapid Primary Survey (RPS)
2. Resuscitation (often concurrent with RPS)
3. Detailed Secondary Survey
4. Definitive Care



Noisy breathing is obstructed breathing until proven otherwise.

A. AIRWAY

- first priority is to secure airway
- assume a cervical injury in every trauma patient and immobilize with collar
- assess ability to breathe and speak
- signs of obstruction
 - agitation, confusion, "universal choking sign"
 - respiratory distress
 - failure to speak, dysphonia
 - cyanosis
- think about ability to maintain patency in future
- can change rapidly, therefore reassess frequently

Airway Management

- goals
 - permit adequate oxygenation and ventilation
 - facilitate ongoing patient management
 - give drugs via endotracheal tube (ETT) if IV not available
- N.B. start with basic management techniques before progressing to advanced (see below)

1. Basic Airway Management (Temporizing Measures)

- protect the C-spine
- head-tilt or jaw thrust if C-spine injury suspected to open the airway
- sweep and suction to clear mouth of foreign material
- nasopharyngeal airway
- oropharyngeal airway (not if gag present)
- "rescue" airway devices (e.g. laryngeal mask airway (LMA); combitube)
- transtracheal jet ventilation through cricothyroid membrane
 - used as last resort to ventilate

2. Definitive Airway Management

- ETT intubation with inline stabilization of spine (see Figure 1)
 - orotracheal ± Rapid Sequence Intubation (RSI)
 - nasotracheal - may be better tolerated in conscious patient
 - ♦ relatively contraindicated with basal skull fracture
- does not provide 100% protection against aspiration
- indications for intubation
 - unable to protect airway (e.g. Glasgow Coma Scale (GCS) ≤8; airway trauma)
 - inadequate oxygenation with spontaneous respiration (O₂ saturation <90% with 100% O₂ or rising pCO₂)
 - profound shock
 - anticipate in trauma, overdose, congestive heart failure (CHF), asthma, chronic obstructive pulmonary disease (COPD) and smoke inhalation injury
 - anticipated transfer of critically ill patients
- rescue airway devices (used to obtain/maintain airway if intubation not possible)
 - laryngeal mask airway
 - intubate LMA
 - combination esophageal/tracheal devices
- surgical airway (if unable to intubate using oral/nasal route and unable to ventilate)
 - cricothyroidotomy



If IV access is not available, the following drugs can be given down an ETT ("NAVEL"):

Naloxone (Narcan)
Atropine
Ventolin (Salbutamol)
Epinephrine
Lidocaine

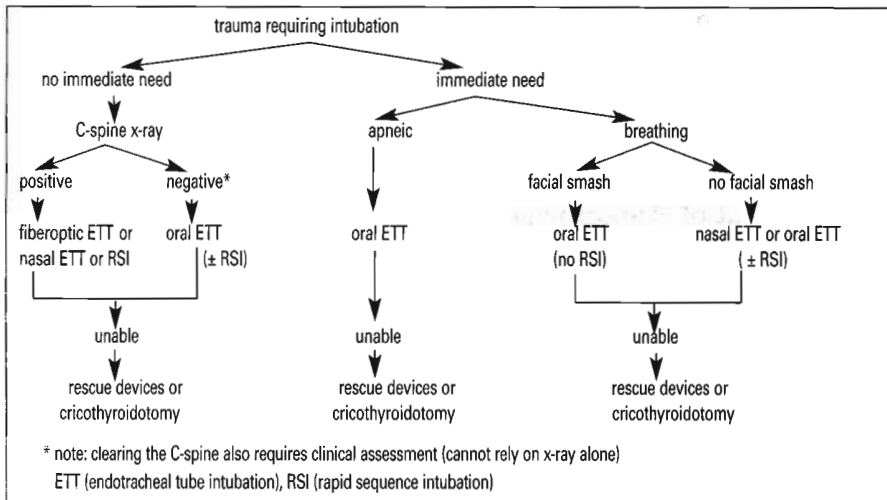


Figure 1. Approach to Endotracheal Intubation in an Injured Patient

B. BREATHING

- LOOK mental status (anxiety, agitation, decreased LOC), colour, chest movement (bilateral or asymmetrical), respiratory rate/effort, nasal flaring
- LISTEN sounds of obstruction (e.g. stridor), breath sounds, symmetry of air entry, air escaping
- FEEL flow of air, tracheal shift, chest wall for crepitus, flail segments, sucking chest wounds, subcutaneous emphysema

Breathing Assessment

- measurement of respiratory function: rate, pulse oximetry, arterial blood gas (ABG), A-a gradient

Management of Breathing

- treatment modalities:
 - nasal prongs → simple face mask → oxygen reservoir → CPAP/BiPAP
 - Venturi mask: used to precisely control O₂ delivery
 - Bag-Valve mask and CPAP to supplement ventilation

C. CIRCULATION

Definition of Shock

- inadequate organ and tissue perfusion with oxygenated blood (brain, kidney, extremities)
- not a level of blood pressure

Table 1. Estimation of Degree of Hemorrhagic Shock

Class	I	II	III	IV
Blood Loss (% of blood volume)	<750 cc (<15%)	750-1500 cc (15-30%)	1500-2000 cc (30-40%)	>2000 cc (>40%)
Pulse	<100	>100	>120	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Respiratory rate	20	30	35	>45
Capillary refill	Normal	Decreased	Decreased	Decreased
Urinary output	30 cc/hr	20 cc/hr	10 cc/hr	None
Fluid replacement	Crystalloid	Crystalloid	Crystalloid + blood	Crystalloid + blood

Table 2. Major Types of Shock

Hypovolemic	Cardiogenic	Distributive	Obstructive
- Hemorrhage (External and Internal)	- Myocardial Ischemia	- Septic	- Cardiac tamponade
- Severe burns	- Arrhythmias	- Anaphylactic	- Tension pneumothorax
- High output fistulas	- Congestive Heart Failure	- Neurogenic (Spinal cord injury)	- Pulmonary embolism
	- Cardiomyopathies		- Aortic stenosis
	- Cardiac valve problems		- Constrictive pericarditis

Shock in a trauma patient is hemorrhagic until proven otherwise.



Causes of Shock (SHOCKE):
S - Spinal/neurogenic, Septic
H - Hemorrhagic
O - Obstructive (e.g. tension pneumothorax, cardiac tamponade, pulmonary embolism)
C - Cardiogenic (e.g. blunt myocardial injury, arrhythmia, MI)
K - anaphylactic
E - Endocrine (e.g. Addison's, myxedema coma)



Estimated Systolic Blood Pressure Based on Position of Most Distal Palpable Pulse
sBP (mm Hg)

Radial	>80
Femoral	>70
Carotid	>60



Hemorrhage Management: RED Rest
Elevate the bleeding area above the level of the heart
Direct pressure on the bleeding site



Since only 30% of infused isotonic crystalloids remains in intravascular space, you must give 3x estimated blood loss.



Signs and Symptoms of Shock (TV SPARC CUBE):

Thirst	Cyanotic
Vomiting	Unconscious
	BP low
Sweating	Eyes blank
Pulse weak	
Anxious	
Respirations – shallow, rapid	
Cool	



The "AVPU" method of assessing level of consciousness:
A – Alert
V – responds to Verbal stimuli
P – responds to Painful stimuli
U – Unresponsive

Clinical Evaluation

- rapidly assess for cause of shock
- clinical features of acute hemorrhage
 - early: tachypnea, tachycardia, narrow pulse pressure, reduced urine output, reduced capillary refill, cool extremities and reduced central venous pressure (CVP)
 - late: hypotension and altered mental status

Management of Hemorrhagic Shock

- secure airway and supply O₂
- TREAT THE CAUSE OF THE SHOCK
- control external bleeding
 - direct pressure
 - elevate extremities if no obvious unstable fracture
 - consider vascular pressure points (brachial, axillary, femoral)
 - do not remove impaled objects as they tamponade bleeding
 - tourniquet only as last resort
- prompt surgical consultation for active internal bleeding
- infusion of 1-2 L of NS/RI. as rapidly as possible → 2 large bore (14 gauge) IVs wide open
- warm blood/IV fluids, especially for massive transfusions
- replace lost blood volume at ratio of 3:1
- if inadequate response, consider ongoing blood loss (e.g. chest, abdomen, pelvis, extremities) → operative intervention required
- indications for blood transfusion
 - severe hypotension on arrival
 - shock persists following crystalloid infusion
 - rapid bleeding
- transfusion options with packed red blood cells (PRBCs)
 - cross matched if possible
 - type-specific (provided by most blood banks within 10 minutes)
 - ♦ preferred to O-negative uncross-matched blood if both available
 - O-negative (children and women of child-bearing age)
 - O-positive if no time for crossmatch (males/postmenopausal women)
 - anticipate complications with massive transfusions
- transfusion with fresh frozen plasma (FFP)
 - used for clinical evidence of impaired hemostasis
 - ongoing hemorrhage, PT >1.5x normal range

D. DISABILITY

- assess level of consciousness by AVPU method (see sidebar) or GCS

Glasgow Coma Scale (GCS)

- for use in trauma patients with decreased LOC; good indicator of severity of injury and neurosurgical prognosis
- often used for metabolic coma, but less meaningful
- most useful if repeated and used for monitoring of trend
 - change in GCS with time is more relevant than the absolute number
 - patient with deteriorating GCS needs immediate attention

Table 3. Glasgow Coma Scale

Eyes Open	Best Verbal Response	Best Motor Response
Spontaneously 4	Answers questions appropriately 5	Obeys commands 6
To voice 3	Confused, disoriented 4	Localizes to pain 5
To pain 2	Inappropriate words 3	Withdraws from pain 4
No response 1	Incomprehensible sounds 2	Decorticate (flexion) 3
	No verbal response 1	Decerebrate (extension) 2
		No response 1

- best reported as a 3 part score: Eyes + Verbal + Motor = Total
- provides indication of degree of injury
 - 13-15 = mild injury
 - 9-12 = moderate injury
 - ≤8 = severe injury
- if patient intubated, GCS score reported out of 10 + T (T= tubed, i.e. no verbal component)

E. EXPOSURE/ENVIRONMENT

- undress patient completely; logroll to examine back
- essential to assess entire body for possible injury
- keep patient warm with a blanket ± radiant heaters; avoid hypothermia
- warm IV fluids/blood

2. Resuscitation

- done simultaneously with primary survey
- attend to ABCs
- manage life-threatening problems as they are identified
- vital signs q5-15 minutes
- ECG, BP and O₂ monitors
- Foley catheter and nasogastric (NG) tube if indicated
- tests and investigations: CBC, electrolytes, BUN, Cr, glucose, amylase, INR/PTT, β-hCG, toxicology screen, cross & type

3. Detailed Secondary Survey

- done after rapid primary survey problems have been addressed
- identifies major injuries or areas of concern
- full physical exam and X-rays (C-spine, chest, pelvis - required in blunt trauma, consider T-spine and L-spine)

HISTORY

- "SAMPLE": Signs and Symptoms, Allergies, Medications, Past medical history, Last meal, Events related to injury

PHYSICAL EXAMINATION**Head and Neck**

- pupils
 - assess equality, size, symmetry, reactivity to light
 - ♦ inequality suggests local eye problem or lateralizing CNS lesion
- reactivity/level of consciousness (LOC)
 - reactive pupils + decreased LOC → metabolic or structural cause
 - non-reactive pupils + decreased LOC → structural cause (especially if asymmetric)
- extraocular movements and nystagmus
- funduscopy (papilledema, hemorrhages)
- palpation of facial bones, scalp
- tympanic membranes, fluid in ear canal, hemotympanum, Battle's sign, neck tenderness

Chest

- inspect for flail segment, contusion
- palpate for subcutaneous emphysema
- auscultate lung fields

Abdomen

- assess for peritonitis, abdominal distention, and evidence of intra-abdominal bleeding
- FAST (Focused Abdominal Sonogram in Trauma), diagnostic peritoneal lavage (DPL) or CT
- rectal exam for gastrointestinal (GI) bleed, high riding prostate and anal tone (best to do during the log roll)
- bimanual exam in females

Musculoskeletal (MSK)

- examine all extremities for swelling, deformity, contusion, tenderness
- log roll and palpate thoracic and lumbar spines
- palpate iliac crests and pubic symphysis, pelvic stability (lateral, AP, vertical)

Neurological

- GCS
- alterations of rate and rhythm of breathing are signs of structural or metabolic abnormalities
 - progressive deterioration of breathing pattern implies a failing CNS
- full cranial nerve exam
- assessment of spinal cord integrity
 - conscious patient: assess distal sensation and motor ability
 - unconscious patient: response to painful or noxious stimulus applied to extremities

**Unproven or Harmful Treatments for Hemorrhage Shock**

- Trendelenberg position
- steroids (used only in spinal cord injury)
- MAST garments
- vasopressors

**Foley contraindications:**

- blood at urethral meatus
- scrotal hematoma
- high-riding prostate on DRE

**NG tube contraindications:**

- significant mid-face trauma
- basal skull fracture

**Signs of increased intracranial pressure (ICP)**

- deteriorating LOC (hallmark of increasing ICP)
- deteriorating respiratory pattern
- Cushing reflex (high BP, low heart rate, irregular respirations)
- lateralizing CNS signs (e.g. cranial nerve palsies, hemiparesis)
- seizures
- papilledema (occurs late)
- N/V and H/A

4. Definitive Care

- continue therapy
- continue patient evaluations and special investigations
- specialty consultations including OR as needed
- disposition: home, admission, or transfer to another setting (e.g. OR, ICU)

Ethical Considerations

Consent to Treatment: Adults

- emergency rule: consent not needed when patient is at imminent risk from a serious injury (e.g. severe suffering, loss of limb, vital organ or life) AND obtaining consent is either: a) not possible (e.g. patient is comatose); OR b) would increase risk to the patient (e.g. time delay)
 - the emergency rule assumes that most people would want to be saved in an emergency
- any capable and informed patient can refuse any treatment or part of treatment, even if it is life-saving
 - consider: is the patient truly capable? does pain, stress, or psychological distress impair their judgment?
- exceptions to the Emergency Rule: treatment cannot be initiated if:
 1. a competent patient has previously refused the same or similar treatment and there is no evidence to suggest the patient's wishes have changed
 2. an advance directive is available – e.g. do not resuscitate (DNR) order
- refusal of help in a suicide situation is not an exception; care must be given
- if in doubt, initiate treatment, care can be withdrawn if appropriate at a later time or if wishes clarified by family

Consent to Treatment: Children

- treat immediately if patient is at imminent risk
- parents/guardians have right to make treatment decisions
- if parents refuse treatment that is life-saving or will potentially alter the child's quality of life, Children's Aid Society (CAS) must be contacted – consent of CAS is needed to treat

Other Issues of Consent

- need consent for HIV testing of patient and for administration of blood products

Duty to Report

- law may vary depending on province and/or state
 - gunshot wounds, potential drunken drivers, suspected child abuse, various communicable diseases



Jehovah's Witnesses

- capable adults have the right to refuse medical treatment
- may refuse whole blood, PRBCs, platelets, plasma and WBCs even if life-saving
- should be questioned directly about the use of albumin, immunoglobulins, hemophilic preparations
- do not allow for autologous transfusion unless there is uninterrupted extra corporeal circulation
- usually ask for the highest possible quality of care without the use of the above interventions (e.g. crystalloids for volume expansion, attempts at bloodless surgery)
- patient will generally sign hospital forms releasing medical staff from liability
- most legal cases involve children of Jehovah's Witnesses; if life-saving treatment is refused CAS is contacted



Traumatology

Epidemiology

- statistics
 - leading cause of death in patients <45 yrs
 - 4th highest cause of death in North America
 - causes more deaths in children/adolescents than all diseases combined
- trimodal distribution of death
 - minutes: lethal injuries, death usually at the scene
 - early: this period includes the "golden hour" (death within 4-6 hours), decreased mortality with trauma care
 - days-weeks: death from multiple organ dysfunction, sepsis, etc.
- injuries generally fall into two categories
 - blunt (most common): motor vehicle collision (MVC), pedestrian-automobile impact, motorcycle collision, fall, assault, sports, etc.
 - penetrating (increasing in incidence): gunshot wound, stabbing, impalement
- high risk injuries:
 - MVC at high speed, resulting in ejection from vehicle
 - motorcycle collisions
 - vehicle vs. pedestrian crashes
 - fall from height >12 ft

Considerations for Traumatic Injury

- important to know the mechanism of injury in order to anticipate traumatic injuries
- always look for an underlying cause (alcohol, medications, illicit substances, seizure, suicide attempt, medical problem)
- always inquire about head injury, loss of consciousness, amnesia, vomiting, headache and seizure activity

Motor Vehicle Collision (MVC)

- vehicle(s) involved: weight, size, speed, amount of damage
- type of crash (to assess location of possible injuries)
 - lateral/T-bone or head-on: head, cervical spine, thoracic, abdominal, pelvic and lower extremity
 - rear-end: hyper-extension of cervical spine (whiplash injury to neck)
 - roll over: energy dissipated, less likely severe injury if victim restrained by seatbelt, however still significant potential morbidity
- location of patient in vehicle
- use and type of seatbelt
 - lap belt: spine and abdominal injury
 - shoulder belt: look for major vessel injury
- ejection of patient from vehicle/entrapment of patient under vehicle
- airbag deployment
- use of helmet in motorcycle or bicycle collisions

Pedestrian-Automobile Impact

- high morbidity and mortality
- vehicle speed is an important factor
- site of impact on car
 - children tend to be run over
 - adults tend to be struck in lower legs, impact again on car (truncal injury) and thrown to the ground (head injury)

Falls

- 1 storey = 12 feet
- distance of fall: 50% mortality at 4 stories and 95% mortality at 7 stories
- position in which patient landed and type of surface
- assess for shock, lower extremity, spine and pelvic fractures

Gunshot Wounds (GSW)

- type of gun
 - handgun injuries: medium or high velocity, extent of injury may be limited to a small area
 - hunting and rifle injuries: high velocity, widespread injury
 - shot gun: wide spread tissue destruction
- type of ammunition (e.g. hollow point bullets)
- range of shot
 - close range: massive tissue destruction, deposition of wadding into wound
- characterize route of entry and site of exit wound (if any)
- GSW with hypotension: immediate transport to OR
 - hypotension indicates severe blood loss (>2 L blood loss in 70 kg patient is required to produce hypotension)

Stab Wounds

- route/direction of entry, length of blade
- type of penetration (stab, slash, impalement)
- victim recollection and witness reports are often inaccurate and may not correlate with depth/severity of wound
- if blade in-situ, DO NOT REMOVE – it may be tamponading on bleeding vessel



Vehicle vs. Pedestrian Crash

In adults look for triad of injuries:

1. tibia-fibula or femur fracture
2. truncal injury
3. craniofacial injury



Head Trauma

- see also Neurosurgery, NS29
- 60% of trauma admissions have head injuries
- 60% of MVC-related deaths are due to head injury

Specific Injuries

- fractures (diagnosed by CT of head, often not visible on x-ray)
 - A) skull fractures:
 - vault fractures:
 - ♦ linear, non-depressed
 - most common
 - typically occur over temporal bone, in area of middle meningeal artery (commonest cause of epidural hematoma)
 - ♦ depressed
 - open (associated overlying scalp laceration, torn dura) vs. closed
 - basal skull
 - ♦ typically occur through floor of anterior cranial fossa (longitudinal more common than transverse)
 - ♦ clinical diagnosis superior (Battle's sign, raccoon eyes, CSF otorrhea/rhinorrhea, hemotympanum)
 - B) facial fractures (see Plastic Surgery, PS27)
- neuronal injury
 - A) diffuse:
 - concussion
 - ♦ mild: temporary disturbance of neurological function, complete recovery
 - ♦ classical: temporary, reversible neurological disturbance, with temporary (<6 hrs) LOC, complete recovery
 - diffuse axonal injury
 - ♦ mild: coma 6-24 hrs, possibly lasting deficit
 - ♦ moderate: coma >24hrs, little or no signs of brainstem dysfunction
 - ♦ severe: coma >24hrs, frequent signs of brainstem dysfunction
 - B) focal injuries
 - ♦ contusions
 - ♦ intracranial hemorrhage (epidural, subdural, intracerebral)



Signs of basal skull fracture

- Battle's sign (bruised mastoid process)
- Hemotympanum
- Raccoon eyes (periorbital bruising)
- CSF otorrhea/rhinorrhea



Warning signs of severe head injury:

- GCS <8
- deteriorating GCS
- unequal pupils
- lateralizing signs
- N.B.** alteration of consciousness is a hallmark of brain injury

Canadian CT Head Rule

CT Head is only required for patients with minor head injuries with any one of the following:

- High risk (for neurological intervention)
- GCS score <15 at 2 h after injury
 - Suspected open or depressed skull fracture
 - Any sign of basal skull fracture (hemotympanum, "raccoon" eyes, cerebrospinal fluid otorrhea/rhinorrhea, Battle's sign)
 - Vomiting ≥2 episodes
 - Age ≥65 years

- Medium risk (for brain injury on CT)
- Amnesia before impact >30 min
 - Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height >3 feet or five stairs)

Minor head injury is defined as witnessed loss of consciousness, definite amnesia, or witnessed disorientation in a patient with a GCS score of 13-15.

I.G. Stiell, G.A. Wells, K. Vandenberg, C. Clement, et al. *The Lancet*, May 5, 2001, 357: 926-931.



Treatment of Increased ICP

- Elevate head of bed
- Mannitol
- Hyperventilate
- Paralyzing agents

ASSESSMENT OF BRAIN INJURY

History

- pre-hospital status
- mechanism of injury

Physical Examination

- assume C-spine injury until ruled out
- vital signs
 - shock (not due to isolated brain injury, except in infants)
 - Cushing's response to increasing ICP (bradycardia, hypertension, irregular respirations)
- severity of injury determined by:
 - 1) level of consciousness
 - Glasgow Coma Scale (GCS): GCS ≤8 intubate, any change in score of 3 or more = serious injury
 - 2) pupils: size, anisocoria >1 mm (in patient with altered LOC), response to light
 - 3) lateralizing signs (motor/sensory), may become more subtle with increasing severity of injury
- re-assess frequently

Investigations

- labs: CBC, electrolytes, coags, glucose, tox screen
- CT scan
- skull X-rays - little value in the early management of obvious blunt head injury
 - for diagnosis of calvarium fractures (not brain injury)
 - may help localize foreign body after penetrating head injury
- C-spine imaging, often with CT neck and head CT

Management

- general
 - ABCs
 - treat other injuries, must treat hypotension, hypoxia (both contribute significantly to mortality)

- early neurosurgical consultation for acute and subsequent patient management
- medical
 - seizure treatment/prophylaxis
 - ♦ benzodiazepines, phenytoin, phenobarbital
 - ♦ steroids are of no proven value
 - treat suspected raised ICP → consider the following:
 - ♦ raise head of stretcher 20° if patient hemodynamically stable
 - ♦ intubate and hyperventilate (100% O₂) to a pCO₂ of 30-35 mmHg
 - ♦ mannitol 1g/kg infused as rapidly as possible (reserved for head-injured patients with signs of increased ICP)
 - ♦ consider paralyzing meds if agitated/high airway pressures
 - ♦ maintenance of cerebral perfusion pressure is critical
- surgical

Disposition

- neurosurgical ICU admission for severe head injuries (HI)
- in hemodynamically unstable patient with other injuries, prioritize most life-threatening injuries and try to maintain cerebral perfusion
- for minor head injury not requiring admission, provide 24-hour HI protocol to competent caregiver, follow-up with neurology as even seemingly minor HI may cause lasting deficits

Spine and Spinal Cord Trauma

- assume cord injury with significant falls (>12 ft), deceleration injuries, blunt trauma to head, neck or back
- spinal immobilization (cervical collar, spine board during patient transport only) must be maintained until spinal injury has been ruled out (see Figure 2)
- vertebral injuries may be present without spinal cord injury; normal neurologic exam does not exclude spinal injury
- spine may be unstable despite normal C-spine X-ray (SCIWARA = spinal cord injury without radiologic abnormality)
- injuries can include: complete/incomplete transection, cord edema, spinal shock

History

- mechanism of injury, previous deficits, SAMPLE
- neck pain, paralysis/weakness, parasthesia

Physical Exam

- ABCs
- abdo: ecchymosis, tenderness
- neuro: complete exam, including mental status
- spine: maintain neutral position, palpate C-spine for tenderness, step-off; log-roll, then palpate thoracic and lumbar spine; assess rectal tone
- extremities: check cap refill, suspect thoracolumbar injury with calcaneal fractures

Investigations

- labs: CBC, electrolytes, creatinine, glucose, coags, cross and type, tox screen
- imaging:
 - full C-spine X-ray series for trauma (AP, lateral, odontoid)
- thoracolumbar X-rays
 - AP and lateral views
 - indicated in:
 - ♦ patients with C-spine injury
 - ♦ unconscious patients (with appropriate mechanism of injury)
 - ♦ patients with symptoms or neurological findings
 - ♦ patients with deformities that are palpable when patient log-rolled
 - ♦ patients with back pain
 - ♦ patients with suggestive injuries, e.g. bilateral calcaneal fractures
- consider CT (for subtle bony injuries), MRI (for soft tissue injuries) if appropriate



Collar everyone with at least one of the following criteria:

- midline tenderness
- neurological symptoms or signs
- significant distracting injuries
- head injury
- intoxication
- dangerous mechanism
- history of LOC



If a fracture is found, be suspicious, look for another fracture.



Note: Patients with penetrating trauma (especially gunshot and knife wounds) can also have spinal cord injury.



Of the investigations, the lateral C-spine X-ray is the single most important film. 95% of all abnormalities are found on this film.

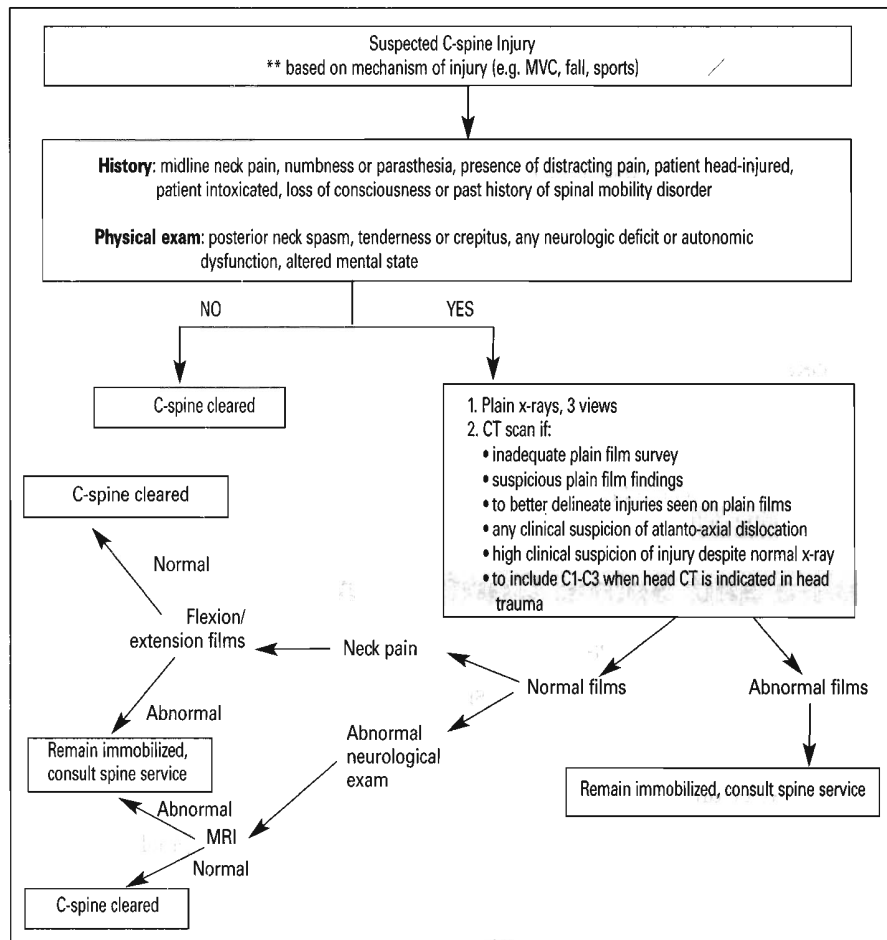


Figure 2. Approach to clearing the C-spine

The Canadian C-Spine Rule

For Alert (Glasgow Coma Scale Score = 15) and Stable Trauma Patients where Cervical Spine (C-Spine) Injury is a concern

1. Any High-Risk Factor That Mandates Radiography?
 - Age ≥ 65 Years
 - Dangerous Mechanism*
 - or
 - Parasthesia in Extremities
 Yes → Radiography
 No → 2.
2. Any Low-risk Factor That Allows Safe Assessment of Range of Motion?
 - Simple Rear-end MVC†
 - or
 - Sitting Position in ED
 - or
 - Ambulatory at Any Time
 - or
 - Delayed Onset of Neck Pain‡
 - or
 - Absence of Midline C-Spine Tenderness
 No → Radiography
 Yes → 3.
3. Able to Actively Rotate Neck?
 - >8° Left and Right
 Able → No Radiography
 Unable → Radiography

*Dangerous Mechanism:
 • fall from ≥ 1 meter/5 stairs
 • axial load to head e.g. diving
 • MVC high speed (> 100 km/hr), rollover, ejection
 • motorized recreational vehicles
 • bicycle collision

†Simple rear-end MVC excludes:
 • pushed into oncoming traffic
 • hit by bus/large truck
 • rollover
 • hit by high-speed vehicle

‡Delayed: Not immediate onset of neck pain

I.G. Stiell, et al. JAMA, Oct 17, 2001, 286(15): 1841-1848.

Management of Cord Injury

- immobilize
- evaluate ABCs
- treat shock (maintain sBP >100 mmHg)
- insert NG and Foley catheter
- high dose steroids: methylprednisolone 30 mg/kg bolus, then 5.4 mg/kg/hr drip, start within 6-8 hrs of injury (controversial and recently has less support)
- complete imaging of spine
- spine consult
- continually reassess high cord injuries as edema can travel up cord
- if cervical cord lesion, watch for respiratory insufficiency
 - low cervical transection (C5-T1) produces abdominal breathing (phrenic innervation of diaphragm still intact)
 - high cervical cord injury (above C4) may require intubation and ventilation
- beware hypotension (neurogenic shock)
 - treatment: warm blanket, Trendelenberg position (occasionally), volume infusion, consider vasopressors

APPROACH TO C-SPINE X-RAYS

- 3-view C-spine series is the screening modality of choice
 - lateral C1-T1 ± swimmer's view (see Figure 3 and Table 2 for interpretation)
 - ♦ lateral view is BEST, identifies 90-95% of injuries



Table 4. Interpretation of Lateral View: The ABCS**A - Adequacy and Alignment**

- **must see C1 to C7-T1 junction**; if not, downward traction of shoulders, swimmer's view, bilateral supine obliques, or CT scan needed
- lines of contour (in children <8 years of age: can see physiologic subluxation of C2 on C3, and C3 on C4, but the spinolaminar line is maintained)
- fanning of spinous processes - suggests posterior ligamentous disruption
- widening of facet joints
- check atlanto-occipital joint:
 - line extending inferiorly from clivus should transect odontoid
 - atlanto-axial articulation - widening of predental space (normal: <3 mm in adults, <5 mm in children) indicates injury of C1 or C2

B - Bones

- height, width and shape of each vertebral body
- pedicles, facets, and laminae should appear as one - doubling suggests rotation

C - Cartilage

- intervertebral disc spaces - wedging anteriorly or posteriorly suggests vertebral compression

S - Soft Tissues

- widening of retropharyngeal (normal: <7 mm at C1-4, may be wide in children <2 yrs on expiration) or retrotracheal spaces (normal: <22 mm at C6-T1, <14 mm in children <5 yrs)

- odontoid view (open mouth or oblique submental view) (see Figure 4)
 - ♦ examine the dens for fractures
 - beware of artifact (horizontal or vertical) caused by the radiological shadow of the teeth overlying the dens
 - if unable to rule out fracture, repeat view or consider CT or plain film tomography
 - ♦ examine lateral aspects of C1 and spacing relative to C2
- AP view
 - ♦ alignment of spinous processes in the midline
 - ♦ spacing of spinous processes should be equal
 - ♦ check vertebral bodies

Supine Oblique Views

- rarely used
- detects some injuries not visible on the usual 3 views but CT is best
- better visualization of posterior element fractures (lamina, pedicle, facet joint)
- can be used to visualize the C7-T1 junction

Sequelae of C-spine Fractures

- decreased descending sympathetic tone (neurogenic/spinal shock) responsible for most sequelae
- cardiac
 - no autoregulation, falling BP, decreasing HR, vasodilation
 - management: give IV fluids ± vasopressors
- respiratory
 - no cough reflex (risk of aspiration pneumonia)
 - no intercostal muscles ± diaphragm
 - management: intubate and maintain vital capacity
- gastrointestinal
 - ileus, vasodilation, bile and pancreatic secretion continues (>1L/day), risk of aspiration, GI stress ulcers
 - management: NG tube may be required for suctioning, feeding, etc.
- renal
 - hypoperfusion → give IV fluids
 - kidney still producing urine (bladder can rupture if patient not urinating)
 - management: Foley catheter may be required (measure urine output)
- skin
 - vasodilation, heat loss, no thermoregulation, atrophy (risk of skin ulcers)
- muscle
 - flaccidity, atrophy, decreased venous return
- penis
 - priapism

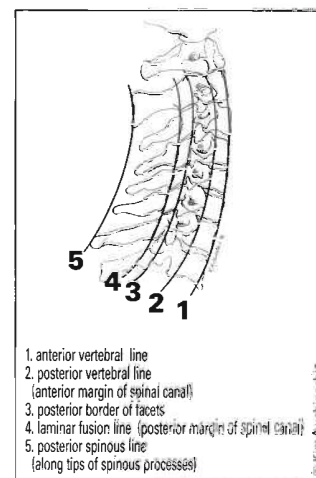


Figure 3. Lines of Contour on a Lateral C-Spine X-Ray

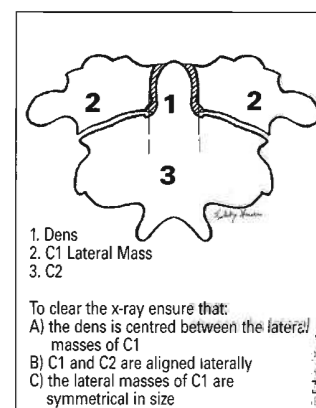


Figure 4. C-Spine X-Ray: Odontoid View



Prevertebral soft tissue swelling is only 49% sensitive for injury.



20% of C-spine fractures are accompanied by other spinal fractures, so ensure thoracic and lumbar spine x-rays are normal before proceeding to OR.



Chest Trauma

- two types:
 - A. found and managed in 1° survey
 - B. found and managed in 2° survey

A. LIFE-THREATENING CHEST INJURIES FOUND IN 1° SURVEY

- see Table 5 below

Table 5. Life-Threatening Chest Injuries Found in 1° Survey

	Physical Exam	Investigations	Management
Airway Obstruction	<ul style="list-style-type: none"> • anxiety, stridor, hoarseness, altered mental status • apnea, cyanosis 	<ul style="list-style-type: none"> • do not wait for ABG to intubate 	<ul style="list-style-type: none"> • definitive airway management • intubate early • remove FB if visible with laryngoscope prior to intubation
Tension Pneumothorax	<ul style="list-style-type: none"> • respiratory distress, tachycardia, distended neck veins, cyanosis, asymmetry of chest wall motion • tracheal deviation away from pneumothorax • percussion hyperresonance • unilateral absence of breath sounds 	<ul style="list-style-type: none"> • non-radiographic diagnosis 	<ul style="list-style-type: none"> • needle thoracostomy – large bore needle, 2nd ICS mid clavicular line, followed by chest tube in 5th ICS, anterior axillary line
Open Pneumothorax	<ul style="list-style-type: none"> • gunshot or other wound (hole >2/3 tracheal diameter) ± exit wound rather than trachea • unequal breath sounds 	<ul style="list-style-type: none"> • ABG: decreased pO₂ 	<ul style="list-style-type: none"> • air-tight dressing sealed on 3 sides • chest tube • surgery
Massive Hemothorax	<ul style="list-style-type: none"> • pallor, flat neck veins, shock • >1500 cc blood loss in chest cavity • unilateral dullness • absent breath sounds, hypotension 	<ul style="list-style-type: none"> • usually only able to do supine CXR – entire lung appears radioopaque as blood spreads out over posterior thoracic cavity 	<ul style="list-style-type: none"> • restore blood volume • chest tube • thoracotomy if: <ul style="list-style-type: none"> • >1500 cc total blood loss • ≥200 cc/hr continued drainage
Flail Chest	<ul style="list-style-type: none"> • free-floating segment of chest wall due to >2 rib fractures, each at 2 sites • palpable crepitus of ribs • decreased air entry on affected side • underlying lung contusion (cause of morbidity and mortality) 	<ul style="list-style-type: none"> • paradoxical movement of flail segment • ABG: decreased pO₂, increased pCO₂ • CXR: rib fractures, lung contusion 	<ul style="list-style-type: none"> • O₂ + fluid therapy + pain control • judicious fluid therapy in absence of systemic hypotension • positive pressure ventilation • ± intubation and ventilation
Cardiac Tamponade	<ul style="list-style-type: none"> • penetrating wound (usually) • Beck's triad: hypotension, distended neck veins, muffled heart sounds • pericardial fluid accumulation impairing ventricular function • tachycardia, tachypnea • pulsus paradoxus • Kussmaul's sign 	<ul style="list-style-type: none"> • echocardiogram 	<ul style="list-style-type: none"> • IV fluids • pericardiocentesis • open thoracotomy

☀️
Trauma to the chest accounts for, or contributes to 50% of trauma deaths.

☀️
80% of all chest injuries can be managed non-surgically with simple measures such as intubation, chest tubes, and pain control.

💡
3 way seal for open pneumothorax (i.s. sucking chest wound)
Allows air to escape during the expiratory phase (so that you don't get a tension pneumothorax) but seals itself to allow adequate breaths during the inspiratory phase.

💡
DDx of Life-Threatening Chest Injuries (HOT and FAT CHEST):
Hemothorax
Open pneumothorax
Tension pneumothorax

Flail chest
Airway obstruction
Tamponade

Contusion: pulmonary, myocardial
Hernia: traumatic, diaphragmatic
ESophageal perforation
Tracheobronchial disruption/
Traumatic injury

B. POTENTIALLY LIFE-THREATENING CHEST INJURIES FOUND IN 2° SURVEY

- need to have high index of suspicion, usually dependent on mechanism of injury
- see Table 6 below

Table 6. Potentially Life-Threatening Chest Injuries Found in 2° Survey

	Physical Exam	Investigations	Management
Pulmonary Contusion	<ul style="list-style-type: none"> • blunt trauma to chest • interstitial edema impairs compliance and gas exchange 	<ul style="list-style-type: none"> • CXR: areas of opacification of lung within 6 hours of trauma 	<ul style="list-style-type: none"> • maintain adequate ventilation • monitor with ABG, pulse oximeter and ECG • chest physiotherapy • positive pressure ventilation if severe
Ruptured Diaphragm	<ul style="list-style-type: none"> • blunt trauma to chest or abdomen (e.g. high lap belt in MVC) 	<ul style="list-style-type: none"> • CXR: abnormality of diaphragm/ lower lung fields/NG tube placement • CT scan and endoscopy - sometimes helpful for diagnosis 	<ul style="list-style-type: none"> • laparotomy for diaphragm repair and because of associated intra-abdominal injuries
Esophageal Injury	<ul style="list-style-type: none"> • usually penetrating trauma (pain out of proportion to degree of injury) 	<ul style="list-style-type: none"> • CXR: mediastinal air (not always) • esophagram (Gastrografin) • flexible esophagoscopy 	<ul style="list-style-type: none"> • early repair (within 24 hrs.) improves outcome but all require repair
Aortic Tear	<ul style="list-style-type: none"> • sudden high speed deceleration (e.g. MVC, fall, airplane crash), complaints of chest pain, dyspnea, hoarseness (frequently absent) • decreased femoral pulses, differential arm BP (arch tear) 	<ul style="list-style-type: none"> • CXR, CT scan, transesophageal echo (TEE), aortography (gold standard) • see sidebar for CXR features 	<ul style="list-style-type: none"> • thoracotomy (may treat other severe injuries first)
Blunt Myocardial Injury (Rare)	<ul style="list-style-type: none"> • blunt trauma to chest (usually in setting of multi-system trauma and therefore difficult to diagnose) • physical examination: overlying injury, i.e. fractures, chest wall contusion 	<ul style="list-style-type: none"> • ECG: arrhythmias, ST changes • patients with a normal ECG and normal hemodynamics never get dysrhythmias 	<ul style="list-style-type: none"> • O₂ • antiarrhythmic agents • analgesia



Ruptured diaphragm is more often diagnosed on the left side, as liver conceals right side defect.



X-ray features of Aortic tear (**ABC WHITE**):

- depressed left mainstem Bronchus
- pleural Cap
- Wide mediastinum (most consistent)
- Hemothorax
- Indistinct aortic knuckle
- Tracheal deviation to right side
- Esophagus (NG tube) deviated to right

C. OTHER POTENTIALLY LIFE-THREATENING INJURIES RELATED TO THE CHEST

1. Penetrating Neck Trauma

- includes all penetrating trauma to the three zones of the neck (Figure 5)
- management: injuries deep to platysma require further evaluation by angiography or surgery
- do not explore penetrating neck wounds except in the OR

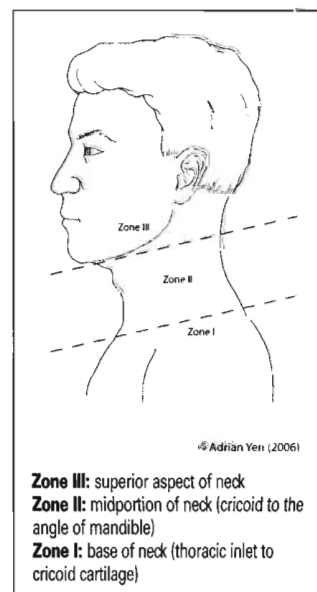
2. Airway Injuries

- always maintain a high index of suspicion
- larynx
 - history: strangulation, clothes line, direct blow, blunt trauma, any penetrating injury involving platysma
 - triad: hoarseness, subcutaneous emphysema, palpable fracture crepitus
 - other symptoms: hemoptysis, dyspnea, dysphonia
 - investigations: CXR, CT scan, arteriography (if penetrating)
 - management
 - ♦ airway – manage early because of edema
 - ♦ C-spine may also be injured, consider mechanism of injury
 - ♦ surgical – tracheotomy vs. repair
- trachea/bronchus
 - frequently missed
 - history: deceleration, penetration, increased intra-thoracic pressure; complaints of dyspnea, hemoptysis
 - examination: subcutaneous air, Hamman's sign (crunching sound synchronous with heart beat)
 - CXR: mediastinal air, persistent pneumothorax or persistent air leak after chest tube inserted for pneumothorax
 - management: surgical repair if >1/3 circumference



If penetrating neck trauma present, **DON'T:**

- clamp structures (can damage nerves)
- probe
- insert NG tube (leads to bleeding)
- remove weapon/impaed object



Zone III: superior aspect of neck
Zone II: midportion of neck (cricoid to the angle of mandible)
Zone I: base of neck (thoracic inlet to cricoid cartilage)

Figure 5. Zones of the Neck in Trauma



Abdominal Trauma

- two mechanisms:
 - blunt trauma: usually causes solid organ injury (spleen injury is most common)
 - penetrating trauma: usually causes hollow organ injury or liver injury (most common)

BLUNT TRAUMA

- results in two types of hemorrhage
 - intra-abdominal bleed
 - retroperitoneal bleed
- adopt high clinical suspicion of bleeding in multi-system trauma

History

- mechanism of injury, SAMPLE history

Physical Exam

- often unreliable in multi-system trauma
 - slow blood loss not immediately apparent
 - other injuries may mask symptoms
 - serial examinations are required
- abdomen:
 - inspect: contusions, abrasions, seatbelt sign, distention
 - auscultate: bruits, bowel sounds
 - palpate: tenderness, rebound tenderness, rigidity, guarding
 - DRE: rectal tone, blood, bone fragments, prostate location
 - placement of NG, foley catheter should be considered part of the abdo exam
- other systems to assess: CVS, respiratory (possibility of diaphragm rupture), pelvis, back, neuro as it pertains to abdo sensation, GU

Investigations

- labs: CBC, electrolytes, coags, cross & type, glucose, creatinine, CK, lipase, amylase, liver enzymes, ABG, blood EtOH, β -hCG, U/A, tox screen
- imaging: see Table 7

Table 7. Imaging in Abdominal Trauma

Imaging	Strengths	Limitations
X-Ray	Chest (looking for free air under diaphragm, diaphragmatic hernia, air fluid levels), pelvis, cervical, thoracic, lumbar spines	No soft tissue
CT scan	Most specific test	Radiation exposure 20x more than xray Cannot use if hemodynamic instability
Diagnostic Peritoneal Lavage (DPL)	Most sensitive test Tests for intra-peritoneal bleed	Cannot test for retroperitoneal bleed or diaphragmatic rupture Cannot distinguish lethal from trivial bleed Results can take up to 1 hr
Ultrasound: FAST (focused abdominal sonogram for trauma)	Identifies presence/absence of free fluid in peritoneal cavity RAPID exam: less than 5 minutes Can also examine pericardium and pleural cavities	NOT used to identify specific organ injuries If patient has ascites, FAST will be falsely positive

- imaging must be done if:
 - equivocal abdominal examination, suspected intra-abdominal injury or distracting injuries
 - multiple trauma patient resulting in unreliable physical exam (altered sensorium, i.e. secondary to drugs, alcohol, head trauma, or distracting injury; spinal cord injury resulting in abdominal anesthesia)
 - unexplained shock/hypotension
 - multiple trauma patients who must undergo general anesthesia for orthopaedic, neurosurgical, or other injuries
 - fractures of lower ribs, pelvis, spine

Management

- general: ABCs, fluid resuscitation and stabilization
- surgical: watchful wait vs. laparotomy
- solid organ injuries: decision based on hemodynamic stability, not the specific injuries
- hemodynamically unstable or persistently high transfusion requirements → laparotomy
- hollow organ injuries: laparotomy
- even if low suspicion on injury: admit and observe for 24 hours

PENETRATING TRAUMA

- high risk of gastrointestinal perforation and sepsis
- history: size of blade, calibre/distance from gun, route of entry

Seatbelt injuries may cause

- retroperitoneal duodenal trauma
- intraperitoneal bowel transection
- mesenteric injury
- L-spine injury

Indications for Foley & NG tube in abdo trauma

Foley catheter: unconscious or multiply injured patient who cannot void spontaneously. **Contraindications:** blood at the meatus, an ecchymotic scrotum, or a "high-riding" prostate on DRE (retrograde cystourethrogram is indicated to rule out a urethral tear or ruptured bladder) **NG tube:** used to decompress the stomach and proximal small bowel **Contraindications:** facial fractures or basal skull fractures suspected.

Criteria for Positive Lavage

- >10 cc gross blood
- bile, bacteria, foreign material
- RBC count >100,000 x 10⁶/L
- WBC >500 x 10⁶/L, amylase >175 IU

Laparotomy is mandatory if penetrating trauma and:

- shock
- peritonitis
- evisceration
- free air in abdomen
- blood in NG tube, Foley catheter, or on rectal exam

- local wound exploration (not reliable) with the following exceptions:
 - thoracoabdominal region (may cause pneumothorax)
 - back or flanks (muscles too thick)

Management

- general: ABCs, fluid resuscitation and stabilization
- gunshot wounds → always require laparotomy
- stab wounds → "rule of thirds" (see sidebar)



"Rule of Thirds" for stab wounds:

- 1/3 do not penetrate peritoneal cavity
- 1/3 penetrate but are harmless
- 1/3 cause injury requiring surgery

Genitourinary Tract Injuries

- see also Urology, U32

Etiology

- blunt trauma – often associated with pelvic fractures
 - renal contusions (minor injury – parenchymal echymoses with intact renal capsule)
 - renal parenchymal tears/laceration: non-communicating (hematoma) vs. communicating (urine extravasation, hematuria)
 - extraperitoneal rupture of bladder from pelvic fracture fragments
 - intraperitoneal rupture of bladder from trauma and full bladder
 - anterior (bulbous) urethral damage with pelvic fractures
 - ureter: rare, at uretero-pelvic junction
- penetrating trauma
 - damage to: kidney, bladder, ureter (rare)
- acceleration/deceleration injury
 - renal pedicle injury – high mortality rate (laceration and thrombosis of renal artery, renal vein, and their branches)
- iatrogenic
 - ureter (from instrumentation)



Gross hematuria suggests bladder injury.

History

- mechanism of injury
- hematuria (microscopic or gross), blood on underwear
- dysuria, urinary retention
- history of hypertension

Physical Examination

- abdominal pain, flank pain, costovertebral angle (CVA) tenderness, upper quadrant mass, perineal lacerations
- DRE: sphincter tone, position of prostate, presence of blood
- scrotum: ecchymoses, lacerations, testicular disruption, hematomas
- bimanual exam, speculum exam
- extraperitoneal bladder rupture: pelvic instability, suprapubic tenderness from mass of urine or extravasated blood
- intraperitoneal bladder rupture: acute abdomen



In the case of gross hematuria, the GU system is investigated from distal to proximal (i.e. urethrogram, cystogram, etc.)

Investigations

- plain film: look for fractures (lower rib, lower thoracic, upper lumbar vertebrae, pelvis)
- renal: CT scan (best, if hemodynamically stable), intravenous pyelogram (IVP) during laparotomy, renal arteriography (if renal artery injury suspected)
- ureter: retrograde ureterogram
- bladder: urinalysis, CT scan, urethrogram, ± retrograde cystoscopy, ± cystogram (distended bladder + post-void)
- urethra: retrograde urethrography

Management

- urology consult
- renal
 - minor injuries – conservative management
 - ♦ bedrest, hydration, analgesia, antibiotics
 - major injuries – admit
 - ♦ conservative management with frequent reassessments, serial urinalysis, ± reimaging
 - ♦ surgical repair (exploration, nephrectomy) (e.g. hemodynamically unstable or continuing to bleed >48h, major urine extravasation, renal pedicle injury, all penetrating wounds and major lacerations, infections, renal artery thrombosis)
- ureter
 - uretero-uretostomy
- bladder
 - extraperitoneal: minor rupture: Foley drainage x 10-14 days
major rupture: surgical repair
 - intraperitoneal: drain abdomen and surgical repair
- urethra
 - anterior: conservative, if cannot void → Foley or suprapubic cystostomy and antibiotics
 - posterior: suprapubic cystostomy (avoid catheterization) ± surgical repair



Orthopaedic Injuries

- see also Orthopaedics, OR10, OR18, OR29, OR34

Goals of ED Treatment

- identify injuries accurately and address potentially life/limb threatening problems appropriately
- reduce immobilize fractures (cast/splint) as appropriate
- provide adequate pain relief
- arrange proper follow-up if necessary

History

- use SAMPLE
- mechanism of injury may be very important

Physical Examination

- **Look** (inspection): "SEADS" Swelling, Erythema, Atrophy, Deformity, Skin changes (e.g. bruises)
- **Feel** (palpation): all joints/bones – local tenderness, swelling, warmth, crepitus, joint effusions, subtle deformity
- **Move**: joints affected plus above and below injury – active ROM preferred to passive
- **Neurovascular status**: distal to injury (BEFORE and AFTER reduction)

LIFE AND LIMB THREATENING INJURIES

- threat to life is usually due to blood loss (e.g. up to 3 L in pelvic fractures, 1.5 L per long bone fracture)
- threat to limb is usually due to interruption of blood supply to distal part of limb or to susceptible part of bone

Table 8. Life and Limb Threatening Orthopedic Injuries

Life Threatening Injuries	Limb Threatening Injuries
• Major pelvic fractures	• Fracture/dislocation of ankle (talar AVN)
• Traumatic amputations	• Crush injuries
• Massive long bone injuries (beware fat emboli)	• Compartment syndrome
• Vascular injury proximal to knee/elbow	• Open fractures
	• Dislocations of knee/hip
	• Fractures above knee/elbow

Open Fractures

- communication between fracture site and external surface of skin – risk of osteomyelitis
- remove gross debris, irrigate, cover with sterile dressing – formal irrigation and debridement often done in the OR
- control bleeding with pressure (no clamping)
- splint
- antibiotics (1st generation cephalosporin and aminoglycoside) and tetanus prophylaxis
- must secure definitive surgical care within 6-8 hours

Vascular Injuries

- realign limb/apply longitudinal traction and reassess pulses (e.g. Doppler probe)
- surgical consult

Compartment Syndrome

- increased interstitial pressure in an anatomical "compartment" (forearm, calf) with little room for expansion, resulting in ↓perfusion and potential muscle/nerve necrosis
- **excessive pain** which is worse with passive stretching and refractory to analgesia is the hallmark sign early on; also look for "the 6 Ps" (see sidebar)
- requires prompt decompression - remove constrictive casts, dressings; fasciotomy may be needed ASAP

UPPER EXTREMITY INJURIES

- anterior shoulder dislocation
 - axillary nerve (lateral aspect of shoulder) and musculocutaneous nerve (extensor aspect of forearm) at risk
 - seen on lateral view: humeral head anterior to glenoid
 - ♦ reduce (traction, leverage of scapular manipulation), immobilize in internal rotation, re-X-ray, out-patient appointment with ortho
 - ♦ with forceful injury, look for fracture
- Colles' fracture (Figure 6)
 - distal radius fracture with dorsal displacement
 - from fall on an outstretched hand (FOOSH)
 - AP film: shortening, radial deviation, radial displacement
 - lateral film: dorsal displacement, volar angulation



Description of Fractures (SOLARTAT):

- Site
- Open vs. closed
- Length
- Articular
- Rotation
- Translation
- Alignment/angulation
- Type (i.e. Salter-Harris, etc.)

Reasons for Emergent Orthopaedic Consultation

- compartment syndrome
- irreducible dislocation
- circulatory compromise
- open fracture
- injury requiring surgical repair

Vascular injury/compartment syndrome is suggested by "The 6 Ps":

- Pulse discrepancies
- Pallor
- Paresthesia/hypoesthesia
- Paralysis
- Pain (especially when refractory to usual analgesics)
- Polar (cold)

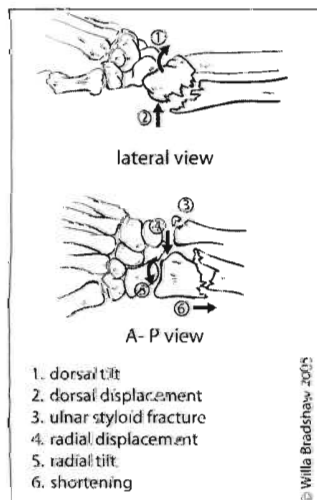


Figure 6. Colles' fracture

- reduce, immobilize with splint, out-patient with ortho or immediate ortho referral if complicated fracture
- if involvement of articular surface, emergent ortho referral
- scaphoid fracture
 - tenderness in anatomical snuff box, pain on scaphoid tubercle, pain on axial loading of thumb
 - negative X-ray: thumb spica splint, re-X-ray in 1 week ± bone scan
 - positive X-ray: thumb spica splint x 6-8 weeks
 - risk of avascular necrosis (AVN) of scaphoid if not immobilized
 - outpatient ortho appointment

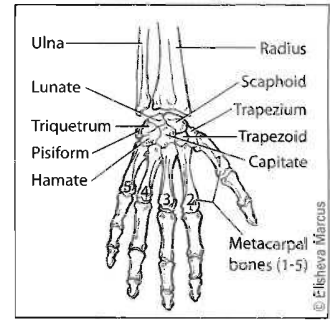


Figure 7. Carpal Bones

LOWER EXTREMITY INJURIES

- ankle and foot fractures
 - see Ottawa Ankle and Foot rules (Figure 8)
- knee injuries
 - see Ottawa Knee rules (Figure 9)
- avulsion of the base of 5th metatarsal
 - occurs with inversion injury
 - supportive tensor or below knee walking cast for 3 weeks
- calcaneal fracture
 - associated with fall from height
 - associated injuries may involve ankles, knees, hips, pelvis, lumbar spine

Reasons for Splinting

- reduces pain
- reduces further damage to vessels and nerves
- reduces risk of inadvertently converting a closed fracture into an open fracture
- facilitates patient transport

An ankle radiographic series is required only if there is any pain in malleolar zone and any of these findings:

1. bone tenderness at A
- or
2. bone tenderness at B
- or
3. inability to bear weight both immediately and in emergency department

A foot radiographic series is required only if there is any pain in midfoot zone and any of these findings:

1. bone tenderness at C
- or
2. bone tenderness at D
- or
3. inability to bear weight both immediately and in emergency department

Figure 8. Ottawa Ankle Rules

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A knee x-ray examination is required only for acute injury patients with one or more of:

- age 55 years or older
- tenderness at head of fibula
- isolated tenderness of patella*
- inability to flex to 90°
- inability to bear weight both immediately and in the emergency department (four steps)**

*no bony tenderness of knee other than patella
 **unable to transfer weight twice onto each lower limb regardless of limping

Figure 9. Ottawa Knee Rules

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Soft Tissue Injuries/Emergency Wound Management

Goals of ED Treatment

- identify injuries and stop any active bleeding – direct pressure
- manage pain
- wound examination and exploration (history and physical)
- cleansing, ± antibiotic and tetanus prophylaxis
- repair and dressing

Tetanus Prophylaxis

- both tetanus toxoid (Td) and immunoglobulin (TIG) are safe (and indicated) in pregnancy

Table 9. Guidelines for Tetanus Prophylaxis for Wounds

Immunization History	Non Tetanus Prone Wounds		Tetanus Prone Wounds ¹	
	Td ²	TIG ³	Td	TIG
Uncertain or <3 doses	Yes	No	Yes	Yes
3 or more, none for >10 years	Yes	No	Yes	No
3 or more, >5 but <10 years ago	No	No	Yes	No
3 or more, < 4 years ago	No	No	Yes	No

¹ wounds >6 hours old, >1 cm deep, puncture wounds, avulsions, wounds resulting from missiles, crush wounds, burns, frostbite, wounds contaminated with dirt, feces, soil, or saliva
² 0.5 mL IM tetanus and diphtheria toxoids (Td), adsorbed ³ tetanus immune globulin (TIG), 250 units deep IM
 Source: MMWR 2001; 50(20): 418, 427. MMWR 1991; 40(1R12): 1-52.

Bruises

- tender swelling (hematoma) following blunt trauma
- is patient on anticoagulants? do they have a coagulopathy (e.g. liver disease)?

Abrasions

- partial to full thickness break in skin
- management
 - clean thoroughly, ± local anesthetic, with brush to prevent foreign body impregnation (tattooing)
 - antiseptic ointment (Polysporin™ or Vaseline™) for 7 days for facial and complex abrasions
 - tetanus prophylaxis – see Table 9 above

Lacerations

- see also *Plastic Surgery, Pl.9*
- consider every structure deep to a laceration injured until proven otherwise
- in hand injury patient, include following in history: handedness, occupation, mechanism of injury, previous history of injury
- physical exam
 - think about underlying anatomy
 - examine tendon function actively against resistance and neurovascular status distally
 - clean and explore under local anesthetic; look for partial tendon injuries
 - x-ray wounds if a foreign body is suspected (e.g. shattered glass) and not found when exploring wound (remember: not all foreign bodies are radiopaque), or if suspect intra-articular involvement
- management
 - disinfect skin/use sterile techniques
 - irrigate copiously with normal saline
 - analgesia ± anesthesia
- maximum dose of lidocaine:
 - 7 mg/kg with epinephrine
 - 5 mg/kg without epinephrine
- in children, topical anesthetics such as LET (lidocaine, epinephrine and tetracaine) and in selected cases a short-acting benzodiazepine (midazolam or other agents) for sedation and amnesia are useful
- secure hemostasis
- evacuate hematomas, debride non-viable tissue, remove hair and remove foreign bodies
- ± prophylactic antibiotics
- suture unless delayed presentation, a puncture wound, or mammalian bite
- take into account patient and wound factors when considering suturing
- advise patient when to have sutures removed



Acute treatment of contusions (RICE):

- Rest
- Ice
- Compression
- Elevation



Suture To	Close with nylon or other nonabsorbable suture	Approx. Duration (days)
Face	6-0	5
Not Joint	4-0	7
Joint	3-0	10
Scalp	4-0	7
Mucous Membrane	absorbable (vicryl)	N/A

N.B. Patients on steroid therapy may need sutures in for longer periods of time



Alternatives to Sutures

- tissue glue
- Steristrips™
- staples



Where **not** to use local anesthetic with epinephrine:
Ears, Nose, Fingers, Toes and Hose (Penis)

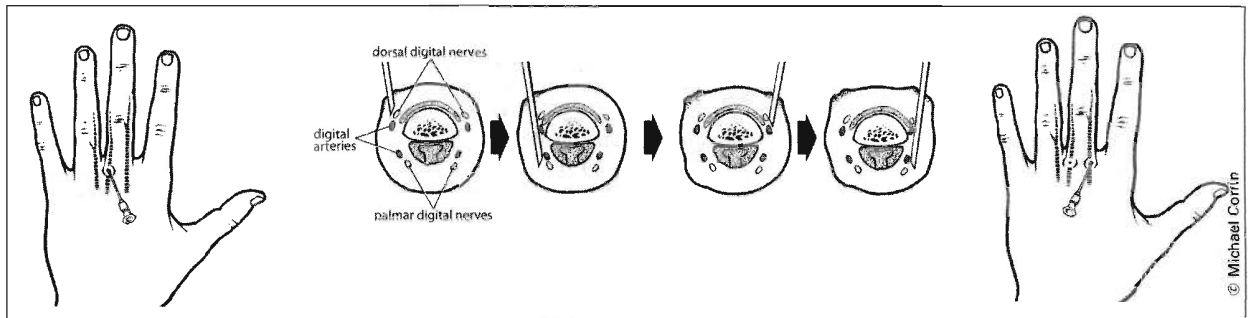


Figure 10. Digital Block – Local Anesthesia of Digits

Cellulitis

- see also Plastic Surgery, PL24
- localized infection of the dermis
- bacterial (*S. aureus*, GAS, *H. influenzae*, rarely pseudomonas, MRSA) infection of skin and subcutaneous tissues
- look for “rubor, calor, dolor, tumor” (erythema, warmth, pain, swelling)
- have high index of suspicion in patients who are immunocompromised (e.g. HIV, DM), vasculopathies, IV drug users
- treat with immobilization and elevation of infected area, antibiotics, analgesics, and close follow-up
- antibiotics for common cellulitis: cefazolin IV then cephalexin PO (alt: clindamycin PO, vancomycin IV then linezolid PO); consider MRSA

Abscess

- may be associated with a retained foreign body
- look for warm, swollen, painful, erythematous fluctuant masses
- ensure absence of systemic symptoms and presence of subcutaneous air in simple abscesses
- anesthetize locally
- treat with incision and drainage ± antibiotics – apply warm compress, give analgesics

Mammalian Bites

- see also Plastic Surgery, PL10
- history
 - time and circumstances of bite, symptoms, allergies, tetanus immunization status, comorbid conditions, rabies risks, HIV/hepatitis risk (human bite)
 - high morbidity associated with clenched fist injuries (CFIs), “fight bites”
- physical examination
 - assess type of wound: abrasion, laceration, puncture, crush injury
 - assess for direct tissue damage: skin, bone, tendon, neurovascular status
- investigations
 - if bony injury or infection suspected check for fracture and gas in tissue with X-rays
 - ALWAYS get skull films in children with scalp bite wounds, ± CT to rule out cranial perforation
- initial management
 - wound cleansing and copious irrigation as soon as possible
 - irrigate/debride puncture wounds if feasible, but not if sealed or very small openings; avoid hydrodissection along tissue planes
 - debridement is important in crush injuries to reduce infection and optimize cosmetic and functional repair
 - culture wound if signs of infection (erythema, necrosis or pus); obtain anaerobic cultures if wound foul smelling, necrotizing, or abscess; notify lab that sample is from bite wound
- prophylactic antibiotics
 - types of infections resulting from bites: cellulitis, lymphangitis, abscesses, tenosynovitis, osteomyelitis, septic arthritis, sepsis, endocarditis, meningitis
 - a 3-5 day course of antibiotics is recommended for all bite wounds to the hand and should be considered in other bites if any high-risk factors present (efficacy not proven)
 - dog and cat bites (pathogens: *Pasteurella multocida*, *S. aureus*, *S. viridans*)
 - ♦ 80% of cat bites, 5% of dog bites become infected
 - ♦ 1st line: amoxicillin + clavulanic acid
 - human bites (pathogens: *Eikenella corrodens*, *S. aureus*, *S. viridans*, oral anaerobes)
 - ♦ 1st line: amoxicillin + clavulanic acid

Differential Diagnosis of cellulitis

- Necrotizing Fasciitis
- Gas gangrene
- Cutaneous anthrax
- Vaccinia vaccination
- Insect bite (hypersensitivity)
- Acute gout
- DVT
- Fixed drug reaction
- Kawasaki's
- Pyoderma gangrenosum

Which Abscesses Need Antibiotics?

- evidence of systemic illness (e.g. cellulitis)
- immunocompromised patient
- patient at risk for endocarditis

Early wound irrigation and debridement are the most important factors in decreasing infection.

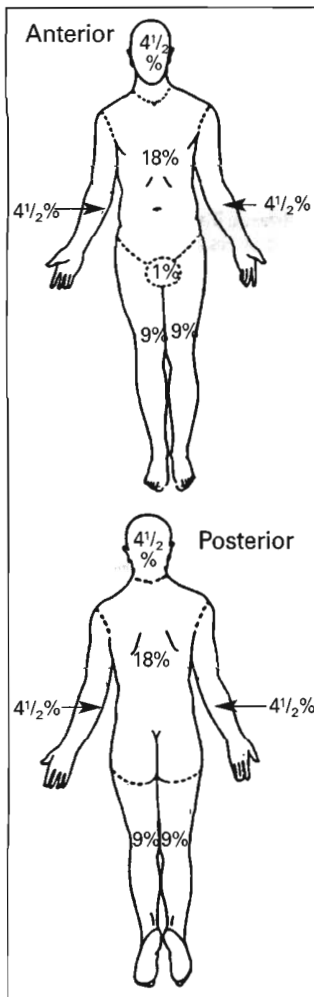
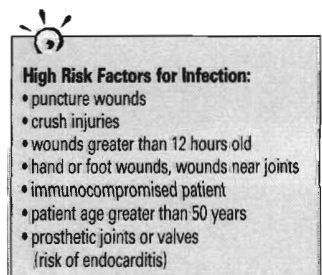
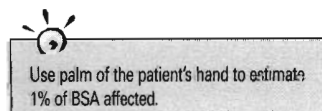


Figure 11. Rule of 9's for Total Body Surface Area



- additional management issues
 - rabies (see [Infectious Diseases, ID9](#))
 - ♦ reservoirs: warm-blooded animals except rodents, lagomorphs (e.g. rabbits)
 - ♦ post-exposure vaccine is effective; treatment depends on local prevalence (contact public health)
 - to suture or not to suture?
 - ♦ vascular structures (i.e. face and scalp) are less likely to get infected, therefore consider suturing
 - ♦ avascular structures (i.e. pretibial regions, hands and feet) by secondary intention

Snake Bites

- history, physical exam, investigations and initial management similar to mammalian bites
- additional management issues
 - snake bites are rarely fatal but proper precautions must be taken
 - supportive management, observe for compartment syndrome, analgesia, tetanus prophylaxis
 - contact regional Poison Control Centre for consultation
 - constriction band should be placed proximal to bite
 - observe for signs and symptoms of envenomation 15min-2hrs after bite (pain, sweating, edema, chills, weakness, numbness, tingling, HR changes, faintness, ecchymosis, N/V); if no envenomation then remove band and monitor closely for 24hrs
 - if envenomation present, administer antivenom

Insect Bites

- Bee Stings
 - 5 types of reactions to stings (local, large local, systemic, toxic, unusual)
 - history and physical exam KEY to diagnosis; no lab test will confirm
 - investigations: CBC, electrolytes, BUN, creatinine, glucose, ABGs, ECG
 - ABC management, epinephrine 0.1mg IV over 5 minutes if shock, antihistamines, cimetidine 300mg IV/IM/PO, steroids, β -agonists for SOB/wheezing 3mg in 5mL NS via nebulizer, local site management
- West Nile Virus (see [Infectious Diseases, ID28](#))
 - severity: asymptomatic 80%, flu-like symptoms 20%, encephalitis <1%
 - clues: aseptic meningitis/encephalitis in late summer in prevalent area
 - incubation 3-14 days, symptoms last 3-6 days
 - general symptoms: fever, malaise, anorexia, headache, altered mental status, motor weakness, ataxia, extrapyramidal signs, GI signs, myalgias, lymphadenopathy, rash, myocarditis, optic neuritis
 - diagnosis: CSF and serum for serology
 - investigations: CBC, electrolytes, CSF, CT/MRI
 - management: ABCs, IV fluids for dehydration, antibiotics if signs of meningitis (based on CSF analysis), analgesia, antipyretics, Interferon-alpha2b, ribavirin

Burns (see also [Plastic Surgery, PS19](#))

- immediate management (some can be done before arrival to hospital)
 - remove noxious agent/stop burning process
 - establish airway if needed (indicated with burns >40% BSA or smoke inhalation injury)
 - resuscitation for 2nd and 3rd degree burns
 - ♦ Parkland Formula: Ringer's lactate 4cc/kg/%BSA burned; give 1/2 in first 8 hours, 1/2 in next 16 hours
 - ♦ urine output is best measure of resuscitation, should be 40-50 cc/hr or 0.5 cc/kg/hr; avoid diuretics
 - pain relief - continuous morphine infusion at 2 mg/hr with breakthrough bolus
 - burn wound care - prevent infection, clean with mild soap and water, sterile dressings
- physical examination
 - Burn size:
 - ♦ rule of nines (see Figure 11); does not include 1st degree burns
 - Burn depth:
 - ♦ 1st degree: epidermis only (e.g. sunburn)
 - ♦ 2nd degree: superficial partial thickness - into superficial dermis deep partial thickness - into hair follicles, sweat glands
 - ♦ 3rd degree: all layers of the skin
 - ♦ 4th degree: to fat, muscle, even bone


- further management
 - escharotomy or fasciotomy for circumferential burns (chest, extremities)
 - topical antibiotics
 - systemic antibiotics infrequently indicated
- guidelines for hospitalization
 - 2nd degree burns to >10% BSA; any significant 3rd degree burns
 - 2nd degree on face, hands, feet, perineum or across major joints
 - electrical, chemical burns and inhalation injury
 - burn victims with underlying medical problems or immunosuppressed patients

Pediatric Trauma

- priorities remain the same (Airway, Breathing, Circulation)

Airway

- "sniffing position"
- short trachea (5 cm in infants, 7.5 cm at 18 months)
- uncuffed ETT under age 8
- surgical cricothyroidotomy NOT indicated
- needle cricothyroidotomy with jet ventilation if unable to intubate



Pediatric Orotracheal Tube Diameter:
 diameter = age + 4
 4

Breathing

- noting tachypnea is important
- stethoscope not as useful for diagnosing problems

Circulation

- normal blood volume = 80 ml/kg
- fluid resuscitation
 - bolus crystalloid 20 ml/kg
 - repeat x 1 if necessary
 - blood replacement if no response to second bolus of crystalloid
- venous access
 - intraosseous infusion if unable to establish IV access in <30 seconds
 - venous cutdown (medial cephalic, external jugular, great saphenous)

Thermoregulation

- children prone to hypothermia
- blankets/external warming/cover scalp

Table 10. Normal Vitals in Pediatric Patients


Age	Respirations	Pulse	Systolic BP	Weight (kg)
Infant	30-50	120-160	>60	3-4
6mo-1yr	30-40	120-140	70-80	8-10
2-4yr	20-30	100-110	80-95	12-16
5-8yr	14-20	90-100	90-100	18-26
9-12yr	12-20	80-100	100-110	26-50
> 12yr	12-16	60-90	100-120	>50

Trauma in Pregnancy

- priorities the same (Airway, Breathing, Circulation)

Hemodynamic Considerations

- near term, inferior vena caval compression in the supine position can decrease cardiac output by 30-40%
 - use left lateral decubitus (LLD) positioning or hip bolster to alleviate compression and increase blood return
- BP drops 5-15 mmHg systolic in 2nd trimester, increases to normal by term
- HR increases 15-20 beats per minute by 3rd trimester



The best treatment for the fetus is the effective treatment of the mother.

Blood Considerations

- physiologic macrocytic anemia of pregnancy (Hb 100-120)
- WBC increases to high of 20,000



All pregnant patients should be positioned in left-lateral decubitus.

Shock

- pregnant patients may lose 35% of blood volume without typical signs of shock (i.e. tachycardia, hypotension)
- the fetus may be in "shock" due to contraction of the uteroplacental circulation
- fetal HR changes are an indication of maternal circulatory compromise

Management Differences

- place bolster under right hip to stop inferior vena cava compression
- fetal monitoring (Doppler)
- early obstetrical consult
- do not avoid necessary x-rays, but shield as much as possible
- consider need for RhoGAM if mother Rh-

Approach to Common ER Presentations



Abdominal Pain

Rule Out Life-Threatening Causes

- GI: perforated viscus, hepatic/splenic injury, ischemic bowel (diffuse pain)
- GU: ectopic pregnancy
- CVS: MI, aortic dissection, ruptured AAA (tearing pain)

Additional Differential Diagnosis

- GI: appendicitis, diverticulitis, bowel obstruction, hepatitis, cholecystitis, pancreatitis
- urinary: cystitis, pyelonephritis, ureteral calculi
- genital
 - female: pelvic inflammatory disease (PID), endometriosis, salpingitis/tubo-ovarian abscess, ovarian torsion/cyst
 - male: testicular torsion, epididymitis
- other: diabetic ketoacidosis (DKA), Herpes Zoster Virus (HZV), intra-abdominal abscess, pneumonia, lead poisoning, porphyria, sickle cell crisis

History and Physical Examination

- determine onset, course, location and character of pain: PQRST
- associated GU, GI, respiratory, CV symptoms
- abdominal trauma/surgeries
- general appearance, vitals
- respiratory, CVS
- back: CVA tenderness, ecchymoses
- extremities: differential pulses, psoas/obturator sign
- abdomen, including DRE, pelvic exam (females), genital exam (males)

Investigations

- do not delay consultation if patient unstable
- CBC, electrolytes, glucose, LFTs, amylase, BUN/creat, U/A, + others if indicated: β-hCG, lactate, ECG
- AXR: look for calcifications, free air, gas pattern, air fluid levels
- CXR upright: look for pneumoperitoneum (free air under diaphragm)
- U/S: biliary tract, ectopic pregnancy, AAA
- CT: trauma, AAA, pancreatitis

Management

- NPO, IV, NG tube, analgesics
 - growing evidence that small amounts of narcotic analgesics improve diagnostic accuracy of physical exam of surgical abdomen
- consult as necessary: general surgery, vascular, gynecology, etc.

Acute Pelvic Pain

Etiology

- gynecological
 - ruptured ovarian cysts – most common cause of pelvic pain, follicular cyst most common type
 - ovarian torsion – rare, 50% will have ovarian tumour
 - leiomyomas (uterine fibroids) – especially with torsion of a pedunculated fibroid or in pregnant patient (degeneration)



Abdominal Assessment (DR. GERM):
Assess in all 4 quadrants for
Distention
Rigidity
Guarding
Evisceration/Ecchymosis
Rebound tenderness
Masses



Unstable patients should not be sent for imaging.



All women of childbearing age assumed to be pregnant until proven otherwise.

- ectopic pregnancy – ruptured/expanding/leaking
- spontaneous abortion – threatened or incomplete
- infection – endometritis, PID, tuboovarian abscess
- dysmenorrhea and endometriosis – rarely cause new onset acute pelvic pain
- non-gynecological
 - GI – gastroenteritis, appendicitis, bowel obstruction, diverticulitis, IBD, IBS
 - GU – cystitis, pyelonephritis, ureteral stone
 - other – porphyria, abdominal angina, aneurysm, hernia, zoster

History and Physical Exam

- determine onset, course, location and character of the pain
- associated symptoms: vaginal bleeding, bowel or bladder symptoms, radiation
- vitals
- gynecological exam
- abdominal exam

Investigations

- β-hCG for all women of childbearing age
- CBC and differential, PTT, INR
- pelvic and abdominal US – evaluate adnexa, look for free fluid in the pelvis or masses, evaluate thickness of endometrium

Management

- general: analgesia, determine if admission and consults needed
 - gynecology consult if history and physical suggestive of serious cause
 - other consults as indicated – general surgery, urology, etc.
- specific:
 - ovarian cysts
 - ♦ unruptured or ruptured and hemodynamically stable – analgesia and follow-up
 - ♦ ruptured with significant hemoperitoneum – may require surgery
 - ovarian torsion – surgical detorsion or removal of ovary
 - uncomplicated leiomyomas, endometriosis and secondary dysmenorrhea can usually be treated on an outpatient basis, discharge with gynecology follow-up

Alcohol Related Emergencies

- see also Psychiatry, PS20

Acute Intoxication

- slurred speech, CNS depression, disinhibition, lack of coordination
- nystagmus, diplopia, dysarthria, ataxia → may progress to coma
- frank hypotension (peripheral vasodilation)
- if obtunded rule out:
 - head trauma/intracranial hemorrhage
 - associated depressant/street drugs
 - ♦ synergistic → respiratory/cardiac depression
 - hypoglycemia (screen with bedside glucometer)
 - hepatic encephalopathy
 - ♦ precipitating factors: GI bleed, infection, sedation, electrolyte abnormalities, protein meal
 - Wernicke’s encephalopathy (“WACO”)
 - post-ictal state, basilar stroke

Withdrawal

- beware withdrawal signs – see Table 11

Table 11. Alcohol Withdrawal Signs

Time since last drink	Syndrome	Description
6-8 hr	mild withdrawal	<ul style="list-style-type: none"> • generalized tremor, anxiety, agitation, but no delirium • autonomic hyperactivity (sinus tachycardia), insomnia, nausea, vomiting
1-2 days	alcoholic hallucinations	<ul style="list-style-type: none"> • visual (most common), auditory and tactile hallucinations • vitals often normal
8 hr-2 days	withdrawal seizures	<ul style="list-style-type: none"> • typically brief generalized tonic-clonic seizures • may have several within a few hours
3-5 days	delirium tremens (DT)	<ul style="list-style-type: none"> • 5% of untreated withdrawal patients • severely confused state, fluctuating levels of consciousness • agitation, insomnia, hallucinations/delusions, tremor • tachycardia, hyperpyrexia, diaphoresis • high mortality rate



EtOH levels correlate poorly with intoxication.



EtOH intoxication may invalidate informed consent.



Wernicke’s encephalopathy (WACO):
 Ataxia
 Coma
 Ocular findings: nystagmus, CN VI paresis



Withdrawal Symptoms
 Nausea and vomiting
 Tremor
 Paroxysmal sweats
 Anxiety
 Agitation
 Visual/tactile/auditory disturbances
 Headache
 Disorientation

- treatment
 - diazepam 10-20 mg IV or PO OR lorazepam 2-4 mg IV or PO q1hr until calm
 - thiamine 100 mg IM then 50-100 mg/day and fluid resus with D5NS
 - magnesium sulfate 4 g IV over 1-2 h (if hypomagnesemic)
 - admit patients with delirium tremens (DT)

Seizures (also see ER35)

- associated with ingestion and withdrawal
- withdrawal seizures
 - occur 8-48 hrs after last drink (typically brief generalized tonic-clonic seizures)
 - if >48 hrs, think of DT (see Table 11)
- prophylaxis: diazepam 20 mg PO q1h x 3 minimum
- CT head if focal seizures have occurred

Cardiovascular Complications

- hypertension (HTN)
- cardiomyopathy: SOB, edema
- arrhythmias ("holiday heart")
 - atrial fibrillation (most common), atrial flutter, PVC, PAC, SVT, VT (especially torsade if hypomagnesemic/hypokalemic)

Metabolic Abnormalities

- alcoholic ketoacidosis
 - history of chronic alcohol intake with abrupt decrease/cessation
 - malnourished, abdominal pain with nausea and vomiting
 - anion gap (AG) metabolic acidosis, urine ketones, low glucose and normal osmolality
 - treatment: dextrose, thiamine (50-100 mg prior to dextrose), volume repletion (with NS)
 - generally resolves in 12-24 hr
- abnormal alcohols (see also *Toxicology*, ER46)
 - ethylene glycol → CNS, CVS, renal findings
 - methanol
 - ♦ early: lethargy, confusion
 - ♦ late: headache, visual changes, N/V, abdominal pain, tachypnea
 - both produce severe metabolic acidosis with AG and osmolar gap
 - EtOH co-ingestion is protective
 - treatment
 - ♦ IV 10% EtOH bolus and drip to achieve blood level of 20 mmol/L
 - ♦ alcohol loading may be done PO
 - ♦ fomepizole if available
 - ♦ urgent hemodialysis required
- other abnormalities associated with alcohol: hypomagnesemia, hypophosphatemia, hypocalcemia, hypoglycemia

Gastrointestinal Abnormalities

- gastritis
 - common cause of abdominal pain and GI bleed in chronic alcohol users
- pancreatitis
 - serum amylase very unreliable in patients with chronic pancreatitis, may need serum lipase
 - hemorrhagic form (15%) associated with increased mortality
 - fluid resuscitation very important
- hepatitis
 - AST/ALT ratio >2 suggests alcohol as the cause as well as elevated GGT with acute ingestion
- peritonitis/spontaneous bacterial peritonitis
 - occasionally accompanies cirrhosis
 - leukocytosis, fever, generalized abdominal pain/tenderness
 - paracentesis for diagnosis (common pathogens: *E. coli*, *Klebsiella*, *Strep*)
- GI bleeds
 - most commonly gastritis or ulcers, even if patient known to have varices
 - consider Mallory-Weiss tear secondary to retching
 - often complicated by underlying coagulopathies

Miscellaneous Problems

- rhabdomyolysis
 - presents as acute weakness associated with muscle tenderness
 - usually occurs after prolonged immobilization
 - increased creatinine kinase (CK), hyperkalemia
 - myoglobinuria – may lead to acute renal failure
 - treatment: IV fluids, forced diuresis (mannitol 20% 15 mg/kg IV over 30 min)
- increased infections – due to impaired host defences, compromised immunity, poor living conditions
 - atypical pneumonias (Gram negatives, anaerobes, TB)

- meningitis
- peritonitis with ascites
- bacteremia – after urinary tract infection (UTI), soft tissue infections
- treatment usually requires admission and IV antibiotics

Altered Level of Consciousness (LOC)



Definitions

- altered mental status – collective, non-specific term referring to change in mental content or attentiveness
- delirium – acute, transient, fluctuating, potentially reversible organic brain disorder presenting as altered LOC or attentiveness
- dementia – insidious, progressive, organic brain disorder with change in memory, judgment, personality and cortical function
- lethargy – state of decreased awareness and mental status (patient may appear wakeful)
- stupor – unresponsiveness from which the patient can be aroused
- coma – a sleep-like state, non arousable to consciousness

Use the GCS to evaluate LOC (see ER4)

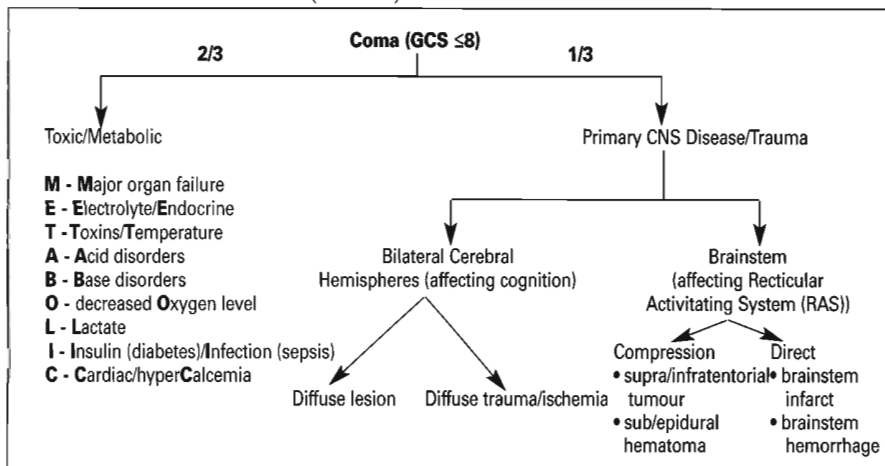


Figure 12. Etiology of Coma

Possible Causes of Coma (AEIOU TIPS):

- Acidosis/Alcohol
- Epilepsy
- Infection
- Overdose
- Uremia
- Trauma (especially head)
- Insulin (too little or too much)
- Psychotic episode
- Stroke

GCS under 8, intubate!

MANAGEMENT OF ALTERED LOC

History

- obtained from family, friends, police, paramedics, old chart, etc.
- onset and progression
 - abrupt onset suggests CNS hemorrhage/ischemia or cardiac cause
 - progression over hours to days suggests progressive CNS lesion or toxic/metabolic cause
- preceding events
 - it is essential to determine patient's baseline LOC preceding deterioration
 - antecedent trauma, seizure activity, fever
- past medical history (e.g. similar episode, depression)

Physical Examination

- vitals including temperature, cardiac, chest, respiratory, abdominal exam, and the "five Ns" (see sidebar)
- complete neuro exam, particular examination of the eyes

Investigations

- rapid blood sugar, CBC, electrolytes, Cr, BUN, LFTs, glucose, serum osmolality, ABGs, coags, troponins, U/A
- ECG, CXR, Head CT
- drug levels of specific toxins if indicated

Diagnosis

- distinguish between structural and toxic-metabolic coma
 - structural coma
 - pupils, extraocular movements and motor findings are asymmetric or absent

Universal Antidotes (DON'T):

- Dextrose
- O₂
- Naloxone
- Thiamine

Evaluation of comatose patient: (Five Ns)

- Noggin** – e.g. raccoon eyes and Battle's sign (bruising of the mastoid process) appears about 8 hours after trauma
- Neck** – C-spine, neurogenic shock, nuchal rigidity
- ENT** – otorrhea, rhinorrhea, tongue biting, odour on breath, hemotympanum
- Needles** – track marks
- Neurological** – concentrate on GCS, respiration, posture, movement, pupils, reflexes

- toxic-metabolic coma
 - ♦ dysfunction at lower levels of the brainstem (e.g. caloric unresponsiveness)
 - ♦ respiratory depression in association with an intact upper brainstem (e.g. equal and reactive pupils; see exceptions in Table 1)
 - ♦ extraocular movements and motor findings are symmetric or absent

Table 12. Toxic - Metabolic Causes of Fixed Pupils

Dilated	Dilated to Normal	Constricted
<ul style="list-style-type: none"> • anoxia • anticholinergic agents (e.g. atropine, TCAs) • methanol (rare) 	<ul style="list-style-type: none"> • hypothermia • barbiturates 	<ul style="list-style-type: none"> • cholinergic agents (e.g. organophosphates) • opiates (e.g. heroin), except meperidine

- essential to re-examine frequently – status can change rapidly
- diagnosis may become apparent only with the passage of time
 - delayed deficit after head trauma suggestive of epidural hematoma (characteristic “lucid interval”)

Disposition

- readily reversible alteration of LOC: discharge if adequate follow-up care available
- ongoing decreased LOC: admit to service based on tentative diagnosis
- transfer patient if appropriate level of care not available

**Anaphylaxis and Allergic Reactions****Etiology**

- exaggerated immune response mediated by histamine, leukotriene C4, prostaglandin D2, and tryptase
- classic anaphylaxis: IgE mediated, sensitization then re-exposure
- anaphylactoid reaction: non-IgE mediated, direct trigger, may occur with first exposure (e.g. radiocontrast dyes); presentation and treatment same as for anaphylaxis

History and Physical Examination

- general – marked anxiety, apprehension, tremor, cold sensation
- skin – generalized urticaria, edema, erythema, pruritus
- respiratory – nasal congestion, sneezing, coryza, cough, hoarseness, sensation of throat tightness, dyspnea, stridor, wheeze
- eyes – itch, tearing, conjunctival injection
- cardiovascular – hypotension, tachycardia, weakness, dizziness, syncope, chest pain, arrhythmia, MI
- GI – abdominal pain, nausea, vomiting, diarrhea

Management

- remove causative agent; secure ABCs
- epinephrine:
 - on scene – epi-pen (injectable epinephrine) if available
 - moderate signs and symptoms (minimal airway edema, mild bronchospasm, cutaneous reactions)
 - ♦ adult: 0.3-0.5 mL of 1:1000 solution IM epinephrine
 - ♦ child: 0.01 mL/kg/dose up to 0.4 mL/dose 1:1000 epinephrine
 - severe signs and symptoms (laryngeal edema, severe bronchospasm and shock)
 - ♦ epinephrine via IV or ETT starting at 1 ml of 1:10,000 (0.1 mg) in adults; 0.01 mL/kg in children
 - ♦ cardiac monitoring, ECG
- diphenhydramine (Benadryl™) 50 mg IM or IV q4-6h
- methylprednisolone 50-100 mg IV dose depending on severity
- salbutamol (Ventolin™) via nebulizer if bronchospasm present
- glucagon (for those on β -blockers with resistant hypotension) 5-15 μ g q1min IV

Angioedema/Urticaria

- cutaneous IgE-mediated reaction
- treatment: epinephrine, antihistamines, steroids (may not work) and airway management

Asthma

- see also Respirology, R6
- chronic inflammatory airway disease with episodes of bronchospasm and inflammation resulting in airflow obstruction

Most common triggers for anaphylaxis

- penicillin
- stings
- nuts
- shellfish




Beware of the silent pathmatic! This is a medical emergency and may require emergency intubation.

Differential Diagnosis of Wheezing

- foreign body aspiration/upper airway obstruction
- bronchiolitis
- pneumonia
- cystic fibrosis (CF)
- congestive heart failure (CHF)
- Hodgkin's lymphoma
- anaphylaxis
- croup

Investigations

- O₂ sat
- peak flow meter
- ± ABG
- CXR if diagnosis in doubt or concerns of pneumonia, pneumothorax, etc.



Treatment of Asthma

ASTHMA:

Adrenergics (β agonist)

Steroids

Hydration

Mask (O₂)

Antibiotics (if concurrent infection)

Table 13. Asthma Assessment and Management

Classification	History and Physical Examination	Management
Respiratory arrest imminent	<ul style="list-style-type: none"> • exhausted, confused, diaphoretic, cyanotic • silent chest, ineffective respiratory effort • decreased HR • O₂ sat <90% despite supplemental O₂ 	<ul style="list-style-type: none"> • 100% O₂, cardiac monitor, IV access • intubate • β-agonist: MDI 4-8 puffs OR nebulizer 5 mg continually • anticholinergics: MDI 4-8 puffs q20 min x 3 OR nebulizer 0.5 mg q20 min x 3 • IV steroids: methylprednisolone 125 mg, hydrocortisone 500 mg
Severe Asthma	<ul style="list-style-type: none"> • agitated, diaphoretic, laboured respirations • difficulty speaking in full sentences • no relief from β-agonist • O₂ sat <90%, FEV₁ <50% 	<ul style="list-style-type: none"> • anticipate need for intubation • similar to above management (β-agonist may be less frequent; q15-20 min)
Moderate Asthma	<ul style="list-style-type: none"> • SOB at rest, cough, congestion, chest tightness • nocturnal symptoms • inadequate relief from β-agonist • FEV₁ 50-80% 	<ul style="list-style-type: none"> • O₂ to achieve O₂-sat >90% • β-agonist - puffer or neb q1h • steroids: prednisone 40-60 mg PO • anticholinergics
Mild Asthma	<ul style="list-style-type: none"> • exertional SOB/cough with some nocturnal symptoms • good response to β-agonist • FEV₁ >80% 	<ul style="list-style-type: none"> • β-agonist • monitor FEV₁ • consider steroids (nebulized or PO)

Chest Pain

Rule Out Life-Threatening Causes

- CVS: acute coronary syndrome/acute MI, pericarditis/cardiac tamponade, aortic dissection
- respiratory: pulmonary embolism (PE)/tension pneumothorax
- GI: esophageal rupture/pneumomediastinum

Additional Differential Diagnosis




- cardiac: stable angina
- respiratory: pneumonia, spontaneous pneumothorax (young, thin, tall)
- GI: peptic ulcer disease (PUD), pancreatitis, cholecystitis, esophagitis, reflux
- MSK: rib fractures, costochondritis, zoster, etc.
- psychogenic/anxiety (diagnosis of exclusion)

Initial Resuscitation and Management

- O₂, IV, cardiac monitoring, CXR (portable if unstable), ECG

History

- must evaluate cardiac risk factors (DM, HTN, hyperlipidemia, smoking, 1st degree relative with CAD <50 yo)
- classic presentations (but presentation seldom classic)
 - aortic dissection: sudden severe tearing pain, often radiating to back
 - pulmonary embolism: pleuritic chest pain (75%), dyspnea, anxiety, tachycardia
 - pericarditis: anterior precordial pain, pleuritic, relieved by sitting up and leaning forward
 - acute coronary artery disease (CAD): retrosternal squeezing/pressure pain, radiation to arm/neck, dyspnea, nausea/vomiting, syncope
 - esophageal: frequent heartburn, acid reflux, dysphagia, relief with antacids
- more likely to be atypical in females, diabetics, and >80 years

Life Threatening causes of Chest Pain "PET MAP"

PE

Esophageal rupture

Tamponade

M/angina

Aortic dissection

Pneumothorax

**Signs and Symptoms of MI (PULSE):**

Persistent chest pain
Upset stomach
Lightheadedness
Shortness of breath
Excessive sweating

**Signs of PE on CXR**

Westermark's sign: abrupt tapering of a vessel on chest film.
Hampton's hump: a wedge-shaped infiltrate that abuts the pleura.

**Wells' Score for PE**

Previous Hx of DVT/emboli +1.5
HR >100: +1.5
Recent immobility or Sx: +1.5
Clinical signs of DVT: +3
Alternate Dx less likely than PE: +3
Hemoptysis: +1
Cancer: +1

Low probability = 0-2
Intermediate probability = 2-6
High probability = >6

**Every Acute MI patient in the ER must be greeted by BMONA right away:**

β-Blockade
Morphine
Oxygen
Nitroglycerin
ASA

Addition of Clopidogrel to Aspirin and Fibrinolytic Therapy for Myocardial Infarction with ST-Segment Elevation

(Sabatine M et al. NEJM. 352(12): 1179-1191, 2005 Mar)
Purpose: To assess the benefit of adding clopidogrel to aspirin and fibrinolytic therapy in ST-elevation MI.
Study Characteristics: Double-blind, RCT, following intention-to-treat analysis, with 3491 patients and clinical follow-up at 30 days.

Participants: Individuals presenting within 12 hours of onset of ST-elevation MI (mean age 57, 80.3% male, 50.3% smokers, 9.1% previous MI). Those presenting after 12 hours, age >75, or with previous CABG were excluded.

Intervention: Clopidogrel (300 mg loading dose followed by 75 mg od until day of angiogram) or placebo, in addition to aspirin, a fibrinolytic agent, and heparin when appropriate.

Primary Outcome: Composite of occluded infarct-related artery on angiography (Thrombolysis in Myocardial Infarction flow grade 0 or 1), or death or recurrent MI prior to angiography.

Results: Rates of primary end point were 21.7% in the placebo group and 15.0% in the clopidogrel group (95% CI, 24-47%). Among the individual components of the primary end point, clopidogrel had a significant effect on the rate of an occluded infarct-related artery and the rate of recurrent MI, but no effect on the rate of death from any cause. At 30 days clinical follow-up, there was no difference in rate of death from cardiovascular causes, a significant reduction in the odds of recurrent MI, and a non-significant reduction in recurrent ischemia with need for urgent revascularization. The rates of major bleeding and intracranial hemorrhage were similar between the two groups.

Conclusion: Addition of clopidogrel improves the patency rate of infarct-related arteries and reduces ischemic complications, both of which are associated with improved long-term survival after MI. The trial was not powered to detect a survival benefit and none was seen.

Physical Examination

- vitals
 - BP in BOTH arms: >20 mmHg difference suggests thoracic aortic dissection
- palpate chest wall for tender points, but be aware that 25% of patients with acute MI have chest wall tenderness
 - consider a diagnosis of MSK disease only if palpation fully reproduces pain and symptoms and more serious causes excluded
- cardiac exam, respiratory exam, peripheral vascular exam

Investigations

- CBC, electrolytes
- serial cardiac enzymes
 - normal CK does NOT rule out MI
 - troponin I more sensitive (but positive later than CK-MB; can have false positives in renal failure, must follow for 8 hrs post onset of symptoms)
- ECG
 - always compare with previous
 - PE and acute MI may have normal ECG in up to 50% of cases
 - consider 15-lead ECG if hypotensive or if ECG shows inferior MI or AV node involvement
- CXR
 - always compare with previous
 - PE
 - 50% completely normal
 - atelectasis, elevated hemidiaphragm, pleural effusion
 - aortic dissection
 - mediastinal widening, bulging aortic arch, separation of intima calcification from edge of aortic shadow, depressed left main bronchus
 - change from previous CXR is the most accurate finding
 - CXR is normal in 20% of thoracic dissections
 - pneumothorax
 - may need inspiration and expiration views
- ABGs – normal in 20% of patients with PE
- D-dimer, V/Q scan or helical CT, venous leg Doppler, if PE suspected (see Wells' Score)
- negative D-dimer rules out PE in low probability patients
- patients with intermediate or high probability Wells' score require imaging

ACUTE MYOCARDIAL INFARCTION

- see also [Cardiology, C25](#)

Management

- immediate stabilization
 - oxygen 4L/min
 - IV access
 - cardiac monitors
 - "STAT" ECG
 - cardiac enzymes (CK, Troponins)
- ASA 160-325mg chewed
- nitroglycerin 0.3 mg SL q5min x 3 (IV for CHF, HTN, unresolved pain)
- morphine 2-5 mg IV q5-30min if unresponsive to NTG
- metoprolol 5 mg slow IV q5min x 3 if no contraindication (beware in inferior wall AMI)
- thrombolytics or primary percutaneous coronary intervention (PCI)
 - agents include t-PA, r-PA, Streptokinase, and TNK
 - evaluate indications and contraindications prior to use
- enoxaparin (Low Molecular Weight Heparin) 1mg/kg SC bid (30mg IV STAT post TNK infusion)
- other – antiarrhythmics, cardioversion, defibrillation, transthoracic pacing, angioplasty
- cardiology consult

Chronic Obstructive Pulmonary Disease (COPD)

- see also [Respirology, R8](#)

Etiology

- emphysema: destruction of alveoli can lead to tachypnea and dyspnea
- chronic bronchitis: chronic cough and sputum production
- usually co-exist

History and Physical Examination

- worsening dyspnea or tachypnea
- acute change in frequency, quantity and colour of sputum production
- premorbid health status
- trigger: pneumonia, urinary tract infection, PE, CHF, drugs

Investigations

- CBC, electrolytes, ABG, CXR, ECG, PFTs

Management

- keep O₂ sat 88-92% (BEWARE OF CO₂ RETAINERS, but do not withhold O₂ if hypoxic)
- bronchodilators + anticholinergics
- steroids: methylprednisolone 125 mg IV or prednisone 40 mg PO (tapered over 3 weeks)
- antibiotics: TMP-SMX, cephalosporins, quinolones (if signs of infection)
- ventilation (chance of ventilation dependency)
- admit if co-morbid illness
- discharge on antibiotics, bronchodilators and short course of steroids (taper if necessary)

Congestive Heart Failure



- also see Cardiology, C33

Etiology

- decreased myocardial contractility: ischemia, infarction, cardiomyopathy, myocarditis
- pressure overload states: hypertension, valvular abnormalities, congenital heart disease
- restricted cardiac output: myocardial infiltrative disease, cardiac tamponade
- volume overload: idiopathic

Causes of Exacerbation or Precipitants

- cardiac: acute myocardial infarction or ischemia, cardiac tachyarrhythmias (e.g. atrial fibrillation), uncontrolled hypertension
- medications: discontinuation of, non-compliance with or change in prescribed cardiac medications, NSAIDs, steroids
- dietary: increased sodium intake
- increased cardiac output demand – infection, anemia, hyperthyroidism, pregnancy
- other: pulmonary embolus, physical overexertion, renal failure

History/Presentation

- left-sided heart failure
 - dyspnea, decreased exercise tolerance, paroxysmal nocturnal dyspnea, orthopnea, nocturia, fatigue, possibly altered mental status
 - in severe cases pulmonary edema: severe respiratory distress, pink frothy or white sputum, rales, S3 or S4
- right-sided heart failure
 - dependant edema, jugular venous elevation/distention, hepatic enlargement, ascites
- patients often present with a combination of right-sided and left-sided symptoms

Physical Examination

- vitals: tachypnea, tachycardia, hypo- or hypertension, hypoxia
- respiratory: crackles, wheezes
- cardiac: laterally displaced apex, S3 or S4, jugular venous distention, hepato-jugular reflex
- abdominal: hepatomegaly, ascites
- peripheral vascular: peripheral or sacral edema, weak peripheral pulses, pulsus alternans (alternating weak and strong pulse), cool extremities

Investigations

- labs: CBC, electrolytes, AST, ALT, bilirubin, creatinine, BUN, cardiac enzymes
- chest X-ray: very important!
 - Grade 1 – pulmonary vascular redistribution
 - Grade 2 – perihilar infiltrates
 - Grade 3 – interstitial edema, Kerley B lines
 - Grade 4 – alveolar edema, bilateral infiltrates (= pulmonary edema)
 - also may see cardiomegaly and in severe cases pleural effusions
- ECG: look for MI, ischemia
 - in CHF: LVH, atrial enlargement, conduction abnormalities
- ABG: if severe or refractory to treatment
 - hypoxemia, hypercapnia and acidosis are signs of severe CHF
- echocardiogram: not usually used in emergency evaluation, previous results may aid in diagnosis



Causes of CHF Exacerbation (FAILURE):

- Forgot medication
- Arrhythmia/anemia
- Ischemia/infarction/infection
- Lifestyle (i.e. too much salt)
- Upregulation of cardiac output (pregnancy, hyperthyroidism)
- Renal failure
- Embolism (pulmonary)



Hospital management required if:

- acute MI
- pulmonary edema or severe respiratory distress
- severe complicating medical illness (e.g. pneumonia)
- anasarca
- symptomatic hypotension or syncope
- refractory to outpatient therapy
- thromboembolic complications requiring interventions
- clinically significant arrhythmias
- inadequate social support for safe outpatient management
- persistent hypoxia requiring supplemental oxygen



**Acute Treatment of CHF (LMNOP):**

Lasix (furosemide)
Morphine
Nitroglycerine
Oxygen
Position (sit upright)

Management (acute)

- ABC, may require intubation if severe hypoxia
- sit upright, cardiac monitoring and continuous pulse oximetry
- IV TKVO only, Foley catheter (to follow effectiveness of diuresis)
- 100% O₂ by mask
 - if poor response may require CPAP, BiPAP, or intubation
- 0.3 mg nitro SL q5min PRN ± topical nitro patch (0.2-0.8 mg/hr)
 - if not responding or ischemia: 10-200 µg/min IV, titrate
- diuretic if volume overloaded (e.g. furosemide 40-80 mg IV)
- morphine 1-2 mg IV – may need to repeat
- if hypotensive may require dobutamine (2.5 µg/kg/min IV) or dopamine (5-10 µg/kg/min IV), titrate up to SBP 90-100
- ASA 160 mg chew and swallow
- treat precipitating factor (e.g. treat pneumonia)
- cardiology or medicine consult

**Diabetic Emergencies**

- see also Endocrinology, E7

Diabetic Ketoacidosis (DKA)

- severe insulin deficiency resulting in dehydration and electrolyte abnormalities
- history and physical examination – often young, type 1 DM, may be first presentation of undiagnosed DM (may occur in small percentage of type 2 patients)
 - early symptoms:
 - ♦ polyuria, polydipsia, malaise
 - late signs and symptoms:
 - ♦ anorexia, nausea, vomiting, dyspnea (often due to acidosis), fatigue
 - ♦ abdominal pain
 - ♦ drowsiness, stupor, coma
 - ♦ Kussmaul's respiration
 - ♦ fruity acetone breath
- investigations
 - CBC, glucose, electrolytes, BUN/creatinine, Ca, Mg, phosphate
 - calculation of Anion Gap [Na – (Cl + HCO₃)]
 - urine glucose and ketones, β-hCG (to rule out ectopic pregnancy)
 - ABG
 - ECG (MI possible precipitant of DKA; electrolyte disturbances may predispose to arrhythmia)
- management
 - treat for SHOCK: ABCs
 - ♦ rehydration
 - bolus of NS, then high rate NS infusion (but beware of overhydration and cerebral edema, especially in pediatric patients)
 - ♦ insulin
 - initial bolus of 5-10 U short-acting/regular insulin (or 0.2 U/kg) IV in adults
 - followed by continuous infusion at 5-10 U (or 0.1 U/kg) per hour
 - add D5W when blood glucose <15 mM (goal is to stop ketogenesis, which requires more insulin than inhibition of gluconeogenesis → ∴ insulin + glucose are given until resolution of acidosis, ketonemia)
 - ♦ potassium
 - essential to avoid hypokalemia: replace KCl (20 mEq/l. if adequate renal function and initial K <5.5 mmol/L)
 - use cardiac monitoring if potassium levels normal or low
 - ♦ note: bicarbonate is not given unless patient is at risk of death or shock

**Precipitating Factors in DKA (the 5 Is):**

Infection
Ischemia
Infarction
Intoxication
Insulin missed



4 criteria for DKA Dx: hyperglycemia, metabolic acidosis, hyperketonemia, ketonuria.



Cerebral edema may occur if hyperosmolality treated too aggressively.


Hyperosmolar Nonketotic Hyperglycemic Syndrome (HONK)

- state of extreme hyperglycemia (due to relative insulin deficiency, increased counter-regulatory hormones, gluconeogenesis) and dehydration (due to osmotic diuresis) in type 2 DM, high mortality
- history and physical examination
 - mental disturbances, coma, delirium, seizures
 - polyuria
 - nausea, vomiting
- investigations
 - CBC, electrolytes, creatinine, BUN, glucose, Mg, phosphate, urine glucose and ketones
 - anion gap
 - ABG
 - ECG
- management
 - rehydration with NS (total water deficit estimated at average 100 cc/kg body weight)

- O₂ and cardiac monitoring, frequent electrolytes and glucose monitoring
- insulin as required
- identify and treat cause

Hypoglycemia

- very common ED presentation
- management focus:
 1. treatment of hypoglycemia
 2. investigation of cause (most often due to exogenous insulin, EtOH, sulfonylureas)
- neuroglycopenic symptoms: dizziness, H/A, confusion, fatigue, decreased concentration, paralysis, seizures, coma
- autonomic symptoms: diaphoresis, trembling, warmth, anxiety, nausea
- history and physical examination
 - last meal, known diabetes, prior similar episodes, drug therapy
 - liver / renal / endocrine / neoplastic disease
 - depression, EtOH or drug use
- management:
 - IV access and rapid BG
 - D50W 50 mL IV push, glucose PO if mental status permits
 - ♦ if IV access not possible, glucagon 1-2 mg IM, repeat x 1 in 10-20 min.
 - O₂, cardiac, frequent BG monitoring
 - thiamine 100 mg IM
 - full meal as soon as mental status permits
 - if episode due to long acting insulin, sulfonylureas, watch for prolonged hypoglycemia due to long t_{1/2}
 - search for cause




Hypoglycemia-inducing Drugs	
Insulin	Sulfa abx
Sulfonylureas	Cotrimazole
Ethanol	Ampicillin
Salicylates	Tetracycline
Acetaminophen	Amphetamines,
NSAIDs	cocaine
β-adrenergic agonists	Pyridoxine
Lithium	ACE-I
Calcium	Theophylline
MAOI	Quinine
Coumadin	

Headache


- see also Neurology, N54

Etiology


- the common
 - common migraine (no aura)/classic migraine (involves aura)
 - ♦ gradual onset, unilateral/bilateral, throbbing
 - ♦ nausea/vomiting, photo/phonophobia
 - ♦ treatment: analgesics, neuroleptics, vasoactive meds
 - tension/muscular headache
 - ♦ never during sleep, gradual over 24 hours
 - ♦ posterior/occipital
 - ♦ increased with stressors
 - ♦ treatment: modify stressor, local measures, NSAIDs
- the deadly
 - subarachnoid hemorrhage (SAH) – see also Neurosurgery, NS15
 - ♦ sudden onset, increased with exertion
 - ♦ “worst” headache, nausea and vomiting, meningeal signs
 - ♦ diagnosis: CT, LP (5-10% of patients with SAH have negative initial CT)
 - sensitivity of CT decreases with time and is much less sensitive by 48-72 hr
 - ♦ management: urgent neurosurgery consult
 - increased ICP
 - ♦ worst in morning, supine, or bending down
 - ♦ physical exam: neurological deficits, cranial nerve palsies, papilledema
 - ♦ diagnosis: CT scan
 - ♦ management: consult neurosurgery
 - meningitis (see Infectious Diseases, ID7)
 - ♦ fever, nausea/vomiting, meningeal signs, purpuric rash
 - ♦ altered level of consciousness
 - ♦ perform CT to rule out SAH then do LP for diagnosis
 - ♦ treatment: early empiric antibiotics (depending on age group), steroid therapy
 - temporal arteritis (not immediately deadly but causes great morbidity) (see Ophthalmology, OP41)
 - ♦ one-sided scalp tenderness, jaw claudication, visual disturbances
 - ♦ labs: elevated ESR
 - ♦ *temporal artery biopsy is gold standard for diagnosis*
 - ♦ treatment: high-dose steroids immediately if TA suspected


Note: up to 5% of patients with subarachnoid hemorrhage have a normal CT scan; if suspect SAH with a negative CT, perform a lumbar puncture.



BEWARE: every headache is serious until proven otherwise.



DDx Subarachnoid Hemorrhage: BATS
 Berry aneurysm
 Arteriovenous malformation/
 Adult polycystic kidney disease
 Trauma
 Stroke



Meningitis:
 Do not delay IV antibiotics for LP



Hypertensive Emergencies

Etiology

Hypertensive Emergency (Hypertensive Crisis)

- definition: acute elevation of systolic and diastolic BP associated with end-organ damage (CNS, eyes, heart, or kidneys)
- immediate goal of IV therapy is to reduce the dBP by 10-15% (to approx. 110 mmHg) in 30-60 min (5-10 min for aortic dissection)
- treatment may be initiated in the ED followed by prompt admission to ICU for continuous BP monitoring
- BP should NOT be lowered rapidly in patients with major cerebrovascular event
 - BP lowering attempted if dBP >120 to 130 mmHg; aim to reduce dBP by 20% in the first 24h
 - ↑BP is an attempt to maintain cerebral perfusion pressure; decreasing BP too fast may extend or worsen stroke

Hypertensive Urgency

- definition: severely elevated blood pressure (usually dBP >115) with no evidence of end-organ damage
- most commonly due to non-compliance with medications
- treatment: gradually reduce pressure over 24-48 hours to a level appropriate for the patient
- goal is to differentiate hypertensive emergencies from hypertensive urgencies

History and Physical Examination

- prior hypertensive crises
- antihypertensive medications prescribed and BP control
- monoamine oxidase inhibitors (MAOIs)
- street drugs (cocaine, amphetamines, phencyclidine, etc.)
- blood pressure measurement in all limbs
- fundoscopic exam (hemorrhages, papilledema, etc.)

Investigations

- CBC, electrolytes, BUN, creatinine, urinalysis
- peripheral blood smear – to detect microangiopathic hemolytic anemia
- CXR – if SOB or chest pain
- ECG, troponins, CK if chest pain
- CT head – if neurological findings or severe headache

Treatment of Hypertensive Emergencies (see Table 14)

HYPERTENSIVE EMERGENCIES

Hypertensive Encephalopathy

- pathophysiology: cerebral hyperperfusion due to blood pressure in excess of the capacity for cerebral autoregulation
- signs and symptoms: headache, nausea, vomiting, mental status changes (lethargy to coma), fundoscopic changes (hemorrhage, exudates, cotton wool spots, papilledema, sausage linking), over hours can lead to coma and death

Pregnancy Induced Hypertension (PIH)

- see Obstetrics, OB14
- watch for HTN, seizures, proteinuria, thrombocytopenia, increased AST, clonus, and hyperreflexia
- initial treatment = magnesium sulfate IV; often lowers BP sufficiently without other agents

Cardiovascular Emergencies

- left ventricular failure (LVF)
 - pathophysiology: decreased LV function due to increased afterload, increased oxygen demand and decreased coronary blood flow may cause angina, MI, or pulmonary edema
 - signs and symptoms: chest pain, SOB
 - avoid diazoxide, hydralazine, minoxidil as these drugs increase oxygen demand
- thoracic aortic dissection (see Cardiology, C48)

Hypertensive Renal Emergencies

- renal failure can be either the cause or effect of a hypertensive emergency
- hypertension associated with deteriorating renal function is considered an emergency
- hypertension in the setting of chronic renal failure is due to sodium and water retention by the diseased kidney and increased activation of the renin-angiotensin system
- diagnosis: proteinuria, RBC and RBC casts in urine, elevated BUN and creatinine
- treatment: IV calcium channel blockers, ± emergent ultrafiltration



With CNS manifestations of severe hypertension, it is often difficult to differentiate causal relationships (i.e. hypertension could be secondary to primary cerebral event [Cushing effect]).

Catecholamine Induced Hypertensive Emergencies

- etiology
 - discontinuation of short-acting sympathetic blocker (e.g. clonidine, propranolol)
 - pheochromocytoma
 - sympathomimetic drugs (cocaine, amphetamines, phencyclidine)
 - MAOI in combination with sympathomimetics or tyramine-containing foods (cheese, red wine)
- treatment: re-administer sympathetic blocker if due to withdrawal (e.g. clonidine, propranolol)

Catecholamine Induced Hypertensive Emergencies
 Avoid use of non-selective β-blockers as they inhibit β-mediated vasodilation and leave α-adrenergic vasoconstriction unopposed.

Table 14. Most commonly used agents for the treatment of hypertensive crisis

Drug	Dosage*	Onset of Action	Duration of Action	Adverse Effects	Special Indications
VASODILATORS					
• Sodium Nitroprusside (vascular smooth muscle dilator) 1st line	0.25 - 10 µg/kg/min	Immediate	3-5 min	NV, muscle twitching, sweating, cyanide intoxication, coronary steal syndrome	Most hypertensive emergencies (esp CHF, aortic dissection) Use in combination with β-blockers (i.e. esmolol) in aortic dissection Caution with high ICP and azotemia
• Nicardipine (CCB)	2 mg IV bolus, then 4 mg/kg/hr IV	15-30 min	40 min flushing, local phlebitis	Tachycardia, headache, (i.e. encephalopathy, RF, eclampsia, sympathetic crisis)	Most hypertensive emergencies Caution with acute CHF
• Fenoldopam Mesylate (dopamine receptor antagonist)	0.05-0.1 µm/kg/min IV	<5 min	8-10 min nausea, flushing	Tachycardia, headache, (i.e. acute RF)	Most hypertensive emergencies Caution with glaucoma
VASODILATORS					
• Enalapril (ACEI)	0.625 - 1.25 mg IV q6h	15-30 min	12-24 hr in high renin states not seen in studies	Theoretical fall in pressure Avoid in acute MI, pregnancy, acute RF	Acute LV failure
• Nitroglycerin	5-20 µg/min IV	1-2 min	3-5 min	Hypotension, bradycardia, headache, lightheadedness, dizziness	MI Pulmonary edema
• Hydralazine	5-10mg IV/IM q20min (max 20mg)	5-20 min	2-6 hrs	Dizziness, drowsiness, headache, tachycardia, Na retention	Eclampsia
ADRENERGIC INHIBITORS					
• Labetalol	20 mg IV bolus q10 min or 0.5 - 2 mg/min	5-10 min	3-6 hr burning in throat, dizziness, nausea, heart block, orthostatic hypotension	Vomiting, scalp tingling, Avoid in acute CHF, HB > 1st degree	Most hypertensive emergencies (esp. eclampsia)
• Esmolol	250 - 500 µg/kg/min for 1 min, then 50 µg/kg/min for 4 min; repeat	1-2 min	10-20 min bronchospasm	Hypotension, nausea, SVT dysrhythmias, perioperative HTN Avoid in acute CHF, HB > 1st degree	Aortic dissection, acute MI
• Phentolamine	5-15 mg q5-15 min	1-2 min	3-10 min	Tachycardia, headache, flushing	Catecholamine excess (ie. pheo)

*Hypotension may occur with all of these agents

Most commonly used agents are labetalol and nitroprusside.

Ophthalmologic Foreign Body and Corneal Abrasion

- see also Ophthalmology, OP19

History

- patient may complain of pain, tearing, itching, redness, photophobia, foreign body sensation
- elicit history of potential trauma to eye
- mechanism of foreign body insertion – if high velocity injury suspected (welding, metal grinding, metal striking metal), must obtain orbital x-rays to exclude presence of intraocular metallic foreign body

Physical Examination

- visual acuity with best corrected vision
- pupils, extraocular movement, external ocular structures
- fundoscopy
- tonometry – measurement of intraocular pressure (normal pressure: 10-20 mmHg)
- slit lamp exam
 - systematic examination of anterior segment structures and vitreous
 - proparacaine anaesthetic drops may ease examination



ALWAYS assess visual acuity in both eyes when a patient presents to the ER with an ophthalmologic complaint.

- look for rust ring with metallic foreign body, corneal edema, anterior chamber cells/flare
- may use fluorescein dye which stains de-epithelialized cornea green when viewing with cobalt blue filter


Contraindications to pupil dilation:

- shallow anterior chamber
- iris-supported lens implant
- potential neurological abnormality requiring pupillary evaluation
- caution with CV disease – mydriatics can cause tachycardia



Legally required to report sexual assault if victim is <16 years of age.

Management

- copious irrigation with saline for any foreign body
- remove foreign body under slit lamp exam with cotton swab or sterile needle
- antibiotic drops qid until healed
- patching may not improve healing or comfort – do not patch contact lens wearers
- limit use of topical anesthetic to examination only
- consider tetanus prophylaxis
- ophtho consult if globe penetration suspected

Sexual Assault

Epidemiology

- 1 in 4 women and 1 in 10 men will be sexually assaulted in their lifetime

General Approach

- ABCs, treat acute, serious injuries
- ensure patient is not left alone and provide ongoing emotional support
- set aside adequate time for exam (usually 1.5 hours)
- obtain consent for medical exam and treatment, collection of evidence, disclosure to police (notify police as soon as consent obtained)
- Sexual Assault Kit (document injuries, collect evidence) if <72hrs since assault
- label samples immediately and pass directly to police
- offer community crisis resources (e.g. shelter, hotline)
- do not report unless victim requests (legally required if <16 years old)

History

- who? how many? when? where did penetration occur? what happened? any weapons or physical assault?
- post-assault activities (urination, defecation, change of clothes, shower, douche, etc.)
- gynecologic history
 - gravity, parity, last menstrual period
 - contraception
 - last voluntary intercourse (sperm motile 6-12 hours in vagina, 5 days in cervix)

Physical Examination

- evidence collection is always secondary to treatment of serious injuries
- never re-traumatize a patient with the examination
- general examination
 - mental status
 - sexual maturity
 - patient should remove clothes and place in paper bag
 - document abrasions, bruises, lacerations, torn frenulum/broken teeth (indicates oral penetration)
- pelvic exam and specimen collection
 - ideally before urination or defecation
 - examine for seminal stains, hymen, signs of trauma
 - collect moistened swabs of dried seminal stains
 - pubic hair combings and cuttings
 - speculum exam
 - ♦ lubricate with water only
 - ♦ vaginal lacerations, foreign bodies
 - ♦ Pap smear
 - ♦ oral/cervical/rectal culture for gonorrhea and chlamydia
 - ♦ posterior fornix secretions if present or aspiration of saline irrigation
 - ♦ immediate wet smear for motile sperm
 - ♦ air-dried slides for immotile sperm, acid phosphatase, ABO group
- others
 - fingernail scrapings
 - saliva sample from victim

Investigations

- VDRL - repeat in 3 months if negative
- serum β -hCG
- blood for ABO group, Rh type, baseline serology (e.g. hepatitis, HIV)

Management

- involve local/regional sexual assault team
- medical
 - suture lacerations
 - tetanus prophylaxis
 - gynecology consult for foreign body, complex lacerations
 - assumed positive for gonorrhea and chlamydia
 - ♦ management: azithromycin 1 g PO x 1 dose
(alt: doxycycline 100 mg PO bid x 7 days)
and cefixime 400 mg PO x 1 dose
 - may start prophylaxis for hepatitis B and HIV
 - pre and post counselling for HIV testing
 - pregnancy prophylaxis offered
 - ♦ levonorgestrel 0.75 mg STAT, repeat in 12 hours (Plan B™)
- psychological
 - high incidence of psychological sequelae
 - have victim change and shower after exam completed
 - follow-up with MD in rape crisis centre within 24 hours
 - best if patient does not leave ED alone

DOMESTIC VIOLENCE

- identify the problem (need high index of suspicion)
 - suggestive injuries
 - somatic symptoms (chronic and vague complaints)
 - psychosocial symptoms
- if disclosed, be supportive and assess danger

Management

- treat injuries
- ask about sexual assault and children at home
- document findings
- plan safety
- follow-up: family doctor/social worker

Seizures

- see also Neurology, N8

Etiology

- generalized seizure (consciousness always lost): tonic/clonic, absence, myoclonic, atonic
- partial seizure (focal): simple partial, complex partial
- causes: trauma, intracranial hemorrhage, structural abnormality, infection, toxins/drugs, metabolic disturbance (hypo/hyperglycemia, hypo/hyponatremia, hypocalcemia, hypomagnesemia); primary seizure disorder
- differential diagnosis: syncope, pseudoseizures, migraines, movement disorder, narcolepsy/cataplexy

History

- from patient and bystander: flaccid and unconscious, often with deep rapid breathing
- preceding aura, rapid onset, loss of bladder/bowel control, tongue-biting

Physical Examination

- injuries to head and spine, tongue laceration, aspiration

Investigations

- known seizure disorder: anticonvulsant levels
- Accucheck
- first time seizure: CBC, serum glucose, electrolytes, BUN, creatinine, Ca, Mg; consider prolactin, β -hCG, tox screen
- consider CT, MRI, C-spine X-ray, EEG

Management

- O₂
- medications to stop seizure – continue to next step if seizure continues:
 - lorazepam 2-4 mg (0.1 mg/kg) IV/IM or diazepam 5-10 mg IV q2-3 min until seizure stops
 - phenytoin 20 mg/kg IV at 50 mg/min
 - consult neurology
 - phenobarbital 20 mg/kg IV at 50-75 mg/min
 - if the above steps fail, RSI
 - emergency EEG if no response after 15-20 minutes
 - ICU admission





Causes of Syncope by System (HEAD, HEART, VeSSELS):
 Hypoxia/Hypoglycemia
 Epilepsy
 Anxiety
 Dysfunctional brainstem
 Heart attack
 Embolism (PE)
 Aortic obstruction
 Rhythm disturbance
 Tachycardia
 Vasovagal
 Situational
 Subclavian steal
 ENT (glossopharyngeal neuralgia)
 Low systemic vascular resistance
 Sensitive carotid sinus

Syncope

- definition: sudden, transient loss of consciousness and postural tone with spontaneous recovery
- usually caused by generalized cerebral hypoperfusion

Etiology

- cardiogenic: arrhythmia, outflow obstruction (e.g. PE, tamponade, tension pneumo, pulmonary HTN), MI, valvular disease
- non-cardiogenic: peripheral vascular (hypovolemia), vaso-vagal, cerebrovascular disorders, CNS, metabolic disturbances

History

- gather details from witnesses
- distinguish between syncope and seizure (see [Neurology, N8](#))
 - signs and symptoms during presyncope, syncope and postsyncope
 - past medical history, drugs

Physical Examination

- postural BP and HR
- cardiovascular, respiratory and neuro exam

Investigations

- ECG, bedside glucose
- as indicated: CBC, electrolytes, BUN, creatinine, ABGs, Troponin, Mg, Ca, β-hCG (tailor to clinical presentation and patient's premorbid condition)

Management

- ABCs, IV, O₂, monitor
- examine for signs of trauma caused by syncopal episode
- cardiogenic syncope: admit to medicine/cardiology
- non-cardiogenic syncope: discharge with follow-up as indicated by cause

Stroke

- see also [Neurology, N57](#)

Types of Stroke

- ischemic stroke (80% of all strokes)
- hemorrhagic stroke

History

- consider acute stroke if acute neurological deficit (focal or global) or altered LOC
- more likely to be hemorrhagic if: nausea, vomiting, headache, change in LOC, seizure
- common symptoms of stroke: abrupt onset of hemiparesis/monoparesis, visual loss/field deficits, diplopia, dysarthria, ataxia, vertigo, aphasia, sudden decrease in LOC
- determine time of symptom onset for consideration of thrombolytic therapy
- N.B. if patient is candidate for thrombolysis, very brief assessment and STAT CT head

Physical Examination

- vitals
- if decreased LOC: assess for ability to protect airway
- rule out trauma, infection, meningeal irritation
- search for cardiovascular causes of stroke
 - ocular fundi (retinopathy, emboli, hemorrhage)
 - CVS (irregular heartbeat, murmurs, gallops)
 - PVS (carotid, radial and femoral pulses; auscultate for carotid bruits)
- neuro:
 - mental status, LOC, cranial nerves, motor function, sensory function, cerebellar function, gait, deep tendon reflexes
 - confirm presence of stroke syndrome, and distinguish from stroke mimics (seizure, systemic infection, brain tumour, positional vertigo, Bell's palsy)
 - establish neurological baseline should patient improve/deteriorate

Table 15. Stroke Syndromes

Region of Stroke	Stroke Syndrome
Anterior Cerebral Artery	<ul style="list-style-type: none"> • Primarily frontal lobe function affected • Altered mental status, impaired judgement, contralateral lower extremity weakness and hypoaesthesia, gait apraxia
Middle Cerebral Artery	<ul style="list-style-type: none"> • Contralateral hemiparesis (arm & face weakness > leg weakness) and hypoaesthesia, ipsilateral hemianopsia, gaze preference to side of lesion • ± agnosia, receptive/expressive aphasia
Posterior Cerebral Artery	<ul style="list-style-type: none"> • Affects vision and thought • Homonymous hemianopsia, cortical blindness, visual agnosia, altered mental status, impaired memory
Vertebrobasilar Artery	<ul style="list-style-type: none"> • Wide variety of CN, cerebellar and brainstem deficits: vertigo, nystagmus, diplopia, visual field deficits, dysphagia, dysarthria, facial hypoaesthesia, syncope, ataxia • Loss of pain and temperature sensation ipsilateral face and contralateral body



Differentiation of UMN Disease versus LMN Disease

Category	UMN Disease	LMN Disease
Muscular deficit	Muscle groups	Individual muscles
Reflexes	Increased	Decreased/absent
Tone	Increased	Decreased
Fasciculations	Absent	Present
Atrophy	Absent/minimal	Present

Thrombolysis for Acute Ischemic Stroke

(Wardlaw JM, del Zoppo G, Yamaguchi T, Berge E. Cochrane Database of Systematic Reviews 2006; Issue 3)
Purpose: To review the efficacy and safety of thrombolysis in acute ischemic stroke.

Study Characteristics: Systematic review of 18 RCTs (16 double-blind) with 5727 patients

Participants: Patients with acute ischemic stroke confirmed by CT

Intervention: Any thrombolytic agent, any dose, intravenously or intra-arterial

Primary Outcomes: Early outcomes (7 to 10 days) include deaths from all causes or symptomatic intracranial hemorrhages. Late outcomes (3 and 6 months) include deaths from all causes, or poor functional outcome at follow-up (death or dependency) as measured by Rankin or Barthel scores.

Results: Thrombolytic therapy is associated with an excess of early deaths (OR 1.81; 95% CI, 1.46-2.24) and symptomatic intracranial hemorrhage (OR 3.37; 95% CI, 2.08-4.22). Use of a thrombolytic agent within three hours of stroke is effective in reducing death or dependency at 3 to 6 months (OR 0.66, 95% CI 0.53 to 0.83) without a statistically significant increase in deaths (OR 1.13, 95% CI 0.96 to 1.48). When given within six hours, thrombolytic therapy significantly reduced the proportion of patients dead or dependent at three to six months (OR 0.84, 95% CI 0.75 to 0.95), but also significantly increased the odds of death (OR 1.32, 95% CI 1.15 to 1.53). Non-random comparisons of rt-PA suggest it may be associated with slightly less hazard and more benefit than other thrombolytics.

Conclusion: Thrombolytic therapy increases immediate hazard in patients, but when used within three hours of ischemic stroke decreases death or dependency without significant increase in mortality.

Investigations

- CBC, electrolytes, blood glucose, coagulation studies, \pm cardiac biomarkers, \pm toxicology screen
- CT scan, non-contrast: look for hemorrhage, ischemia
- ECG: rule out atrial fibrillation, acute MI as source of emboli

**Management**

- ABC's with RSI if GCS ≤ 8 /rapidly decreasing GCS/inadequate airway protection reflexes
- IV \pm cardiac monitoring
 - judge fluid rate carefully to avoid overhydration (cerebral edema) as well as underhydration (underperfusion of the ischemic penumbra)
- BP control: only treat severe hypertension (sBP >200 , dBP >100 , mean arterial BP >140) or hypertension associated with hemorrhagic stroke transformation, cardiac ischemia, aortic dissection, or renal damage; use IV nitroprusside or labetalol
- cerebral edema control: hyperventilation, mannitol to decrease ICP if necessary
- consult neurosurgery, neurology as indicated

Medications

- acute ischemic stroke: thrombolytics (rt-PA, e.g. alteplase) if within 3 hours of symptom onset with no evidence of hemorrhage by CT scan
- antiplatelet agents: prevent recurrent stroke or stroke after TIAs (e.g. aspirin (1st line); clopidogrel, ticlopidine (2nd line))

Vaginal Bleed

- see also Gynecology, GY6 and Obstetrics, OB22

Etiology

- pregnant patient
 - 1st/2nd trimester pregnancy: ectopic pregnancy, abortion (threatened, incomplete, complete, missed, inevitable, septic), molar pregnancy
 - 2nd/3rd trimester pregnancy: placenta previa, placental abruption, premature rupture of membranes, preterm labour
 - either: trauma, bleeding cervical polyp
- postpartum
 - postpartum hemorrhage, uterine inversion, retained placental tissue, endometritis
- non-pregnant patients
 - dysfunctional uterine bleeding, uterine fibroids, pelvic tumors, trauma, endometriosis, PID

History

- last menstrual period, sexual activity, contraception, history of PID
- pregnancy details
- determine amount of blood
- urinary, GI symptoms

Physical Examination

- look for signs of hypovolemia
- pelvic examination – NOT if suspected placenta previa (ultrasound first)
- speculum exam
 - if pregnant use sterile speculum
- bimanual examination
 - sterile gloves if pregnant
 - if patient is near term with possible rupture of membranes and without other indications defer bimanual examination

Investigations

- β -hCG test for all patients with child-bearing potential
- CBC, blood and Rh type, quantitative β -hCG, PTT, INR
- type and cross if significant blood loss
- 1st/2nd trimester/non-pregnant:
 - ultrasound (U/S) – intrauterine pregnancy, ectopic pregnancy, traumatic injury, foreign body
 - must correlate U/S findings with β -hCG if U/S is non-diagnostic
- 2nd/3rd trimester pregnancy:
 - U/S if no fetal heart tones, no documented intrauterine pregnancy or unknown lie of placenta
 - DIC panel if placental abruption – platelets, PTT, INR, fibrinogen

- postpartum:
 - U/S for retained products
 - β -hCG if concerned about retained tissue

Management

- ABCs
- pulse oximeter and cardiac monitors if unstable
- Rh immune globulin for vaginal bleeding in pregnancy and Rh-negative mother
- 1st/2nd trimester pregnancy:
 - ectopic pregnancy: definitive treatment with surgery or methotrexate
 - intrauterine pregnancy, no concerns of coexistent ectopic: discharge patient with obstetrics follow up
 - U/S indeterminate or β -hCG > 1000-2000 IU for further work-up and/or gynecology consult
 - abortions: if complete, discharge if stable, for all others get gynecology consult
- 2nd/3rd trimester pregnancy:
 - placenta previa or placental abruption: obstetrics consult for possible admission
- postpartum:
 - uterine inversion: replace uterus immediately, may require operative management
 - postpartum hemorrhage: extraction of placenta if retained, hysterectomy if uncontrolled bleeding
 - retained tissue: D&C
 - endometritis: IV antibiotics
- non-pregnant
 - dysfunctional uterine bleeding
 - ♦ <35-40 years of age: Provera™ 10 mg PO x 10 days, warn patient of a withdrawal bleed, discharge if stable
 - ♦ if unstable, admit for IV hormonal therapy, possible D&C
 - ♦ >35-40 years of age: uterine sampling necessary prior to initiation of hormonal treatment to rule out endometrial cancer, U/S for any masses felt on exam
 - structural abnormalities: fibroids or uterine tumors may require D&C for diagnosis/treatment, U/S for workup of other pelvic masses, Pap smear/biopsy for cervical lesions

Environmental Injuries

Heat Exhaustion and Heat Stroke



Heat exhaustion (HE) may closely resemble heat stroke. HE may eventually progress to heat stroke. Therefore if diagnosis is uncertain treat as heat stroke.

Heat Exhaustion

- clinical features relate to loss of circulating volume caused by exposure to heat stress
- “water depletion”: heat exhaustion (HE) occurs if lost fluid not adequately replaced
- “salt depletion”: HE occurs when losses replaced with hypotonic fluid

Heat Stroke

- life-threatening emergency resulting from failure of normal compensatory heat-shedding mechanisms
- divided into classical and exertional subtypes (see Table 16 below)

Table 16. Heat Exhaustion vs. Heat Stroke

	Heat Exhaustion	Classical Heat Stroke	Exertional Heat Stroke
Clinical Features	<ul style="list-style-type: none"> • non-specific malaise, headache, fatigue • body temp <40.5°C (usually normal) • no coma or seizures • dehydration (↑ HR, orthostatic hypotension) 	<ul style="list-style-type: none"> • occurs in setting of high ambient temperatures (e.g. heat wave, poor ventilation) • often patients are older, poor, and sedentary or immobile • dry, hot skin • temp usually >40.5°C • altered mental status, seizures, delirium, coma • may have elevated AST, ALT 	<ul style="list-style-type: none"> • occurs with high endogenous heat production (e.g. exercise) and overwhelmed homeostatic mechanisms • patients often younger, more active • skin often diaphoretic • other symptoms as for classical HS, but may also have DIC, acute renal failure, rhabdomyolysis, marked lactic acidosis
Treatment	<ul style="list-style-type: none"> • rest in a cool environment • normal saline IV if orthostatic hypotension; otherwise replace losses slowly PO 	<ul style="list-style-type: none"> • cool down body temperature with water mist (e.g. spray bottle) and standing fans • ice water immersion also effective; monitor body temp closely to avoid hypothermic overshoot • secure airway because of risk of seizures and aspiration • give fluid resuscitation if still hypotensive after above therapy • avoid α-agonists (epinephrine, etc.) peripheral vasoconstriction and antipyretics (ASA, etc.) 	

- if patient does not respond relatively quickly to cooling treatments, consider other possible etiologies of hyperpyrexia (e.g. meningitis, thyroid storm, anticholinergic poisoning, delirium tremens, other infections, etc.)

Hypothermia



- predisposing factors: extremes of age, lack of housing, drug overdose, EtOH ingestion, trauma (incapacitating), cold water immersion, outdoor sports
- treatment based on: (a) re-warming and (b) supporting cardiorespiratory function
- complications: coagulopathy, acidosis, ventricular arrhythmias (Vfib), asystole, volume/electrolytes depletion
- labs: CBC, electrolytes, ABG, serum glucose, creatinine/BUN, Mg, Ca, amylase, coags
- imaging: CXR (aspiration pneumonia, pulmonary edema are common)
- monitors: ECG, rectal thermistor, Foley catheter, NG tube, monitor metabolic status frequently

Table 17. Classification of Hypothermia

Class	Temp	Symptoms/Signs
Mild	32-34.9°C	Tachypnea, tachycardia, ataxia, dysarthria, shivering
Moderate	28-31.9°C	Loss of shivering, arrhythmias, Osborne (J) waves on ECG, decreased LOC, combative behaviour, muscle rigidity, dilated pupils
Severe	<28°C	Coma, hypotension, acidemia, ventricular fibrillation, asystole, flaccidity, apnea

Re-warming Options

- gentle fluid and electrolyte replacement in all (due to cold diuresis)
- Passive External Re-warming (PER):
 - suitable for most stable patients with core temperature >32.2°C
 - involves covering patient with insulating blanket; body generates heat and re-warms through metabolic process, shivering
- Active External Re-warming (AER)
 - involves use of warming blankets
 - beware "afterdrop" phenomenon (warming of extremities causes vasodilation and movement of cool pooled blood from extremities to core, resulting in a DROP in core temperature → cardiac arrest)
 - safer when done in conjunction with active core re-warming (below)
- Active Core Re-warming (ACR)
 - generally for patients with core temperature <32.2°C, and/or with cardiovascular instability
 - avoids "afterdrop" seen with AER alone
 - re-warm core by using:
 - warmed humidified oxygen, IV fluids
 - peritoneal dialysis with warm fluids
 - gastric/colonic/pleural irrigation with warm fluids
 - external circulation (cardiopulmonary bypass machine)

Cardiac Arrest in the Hypothermic Patient

- do all procedures gently or may precipitate ventricular fibrillation (VF)
- check pulse and rhythm for at least 1 minute; may have profound bradycardia
- if any pulse at all (even very slow) do NOT do CPR
- if in VF try to defibrillate up to max 3 shocks if $T_c < 30^\circ\text{C}$
- intubate gently if required, ventilate with warmed, humidified O_2
- medications (vasopressors; antiarrhythmics) may not be effective at low temperatures
 - controversial; may try one dose
- focus of treatment is re-warming!

Frostbite



Classification

- ice crystals form between cells
- classified according to depth – similar to burns (1st to 3rd degree)
- **1st degree**
 - symptoms: initial paresthesia, pruritus
 - signs: erythema, edema, hyperemia, no blisters
- **2nd degree**
 - symptoms: numbness
 - signs: blistering (clear), erythema, edema
- **3rd degree**
 - symptoms: pain, burning, throbbing (on thawing); may be painless if severe
 - signs: hemorrhagic blisters, skin necrosis, edema, no movement

Management

- treat for hypothermia: O₂, IV fluids, maintenance of body warmth
- remove wet and constrictive clothing
- immerse in 40-42°C agitated water for 10-30 minutes (very painful; administer adequate analgesia)
- clean injured area, leave injured region open to air
- consider aspiration/debridement of blisters (controversial)
- debride skin gently with daily whirlpool immersion (topical ointments not required)
- tetanus prophylaxis
- consider penicillin G as frost bite injury at high risk of infection
- surgical intervention may be required to release restrictive eschars
- never allow a thawed area to re-chill/freeze

**Inhalation Injury****Etiology**

- carbon monoxide (CO) poisoning (see *Toxicology* section, ER46)
- direct thermal injury – limited to upper airway
- smoke causes bronchospasm and edema from particulate matter and toxic inhalants (tissue asphyxiates, pulmonary irritants, systemic toxins)

History

- risk factors: closed space fires, decreased mentation (overdose, alcohol intoxication, head injury, etc.)

Physical

- cherry red skin/blood (usually a post-mortem finding, generally unreliable)
- facial burns, intraoral burns, singed nasal hairs, soot in mouth/nose, hoarseness, carbonaceous sputum, wheezing
- headache, nausea, confusion
- PO₂ normal but O₂ sat low

Investigations

- true O₂ sat must be measured (not pulse oximeter nor calculated value based on a blood gas)
- measure carboxyhemoglobin levels
- ABG
- CXR ± bronchoscopy

Management

- CO poisoning: 100% O₂ ± hyperbaric O₂ (controversial)
- direct thermal injury: humidified oxygen, early intubation, pulmonary toilet, bronchodilators

**Near Drowning**

- most common in children <4 yrs and teenagers
- must also assess for shock, C-spine injuries, hypothermia, SCUBA-related injuries (barotrauma, air emboli, lung re-expansion injury)
- complications: volume shifts, electrolyte abnormalities, hemolysis, rhabdomyolysis, ATN, DIC

Physical Examination

- ABC's, vitals – watch closely for hypotension
- lungs: rales (ARDS, pulmonary edema), decreased breath sounds (pneumothorax)
- CVS: murmurs, arrhythmias, JVP (CHF, pneumothorax)
- H&N: assess for C-spine injuries
- neuro: GCS or AVPU, pupils, focal deficits

Investigations

- labs: CBC, electrolytes, ABGs, Cr, BUN, urinalysis
- imaging: CXR (pulmonary edema, pneumothorax)
- ECG

 **Biological Weapons**
Microbes (anthrax, Q fever, viruses), bacterial toxins (ricin, botulinum), mycotoxins and others are usually spread by droplets (aerosols).

Diluted household bleach (1:19 with water) is good for most biohazard materials for decontamination.

Use contact isolation protocols, and treat for the specific agent.

Management

- ABCs, treat for trauma, shock, hypothermia
- intensive respiratory care:
 - ventilatory assistance if decreased respirations, $p\text{CO}_2 > 50$ mmHg, or $p\text{O}_2 < 60$ mmHg on max O_2
 - hypoxia: maintain $p\text{O}_2$ at 60-80 mmHg
- respiratory acidosis: ventilate
- metabolic acidosis: improve perfusion, $\downarrow p\text{CO}_2$
- arrhythmias: usually respond to corrections of hypoxemia, hypothermia, acidosis
- pulmonary edema: O_2 , CPAP/BiPAP/positive pressure ventilation
- vomiting: very common, insert NG suction to avoid aspiration
- convulsions: usually respond to O_2 ; if not, diazepam 5-10 mg IV slowly
- bronchospasm: bronchodilators
- bacterial pneumonia: not necessary to prophylax with antibiotics unless contaminated water or hot-tub (*Pseudomonas*)
- must observe for 24 hours as non-cardiogenic pulmonary edema may develop late

Common Pediatric ER Presentations

Modified Coma Score for Children

Table 18. Modified GCS

Modified GCS for Children <4 yr

Eye opening	Verbal Response	Motor Response
4 – spontaneously	5 – oriented, social, speaks, interacts	6 – normal, spontaneous movement
3 – to speech	4 – confused speech, disoriented, consolable	5 – localizes pain
2 – to pain	3 – inappropriate words, not consolable/aware	4 – withdraws to pain
1 – no response	2 – incomprehensible, agitated, restless, not aware	3 – decorticate flexion
	1 – no response	2 – decerebrate extension
		1 – no response

Modified GCS for infants

Eye opening	Verbal Response	Motor Response
4 – spontaneously	5 – coos, babbles	6 – normal, spontaneous movement
3 – to speech	4 – irritable cry	5 – withdraws to touch
2 – to pain	3 – cries to pain	4 – withdraws to pain
1 – no response	2 – moans to pain	3 – decorticate flexion
	1 – no response	2 – decerebrate extension
		1 – no response

Any infant <1 year of age with a large, baggy scalp hematoma requires skull x-rays ± CT.

The Febrile Infant

- see also [Pediatrics](#), P51
- for fever $> 38^\circ\text{C}$ without obvious focus:
 - < 28 days
 - ♦ admit
 - ♦ full septic work up (CBC & diff, blood C&S, urine C&S, CSF, CXR if indicated)
 - ♦ treat empirically with broad spectrum IV antibiotics
 - 28-90 days
 - ♦ as above unless infant meets Rochester criteria (see below)
 - > 90 days
 - ♦ toxic: admit, treat, full septic workup
 - ♦ non-toxic and no focus: investigate as indicated by history and physical

- **Rochester Criteria for Febrile Infants age 28-90 days old:**
 - ♦ febrile infants with temperature $>38^{\circ}\text{C}$
 - ♦ non toxic - looking
 - ♦ previously well (>37 weeks GA, home with mother, no hyperbilirubinemia, no prior antibiotics or hospitalizations, no chronic/underlying illness)
 - ♦ no skin, soft tissue, bone, joint, or ear infection on physical exam
 - ♦ WBC 5000-15,000, bands <1500 ; urine <10 WBC/HPF, stool <5 WBC/HPF
 - ♦ serious bacterial infections occur in 7-9% of well-appearing infants 28-90 days old BUT if all of the above Rochester criteria are present, incidence of serious bacterial infection is $<1\%$



Febrile Seizures

- see Pediatrics, P78

Etiology

- children aged 6 months to 5 years with fever or history of recent fever
- simple vs complex febrile seizures

Table 19. Simple vs Complex Febrile Seizures

Characteristic	Simple	Complex
Duration	<15 min	>15 min
Type of seizure	Generalized	Focal features
Frequency	1 in 24 hours	>1 in 24 hours

- normal neurological exam afterward
- no evidence of intracranial infection or history of previous non-febrile seizures
- often positive family history of febrile seizures

Investigations and Management

- if it is a febrile seizure: treat fever AND look for source of fever
- if not a febrile seizure: treat seizure AND look for source of seizure
 - note: may also have fever but may not meet criteria for febrile seizure

Common Childhood Infections

- see also Pediatrics, P50

Table 20. Antibiotic Treatment of Pediatric Bacterial Infections

Infection	Pathogens	Treatment
Meningitis		
Sepsis		
Neonatal	GBS, <i>E.coli</i> , <i>Listeria</i> , <i>S. aureus</i> , Gram negative bacilli	• ampicillin + aminoglycoside (gentamicin) or • ampicillin + cefotaxime \pm cloxacillin if risk of <i>S. aureus</i> • ampicillin + cefotaxime \pm cloxacillin if risk of <i>S. aureus</i>
1-3 months	same pathogens as above and below	
>3 mos	<i>S. pneumococcus</i> , <i>H. influenzae</i> type b (≥ 5 yrs), meningococcus	• cefuroxime • ceftriaxone or cefotaxime, if risk of meningitis • vancomycin, if penicillin/cephalosporin-resistant pneumococci
Otitis Media		
1st line	<i>S. pneumoniae</i> , <i>H. influenzae</i> type b, <i>M. Catarrhalis</i>	• amoxicillin
2nd line		• high dose amoxicillin or clavulin
Treatment Failure		• high dose clavulin or cefuroxime or ceftriaxone
Strep Pharyngitis		
	group A β -hemolytic <i>Streptococcus</i>	• penicillin/amoxicillin or erythromycin (penicillin allergy)
UTI		
	<i>E. Coli</i> , <i>Proteus</i> , <i>H. influenzae</i> , <i>Pseudomonas</i> , <i>S. saprophyticus</i> , <i>Enterococcus</i> , GBS	• amoxicillin/ampicillin or • trimethoprim-sulfamethoxazole
Pneumonia		
1-3 mos	viral, <i>S. pneumoniae</i> , <i>C. trachomatis</i> , <i>B. pertussis</i> , <i>S. aureus</i> , <i>H. influenzae</i>	• cefuroxime \pm macrolide (erythromycin) or • ampicillin \pm macrolide
3 mos-5yrs	viral, <i>S. pneumoniae</i> , <i>S. aureus</i> , <i>H. influenzae</i> , <i>Mycoplasma pneumoniae</i>	• ampicillin/amoxicillin or cefuroxime
>5 years	as above	• ampicillin/amoxicillin + macrolide or cefuroxime + macrolide

Concerning Rashes

- see also Pediatrics, P50 and Dermatology, D44

Measles

- see also Pediatrics, P58
- maculopapular rash starting at hairline, spreading to face/trunk + 3 C's (cough, coryza, conjunctivitis)
- complications: pneumonia, OM, encephalitis
- management: Vit A if hospitalized and/or immunocompromised; respiratory isolation, treat contacts with immune globulin

Erythema Infectiosum

- see also Pediatrics, P60
- 'slapped cheeks', maculopapular lacy-like rash on trunk/limbs
- complications: STAR (sore throat, arthritis, rash), aplastic crisis
- management: supportive, respiratory isolation x 7d

VZV/Chicken Pox

- see also Pediatrics, P57
- itchy, vesicular, maculo-papular rash at multiple stages
- complications: GAS, acute encephalitis, acute cerebellar ataxia, hepatitis, DIC
- management: symptomatic, acyclovir only for complicated cases, respiratory + contact isolation
- prevention: VZIG within 96 hrs of exposure, Varicella vaccine (Varivax™)

Kawasaki Disease

- leading cause of acquired cardiac disease in children; can cause coronary artery aneurysms
- fever >5 d plus 4 of 5 of the following:
 - unilateral lymphadenopathy
 - bilateral, non-purulent conjunctivitis
 - cracked lips, strawberry tongue
 - rash
 - puffy, red palms and soles
- management:
 - acute phase: IVIG 2g/kg and ASA 100 mg/kg/day until fever resolves
 - subacute: ASA 3-5 mg/kg/day until platelets normalize, or indefinitely in case of cardiac disease
 - ECG and echocardiography with echocardiography follow-up at 2, 6, 12 months

Respiratory Distress

- see also Pediatrics, P86

History and Physical Examination

- infants not able to feed, older children not able to speak in full sentences
- anxious, irritable, lethargic – may indicate hypoxia
- tachypnea >60, retractions
- pulsus paradoxus
- wheezing, grunting, vomiting

Table 21. Stridorous Upper Airway Diseases: Diagnosis

Feature	Croup	Bacterial Tracheitis	Epiglottitis ¹
Age range (yrs)	0.5-4	5-10	2-8
Prodrome	Days	Hrs to days	Minutes to hrs
Temperature	Low grade	High	High
Radiography	Steeple sign	Exudates in trachea	Thumb sign
Etiology	Parainfluenza	<i>S. aureus</i> /GAS	<i>H flu</i> type b
Barky Cough	Yes	Yes	No
Droping	Yes	No	Yes
Appear Toxic	No	Yes	Yes
Intubation? ICU?	No	Yes	Yes
Antibiotics	No	Yes	Yes
NOTE:			No oral exam

¹rare now with Hib vaccine in common use



- **management of croup**
 - humidified O₂
 - racemic epinephrine q1h x 3 doses, observe for 'rebound effects'
 - dexamethasone x 1 dose
 - consider bacterial tracheitis/epiglottitis if unresponsive to croup therapy
- **management of bacterial tracheitis**
 - start croup therapy
 - usually require intubation, ENT consult, ICU
 - start abx (e.g. cloxacillin), pending C&S
- **management of epiglottitis**
 - 4 D's: drooling, dyspnea, dysphagia, dysphonia + tripod sitting
 - do NOT EXAMINE OROPHARYNX or AGITATE patient
 - immediate anaesthesia, ENT call - intubate
 - then IV fluids, Abx, blood cultures
- **management of asthma**
 - supplemental O₂ if sats <90% or PaO₂ <60%
 - bronchodilator therapy: salbutamol (Ventolin™) 0.15 mg/kg by masks q20 min x 3
 - add 250-500 µg ipratropium (Atrovent™) to first 3 doses salbutamol
 - give corticosteroid therapy as soon as possible after arrival (prednisolone 2 mg/kg, dexamethasone 0.3 mg/kg)
 - MgSO₄ if critically ill, not responding to inhaled bronchodilators, steroids; give IV bolus, then infusion
 - IV β₂-agonists if critically ill and not responding to above



Abdominal Pain

- see also [Pediatrics](#), P40

History

- nature of pain, associated fever
- associated GI, GU symptoms
- anorexia, decreased fluid intake

Physical Examination

- HEENT, respiratory, abdominal exam including DRE, testicular/genital exam

Table 22. Differential Diagnosis of Abdominal Pain in Infants/Children/Adolescents

Medical	Surgical
Colic	Malrotation with volvulus
UTI	Hirschsprung's
Constipation	Necrotizing enterocolitis
Gastroenteritis	Incarcerated hernia
Sepsis	Intussusception
HSP (Henoch Schonlein purpura)	Duodenal atresia
Inflammatory Bowel Disease	Appendicitis
HUS (Hemolytic Uremic Syndrome)	Cholecystitis
Pneumonia	Pancreatitis
Strep Throat	Testicular torsion
SCD crisis	Ectopic pregnancy
DKA	Trauma
Functional	Pyloric stenosis

*remember to keep an index of suspicion for child abuse

Child Abuse and Neglect

- see also [Pediatrics](#), P15
- obligation to report ANY suspected/known case of child abuse or neglect to CAS yourself (DO NOT DELEGATE)
- document injuries
- consider skeletal survey X-rays, ophtho consult, CT head
- injury patterns associated with child abuse:
 - **head injuries:** torn frenulum, dental injuries, bilateral black eyes, traumatic hair loss, diffuse severe CNS injury, retinal hemorrhage
 - **Shaken Baby Syndrome:** diffuse brain injury, subdural/subarachnoid hemorrhage, retinal hemorrhage, minimal/no evidence of external trauma, associated bony fractures
 - **skin injuries:** bites, bruises/burns in shape of an object, glove/stocking distribution of burns, bruises of various ages, bruises in protected areas

- **bone injuries:** rib fractures without major trauma, femur fractures age <1 year of age, spiral fractures of long bones in non-ambulatory children, metaphyseal fractures in infants, multiple fractures of various ages, complex/multiple skull fractures
- **genitourinary/gastrointestinal injuries:** chronic abdominal/perineal pain, injury to genitals/rectum, STI/pregnancy, recurrent vomiting or diarrhea

Common Psychiatric ER Presentations

Approach to Common Psychiatric Presentations

- see Psychiatry, PS2
- before seeing patient, ensure your own safety; have security/police available if necessary

History

- safety
 - assess suicidality: suicidal ideation, intent, plan, lethal means, past attempts, future planning
 - assess homicidality: access to weapons, intended victim, history of violence
 - command hallucinations
- mood symptoms
- psychotic symptoms: delusions, hallucinations, disorganized speech, disorganized or catatonic behavior, negative symptoms (affective flattening, alogia, avolition)
- substance use history: most recent use, amount, previous withdrawal reactions
- past psychiatric history, medications, compliance with medications
- medical history: obtain collateral if available

Physical

- complete physical exam focusing on: vitals, neurological exam, signs of head trauma, signs of drug toxicity, signs of metabolic disorder
- mental status exam: general appearance, speech, mood and affect, thought content and form, perceptions, cognition including MMSE, judgment, insight, reliability

Investigations

- investigations vary with: patient's age, established psychiatric diagnosis vs. first presentation, history and physical suggestive of organic cause
- as indicated: blood glucose, urine and serum toxicology screen, pregnancy test, electrolytes, TSH, AST/ALT, bilirubin, serum creatinine, BUN, osmolality
- blood levels of psychiatric medications
- CT head if suspect neurological etiology
- LP if indicated

Acute Psychosis

Differential Diagnosis

- primary psychotic disorder (e.g. schizophrenia)
- secondary to medical condition (e.g. delirium)
- drugs: substance intoxication or withdrawal, medications (e.g. steroids, anticholinergics)
- infectious (CNS)
- metabolic (hypoglycemic, hepatic, renal, thyroid)
- structural (hemorrhage, neoplasm)

Management

- violence prevention
 - remain calm, empathetic and reassuring
 - ensure safety of staff and patients, have extra staff and/or security on hand
 - patients demonstrating escalating agitation or overt violent behavior may require physical restraint and/or chemical tranquilization (see *Violent Patient*, ER46)
- treat agitation: whenever possible, offer medication to patients as opposed to administering with force (helps calm and engage patient)
 - benzodiazepines – lorazepam 2 mg PO or IM
 - antipsychotics – olanzapine 5 mg PO, haloperidol 5 mg PO/IM
- treat underlying medical condition
- psychiatry or Crisis Intervention Team consult



Key functions of emergency psychiatric assessment:

1. Is the patient medically stable?
2. Rule out medical cause
3. Is psychiatric consult needed?
4. Are there safety issues (SI, HI)?
5. Is patient certifiable?



Features that suggest organic etiology:

- A** age >40 years old
- B** babbling (incoherent speech or speech difficulties)
- C** concerning vital signs
- D** disorientation
- E** emotional lability
- F** fluctuating course
- G** global impairment of cognitive function
- H** headaches
- I** immodesty
- J** just started (sudden onset)
- K**
- L** loss of consciousness
- M** movement abnormalities (tremor, ataxia, psychomotor retardation)
- N** neurological findings (focal)
- O** other abnormalities on physical exam
- P** perceptions (visual hallucinations)



Suicidal Patient

Epidemiology

- attempted suicide F>M, completed suicide M>F
- second leading cause of death in people <24 yo

Management

- ensure patient safety: close observation, remove potentially dangerous objects from person and room
- assess thoughts (ideation), means, action (preparatory, practice attempts), previous attempts
- admit if there is evidence of intent and organized plan, access to lethal means, psychiatric disorder, intoxication (suicidal ideation may resolve with few days of abstinence)
- patient may require certification if unwilling to stay voluntarily
- do not start long-term medications in the emergency department
- psychiatry or crisis team consult



High risk patients "SAD PERSONS"

- S**ex = male
- A**ge >45 years old
- D**epression
- P**revious attempts
- E**thanol use
- R**ational thinking lost
- S**uicide in family
- O**rganized plan
- N**o spouse, no support system
- S**erious illness

Total number of risk factors >7
hospitalize, consider hospitalization
if 5-6

Violent Patient

Differential Diagnosis

- rule out lethal organic cause (see *Acute Psychosis*, ER45)
- leading organic causes are EtOH, drugs, and head injuries

Prevention

- be aware and look for prodromal signs of violence: anxiety, restlessness, defensiveness, verbal attacks
- try to de-escalate the situation: address the patient's anger, empathize

Restraints

- pharmacological
 - often necessary – may mask clinical findings and impair exam
 - haloperidol 5-10 mg IM (be prepared for dystonic reactions, especially with multiple doses of neuroleptics over a short period) + lorazepam 2 mg IM/IV
 - look for signs of anticholinergic OD first (see *Toxicology*, ER46)
- physical
 - present option to patient in firm but non-hostile manner
 - sufficient people to carry it out safely
 - restrain supine or on side; preferably 4-point restraints, never less than 2-points (opposite arm and leg)
 - suction and airway support available in case of vomiting
- once restrained, search person/clothing for drugs and weapons

Toxicology



Approach to the Overdose Patient/Toxic Exposure

History

- who? age, weight, underlying medical problems, medications
- what? substance and how much
- when? time since exposure determines prognosis and need for contamination, symptoms since
- how? route
- why? intention, suicidality

Physical Examination

- focus on: ABCs, LOC/GCS, vitals, pupils

Principles of Toxicology

- 5 principles to consider with all ingestions
 - resuscitation (ABCs)
 - screening (toxidrome? clinical clues?)
 - decrease absorption of drug
 - increase elimination of drug
 - antidote available?



Suspect overdose when:

- altered level of consciousness/coma
- young patient with life-threatening arrhythmia
- trauma patient
- bizarre or puzzling clinical presentation

ABCs of Toxicology

- basic axiom of care is symptomatic and supportive treatment
 - address underlying problem only once patient is stable
 - A Airway (consider stabilizing the C-spine)
 - B Breathing
 - C Circulation
 - D1 Drugs
 - ACLS as necessary to resuscitate the patient
 - universal antidotes
 - D2 Draw bloods
 - D3 Decontamination (decrease absorption)
 - E Expose (look for specific toxidromes)/Examine the Patient
 - F Full vitals, ECG monitor, Foley, X-rays, etc.
 - G Give specific antidotes, treatments
- Go back and reassess
Call Poison information
Obtain corroborative history from family, bystanders

D1 – Universal Antidotes

- treatments that will not harm patients and may be essential

Oxygen

- do not deprive a hypoxic patient of oxygen no matter what the antecedent medical history (i.e. even COPD with CO₂ retention)
- if depression of hypoxic drive, intubate and ventilate
- exception: paraquat or diquat (herbicides) inhalation or ingestion (oxygen radicals increase morbidity)

Glucose


- give to any patient presenting with altered LOC
- measure blood glucose prior to glucose administration if possible
- adults: 0.5-1.0 g/kg (1-2 mL/kg) IV of D50W
- children: 0.25 g/kg (2-4 mL/kg) IV of D50W

Thiamine (Vitamin B₁)

- 100 mg IV/IM to all patients with IV/PO glucose
- a necessary cofactor for glucose metabolism, but do not delay glucose if thiamine unavailable
- to prevent Wernicke-Korsakoff syndrome
 - Wernicke's encephalopathy - Ataxia, Confusion, Ophthalmoplegia (WACO)
 - untreated, may progress to Korsakoff's psychosis (disorder in learning and processing of new information), usually irreversible
 - prophylaxis: thiamine (100 mg/day x 3 days)
- must assume all undifferentiated comatose patients are at risk

Naloxone

- antidote for opioids: administration is both diagnostic and therapeutic (1 min onset of action)
- used for the undifferentiated comatose patient
- loading dose
 - adults
 - ♦ 2 mg initial bolus IV/IM/SL/SC or via ETT (ETT dose = 2-2.5x IV dose)
 - ♦ if no response after 2-3 minutes, increase dose by 2 mg increments until a response or to max 10 mg
 - ♦ known chronic user, suspicious history, or evidence of track marks, give 0.01 mg/kg
 - child
 - ♦ 0.01 mg/kg initial bolus IV/IO/ETT
 - ♦ 0.1 mg/kg if no response and narcotic still suspected
- maintenance dose
 - may be required because half-life of naloxone much shorter than many narcotics (half-life of naloxone is 30-80 minutes)
 - ♦ hourly infusion rate at 2/3 of initial dose that produced patient arousal



Populations at risk for thiamine deficiency:

- alcoholics
- anorexics
- hyperemesis of pregnancy
- malnutrition states

D2 - Draw Bloods

- essential bloods (see Table 24 for interpretation)
 - CBC, electrolytes, BUN/creat, glucose, INR/PTT, osmolality
 - ABGs, measure O₂ sat
 - acetylsalicylic acid (ASA), acetaminophen, EtOH levels
- potentially useful bloods
 - drug levels – NOT serum drug screen
 - Ca, Mg, PO₄
 - protein, albumin, lactate, ketones, liver enzymes, CK - depending on drug and clinical presentation

Serum Drug Levels

- treat the patient, not the drug level
- negative tox screen signifies only that the specific drugs tested were not detectable in the specimen at the time it was obtained (i.e. does not rule out a toxic ingestion)
- specific drugs available on general screen vary by institution; check before ordering
- urine screens also available (qualitative only)

Table 23. Toxic Gaps (see also Nephrology, NP17)

<p>Anion Gap (AG) = Na⁺ - (Cl⁻ + HCO₃⁻)</p> <ul style="list-style-type: none"> normal range 10-14 mmol/L <p>Metabolic Acidosis</p> <p>Increased AG: "MUDPILES CAT" (* = toxic)</p> <ul style="list-style-type: none"> Methanol Uremia Diabetic ketoacidosis/Starvation ketoacidosis Phenformin*/Paraldehyde* Isoniazid, iron, ibuprofen Lactate (anything that causes seizures or shock) Ethylene glycol* Salicylates* Cyanide, carbon monoxide* Alcoholic Ketoacidosis* Toluene, theophylline* <p>Decreased AG</p> <ul style="list-style-type: none"> error electrolyte imbalance (increased Na⁺/K⁺/Mg²⁺) hypoalbuminemia (50% fall in albumin → 5.5 mmol/L decrease in the AG) Li, Br elevation paraproteins (multiple myeloma) <p>Normal AG</p> <ul style="list-style-type: none"> high K: pyelonephritis, obstructive nephropathy, renal tubular acidosis (RTA), IV, TPN low K: small bowel losses, acetazolamide, RTA I, II 	<p>Plasma Osmolar Gap (POG) = measured - calculated osmoles</p> <ul style="list-style-type: none"> normally POG <10 mOsm/L calculated osmolality = 2Na + BUN + blood glucose (mmol/L) <p>Increased POG: "MAE DIE" (if it ends in "-ol", it will likely ↑ the POG)</p> <ul style="list-style-type: none"> Methanol Acetone Ethanol Diuretics (glycerol, mannitol, sorbitol) Isopropanol Ethylene Glycol <p>Note: normal osmolar gap does not rule out toxic alcohol; only an elevated gap is helpful</p> <p>Oxygen saturation gap = measured - calculated O₂ sat</p> <ul style="list-style-type: none"> measured by absorption spectrophotometry (pulse oximetry) calculated from Hb/O₂ saturation curve <p>Increased O₂ saturation gap</p> <ul style="list-style-type: none"> carboxyhemoglobin methemoglobin sulfhemoglobin
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Table 24. Use of the Clinical Laboratory in the Initial Diagnosis of Poisoning

Test	Finding	Selected Causes
ABG	<ul style="list-style-type: none"> hypoventilation (↑ pCO₂) hyperventilation (↓ pCO₂) 	<ul style="list-style-type: none"> CNS depressants (opioids, sedative-hypnotic agents, phenothiazines, EtOH) salicylates, CO, other asphyxiants
Electrolytes	<ul style="list-style-type: none"> ↑ anion-gap metabolic acidosis hyperkalemia hypokalemia 	<ul style="list-style-type: none"> "MUDPILES CAT": see "Metabolic Acidosis" above digitalis glycosides, fluoride, potassium theophylline, caffeine, β-adrenergic agents, soluble barium salts, diuretics
Glucose	<ul style="list-style-type: none"> hypoglycemia 	<ul style="list-style-type: none"> oral hypoglycemia agents, insulin, EtOH, ASA
Osmolality and Osmolar Gap	<ul style="list-style-type: none"> elevated osmolar gap 	<ul style="list-style-type: none"> "MAE DIE"; see "Toxic Gaps" above
ECG	<ul style="list-style-type: none"> wide QRS complex prolonged QT interval atrioventricular block 	<ul style="list-style-type: none"> TcAs, quinidine, other class Ia and Ic antiarrhythmic agents quinidine and related antiarrhythmics, terfenadine, astemizole Ca²⁺ antagonists, digitalis glycosides, phenylpropanolamine
Abdominal X-Ray	<ul style="list-style-type: none"> radiopaque pills or objects 	<ul style="list-style-type: none"> "CHIPES": Calcium, Chloral hydrate, CCl₄, Heavy metals, Iron, Potassium, Enteric coated Salicylates, and some foreign bodies
Serum Acetaminophen	<ul style="list-style-type: none"> elevated level (>140 mg/L or 1000 μmol/L 4 hours after ingestion) 	<ul style="list-style-type: none"> may be only sign of acetaminophen poisoning

D3 – Decontamination and Enhanced Elimination

Ocular Decontamination

- saline irrigation to neutralize pH; alkali exposure requires ophthalmology consult

Dermal Decontamination (wear protective gear)

- remove clothing, brush off toxic agents, irrigate all external surfaces

Gastrointestinal Decontamination

- single dose activated charcoal (SDAC)
 - absorption of drug/toxin to AC prevents availability
 - contraindications: caustics, SBO, perforation
 - dose: 10g/g drug ingested or 1g/kg body weight
 - odourless, tasteless, prepared as slurry with H₂O
- whole bowel irrigation
 - 500 mL (child) to 2000 mL (adult) of balanced electrolyte solution/hour by mouth until clear effluent per rectum
 - indications
 - ♦ awake, alert patient who can be nursed upright
 - ♦ delayed release product
 - ♦ drug/toxin not bound to charcoal
 - ♦ drug packages (if any evidence of breakage → emergency surgery)
 - ♦ recent toxin ingestion
 - contraindications
 - ♦ evidence of ileus, perforation, or obstruction
- surgical removal in extreme cases
 - indicated for drugs that are toxic, form concretions, or cannot be removed by conventional means



Substances NOT Absorbed by Activated Charcoal

- Li
- Fe
- Alcohols
- Lead
- Caustics

EXTRA-CORPOREAL DRUG REMOVAL (ECDR)

Urine Alkalinization

- weakly acidic substances can be trapped in alkali urine (pH >7.5) to increase elimination (e.g. ASA, methotrexate, 2,4-D, Phenobarb)

Multidose Activated Charcoal (MDAC)

- for toxins which undergo enterohepatic or enteroenteric recirculation including phenobarbital and theophylline
- removes drug that has already been absorbed by drawing them back into GI tract
- various regimens: 12.5g (1/4 bottle) PO q1h or 25g (1/2 bottle) PO q2h until non-toxic and charcoal stool

Criteria for Hemodialysis

- toxins that have:
 - high water solubility, low protein binding, low molecular weight, adequate concentration gradient, small volume of distribution (Vd) or rapid plasma equilibration
- removal of toxin will cause clinical improvement
- advantage is shown over other modes of therapy
- predicted that drug or metabolite will have toxic effects
- impairment of normal routes of elimination (cardiac, renal, or hepatic)
- clinical deterioration despite maximal medical support
- useful for the following toxin blood levels:
 - methanol
 - ethylene glycol
 - salicylates
 - lithium
 - bromine: >15 mmol/L
 - phenobarbital: 430-650 mmol/L
 - chloral hydrate (→ trichloroethanol): >200 mg/kg
- others include theophylline, carbamazepine, valproate, methotrexate

E - Examine the Patient

- vital signs (including temperature), skin (needle tracks, colour), mucous membranes, pupils, odours and CNS
- head-to-toe survey including:
 - C-spine
 - signs of trauma, seizures (incontinence, "tongue biting", etc.), infection (meningismus), chronic alcohol/drug abuse (track marks, nasal septum erosion)
- mental status

Table 25. Specific Toxidromes

Toxidrome	Overdose Signs and Symptoms	Examples of Drugs
Anticholinergics	Hyperthermia Dilated pupils Dry skin Vasodilation Agitation/hallucinations Ileus Urinary retention Tachycardia	"Hot as a hare" "Blind as a bat" "Dry as a bone" "Red as a beet" "Mad as a hatter" "The bowel and bladder lose their tone and the heart goes on alone"
Cholinergics	"DUMBELS" Diaphoresis, Diarrhea, Decreased blood pressure Urination Miosis Bronchospasm, Bronchorrhea, Bradycardia Emesis, Excitation of skeletal muscle Lacrimation Salivation, Seizures	Antidepressants (e.g. TCAs) Cyclobenzaprine (Flexeril™) Carbamazepine Antihistamines (e.g. diphenhydramine) Antiparkinsonians Antipsychotics Antispasmodics Belladonna alkaloids (e.g. atropine)
Extrapyramidal	Dysphonia, dysphagia Rigidity and tremor Motor restlessness, crawling sensation (akathisia) Constant movements (dyskinesia) Dystonia (muscle spasms, laryngospasm, trismus, oculogyric Crisis, torticollis)	Major tranquilizers Antipsychotics
Hemoglobin Derangements	Increased respiratory rate Decreased level of consciousness Seizures Cyanosis unresponsive to O ₂ Lactic acidosis	Carbon monoxide poisoning (carboxyhemoglobin) Drug ingestion (methemoglobin, sulfhemoglobin)
Narcotics, Sedatives/ Hypnotics, EtOH	Hypothermia Hypotension Respiratory depression Dilated or constricted pupils (pinpoint in opiate OD) CNS depression	EtOH Benzodiazepines Opiates (morphine, heroin, etc.) Barbiturates GHB
Sympathomimetics	Increased temperature CNS excitation (including seizures) Tachycardia, hypertension Nausea and vomiting Diaphoresis Dilated pupils	Amphetamines caffeine Cocaine, LSD, PCP Ephedrine & other decongestants Thyroid hormone Sedatives, EtOH withdrawal
Serotonin Syndrome	Mental status changes, autonomic hyperactivity, neuromuscular abnormalities, hyperthermia, diarrhea, HTN	MAOI, TCA, SSRI, opiate analgesics, Cough medicine, weight reduction medications

Note: ASA poisoning and hypoglycemia mimic sympathomimetic toxidrome



Anticholinergics
"Hot and Dry"

Sympathomimetics
"Hot and Wet"

G – Give Specific Antidotes and Treatments

Table 26. Protocol for Warfarin Overdose

INR	Management
<5.0*	Cessation of warfarin administration, observation, serial INR/PT
5.1–9.0*	If no risk factors for bleeding, hold warfarin x 1-2 days and reduce maintenance dose OR Vitamin K 1-2 mg PO if patient at increased risk of bleeding
9.1–20.0*	Hold warfarin, Vitamin K 2-4 mg PO, serial INR/PT, additional Vitamin K if necessary
>20.0 or	Fresh frozen plasma (FFP) 10-15 mL, Vitamin K 10 mg IV over 10 min, increase Vitamin K dosing (q4h) if needed, phenobarbital (little evidence)

Urine Alkalinization Treatment for ASA Overdose

- urine pH >7.5
- fluid resuscitate first, then 3 amps NaHCO₃/litre of DSW @ 1.5 x maintenance
- add 20-40 mEq kcal/litre if patient is able to urinate



Table 27. Specific Antidotes and Treatments – call local poison information centre for specific doses and treatment recommendations

Toxin	Treatment	Considerations
Acetaminophen	Decontaminate (charcoal) N-acetylcysteine	Often clinically silent; evidence of liver/renal damage delayed >24 hrs Toxic dose >200 mg/kg (>75g adult) Monitor drug level immediately and @ 4 hrs post-ingestion; also liver Enzymes, INR, PTT, BUN, Cr Hypoglycemia, metabolic acidosis, encephalopathy → poor prognosis
ASA	Decontaminate (activated charcoal) Alkalinize urine (see Table 23); want urine pH >7.5	Monitor serum pH and drug levels closely Monitor K ⁺ level; may require supplement for urine alkalinization Hemodialysis may be needed if intractable metabolic acidosis, very high levels, or end-organ damage (i.e. unable to diurese)
Anticholinergics	Decontaminate (activated charcoal) Supportive care	Special antidotes available. Consult PIC
Benzodiazepines	Decontaminate (activated charcoal) Supportive care	
β-blockers	Decontaminate (activated charcoal)	Special antidotes considered. Consult PIC
Calcium Channel Blockers	CaCl 1-4 g of 10% sol'n IV if hypotensive atropine or isoproterenol if severe other: high-dose insulin, inotropes or aggressive supportive therapy	Order ECG, lytes (especially Ca, Mg, Na, K)
Cyanide	Cyanide antidote kit or hydroxycobalamin Nitrate, then Na Nitrite; Na thiosulfate	
Digoxin	Decontaminate (charcoal) Digoxin-specific Ab fragments 10-20 vials IV if acute; 3-6 if chronic 1 vial (40 mg) neutralizes 0.6 mg of toxin	Use for life-threatening arrhythmias unresponsive to Conventional therapy, 6 hr serum digoxin >19 nmol/L, initial K ⁺ >5 mM, ingestion >10 mg (adult) / >4 mg (child) Common arrhythmias include V-fib, V-tach, and conduction blocks
Acute Dystonic Rxn	Benztropine: 1-2 mg IM/IV then 2 mg PO x 3 days OR Diphenhydramine 1-2 mg/kg IV, Then 25 mg PO qid x 3 days	Benzotropine (Cogentin™) has euphoric effect and potential for abuse
Heparin	Protamine sulfate 25-50 mg IV	
Insulin/ oral hypoglycemic	Glucose IV/PO/NG tube Glucagon: 1-2 mg IM (if no access to glucose)	Glyburide carries highest risk of hypoglycemia among oral agents; Consider octreotide (50-100 ug SC q6h) in these cases consult local PIC

Table 27. Specific Antidotes and Treatments – call local poison information centre for specific doses and treatment recommendations (continued)

Toxin	Treatment	Considerations
Ethanol	Gastric decontamination if ingestion <1hr Thiamine 100 mg IM/IV Manage airway and circulatory support Consider hemodialysis if serum EtOH >500 mg/dL	Hypoglycemia very common in children Mouthwash = 70% EtOH; perfumes and colognes = 40-60% EtOH Order serum EtOH level and glucose level; treat glucose level appropriately
Ethylene glycol/ Methanol	Ethanol (10%) 10 ml/kg over 30 min, then 1.5 ml/h Or fomepizole (4-methylpyrazole) 15 mg/kg IV load Over 30 min, then 10 mg/kg q12h	CBC, lytes, glucose, ethanol level Consider hemodialysis
CO Poisoning	See ER40	
Opioids	See ER47	
TCA's	Aggressive supportive care NaHCO ₃ bolus for wide QRS/seizures	Flumazenil antidote contraindicated in combined TCA/benzodiazepine overdose Also consider cardiac and Hypotension support, gastric decontamination, seizure control
MDMA	Decontaminate (charcoal), supportive care,	Monitor CK; treat rhabdomyolysis with high flow fluids
Cocaine	Decontaminate (charcoal) if oral Aggressive supportive care	

Disposition from the Emergency Department

- methanol, ethylene glycol
 - delayed onset, admit and watch clinical and biochemical markers
- TCA's
 - prolonged/delayed cardiotoxicity warrants admission to monitored (ICU) bed
 - if asymptomatic and no clinical signs of intoxication: 6 hour ED observation adequate with proper decontamination
 - sinus tachycardia alone (most common finding) with history of OD warrants observation in ED
- hydrocarbons/smoke inhalation
 - pneumonitis may lag 6-8 hours
 - consider observation for repeated clinical and radiographic examination
- ASA, acetaminophen
 - if borderline level, get second level 2-4 hours after first
- oral hypoglycemics
 - admit all patients for minimum 24 hours if hypoglycemic
 - observe asymptomatic patient for at least 8 hours

Psychiatric Consultation

- once patient medically cleared, arrange psychiatric intervention if required
- beware - suicidal ideation may not be expressed

Procedural Sedation

- procedural sedation: the technique of sedative or dissociative agent administration with or without analgesics to induce a state that allows a patient to tolerate an unpleasant or painful procedure while maintaining all protective cardiorespiratory functions (i.e. a depressed level of consciousness without loss of a patient's protective airway reflexes)
 - must weigh degree of pain and expected relief versus risk/complications of sedation and procedure

Requirements for Safe Procedural Sedation in the Emergency Department

- airway suitable for safe intubation and ventilation
- appropriate equipment/personnel available
- intact and functioning cardiorespiratory and neurological system
- ideally, NPO for minimum 4-6 hours
- anesthetic history and drug allergies, include manifestations
- appropriate IV access, monitoring (oxygen saturation, BP, HR, etc.)
- informed consent obtained

Common Procedural Sedation Medications (titrate to effect)

- see *Commonly Used Medications* section, ER53

Commonly Used Medications

Drug	Dosing Schedule	Indications	Comments
fentanyl	0.5-1.0 µg/kg IV	Procedural sedation	Very short acting narcotic (complication=apnea)
midazolam	50 µg/kg IV	Procedural sedation	Short acting benzodiazepine (complication=apnea when used with narcotic) fentanyl and midazolam often used together for procedural sedation
propofol	0.25-0.5 mg/kg IV	Procedural sedation	Short acting Anesthetic/sedative (complication=apnea, decreased BP)
flumazenil	0.3 mg IV bolus q5min x 3doses	Reversal of procedural sedation	Benzodiazepine antagonist NB don't use in chronic benzo
lidocaine with epi	max 7 mg/kg SC	Local anesthetic	Not to be used in fingers, nose, toes, peris, ears
lidocaine w/o epi	max 5 mg/kg SC	Local anesthetic	
Polysporin®	apply to affected area bid-tid	Superficial infections	
morphine (MS Contin)	15-30 mg PO q8-12h 0.1-0.2mg/kg max 15 mg IV q4h	Mild to moderate acute/chronic pain Prescribed in combination with NSAIDs or acetaminophen	GI and constipation side effects DO NOT CRUSH, CUT or CHEW
Percocet 10/325®	1-2 tabs PO q6h prn	Moderate pain control	Oxycodone + acetaminophen Max 4 g acetaminophen OD
acetaminophen	325-650mg PO q4-6h prn	Pain control	Max 4 g OD
Tylenol #3®	1-2 tabs q4-6h prn	Pain control	Max 4 g acetaminophen OD
Ibuprofen	200-800 mg PO tid prn max 1200 mg/d	Mild to moderate acute pain Analgesia and anti-inflammatory properties	
thiamine	Wernicke's encephalopathy: 100 mg IV/IM initially then 50-100 mg IM/IV OD/PO x 3d	To treat/prevent Wernicke's encephalopathy	Caution use in pregnancy
diazepam	anxiety: 2-10 mg PO tid/qid alcohol withdrawal: 10-20 mg PO/W q1h titrated to signs/symptoms	Anxiety Alcohol withdrawal	
lorazepam	anxiety: 0.5-2 mg PO/IM/IV q6-8h status epilepticus; 4 mg IV repeat up to q5min	Anxiety Status epilepticus	
phenytoin	status epilepticus: Load 20 mg/kg IV @ less than 50 mg/min then 5-10 mg/kg IV @ less than 50 mg/min	Status epilepticus	Begin maintenance dose ~12hr after loading dose Continuous ECG, BP monitoring recommended
epinephrine	anaphalaxis: 0.1-0.5 mg IM; can repeat q10-15min	Anaphalaxis	Max 1 mg/dose
salbutamol	2 puffs inhaled q4-6h (4yrs) max 12 puffs/day	Asthma	Caution with cardiac abnormalities
Ipratropium bromide	2-3 puffs tid-qid, max 12 puffs/day	Asthma	Contraindicated with peanut/soy allergy Caution with narrow-angle glaucoma
nitroglycerin	acute angina: 0.3-0.6 mg SL q5min, OR 5 µg/min IV increasing by 5-20 µg/min q3-5min	Angina Acute MI	Not to be used with other anti-hypertensives
ASA	325-650 mg PO q4h max 4g/day stroke/MI risk: 81-325 mg PO OD	Pain control Cardiac prevention	
β-blockers (metoprolol)	5 mg slow IV q5min x 3 if no contraindications	Acute MI	
enoxaparin	1 mg/kg SC BID	Acute MI	
insulin R	bolus 5-10U (0.2 U/kg) then 5-10 U (0.1 U/kg) per hour	Hyperglycemia	Monitor blood glucose levels Consider K replacement also measure blood glucose levels before administration
glucose	0.5-1.0 g/kg (1-2ml/kg) IV of D50W	Hypoglycemia/DKA	
furosemide (Lasix)	CHF: 40-80 mg IV HTN: 10-40 mg PO BID	CHF HTN	Monitor for electrolyte imbalances
haloperidol	2.5-5.0 mg PO/IM initial effective dose 6-20 mg/day	Psychosis	Monitor with Parkinsons; results in CNS depression
naloxone	0.5-2 mg or 0.01-0.02 mg/kg initial bolus IV/IM/SL/SC or via ETT (2-2.5x IV dose), increase dose by 2 mg until response/max 10 mg	Comatose patient Opioid overdose Reversal in procedural sedation	
charcoal	30-100 g PO in 250 ml H ₂ O	Poisoning/overdose	

Summary Key Questions

Questions	Answers
1. How do you assess a patient that presents to the ED? When do you restart this assessment?	Airway/C-spine, Breathing, Circulation, Disability, Environment/Exposure. Restart when conditions deteriorates.
2. How does consent change in the context of Emergency Medicine (EM)?	Consent is not needed when patient is at imminent risk from serious injury AND obtaining consent is not possible.
3. What is the Cushing's reflex?	Sign of increased ICP: high BP, low HR, irregular respirations
4. What are the universal antidotes in EM?	Oxygen, glucose, naloxone, thiamine.
5. What should every patient with an MI receive?	"BEMOAN": Beta-blockers, Enoxaparin, Morphine, Oxygen, ASA, Nitroglycerin
6. What are the signs of a basal skull fracture?	Battle sign, hemotympanum, racoon eyes, CSF otorrhea/rhinorrhea
7. Shock in a trauma patient is ____ until proven otherwise?	Hemorrhagic
8. Level of consciousness is assessed using what scale?	GCS or AVPU
9. At what GCS should you intubate?	8 or less
10. What investigation is KEY for a potential spinal cord trauma patient?	C-spine X-rays
11. What is the management of a tension pneumothorax?	Large bore IV needle inserted into 2nd ICS mid-clavicular line, followed by chest tube in 5th ICS ant-axillary line
12. What imaging modalities should be considered in abdominal trauma?	FAST, DPL, X-ray, CT
13. For penetrating trauma, when is laparotomy mandatory?	Shock, peritonitis, evisceration, free air, gunshot, blood in NG, Foley, or on DRE
14. What are the contraindications to a Foley catheter?	Blood at the urethral meatus, ecchymosis of the scrotum, "high riding" prostate
15. What nerves are at risk with an anterior shoulder dislocation?	Axillary nerve (lateral), and musculocutaneous nerve (extensor aspect of forearm)
16. When is an X-ray series of the ankle required?	Any pain in the malleolar zone AND tenderness in either malleolar zone OR inability to weight bear
17. When is an X-ray series of the foot required?	Any pain in the midfoot zone AND Tenderness at the navicular or 5th metatarsal OR inability to weight bear
18. What is the maximum dose of subcutaneous lidocaine that can be given with and without epinephrine?	7 mg/kg with epinephrine, 5 mg/kg without epinephrine
19. Where should lidocaine with epinephrine NOT be used?	Ears, nose, fingers, toes, and hose (penis)
20. What is the most commonly used antibiotic for cellulitis?	Cefazolin/Ancef (IV) and Ceohalexin/Keflex (PO)
21. What is the first line antibiotic for human bites?	Amoxicillin + clavulanic acid

Questions	Answers
22. What is the resuscitation formula for someone with 2nd or 3rd degree burns?	Parkland formula: RL 4cc/kg/%BSA; give 1/2 in 1st 8 hours, 1/2 in next 16 hrs
23. What volume of fluid should be given in pediatrics as resuscitation?	NS or RL 20cc/kg IV
24. What investigation must you order for a female with abdominal pain?	Beta-hCG
25. How do you manage a patient with EtOH withdrawal?	Diazepam 20 mg IV/PO q1h until calm, thiamine 100 mg IV/IM/PO OD x3d
26. If you suspect a patient is experiencing delirium tremens (DT), approx. when was their last drink?	3-5 days ago
27. How you manage an asthma exacerbation in the ER?	Oxygen, beta-agonist If severe; anticholinergics, steroids, & prepare to intubate
28. What are the principles of management of DKA?	Rehydration w/NS IV, insulin R IV w/ D5W, potassium replacement
29. What is the acute treatment of CHF?	Lasix, morphine, nitroglycerine, oxygen, and sitting upright
30. What are the headache (H/A) red flags?	Worst H/A of your life, new H/A after age 50, morning H/A, N/V meningeal signs, visual changes, scalp tenderness, jaw claudication, worse w/bending or Valsalva
31. Within what window of time must thrombolytics be administered for stroke?	Within 3 hours and NO evidence of hemorrhagic stroke
32. What is the risk of performing any cardiac procedures in the hypothermic patient?	Ventricular fibrillation
33. What is a sign of hypothermia, sometimes found on ECG?	Osborne (J) waves
34. For an infant <28 days with a fever >38°C, what workup must be ordered?	Full septic workup (CBC diff, blood C&S, urine C&S, CSF, CXR if indicated) BEFORE antibiotics are administered
35. A "slapcheek" distribution of a rash in a child is suggestive of what virus?	Parvovirus
36. What is the role of the ED physician in management of the suicidal patient?	Assessing intent and organized plan, access to lethal means, patient safety; completion of Form 1 when appropriate (Ontario only)
37. How long is a form 1 valid?	72 hours
38. What are the five principles of toxicology?	Resuscitation, screening (draw blood), decrease drug absorption, increase drug elimination, administer available antidote
39. What are the signs and symptoms of an anticholinergic overdose?	"Mad as a Hatter" – agitation/hallucinations "Hot as a hare" – hyperthermia "Blind as a bat" – dilated pupils "Dry as a bone" – dry skin "Red as a beet" – vasodilatation "The bowel and bladder lose their tone and the heart goes on alone" – urinary retention, tachycardia
40. What populations are at risk for thiamine deficiency?	Alcoholics, anorexics, hyperemesis of pregnancy, malnutrition states
41. What are the signs and symptoms of an amphetamine overdose (sympathomimetics)?	Increased temp, CNS excitation, tachycardia, hypertension, resp, depression, pupil changes, CNS depression
42. What is maximum daily dose of acetaminophen?	4g
43. What is the acute management of acetaminophen overdose?	Decontaminate (charcoal), N-acetylcysteine

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