Chapter 11
SURGICAL EMERGENCIES

Learning Objectives:

- Assess, resuscitate and stabilize a surgical emergency patient's condition rapidly and accurately.
- Understand the basic pathophysiology of Traumatic brain injury.
- Evaluate patients with head injuries.
- Perform a focused neurologic examination.
- Explain the importance of adequate resuscitation in limiting secondary brain injury.
- Determine the need for patient transfer, admission, consultation, or discharge.
- Arrange appropriately for a patient's inter-hospital or intra-hospital transfer (what, who, when, how).

INTRODUCTION

Trauma is a leading cause of death and disability in Bhutan. Motor vehicle crashes caused the maximum deaths in last couple of years followed by fall injuries either in the farm work setting or at the construction sites leading to significant morbidity and mortality.

On the other hand, surgical emergencies pose a significant anxiety and dilemma to the local health staff as well as to the patient where there is no surgical set up. It is important to at least alleviate the anxiety of the patient and also to know which cases require urgent surgical consultation or immediate transfer to the surgical centers.

Surgical emergencies focus on general trauma, head injury, burns, wound care, pediatric trauma, and trauma in pregnancy and non-traumatic surgical emergencies.

APPROACH TO TRAUMA

Definition: Trauma is defined as any physical injury severe enough to pose a threat to limb or life.

Patient assessment

a) Pre-hospital phase: responsibility of first responder and basic life support provider (HHC and EMRs).
b) Hospital phase: hospital emergency response.

Triage: system of making a rapid assessment of each patient and assigning a priority rating on the basis of clinical need and urgency with the goal to do the **greatest good for the greatest number**. Triage should be applied in:

a) Multiple casualties
b) Mass casualties

Primary survey

a) Airway maintenance with cervical spine protection
b) Breathing and ventilation
c) Circulation with hemorrhage control
d) Disability (neurologic evaluation)
e) Exposure/ environmental control

Resuscitation

a) Airway
b) Breathing/ventilation/oxygenation
c) Circulation and bleeding control

Adjuncts to primary survey and resuscitation

a) Electrocardiographic monitoring
b) Urinary and gastric catheters
c) Other monitoring as relevant
d) X-rays and diagnostic studies

Consider need for patient transfer.

Secondary survey

a) History
b) Physical examination

Adjuncts to secondary survey.

Reevaluation.

Definitive care.

In an emergency, stay calm and speak clearly!

REGIONAL TRAUMA

A. Maxillofacial Trauma

- Trauma to the face demands aggressive airway management
- Usually seen in unbelted automobile passenger who is thrown into the windshield and dashboard
- Trauma to the mid-face can produce fractures and dislocations that compromise the nasopharynx and oropharynx
- Facial fractures can be associated with hemorrhage, increased secretions, and dislodged teeth, which cause additional difficulties in maintaining a patent airway
- Fractures of mandible, especially bilateral body fractures, can cause loss of normal airway support.
- Airway obstruction can result if the patient is in a supine position.

B. Neck Trauma

Neck injuries can be blunt or penetrating

- Blunt or penetrating injury can cause disruption of the larynx or trachea, resulting in airway obstruction and /or severe bleeding into the trachea-bronchial tree
- Definitive airway and operative control will be urgently required in this situation.
- Cervical spine injury can occur as well commonly at C5-C6 and C6-C7 levels
- Maintain immobilization in suspect C-spine injury until definitely ruled out by a reliable method.

Figure 11.1 Cervical collar.

Indications for Cervical collar

- Trauma
- Focal cervical spine tenderness
- Distracting injury
- Intoxication/altered mental status
- New neurological deficit

C. Thoracic Trauma

- Identify and initiate treatment of the following life-threatening injuries during the primary survey:
  a) Airway obstruction
  b) Tension pneumothorax
  c) Open pneumothorax
  d) Rib fractures with Flail chest and pulmonary contusion
  e) Massive hemothorax

f) Cardiac tamponade

- Identify and initiate treatment of potentially life-threatening injuries during secondary survey:
  a) Simple pneumothorax
  b) Hemothorax
  c) Pulmonary contusion
  d) Trachea-bronchial tree injury
  e) Blunt cardiac injury
  f) Traumatic aortic disruption
  g) Traumatic diaphragmatic injury
  h) Blunt esophageal rupture
- Describe the significance and treatment of:
  a) Subcutaneous emphysema
  b) Thoracic crush injuries
  c) Sternal injury
  d) Rib fractures
  e) Clavicular fractures
- Describe lifesaving chest procedures like:
  a) Needle decompression
  b) Chest tube insertion
  c) Needle pericardiocentesis

Rib Fractures, Flail chest

- Most common injury after blunt chest trauma, accounts for more than half of thoracic injuries
- Clinical diagnosis: localized pain, tenderness
- May not be seen on X-ray
- Rule out: pneumothorax, hemothorax, pulmonary contusion, vascular injury.
- More than 2 rib fractures: increased risk of internal injuries
- **Flail chest**: segmental fractures of 3 or more ribs
  - Paradoxical chest wall movement
  - May cause hypoxemia via pulmonary contusion
  - Treatment: direct pressure, intubation, consider chest tube

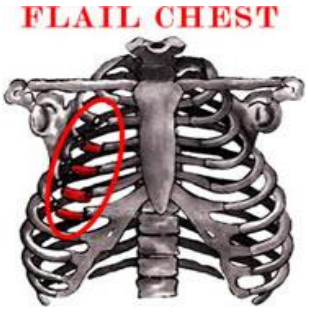


Figure 11.2 Flail chest (paradoxical chest expansion during respiratory movements).

Pulmonary Contusion

- Contusion causes direct capillary damage
- Leads to internal edema, hypoxia, hemorrhage
- Commonly associated with flail chest

- Hemoptysis common, may be cyanotic
- Chest X-ray: patchy alveolar infiltrates, consolidation, can be delayed up to 6 hours

Treatment:

- oxygenation, may need intubation
- aggressive fluid resuscitation can be harmful so keep relatively dry

Figure 11.3 Showing right-sided pulmonary contusion.

Hemothorax

Primary cause is lung laceration or laceration of an intercostals vessel or internal mammary artery due to either penetrating or blunt trauma**.** It **c**an be simple or massive.

Simple:

- ✓ Amount of blood <1500ml
- ✓ Self-limiting and does not require operative intervention
- ✓ If not drained may get infected and develop into empyema

Massive:

- ✓ Rapid accumulation of blood >1500ml, or one third or more of the patient's blood volume in the chest cavity
- ✓ Presents with shock and respiratory distress

Treatment is by correcting the shock and by draining the blood with chest tube insertion. As a Guideline, if > 1500 ml of blood is drained immediately through the chest tube, if drainage of more than 200ml/hr. for 2-4hr occurs, or if blood transfusion is required, operative exploration should be considered.

Pneumothorax (PTX)

Simple

- Chest pain, dyspnea, decreased breath sounds, subcutaneous emphysema
- Seen on chest X-ray, may be delayed; consider repeating in 4-6hours

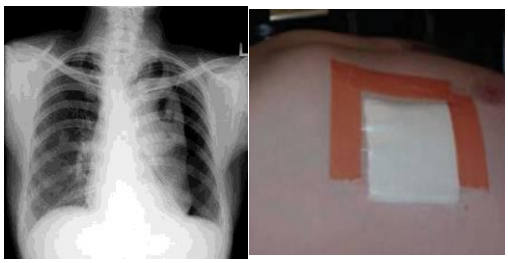


Figure 11.4 Showing left-sided pneumothorax (left) and three-sided occlusive dressing (right).

Treatment:

Oxygen, chest tube, occlusive dressing (close the wound defect with sterile occlusive dressing that is large enough to overlap the wound's edges; tape it securely on three sides to provide a flutter-type valve effect)

- **Tension**
  - Severe dyspnea

- Decreased breath sounds
- Distended neck veins
- Tracheal deviation away from PTX
- Do not wait for X-ray before placing chest tube
- Needle in chest 2nd intercostal space before chest tube

Figure 11.5: Patient with tension pneumothorax with bilateral intercostal needle decompression.

Chest Tube Placement

- Place patient in supine or 45^0, arm over head
- Topical skin cleaner
- Local anesthesia with 5cc lignocaine 2%, IV analgesia
- 4cm skin incision at midaxillary line in 4th or 5th intercostal space, along the direction of the rib
- Blunt dissection with instrument through pleura, over the top of the rib (avoid neurovascular bundle)
- Pass tube through hole, direct towards apex of lung
- Attach to drainage device
- Secure tube on skin with 1-0 silk sutures
- Apply occlusive dressing over tube
- Chest x-ray for confirmation

Figure 11.6: Showing placement of left chest tube drainage on the left-side for tension PTX.

Cardiac Tamponade

- Fluid (blood) filling pericardial sac, compressing heart and decreasing cardiac output
- More common in penetrating trauma
- Findings:

- Triad: hypotension, JVD, muffled heart sounds
- Pulses paradoxus: weaker pulse & lower systolic pressure with inspiration
- Electrical alternans: alternating QRS direction on ECG

- Diagnosis by ultrasound

- Treatment: pericardiocentesis, thoracotomy

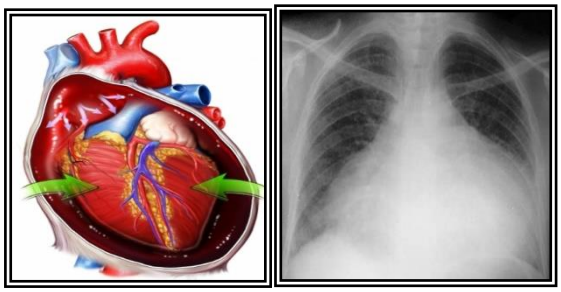


Figure 11.7: Showing cardiac tamponade (left) schematic and (right) Chest X-ray.

Myocardial Contusion

- Seen in blunt trauma with deceleration forces
- May be caused by sternal or rib fractures
- Symptoms: chest pain, dyspnea
- Diagnosis: echocardiogram. ECG –slowed conduction, ectopy, ST-T wave changes, tachycardia
- Complications: effusion, aneurysm, thrombosis, dysrhythmia
- Most heal with no specific treatment

D. Abdominal and Pelvic Trauma

Abdominal Trauma

Can be blunt or penetrating injuries

- Most blunt trauma from MVCs and falls
- Can cause compression and crushing injuries to solid organs, hollow organs, vessels causing rupture with secondary hemorrhage, contamination by visceral contents, and peritonitis.
- Shearing forces cause crushing injuries
- Deceleration forces cause lacerations of liver and spleen
- Penetrating trauma has high risk of intra-peritoneal, bowel, or solid organ injury
- Often need immediate laparotomy and exploration
- Establish immediate IV access, resuscitate with fluid or blood as appropriately

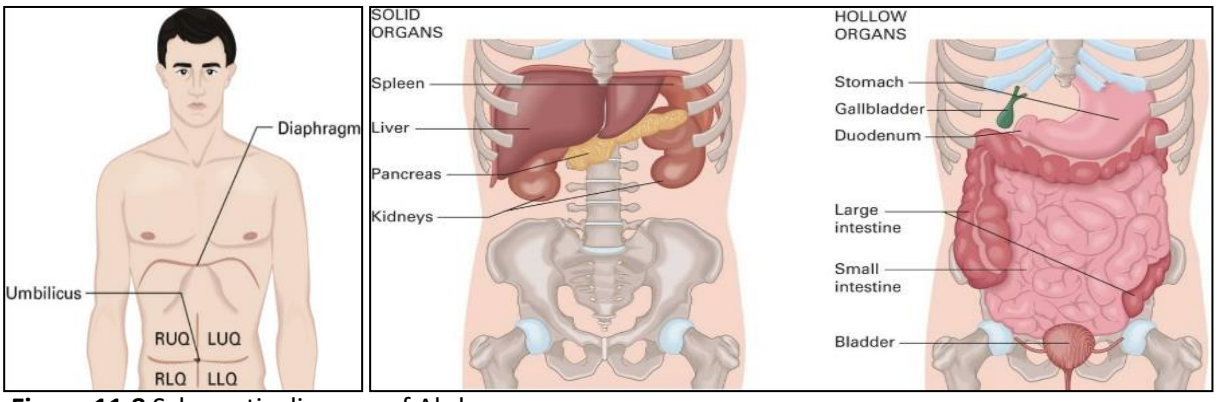


Figure 11.8 Schematic diagram of Abdomen.

In patients who sustain blunt trauma, the organs most frequently injured are the spleen (40% to 55%), liver (35% to 45%), and small bowel (5% to 10%). Additionally, there is 15% incidence of retroperitoneal hematoma in patients who undergo laparotomy for blunt trauma.

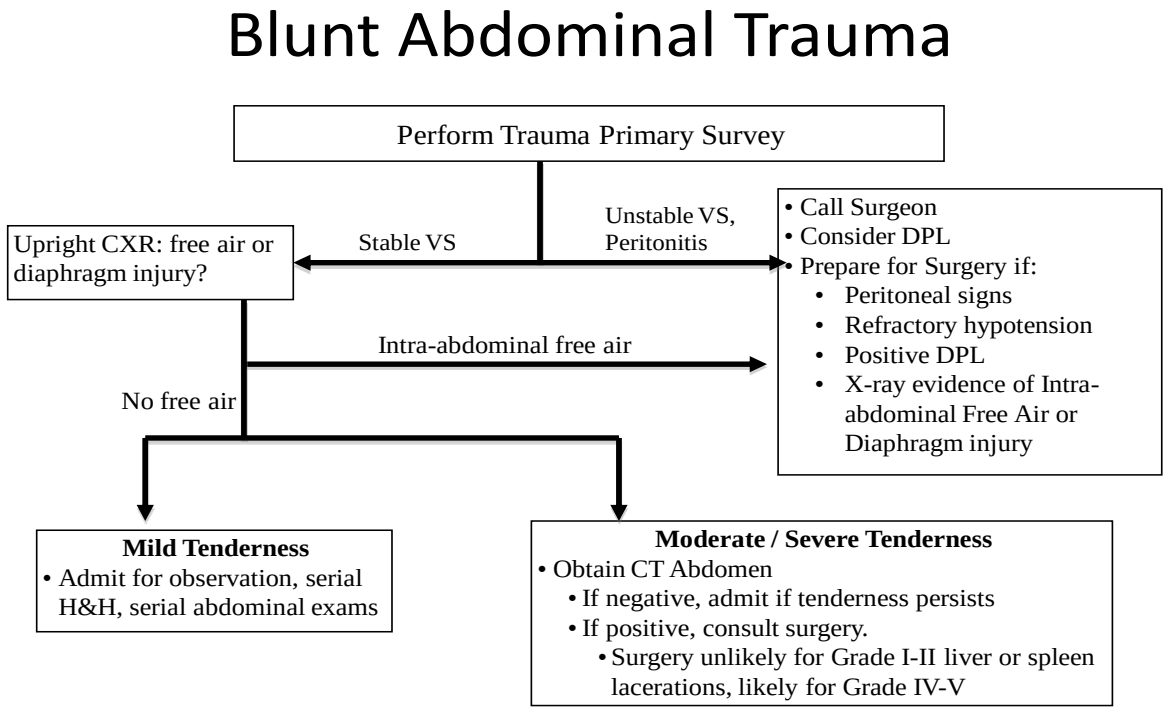


Figure 11.9 Algorithm of assessment of abdominal trauma.

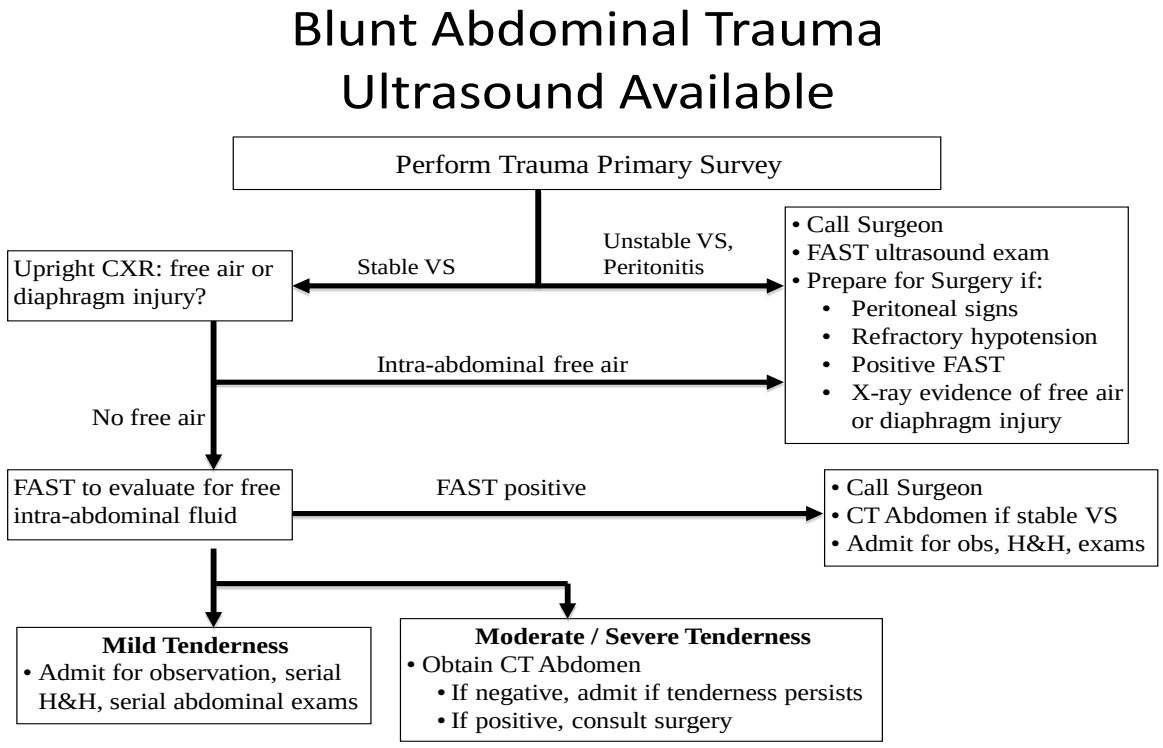


Figure 11.10 Algorithm of assessment of abdominal trauma with ultra-sound.

Figure 11.11 Mannequin showing Open chest wound and open abdominal injury (Intestinal loops from penetrating abdominal injuries should be covered with a clean wet cloth or dressing, and open chest wound should be closed with three-sided occlusive dressing).

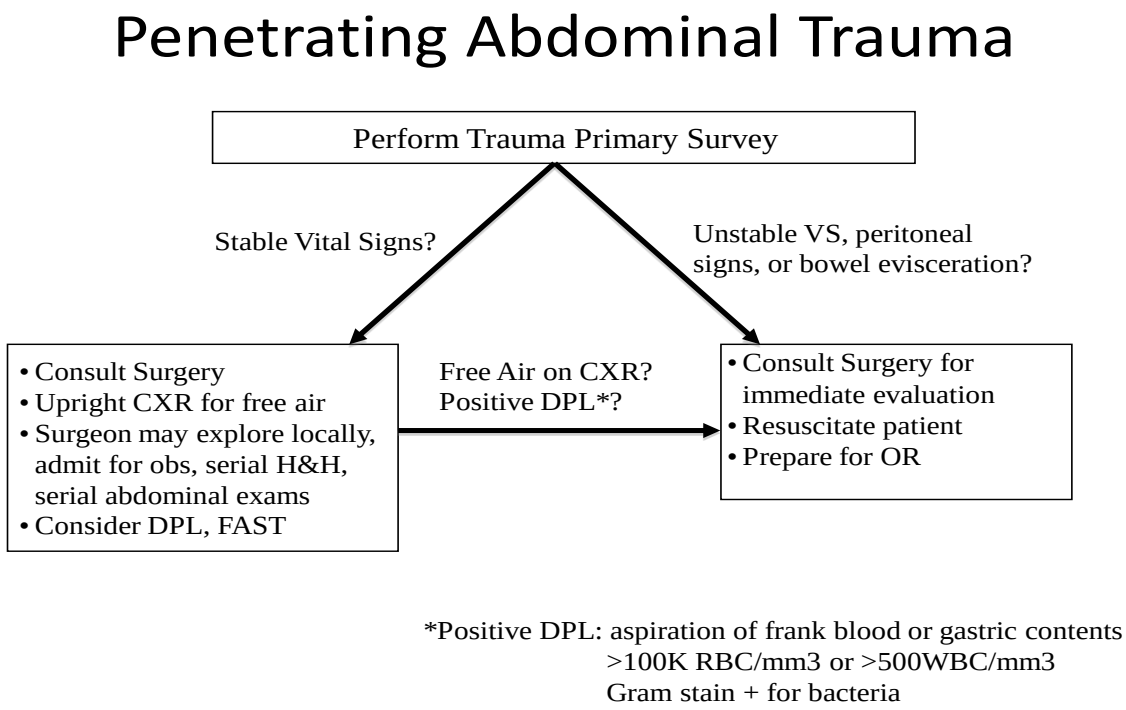


Figure 11.12 Algorithm of assessment of penetrating abdominal trauma.

Pelvic Trauma

- Pelvic injury commonly involves pelvic fractures and pelvic organ injuries
- Major hemorrhage may occur from pelvic fracture in patients who sustain blunt truncal trauma
- Early pelvic stability assessment begins with manual compression of the anterosuperior iliac spines or iliac crests
- Abnormal movement or bony pain suggests fracture and the exam may stop with this maneuver as further movements can aggravate bleeding.
- Presence of blood at the urethral meatus strongly suggest a urethral tear (high riding prostate in per-rectal exam suggests urethral disruption) and per-urethral catheterization should be avoided
- Perineal and rectal injuries may be present as well
- Pelvis should be temporarily stabilized by using an available compression device or sheet to decrease bleeding.

Figure 11.13 Pelvic stabilization either by commercial binder or bed sheet or belt to prevent further internal bleeding (Adapted from ACS, 2008. ATLS 8th Edition).

BURNS

- ABCs and initial assessment as discussed in chapter 2.
- Assess burn
  - Depth
  - % body surface area
  - Circumferential burns may require early escharotomy
- Fluid resuscitation
  - Warm environment to stop fluid losses
- Wound care, Tetanus
- Pain control

Table 11.1 Burn categories

Degrees	Depth	Appearance	Sensation	Healing
1st degree	Superficial, epidermis	Dry, dry, blanching; no blisters	Painful	3-6days
2nd degree	Superficial, partial thickness	Moist blisters, weeping, red, blanching	More painful	7-21days
3rd degree	Deep, partial thickness	Blisters, wet or dry, red to white, no blanching	Pressure and painful	>21days
4th degree	Full thickness	Waxy white to gray, charred, dry, inelastic, no blanching	No pain (may feel deep ache)	None: requires surgical debridement and grafting

Fluid Resuscitation

In contrast to resuscitation for other types of trauma in which fluid deficit is typically due to hemorrhagic losses, burn resuscitation is required to replace the ongoing losses from capillary leak due to inflammation.

- Admit if partial thickness burns >10%TBSA for fluid resuscitation
- Ringer's lactate is fluid of choice
- The current consensus guidelines state that fluid resuscitation should begin at 2 ml of Lactated Ringer × patients body weight in kg × TBSA for second- and third- degree burns
  - 2ml/kg/%TBSA
  - 1st half given over 8hours
  - 2nd half given over next 16 hours

Wound care

- Tetanus booster if indicated (if >5yr give booster)
- Irrigate contaminated wounds before dressing
- Do not apply ice or butter, cool wet dressings best
- Antibiotic ointment or silver sulfadiazine (unless sulfa allergic)
- Superficial burns: apply dressing
- Partial thickness
  - ➢ Do not debride intact blisters
  - ➢ Debride ruptured blisters, devitalized tissue
  - ➢ Wound check 48hrs, if no infection, can continue at home
- Full thickness
  - ➢ Consult surgery for operative debridement, skin grafting

Burn complications

- Infection
  - ➢ Pseudomonas
  - ➢ Gram negative infections
- ARDS
  - ➢ From shock state
  - ➢ From direct pulmonary injury
- DIC from diffuse tissue injury
- Toxicity from smoke itself (CO, CN)
- Stress ulcers, GI bleeding

Fasciotomy

- Indicated in full thickness circumferential limb burns and chest wall burns
  - ➢ Vascular insufficiency, poor pulses and cap refill
  - ➢ Inadequate ventilatory motion
- Cut along long axis sides (avoid vasculature)
- Painless “pop” as subcutaneous tissues expand

Figure 11.15 Fasciotomy incision wound.

Other Burns

- Chemical burns
  - ➢ Irrigate copiously with water or saline
    - ○ Acids: extensive superficial burns
    - ○ Bases: extensive deep tissue involvement
- Electrical burns
  - ➢ High voltage may cause limited superficial injury, extensive deep injury
  - ➢ Exit wound often more severe than entrance wound

- ➢ Immediate cause of death: arrhythmias
  - ○ ECG, Monitor, CBC, coagulation profile, IV
- Wound debridement after demarcation of devitalized tissues
- Admit for observation, IVF, monitoring

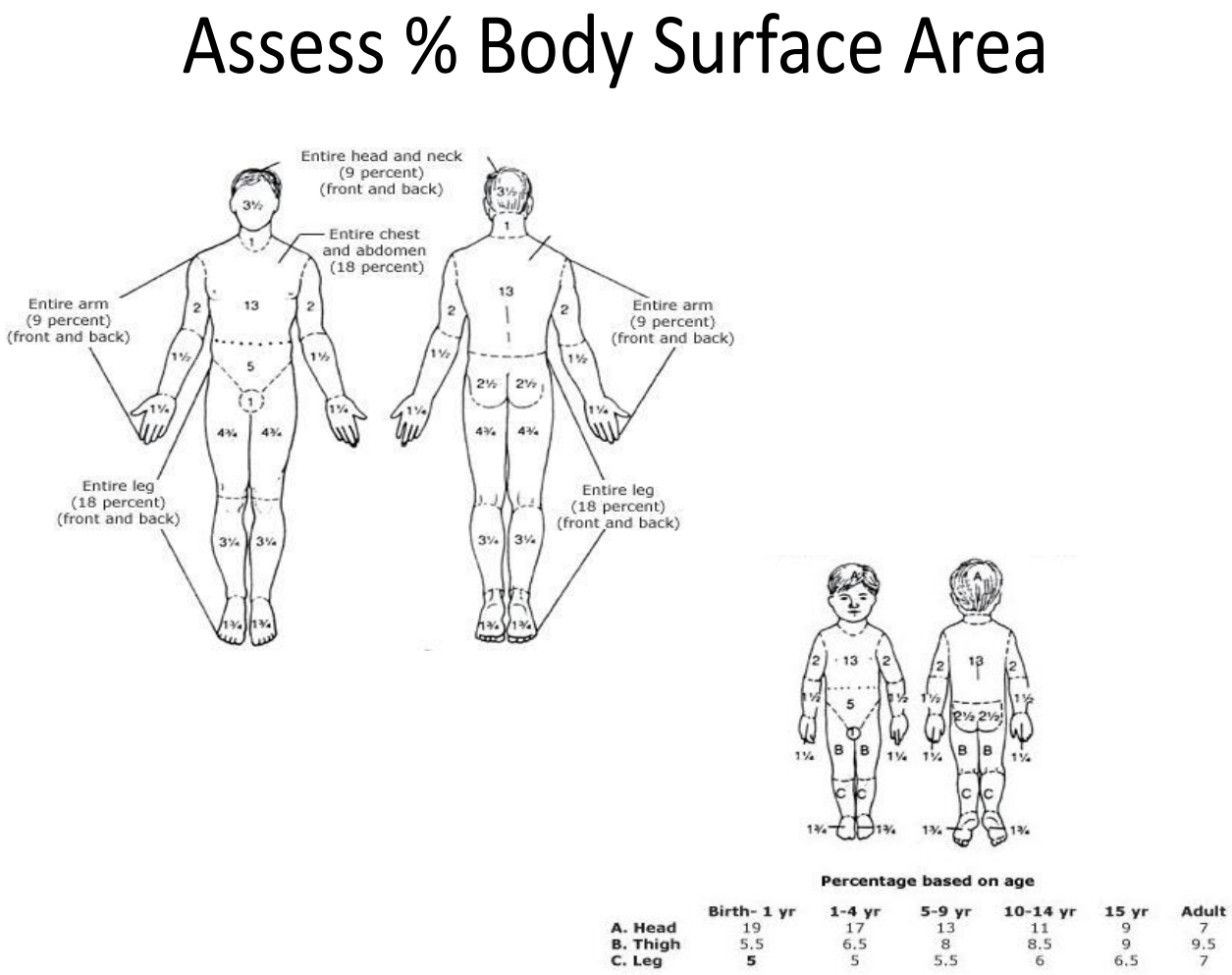


Figure 11.14 Schematic diagram showing how to assess burn percentage from body surface area.

WOUND CARE

A wound is defined as a disruption of the integrity and function of tissues in the body.

Wound Evaluation

- Simple or complex
- Clean or contaminated
- Bite or puncture
  - ➢ Human or animal
  - ➢ Copious irrigation with normal saline
  - ➢ Loose approximation if necessary
  - ➢ High risk of infection treats with prophylactic antibiotics available
  - ➢ Delayed presentation: can be closed up to 12hrs
  - ➢ After that must heal by secondary intention

Wound closure

- Sterile environment
- Lignocaine (2%) for analgesia
- Max dose 4.5mg/kg, 7mg/kg if with epinephrine
- No epinephrine in fingers, toes, nose, penis
- Normal saline for irrigation
- Betadine prep for outside wound
- Debride necrotic tissue, remove foreign bodies
- Suture

Suture options

- Absorbable: vascular ligation, muscle/fascia repair, intraoral, dermal approximation
  - Plain catgut: strength 7-10
  - Chromic catgut: 21-30
  - Vicryl:21d
- Non-absorbable: skin closure, eyelid laceration
  - Nylon
  - Dafilon
  - Prolene
  - Silk

Wound Repair

Simple

- Face: Nylon or Prolene 6-0
- Extremities: Nylon or Prolene 3-0 or 4-0
- Scalp: Nylon, Prolene, or silk 3-0 or 4-0

Complex

- Scalp: if lacerated galea, place subcutaneous sutures
- Lip: repair vermillion border first if involved
- Face: ENT/Maxillofacial consult if facial nerve or nasolacrimal duct involved
- Eye: Ophthalmological consult if canthus involved

Suture care

- 48hr post repair for wound check, dressing change
  - Keep wounds clean and dry
  - Watch for signs of infection- if present either suture release and /or antibiotics with more frequent dressing
- Suture removal
  - Face: 5 days
  - Neck :5-6 days
  - Hands & feet: 7 days
  - Scalp, chest, abdomen & extremities: 7-10 days
  - Back, upper and lower extremity joints: 10 days

Consider Antibiotic Prophylaxis

- High risk sites (hands, face, feet)
- Puncture wounds, foreign bodies
- Contaminated wounds, bites
- Extensive soft tissue injury

- Through and through mouth lacerations
- Open fractures, exposed joints & tendons
- Prosthetic valves
- Immuno-compromised

Indication for Transfer

- Indication for advanced airway
- Hemodynamic instability
- Identified need for consultant service
  - Presumed head bleed
  - Cervical spine injury
  - Chest tube placement
  - Free air under diaphragm
  - Positive diagnostic tap or ultrasound of abdomen
  - Unstable pelvic fracture
  - Open bony fractures
  - Any evidence of neurovascular compromise
  - Need for surgery (any kind)

Key Messages

- Always start with ABCs
- Quickly identify hemodynamic emergencies
- Immobilize broken bones
- Provide resuscitation as necessary
- Immobilize prior to transfer
- Communicate with receiving physician

SHOCK IN TRAUMA PATIENT

Shock is defined as the inadequate delivery of oxygen to tissues leading to cellular dysfunction and injury.

Hemorrhagic: Most commonly caused by blood loss.

- Lacerations
- Intra-abdominal injury
- Thoracic injury
- Pelvic injury
- Long bone fractures
- Arterial/aortic injury

Signs of Hemorrhagic Shock:

- Pulse
  - Tachycardia
  - Thread, weak peripheral pulses
- Blood Pressure
  - Narrow pulse pressure (systolic BP- diastolic BP)
  - Hypotension
- Peripheral perfusion
  - Pale skin & conjunctiva
  - Delayed capillary refill

- Mental status
  - ➢ Anxiety, distress, lethargy, coma

Non-hemorrhagic Shock in Trauma:

- Cardiogenic: blunt chest trauma
  - ➢ IVF, ventilator support, pressor if needed
  - ➢ Obtain ECG, admit for cardiac monitoring
- Obstructive: tension pneumothorax, cardiac tamponade
- ➢ Chest tube or pericardiocentesis
- Neurogenic: Spinal cord injury
- ➢ Loss of sympathetic peripheral vascular tone leads to vasodilation
- ➢ Hypotension with warm & perfused extremities
- ➢ Treat with IV fluids

Table 11.2 Classification of Hemorrhagic Shock

	Volume loss	Signs	Treatment
Class I	0-15% <500ml	Slight tachycardia	Resuscitate with at least 2L crystalloid (Ringer's lactate). Use warm fluids to prevent hypothermia
Class II	15-30% 500-1000ml	Tachycardia, narrowed pulse pressure	Same as above
Class III	30-40% 1-2L	Tachycardia, hypotension, altered mental status	Start with crystalloid, Packed red blood cells (PRBC) if no improvement (O -ve), surgery consult
Class IV	> 40% >2L	Unstable, critical hypotension	Both crystalloid &PRBC, immediate surgery consult, prepare for operation

PEDIATRIC TRAUMA

Injury continues to be the most common cause of death and disability in childhood. Pediatric trauma presents a big challenge to many surgeons. Hence, there is a need to deal them separately with application of ATLS principles which can have a significant impact on ultimate survival.

Initial Assessment and Resuscitation

- Guided by same approach as in adults
- Early involvement of a surgeon is imperative in management of injuries in a child

Unique Characteristics of Pediatric Patients

- Most serious pediatric trauma is blunt trauma that involves the brain
- Apnea, hypoventilation, and hypoxia occur five times more often than hypovolemia with hypotension in seriously injured children
- Therefore, treatment protocols for pediatric trauma patients emphasize aggressive management of the airway and breathing

What physiologic differences will have an impact on treatment of pediatric trauma patients?

- Injuries in children may result in significant blood loss

- A child's increased physiologic reserve allows for maintenance of systolic blood pressure in the normal range, even in the presence of shock
- Tachycardia and poor skin perfusion often are the only keys to early recognition of hypovolemia and the early initiation of appropriate crystalloid fluid resuscitation

Table 11.3 Common mechanisms of injury and associated patterns of in injury in pediatric patients

Mechanism of injury	Common patterns of injury
Pedestrian struck	Low speed: lower extremity fractures High speed: multiple trauma, head and neck injuries, lower extremity fractures
Automobile occupant	Unrestrained: multiple trauma, head and neck injuries, scalp and facial lacerations Restrained: chest and abdomen injuries, lower spine fractures
Fall from height	Low: upper extremity fractures Medium: head and neck injuries, upper and lower extremity fractures High: multiple trauma, head and neck injuries, upper and lower extremity fractures
Fall from bi-cycle	Without helmet: head and neck lacerations, scalp and facial lacerations, upper extremity fractures With helmet: upper extremity fractures Striking handlebar: internal abdominal injuries

Early Resuscitation

Refer to the neonate and pediatric resuscitation in chapter 3. Recognition of circulatory compromise.

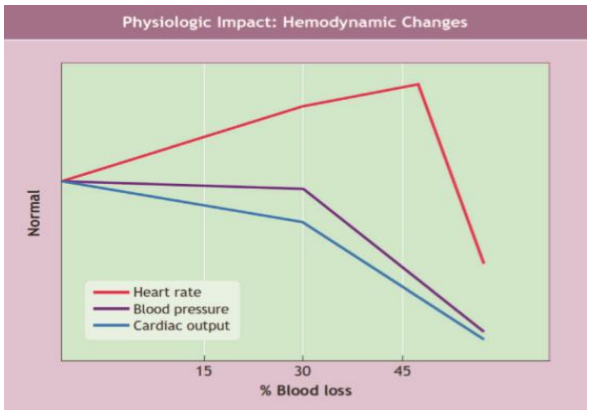


Figure 11.16 Physiological impact of Hemodynamic Changes on Pediatric Patients.

TRAUMATIC BRAIN INJURY (TBI)

Pathophysiology

The pathophysiology of TBI-related brain injury is divided into two separate but related categories: primary brain injury and secondary brain injury. Current clinical approaches to the management of TBI center on these concepts of primary and secondary brain injury. Surgical treatment of primary brain injury lesions is central to the initial management of severe head injury. Likewise, the identification, prevention, and treatment of secondary brain injury is the principle focus of neurointensive care management for patients with severe TBI.

Figure 11.17 Head injury with scalp laceration (prevent shock from bleeding vessels).

Key messages:

- *In chest trauma-mobility of mediastinal structures makes the child more susceptible to tension pneumothorax.*
- *In abdominal injury-the chief indication for surgical (operative) management in children who continue to have no hemodynamic abnormalities is a transfusion requirement that exceeds one-half the child's blood volume, or 40ml/kg, during the first 24hrs after injury.*
- *In head injury- an infant who is not in a coma but who has bulging fontanelles or sutures diastases should be treated as having a more severe injury.*
- *Adequate and rapid restoration of an appropriate circulating blood volume and avoidance of hypoxia are mandatory.*

Primary Brain Injury

Primary brain injury occurs at the time of trauma. Common mechanisms include direct impact, rapid acceleration/deceleration, penetrating injury, and blast waves. Although these mechanisms are heterogeneous, they all result from external mechanical forces transferred to intracranial contents. The damage that results includes a combination of focal contusions and hematomas, as well as shearing of white matter tracts (diffuse axonal injury [DAI]) along with cerebral edema and swelling.

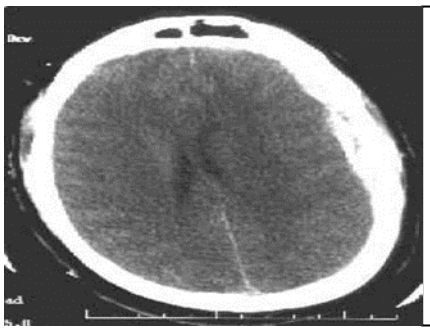
1. Shearing mechanisms lead to DAI, which is visualized pathologically and on neuroimaging studies as multiple small lesions seen within white matter tracts. Patients with severe DAI typically present with profound coma without elevated intracranial pressure (ICP), and often have poor outcome. This typically involves the gray-white junction in the hemispheres, with more severe injuries affecting the corpus callosum and/or midbrain. Magnetic resonance imaging (MRI; in particular diffusion tensor imaging) is more sensitive than computed tomography (CT) for detecting DAI, and the sensitivity of the test declines if delayed from the time of injury.
2. Focal cerebral contusions are the most frequently encountered lesions. Contusions are commonly seen in the basal frontal and temporal areas, which are particularly susceptible due to direct impact on basal skull surfaces in the setting of acceleration/deceleration injuries. Coalescence of cerebral contusions or a more severe head injury disrupting intraparenchymal blood vessels may result in an intraparenchymal hematoma.
3. Extra-axial (defined as outside the substance of the brain) hematomas are generally encountered when forces are distributed to the cranial vault and the most superficial cerebral layers. These include epidural, subdural, and subarachnoid hemorrhage.

In adults, **epidural hematomas (EDHs)** are typically associated with torn dural vessels such as the middle meningeal artery, and are almost always associated with a skull fracture. EDHs are lenticular shaped and tend not to be associated with underlying brain damage. For this reason, patients who are found to have EDHs only on CT scan may have a better prognosis than individuals with other traumatic hemorrhage types.

1. Accumulation of blood between dura and arachnoid membrane
2. Bleeding originates from bridging veins between venous sinuses and cortex
3. Most common type of intracranial mass lesion

Figure 11.18 CT scan demonstrating a right EDH. Note the lenticular shape.

Subdural hematomas (SDHs) result from damage to bridging veins, which drain the cerebral cortical surfaces to dural venous sinuses, or from the blossoming of superficial cortical contusions. They tend to be crescent shaped and are often associated with underlying cerebral injury.

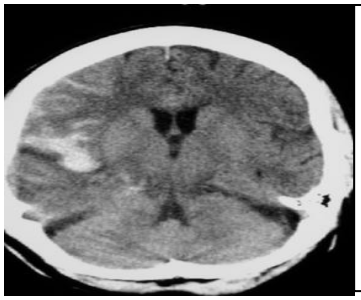


1. Accumulation of blood between skull and dural membrane
2. Bleeding originates from vessels in close proximity to skull
3. Typically, underlying brain is minimally injured
4. Good prognosis if treated as soon possible

Figure 11.19 CT scan showing a right acute SDH. SDHs are typically crescent shaped. In this case the SDH is causing significant mass effect and shift of midline structures to the left.

Subarachnoid hemorrhage (SAH)

Non-aneurysmal SAH can occur with disruption of small pial vessels and commonly occurs in the sylvian fissures and interpeduncular cisterns. Intraventricular hemorrhage or superficial intracerebral hemorrhage may also extend into the subarachnoid space.



1. Accumulation of blood between arachnoid membrane and pia mater
2. High mortality rate (18-26%)
3. Survivors have high rate of memory, mood, and neurocognitive impairment

Figure 11.20 CT scan showing subarachnoid hemorrhage.

Secondary Brain Injury

Secondary brain injury in TBI is usually considered as a cascade of molecular injury mechanisms that are initiated at the time of initial trauma and continue for hours or days.

These mechanisms include:

1. Neurotransmitter-mediated excitotoxicity causing glutamate, free-radical injury to cell membranes
2. Electrolyte imbalances
3. Mitochondrial dysfunction
4. Inflammatory responses
5. Apoptosis
6. Secondary ischemia from vasospasm, focal microvascular occlusion, vascular injury

These leads, in turn, to neuronal cell death as well as to cerebral edema and increased ICP that can further exacerbate the brain injury. This injury cascade shares many features of the ischemic cascade in acute stroke. These various pathways of cellular injury have been the focus of extensive preclinical work into the development of neuroprotective treatments to prevent secondary brain injury in TBI. No clinical trials of these strategies have demonstrated clear benefit in patients.

However, a critical aspect of ameliorating secondary brain injury after TBI is the avoidance of secondary brain insults, which would otherwise be well tolerated but can exacerbate

neuronal injury in cells made vulnerable by the initial TBI. Examples include hypotension and hypoxia (which decrease substrate delivery of oxygen and glucose to injured brain), fever and seizures (which may further increase metabolic demand), and hyperglycemia (which may exacerbate ongoing injury mechanisms).

Definition of TBI

1. Alteration in mental or physical function due to sudden brain trauma
2. Does not require loss of consciousness

Management Guideline

Primary focus should be to prevent secondary brain injury by providing adequate oxygenation and maintaining a blood pressure that is sufficient to perfuse the brain thereby improve the outcome

Initial Assessment

Primary survey: initial assessment as mentioned in chapter 2.

Mini-neurologic examination (APVU)

1. Level of consciousness
2. Pupil reactivity
3. Limb motor activity
4. GCS score

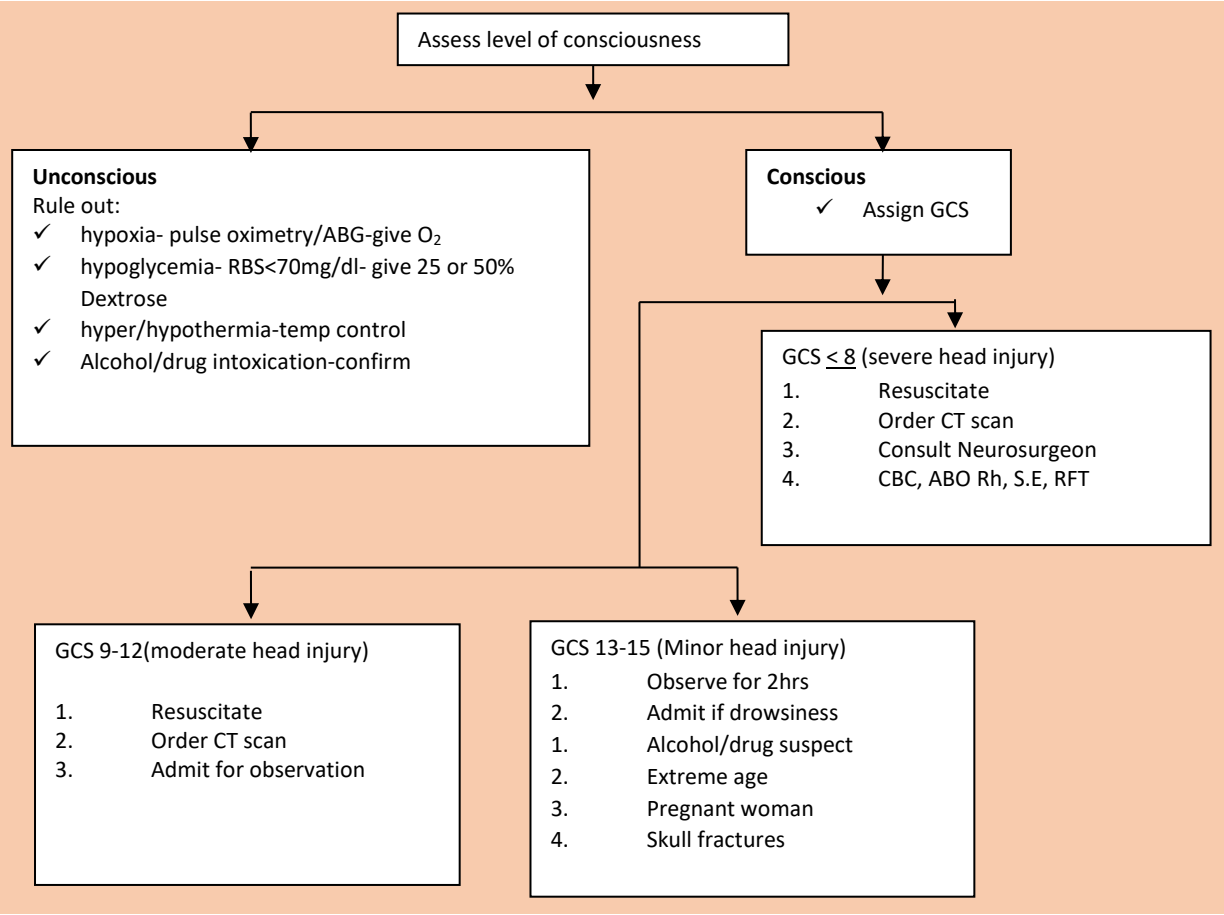


Figure 11.21 Algorithm of assessment and management of head injury.

Table 11.4 Glasgow coma scale		
Best Eye Opening	4	Spontaneous
	3	To verbal command
	2	To pain
	1	No response
Best Motor Response	6	Obeys
	5	Localizes pain
	4	Flexion-withdrawal
	3	Flexion- abnormal (decorticate rigidity)
	2	Extension (decerebrate rigidity)
	1	No response
Best Verbal Response	5	Oriented and converses
	4	Disoriented and converses
	3	Inappropriate words
	2	Incomprehensible sounds
	1	No response

The GCS is scored between 3 and 15, 3 being the worst and 15 the best. It is composed of three parameters: best eye response (E), best verbal response (V), and best motor response (M). The components of the GCS should be recorded individually; for example, E2V3M4 results in a GCS score of 9. A score of 13 or higher correlates with mild brain injury, a score of 9 to 12 correlates with moderate injury, and a score of 8 or less represents severe brain injury.

Secondary survey: examination of rest of the head as in **Chapter 2**.

Physical examination signs suggesting intracranial mass lesion

1. Coma & unilateral dilated, fixed pupil
2. Lateralized extremity weakness
3. Posturing (esp. if asymmetric)

– Decorticate – arms adducted and flexed, with the wrists and fingers flexed on the chest, legs are stiffly extended and internally rotated with planter flexion of the feet.
– Decerebrate – arms are adducted and extended and, with wrists pronated and fingers flexed, legs are stiffly extended, with planter flexion of feet.

Indications for CT scan Head:

1. Altered mental status
2. Lateralizing signs
3. Progressive headache
4. Persistent vomiting
5. Any neurologic deterioration
6. Open brain injury
7. Signs of basilar skull fracture (Battle's sign, Racoon's sign)

Primary Treatments

1. Initial resuscitation
2. Cervical spine control
3. Prevent secondary injury

Secondary Treatments

1. Antibiotics – anti-staphylococcal (first generation cephalosporins) if penetrating skull injury, major contamination, or CSF leak
2. Tetanus toxoid if last immunization > 5years ago
3. Diazepam (0.2-0.3mg/kg IV) or lorazepam (0.1-0.2mg/kg IV) followed by phenytoin sodium (18mg/kg at rate < 50mg/kg/min) for seizures
4. Consider pain medications if severe
5. Catheterization before mannitol
6. Nasogastric tube to decompress stomach
7. NS or RL remains the standard resuscitation fluid

Treatment of Increased ICP/Cerebral edema

1. Hyperventilation to PCO_2 of 30 to 35 mmHg (excessive hyperventilation can reduce blood flow to damaged brain areas
2. Fluid restriction (if not in shock and ongoing fluid losses)
3. Mannitol 5ml/kg IV over 15minutes loading dose, then 2.5-3ml/kg (.25-1g/Kg bw) and +/- Furosemide 1mg/kg IV bolus and repeat
4. Consider use of barbiturates (Phenobarbital 10-20mg/g IV loading or pentobarbital 3-6mg/kg IV)
5. Steroids not indicated unless spinal cord injury also present(debatable)

SCALP lacerations

1. Usually can repair in one layer
2. Need to repair galea as separate layer (with absorbable suture) if also lacerated
3. Usually do not require antibiotics
4. Suture removal in 7 days

Skull fractures

1. Most do not require specific treatment (underlying brain injury may need separate treatment)
2. Need surgery if:
3. open fracture (save any bone fragments identified)
4. depressed >3-5mm
5. skull x-rays only indicated if head CT not otherwise needed and patient has
6. suspected depressed or open skull fracture by physical exam
7. large scalp hematoma thru which skull cannot be felt well enough to rule out depressed fracture

Concussion

1. Symptoms
2. Brief loss of consciousness (<5min)
3. Headache
4. Dizziness
5. Nausea/vomiting
6. Normal neurologic exam within 6hrs
7. May need to be admitted if severe dizziness or persistent vomiting
8. Usually do not need CT Scan but need observation in hospital for 2-24hours

Penetrating Brain Injury

1. Patients with obvious fatal penetrating brain injuries may still warrant resuscitation to become organ donors
2. CT indicated even for tangential gunshot wounds to rule out blast effect to brain
3. Post-traumatic seizures can occur in up to 50% of cases, so usually seizure prophylaxis (with phenytoin or Phenobarbital) is indicated
4. All should receive antibiotics.

Figure 11.22 Pictures showing penetrating head injury "Khuru" injury (left) and arrow (right).

Key Messages for Impaled Objects

1. Do not remove impaled object
2. Stabilize object in place
3. Pad around object
4. Use hacksaw to shorten object if needed
5. Consult neurosurgeon

Other Key Messages

1. The best initial treatment for the fetus is the provision of optimal resuscitation of the mother and early assessment of the fetus
2. A qualified surgeon and an obstetrician should be consulted early in the evaluation of pregnant trauma patients
3. The abdominal wall, uterine myometrium, and amniotic fluid act as buffers to direct fetal injury from blunt trauma.
4. As the gravid uterus increases in size, the remainder of the abdominal viscera are relatively protected from penetrating injury, whereas the likelihood of uterine injury increases
5. Vigorous fluid and blood replacement should be given to correct and prevent maternal and fetal hypovolemic shock.
6. Assess and resuscitate the mother first, and then assess the fetus before conducting a secondary survey of the mother
7. All pregnant Rh-negative trauma patients should receive Rh immunoglobulin therapy unless the injury is remote from the uterus as even a minor degree of fetomaternal hemorrhage can cause sensitization of Rh-negative mother
8. Trauma can cause abruptio placentae, amniotic fluid embolism, and premature rupture of membranes
9. Presence of indicators that suggest domestic violence should serve to initiate further investigation and protection of the victim

NON- TRAUMATIC SURGICAL EMERGENCIES (Acute Abdomen)

Definition of acute abdomen

1. Acute abdomen is defined as sudden or recent onset of unexpected abdominal pain (usually within 24-72 hours of presentation).

2. Frequently associated with gastrointestinal signs and symptoms indicative of intra- and extra-peritoneal processes.
3. It is important to detect acute abdominal conditions early and initiate treatment to prevent morbidity and mortality. However, it does not invariably signify the need for surgical intervention.

The types of acute abdominal conditions mostly depend on the origin of organs in the different locations of abdomen as shown below:

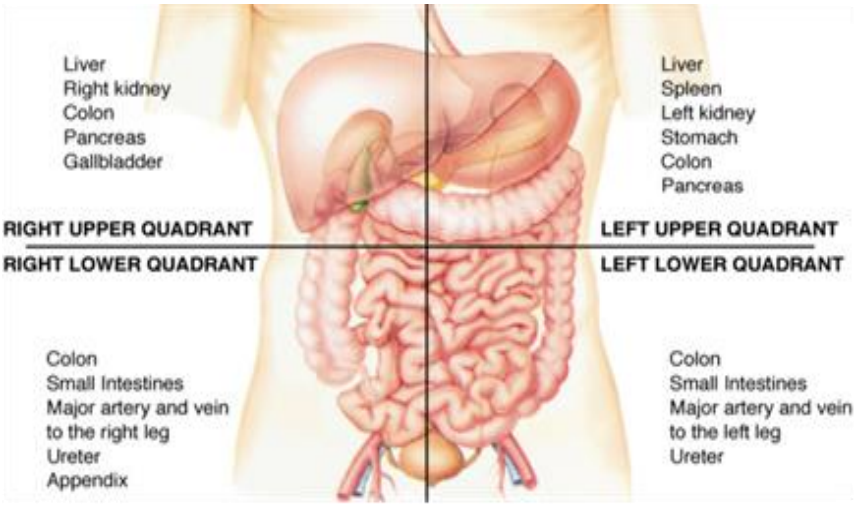


Figure 11.23 Schematic diagram showing different visceral organs in the abdomen.

Acute Appendicitis

- Classical presentation with colicky pain originating from peri-umbilical region and later settling down in right iliac fossa associated with fever, nausea or vomiting, and anorexia
- McBurney's point tenderness if localized
- Lower abdominal or diffuse peritonitis in cases of ruptured appendix
- Blood counts will show raised counts with predominant neutrophils
- Treatment – available triple antibiotics therapy with ampicillin, gentamicin and metronidazole
- Referral for surgery if either signs of peritonitis or not responding to conservative treatment suspecting abscess, gangrene, perforation and general peritonitis
- Consider other differential diagnoses: gastroenteritis, mesenteric lymphadenitis, Meckel's diverticulitis, perforated peptic ulcer disease, Typhlitis, pyelonephritis, ureteric colic and gynecologic conditions.

Acute Cholecystitis

- Acute pain in right hypochondrium or epigastrium typically after consumption of a fatty meal, associated with fever, tachycardia, and tenderness often with guarding and rebound tenderness (Murphy's sign) most commonly due to cystic duct obstructed by gallstone.
- Blood counts may show leukocytosis
- Ultrasound may show presence of gall stones, thickened gallbladder wall, peri-cholecystic fluid and sonographic Murphy's sign.
- Initial treatment includes bowel rest, intravenous hydration, analgesia, and intravenous antibiotics

- Referral should be urgent if there is no response to conservative treatment or there is a sign of empyema, perforation or associated pancreatitis

Acute Pancreatitis

- Commonly presents with severe pain in the epigastric region usually after alcohol consumption or heavy meal associated with nausea and vomiting
- Pain typically radiates to back and better when bending forwards
- Severe cases may have fever, tachycardia, and hypotension if severe
- Treatment initially is to control pain, bowel rest, IV fluids, and broad-spectrum antibiotics
- Blood counts may show increased counts, increased amylase
- Ultrasound may give evidence of pancreatic enlargement but CT scan is required in severe conditions.
- Refer for further management if suspected.

Intestinal Obstruction

- It usually presents as sharp, crampy periumbilical pain with intervening pain-free periods, and associated with:
- Nausea and vomiting
- Constipation or Obstipation (absence of bowel movements and flatus)
- Abdominal distension
- Examination would show marked abdominal distension; high-pitched or tinkling bowel sounds and variable degree of abdominal tenderness.
- Causes can be mechanical or non-mechanical
- Mechanical:
- Adhesion bands due to previous abdominal surgeries or congenital
- Hernias
- Volvulus (particularly sigmoid volvulus)
- Neoplasms
- Intussusception (especially in children)
- Bowel ischemia
- Non-mechanical
- Post-operative paralytic ileus
- Peritonitis
- Spinal injury
- Drugs, hypokalemia
- Diagnosis:
- Bowel obstruction is a clinical diagnosis
- Plain erect and supine abdominal X-rays will show air in distended bowel loops with air fluid levels usually in distal obstructions
- **Treatment:**
- Non-operative with IV fluids, antibiotics, nasogastric aspiration, and analgesics
- Operative for cases not responding to conservative treatment like persistent pain, rigid, tender and silent abdomen, increasing abdominal distension and visible peristaltic waves.

Peptic Ulcer Perforation

- Typically presents as sudden onset of severe epigastric pain that eventually involves the patient's entire abdomen.

- Associated with chronic use of non-steroidal anti-inflammatory medications
- Most patients provide a history compatible with peptic ulcer disease
- Physical examination would be remarkable for diffuse abdominal tenderness, rigidity and peritoneal signs
- Plain films usually but not always, reveal free intra-peritoneal air under diaphragm
- Treatment consists of fluid resuscitation, intravenous antibiotics and emergent surgical exploration.

Peritonitis

- It is an acute life-threatening condition caused by bacterial or chemical contamination of peritoneal cavity
- Treatment is aimed at treatment of the underlying cause
- **Major Causes:**
- Appendicitis
- Perforated peptic ulcer
- Strangulated bowel
- Pancreatitis
- Cholecystitis
- Intra-abdominal abscess
- Typhoid perforation
- Anastomotic leak following surgery
- Tuberculosis of abdomen
- Ascending infection from salpingitis and postpartum infections
- **Clinical Diagnosis**:
- Sharp pain, which is worse on movement or coughing
- Fever
- Abdominal distension, tenderness and guarding
- Diminished or absent bowel sounds
- Shoulder pain (referred from diaphragm)
- Tenderness on rectal or vaginal examination (suggests pelvic peritonitis)
- **Management**: NPO, IV fluids, triple antibiotic therapy, nasogastric aspiration and surgical consultation

Mesenteric Ischemia

- It presents as sudden onset of severe, constant abdominal pain with associated vomiting and diarrhea.
- It may result from superior mesenteric artery thrombosis from severe vascular disease or from superior mesenteric artery occlusion by embolus (e.g. atrial fibrillation)
- Examination may reveal pain out of proportion to physical findings.
- Blood counts may show marked leukocytosis
- Rule out other common causes of pain abdomen
- High suspicion of mesenteric ischemia needs angiography to confirm the diagnosis

Ruptured Abdominal Aortic Aneurysm

- Most lethal cause of abdominal pain
- Patients with free intra-abdominal rupture rarely, if ever, survive until hospital arrival; those with contained rupture or leak may present in shock

- Commonly presents with lumbar or lower abdominal pain with tearing sensation radiating to back, flank or both
- Associated with nausea and vomiting
- Examination is marked by presence of the following:
- Presence of marked tenderness a pulsatile abdominal mass
- Mottled or spotty abdominal skin
- Decreased or absent femoral or distal pulses
- Urgent referral for definitive management

Acute Urologic conditions:

- Paraphimosis
- Testicular torsion
- Urolithiasis
- Massive hematuria
- Acute urinary retention

Paraphimosis

- Inability to pull retracted foreskin back over glans
- It is a surgical emergency
- Vascular compromise
- Treatment:
  - ✓ Continuous firm pressure to glans for 5-10min
  - ✓ Dorsal slit
  - ✓ Circumcision

Testicular Torsion

- It develops most often in peripubertal (12-18years old) age group, although it can occur at any age
- Presents with acute onset of unilateral testicular pain and swelling, commonly associated with nausea and vomiting.
- Typical history of Strenuous physical activity and blunt trauma
- Some patients give a history of a prior episode that spontaneously resolved
- Absent urinary symptoms
- Examination reveals extreme tenderness, swollen firm testicle high in the scrotum with transverse lie
- Absent cremasteric reflex
- Elevation of scrotum does not relief pain
- Difficult to differentiate rom epididymitis
- **Investigation**: Color Doppler ultrasound
- **Treatment:** manual detorsion (“open book” technique), Surgery (orchidopexy) which can salvage rate 80-100% up to 6hrs of ischemia, 20% after 10hours and 0% after 24hours

Acute urinary retention

Acute urinary retention is a very painful and discomforting condition and it is an indication for emergency drainage of bladder

✓ **Predisposing factors**

- Pre-existing history of LUTS

- Bladder outlet obstruction (i.e. BPH, urethral stricture)
- Infection (i.e. prostatitis, urethral herpes)
- Bladder neck/prostate/urethral malignancies
- Constipation
- Neurogenic disorders (i.e. spinal cord injury, MS, Parkinson's)
- Urethral trauma

✓ **Acute Causes:**

- Urethral stricture and benign prostatic hypertrophy, prostatic cancer in males
- Urethral trauma
- If the bladder cannot be drained through the urethra, it requires suprapubic drainage
- Avoid per-urethral catheterization if retention is due to urethral trauma

Chronic retention

Treatment of chronic retention is not urgent but requires referral to surgeon for further management.

ACUTE GYNECOLOGIC ABDOMINAL PAIN

Ruptured ectopic pregnancy

✓ Always suspect in child bearing woman with reliable or doubtful missed period
✓ **Presents with:**
✓ Acute abdominal and pelvic pain
✓ Collapse and weakness
✓ Fast and weak pulse
✓ Hypotension
✓ Hypovolemia
✓ Abdominal distension
✓ Rebound tenderness
✓ Pallor
✓ **Diagnosis**: Serum pregnancy test combined with ultrasonography
✓ **Treatment**:

- Treat hypotension with fluids and blood
- Immediate laparotomy for definitive management

Ruptured Ovarian cyst

- Rupture of hemorrhagic cyst can occur in both pregnant or non-pregnant woman
- Can be confused with ectopic pregnancy
- Sudden severe lower abdominal pain
- Signs of peritoneal irritation
- CBC and hCG should always be done
- Ultrasound can aid in visualizing cyst or free fluid in pelvis indicating rupture
- Severe bleed can cause hemodynamic instability
- Surgical treatment will be required

Adnexal torsion

- Occurs in a reproductive age group when the ovary, tube, or both, twist on the infundibulopelvic ligament usually on the right side with large ovaries or ovarian masses
- Complete torsion is a surgical emergency as it causes necrosis of adnexa
- Presents with acute and severe, sharp, intermittent unilateral lower pelvic pain

- Temperature, tachycardia or bradycardia (from vagal stimulation)
- Diagnosis is clinical and ultrasonography
- Immediate surgical removal for complete necrosis

References

1. Advanced Trauma Life Support: *student course manual 10th edition*
2. Trauma: *Ernest E. Moore 8th edition*