Trauma management classified by organs & systems

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Contents:

Trauma: Introduction

-From the Ancient Greek τραυματικός (traumatikós), Which means wound.

- It's now referred to any injury of the body

-**Trauma** can be defned as an injury to any part of the human body as the result of energy transfer from an inficting source.

-**Major trauma** denotes injuries to more than one body region or organ system that are life-threatening and could be life changing because it may result in long-term disability.

Major Trauma also defned as an injury severity score (ISS) greater than 15

Injury Severity Score (ISS)

The Injury Severity Score (ISS) is an established medical score to assess trauma severity.
It correlates with mortality, morbidity and hospitalization time after trauma. It is used to define the term major trauma

Injury Severity Score (ISS)

Body Region
Head
Face
Neck
Thorax
Abdomen
Spine
Upper Extremity
Lower Extremity
External and other

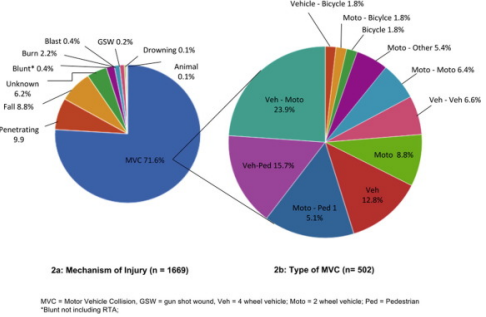
Score	Abbreviated Injury Scale (AIS)
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurviveable

All injuries are assigned from an internationally recognised dictionary that describes over 2000 injuries. Multiple injuries are scored by adding together the squares of the three highest AIS scores. The ISS can range from 1 to 75. Scores of 7 and 15 are unattainable because these figures cannot be obtained from summing squares. The maximum score is 75. By convention, a patient with an AIS of 6 in one body region is given an ISS of 75.

Example

Region	Injury description	AIS*	Square top three
Head & neck	Cerebral contusion	3	**9**
Face	No injury	0	
Chest	Flailed chest	4	**16**
Abdomen	Minor contusion of liver	2	
	Complex rupture spleen	5	**25**
Extremity	Fractured femur	2	
External	No injury	0	
Injury Severity Score			**50**

*AIS represent Abbreviated Injury Scale



Trauma Epidemiology

-Trauma as a disease is a leading global public health problem affecting 135 million people a year and is responsible for about 5.8 million deaths annually (approximately 10% of all deaths

-Road trafc accidents (RTAs), falls and intentional violence continue to be the most prevalent causes of trauma fatalities, with a combined rate of 64%

-In 2023 in Jordan, The number of recorded Road traffic accident was 169,409 accident with 563 fatality, which mean there's around 20 car accidents ever hour with more than 2 deaths daily, and much larger number of long term disabilities

-The estimated cost of these accident was around 322,000,000 Jd, roughly half of it was for medical bills, and that's for road traffic accidents alone.

Trauma Management

Trauma management refers to the comprehensive approach of assessing, stabilizing, and treating patients who have suffered severe physical injuries, often as a result of accidents, violence, or natural disasters.
It encompasses rapid assessment, resuscitation, surgical intervention, and ongoing care to optimize outcomes and minimize morbidity and mortality in trauma patients.
Injury assessment consist of, Primary Survey, Secondary Survey, Tertiary Survey

Advanced Trauma Life Support (ATLS) is a comprehensive protocol for the initial evaluation and management of critically injured patients

Primary vs Secondary vs Tertiary Survey in Trauma Patients.

Primary Survery

- C - Catastrophic haemorrhage control and C-spine stabilisation
- A - Airway
- B - Breathing
- C - Circulation
- D - Disability
- E - Exposure and Environment
- Adjuncts (X-ray, monitoring, blood testing)

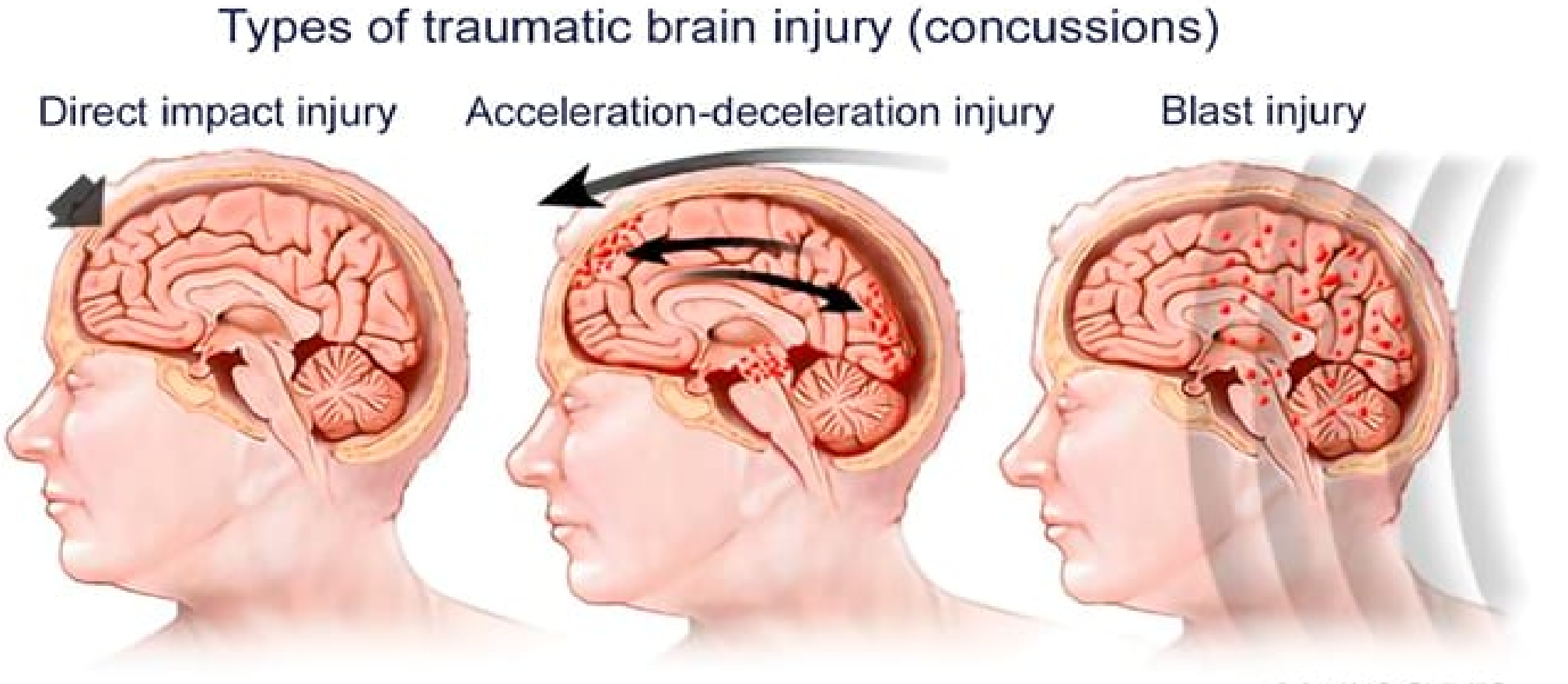
Secondary Survery

- Detailed history-taking
- Systematic "top-to-toe" examination

Tertiary Survey

- Repeat systematic examination
- Risk stratification for patient's disposition

Head Trauma


Types of traumatic brain injury (concussions)
Direct impact injury
Acceleration-deceleration injury
Blast injury

Pathophysiology

I. **Primary brain injury:** occurs at impact and leads to disruption of neurons, glia cells, and microvasculature localized at the area of impact.

II. **Secondary brain injury:** may result from hypoxia, hypotension, hyperventilation, pyrexia, the effects of increased intracranial pressure (ICP), and altered cellular biochemical processes that are often ongoing long after the primary insult.

- **The prevention of these secondary injuries is the goal of both medical and surgical management of TBI.**

Clinical Assessment

- The objectives during early clinical assessment of the patient with head injury are multiple and must be accomplished simultaneously.
- These include:

1. Establishing adequate oxygenation, ventilation, and circulatory stability.
2. Evaluating the extent of brain injury while treating ICP elevations.
   Although some evidence indicates that systemic hypotension may infrequently be the result of a head injury, always initially presume that hypotension in a trauma patient is the result of hypovolemia.

Clinical Assessment

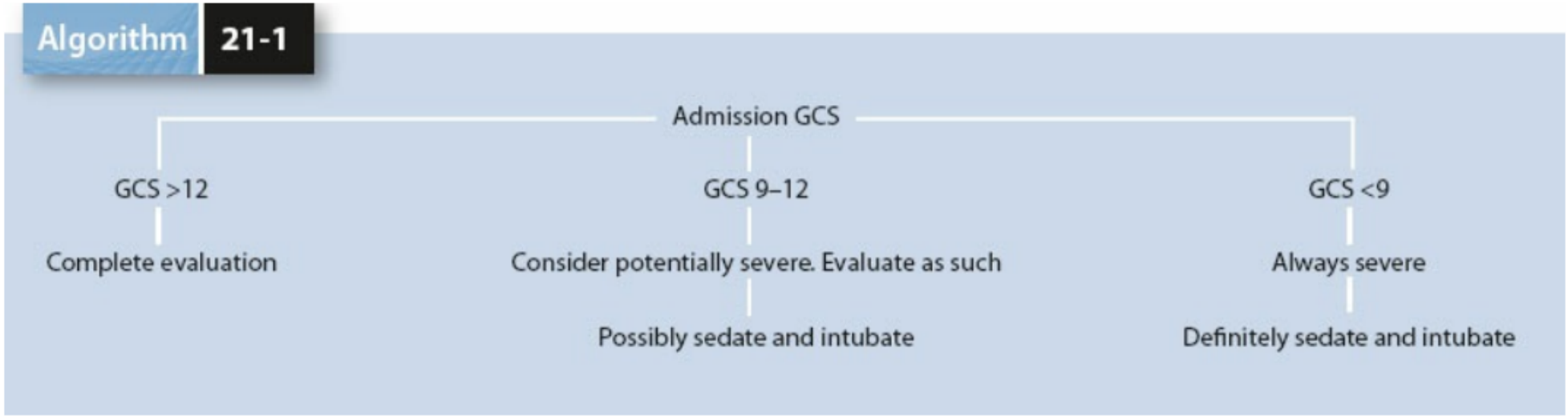
- It should be presumed that any change in mental status or the neurologic examination in general, or any evidence of herniation (e.g., anisocoria), suggests an expanding intracranial mass lesion.
- **Under such circumstances, therapeutic ICP reduction becomes the first priority and diagnostic imaging, or surgical decompression must be accomplished emergently**.
- With regard to the brain injury, several critical assessments are necessary and should be precisely recorded because trends are at least as important as any single observation.
- **The three key parameters are level of consciousness, pupillary reflexes and size, and the motor examination.**

Glasgow Coma Scale

- **The single most important assessment for a patient with head injury is to evaluate the level of consciousness.**
- In this regard, the Glasgow Coma Scale (GCS) has become an international standard that is easily, rapidly, and reliably obtained.
- **Components of the GCS include assessment of eye opening (E), verbal response (V), and motor response (M).**
- For individual patients, it is recommended that all three components be reported separately (e.g., E4V5M6) instead of a sum score (e.g., GCS = 15).
- The derived sum score is more relevant for comparisons at the group level, and for classification and prognosis.
- **For triage purposes, patients can be stratified using their GCS scores into those with severe injuries (GCS ≤8), moderate injuries (GCS 9 to 12), or mild injuries (GCS ≥13).**

Component tested	Score
Eye response	
Eyes open spontaneously	4
Eye opening to verbal command	3
Eye opening to pain	2
No eye opening	1
Motor response	
Obeys command	6
Localises pain	5
Withdraws from pain	4
Flexion response to pain	3
Extension response to pain	2
No motor response	1
Verbal response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1

Glasgow Coma Scale



Algorithm 21-1. Glasgow Coma Scale (GCS) triage guide for initial evaluation of head injury. For the motor scale, the best response for any limb is recorded.

Pupils

- Pupillary asymmetry, dilation, or loss of light reflex in an unconscious patient usually reflects herniation because of the mass effect from intracranial hemorrhage ipsilateral to the dilated pupil.

- Occasionally, pupillary signs may indicate direct second or third nerve injury or trauma to the globe, but this must always be a diagnosis of exclusion.

Motor Examination

- The motor system is examined for asymmetry, abnormal posturing, or lack of movement.
- Hemiparesis, paraparesis, or quadriparesis suggests a cervical or thoracolumbar spine fracture with spinal cord injury.
- In the unconscious patient, **a painful stimulus should be used to evaluate motor function**.
- **All four extremities should be examined and the results noted**, because only the response of the best limb will be reflected in the GCS score.

Physical examination

- Inspect and palpate the entire bony structure of the head and face for **tenderness, deformity and bleeding**.
- **Scalp lacerations** are easily missed visually but often found by palpation.
- Be attentive for **foreign bodies**, such as glass in the scalp after a car accident.
- Note any signs suggesting **basilar skull fracture** (eg, hemotympanum). Retroauricular (Battle's sign) and periorbital ecchymosis (raccoon's eyes) are also indicative of basilar skull fracture but generally do not appear until at least 24 hours after an injury.
- Look for **nasal septal hematomas**.

Radiographic Diagnosis

- Prompt radiographic evaluation is essential and **CT scanning is the imaging modality** of choice for virtually all acute neurologic conditions.
- The spine should be cleared radiographically or immobilized and protected in every patient with a severe head injury.
- With the routine availability of 24-hour CT scanning capabilities, plain skull radiography has largely become obsolete in TBI.

Indications For Neurologic Imaging

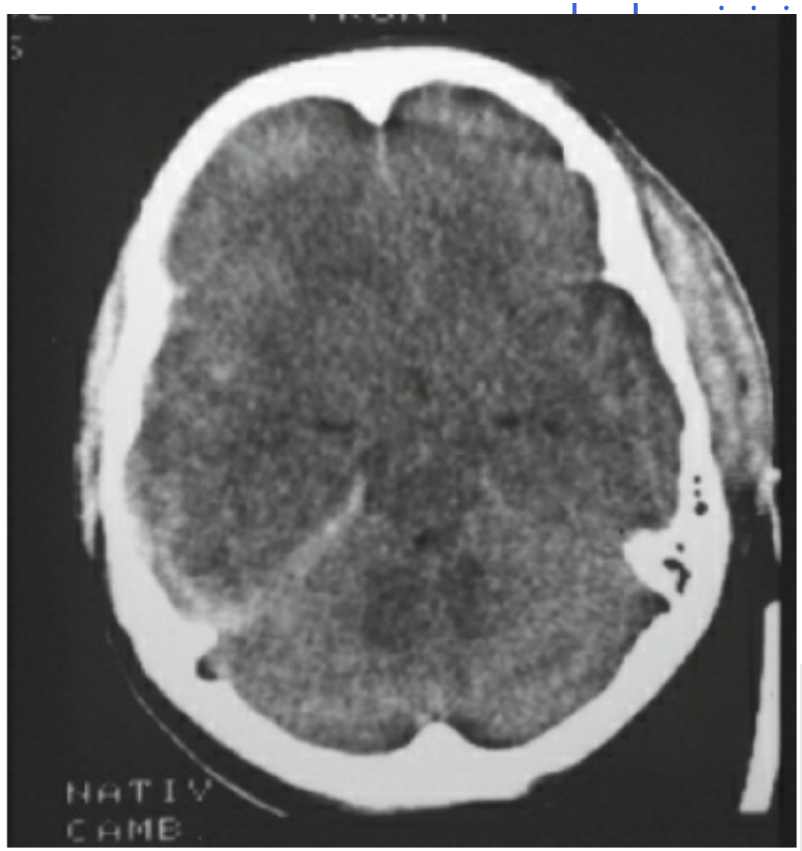
CT Head Immediately	CT head within 8 hours of injury
GCS <13 on initial assessment	65 years old or older
GCS <15 at 2 hours post injury	History of bleeding or clotting disorders
Suspected open or depressed skull fracture	Dangerous mechanism of injury (a pedestrian or cyclist struck by a motor vehicle, an occupant ejected from a motor vehicle or a fall from a height of greater than 1 metre or 5 stairs)
Post traumatic seizure	>30 minutes' retrograde amnesia of events immediately before the head injury
Focal neurological deficit	
>1 episode of vomiting	
Signs of basal skull fracture (CSF otorrhoea, CSF rhinorrhoea, hemotympanum, battle's sign, panda eyes	

Indications For Neurologic Imaging

- Suspected skull penetration by a foreign body
- Discharge of cerebrospinal fluid (CSF), blood, or both from the nose
- Hemotympanum or discharge of blood or CSF from the ear
- Protracted unconsciousness
- Altered state of consciousness at the time of examination
- Focal neurologic signs or symptoms
- Any situation precluding proper surveillance
- Head injury plus additional trauma
- Possible head injury in the presence of additional pathologic findings, such as stroke
- Head injury with alcohol or drug intoxication

Intracranial hypertension

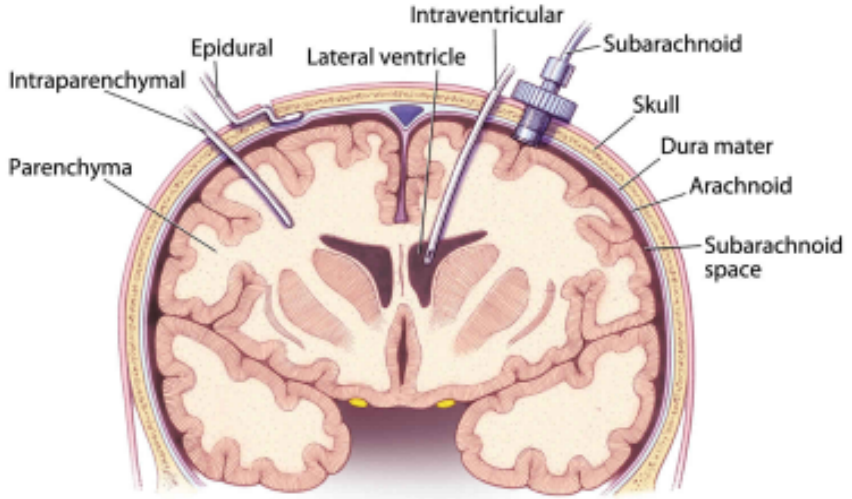
- The CT finding that correlates most highly with intracranial hypertension is compression or obliteration of the basilar cisterns.
- The primary predictor of outcome in patients with this CT picture is the peak level of intracranial hypertension occurring during the first 72 hours.
- When cisternal compression is paired with a midline shift of more than 5 mm, the prognosis is even more ominous.
- **ICP monitoring** should be immediately initiated in any patient with cisternal compression and **intracranial hypertension should be vigorously treated**.

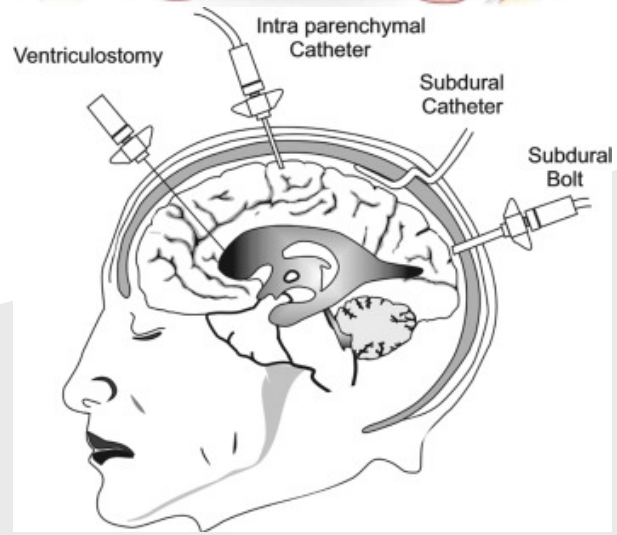


A computed tomography scan that is highly predictive of intracranial hypertension. The basilar cisterns are obliterated and the sulci are flattened.

Intracranial Pressure Monitoring

- All patients with survivable, severe brain injuries and a significant percentage of those with moderate injuries require continuous ICP monitoring.
- Although many techniques are available, **the most common involve small fiber optic or strain gauge catheter tip pressure sensors** placed several millimeters into the brain or fluid-coupled catheters placed into the lateral ventricles.
- Ventriculostomy catheters have the added capability of allowing CSF drainage for ICP control. They are technically more difficult to place, and the complication rate is somewhat higher at 1% to 7%.
- Monitoring ICP not only provides **early warning of herniation but also, by allowing calculation of CPP, opens up the possibility of more precisely optimizing CBF and preventing ischemic secondary brain injury.**





Control of Established Intracranial Hypertension

- **CSF drainage, hyperventilation, mannitol, barbiturates**, and so on are the mainstays of therapy to control intracranial hypertension.
- Each, however, has significant potential complications, which can obviate their beneficial effects. Therefore, **they should not be employed unless intracranial hypertension is established by monitoring ICP**, and caution and vigilance must attend their usage.
- When available via ventriculostomy, CSF drainage should be the first method of managing intracranial hypertension.

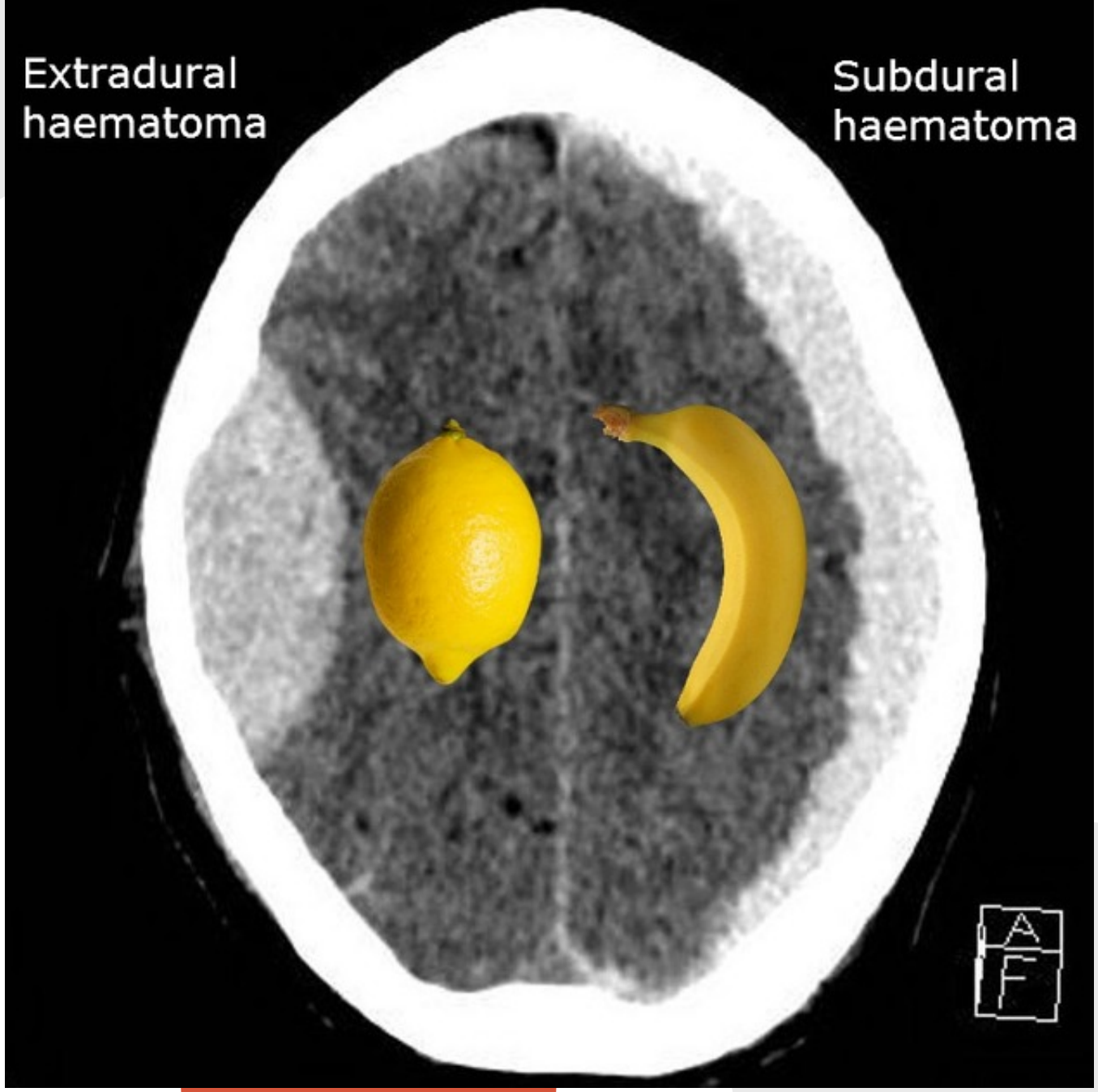
Epidural hematomas

- Acute epidural hematomas correlate well with skull fractures.
- The classic clinical course involving a lucid interval following a brief loss of consciousness with subsequent suspicion must remain high.
- The **typical CT appearance is a high- or mixed-density biconvex extra-axial hematoma with smooth borders.**

Typical computed tomography scan appearance of mixed-density, lens-shaped, acute epidural hematoma with mass effect.

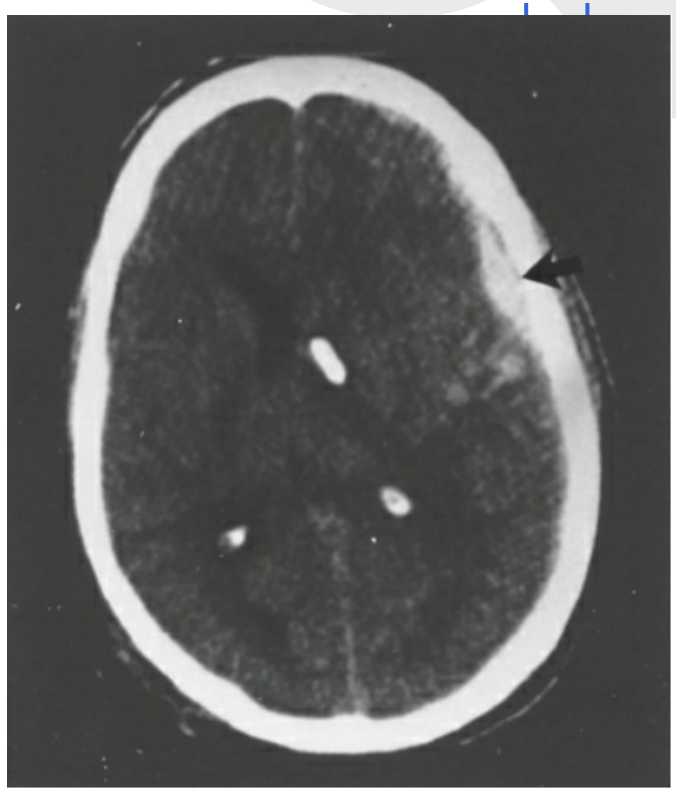
Management of epidural hematomas

- An epidural hematoma larger than 30 mL, clot thickness greater than 15 mm, or midline shift over 5 mm should be **surgically evacuated regardless of the patient's GCS score.**
- In patients with a **GCS score of 8 or less, evacuation should be emergent.**
- **If the GCS score is higher than 8, evacuation should be done as soon as possible** but must not interfere with other resuscitative efforts unless there is evidence of progressive deterioration.
- It is strongly recommended that patients with **any acute epidural hematoma with anisocoria undergo surgical evacuation as soon as possible.**
- Epidural hematomas of less than 30 mL, clot thickness below 15 mm, and midline shift less than 5 mm **should be considered for evacuation because the risk of evacuation appears less than the dangers of enlargement and neurologic injury.**
- Epidural hematomas of this size in patients with **GCS scores above 8 may be considered for nonoperative management**, including frequent neurologic monitoring in an ICU setting and serial CT imaging.


Extradural
haematoma
Subdural
haematoma

Subdural hematomas

- Acute subdural hematomas occur over the convexity of the brain.
- On CT scan, a subdural hematoma appears as an **extra-axial high- or mixed-density crescentic mass that spreads out over the hemisphere**, following the cortical irregularities.
- The midline shift may be out of proportion to the size of the hematoma because of the contributing mass effect from an underlying brain contusion or hemispheric swelling.

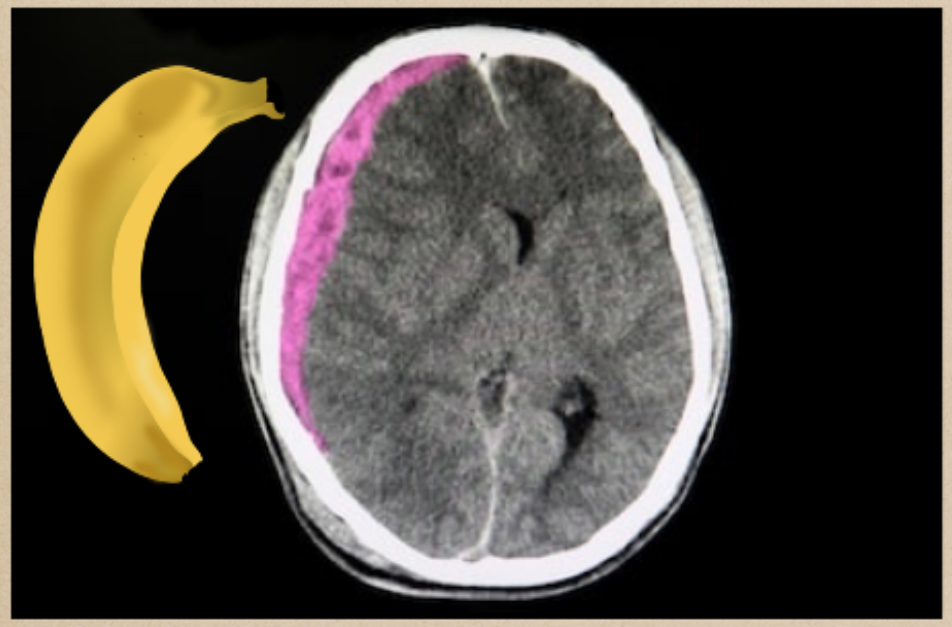


Usual computed tomography scan appearance of a crescent-shaped, high-density blood collection conforming to the contour of the cerebral hemisphere in a subdural hematoma.

Management of subdural hematomas

- An acute subdural hematoma with a thickness greater than 10 mm or midline shift above 5 mm on CT **should be surgically evacuated, regardless of the patient's GCS score.**
- Evacuation should be on an **emergency basis if the initial GCS score is less than 8.**
- In patients with **higher GCS scores, evacuation should be as soon as reasonably possible.**
- A comatose patient (GCS score 8) with a subdural hematoma with less than 10 mm thickness and midline shift below 5 mm **should undergo surgical evacuation of the lesion if any of the following apply:**
  I. The GCS score decreased between the time of injury and hospital admission by 2 or more GCS points.
  II. The patient presents with asymmetric or fixed and dilated pupil(s).
  III. The ICP exceeds 20 mm Hg for more than 5 to 10 minutes.
- Patients with subdural hematomas of **less than 10 mm thickness and midline shift below 5 mm and GCS scores greater than 8 can be treated nonoperatively**, but should be closely observed.

Subdural Hematoma



- Concave/Crescent-Shaped
- Bridging Veins
- Elderly, Alcoholics

suB = Banana

Epidural Hematoma

- Convex/Lens-Shaped
- Middle Meningeal Artery
- “Lucid Interval”

Epi = Pie = Lemon

Diffuse Axonal Injury

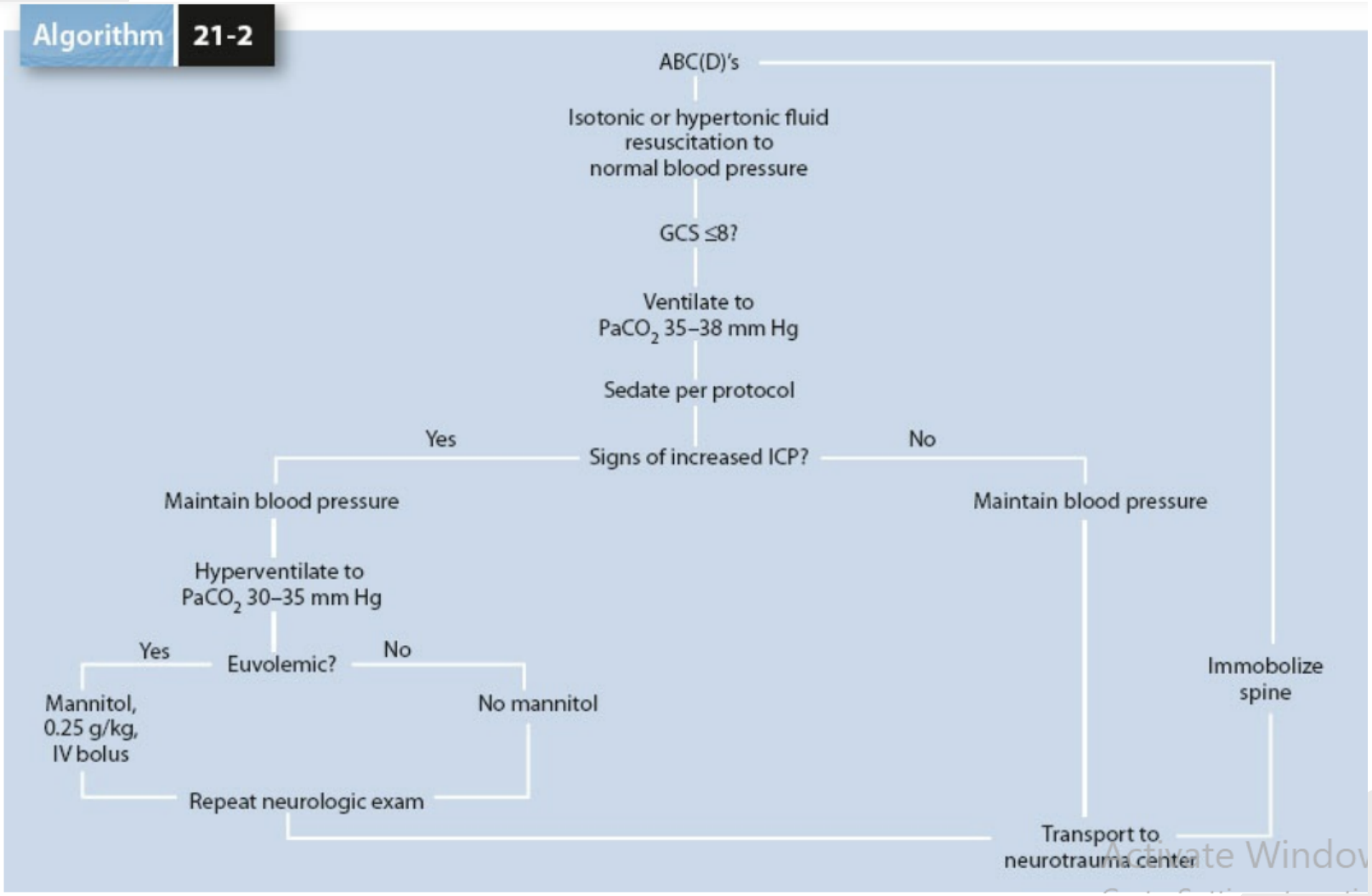
- DAI, typical of acute acceleration–deceleration injury.
- Appears on CT scan as small areas of focal hemorrhage in the brainstem, thalamus or deep nuclear region, corpus callosum, and hemispheric white matter and may be accompanied by cerebral swelling.
- Interestingly, there is no association between diffuse axonal injury and underlying skull fractures.

CT scan of the brain showing DAI. Note the deep shearing-type injury in or near the white matter of the left internal capsule (arrow).

Management of Traumatic Brain Injury

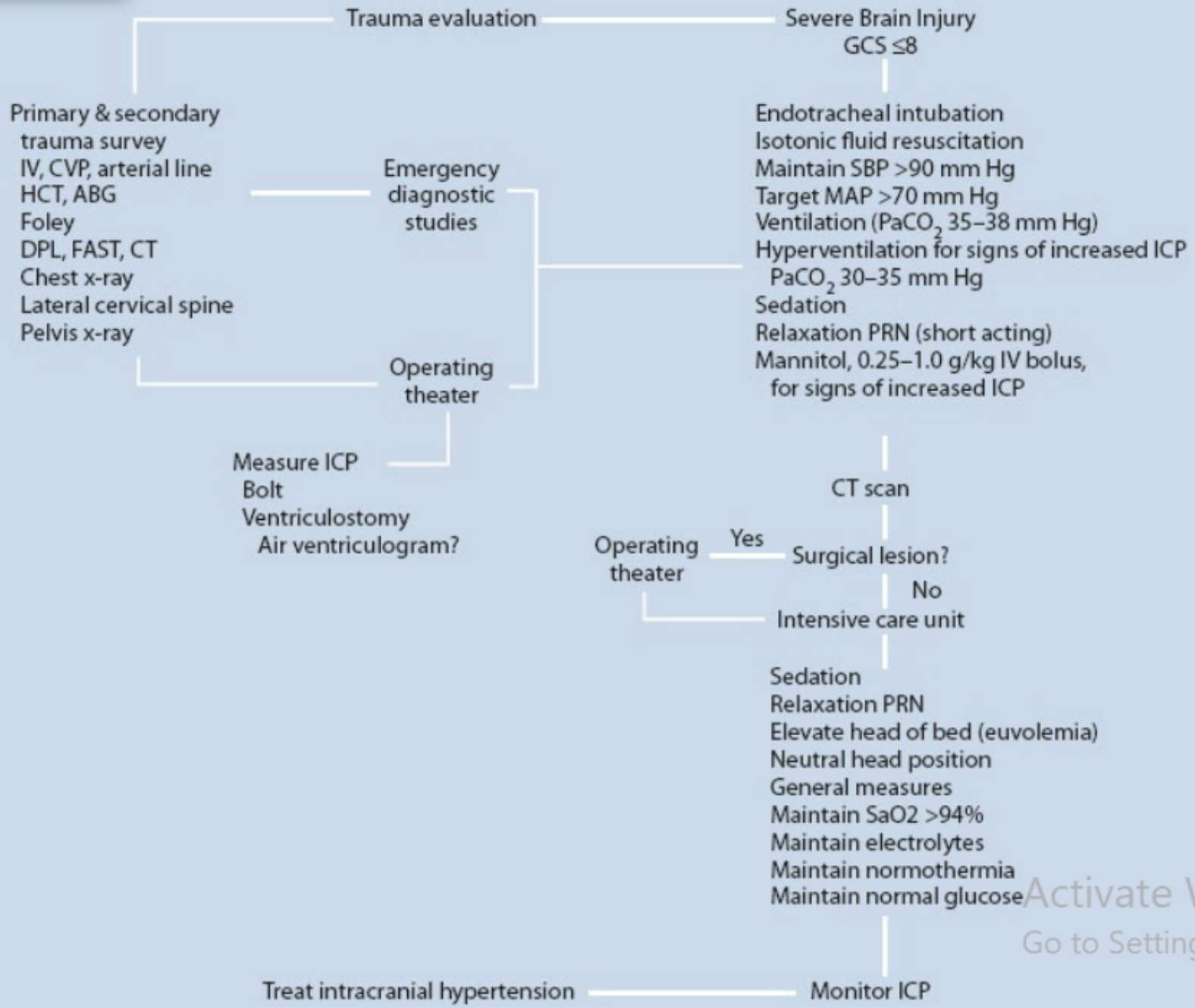
- Isotonic crystalloid solution in the form of 0.9% normal saline (NS) is preferable to lactated Ringer solution as a resuscitation fluid for TBI.
- For some time, a growing body of indirect scientific support appeared to support the use of 250 mL of 7.5% hypertonic saline as the first resuscitation fluid in TBI victims.
- **The endpoints of resuscitation do not change depending on the presence or absence of a head injury.**
- Blood volume should be normal, with an appropriate blood pressure and central venous pressure, adequate urine output and peripheral perfusion, and progressive improvement of any base deficit.
- **The systolic blood pressure should never be allowed to drop below 90 mm Hg.** Some evidence indicates an advantage to targeting a mean arterial pressure of 80 to 90 mm Hg during resuscitation until ICP monitoring can be initiated.
- **Once ICP is available, a minimal CPP of 60 mm Hg should initially be the goal.**

Management of Traumatic Brain Injury



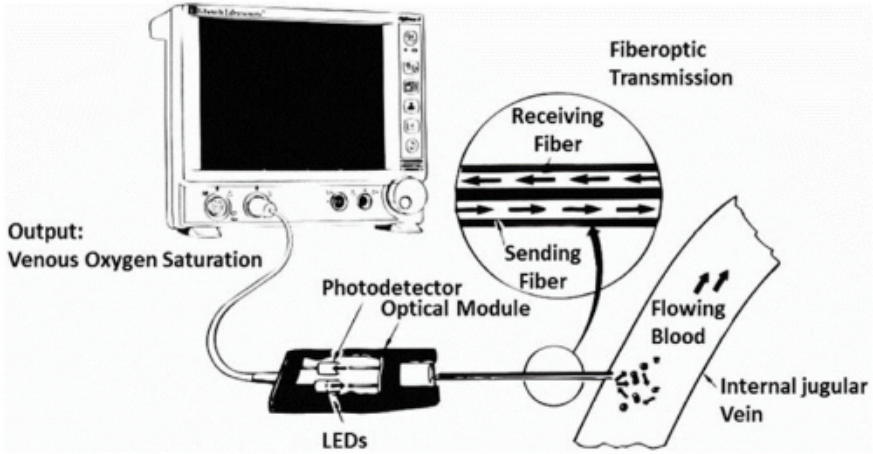
Prehospital evaluation and treatment of a patient with severe traumatic brain injury. "Signs of increased ICP" is the decision point for determining the necessity of intracranial pressure (ICP)-lowering therapy. These signs include pupillary abnormalities, motor posturing, or neurologic deterioration not related to medications.

Algorithm 21-3



Monitoring of Cerebral Perfusion and Oxygenation

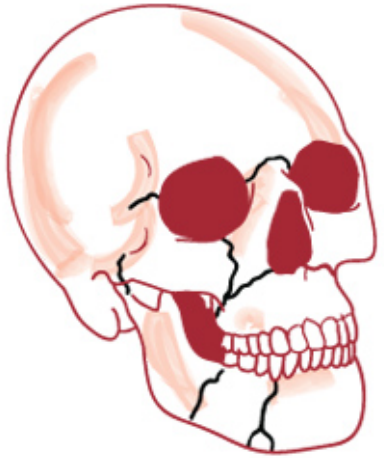
- **Preventing cerebral ischemia is a mainstay in the management of severe TBI patients**. There are currently several methods that are readily available for ICU measurement of the adequacy of cerebral oxygen delivery.
- Placing a catheter into the jugular bulb via a retrograde venous route allows sampling of the saturation of oxygen in the blood leaving the brain. **Jugular venous oxygen saturation values below 50% are associated with cerebral ischemia and worsened recovery**, whereas saturations above approximately 85% suggest hyperemic flow.
- It should be noted that this method cannot completely rule out ischemia.
- Fever will elevate ICP and is independently correlated with decreased recovery in severe TBI. Local measures (e.g., cooling blankets, fans) should be used in conjunction with acetaminophen to **keep temperatures below 37.5°C to 38°C when ICP requires treatment.**
- In patients presenting with radiographic evidence of intracranial injury or GCS less than 8, **administration of prophylactic antiepileptic drugs is indicated for 7 days postinjury to prevent early seizures.**

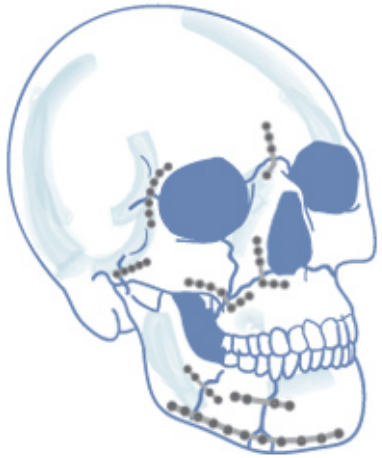


Cerebral Edema and Osmolar Therapy

- Our present treatment for cerebral edema in trauma is limited to the administration of **osmotic agents, most classically mannitol.**
- Generalizing the documented efficacy of **corticosteroids** to decrease tumor-related cerebral edema to **the setting of trauma-induced edema** has proven to be ineffective and actually harmful and **is now considered contraindicated.**

Maxillofacial injury





Mechanism

- Most common cause of Severe injuries is motor vehicle collisions (high energy) , followed by interpersonal and domestic violence (low energy) .
- Sports like football, baseball, and hockey account for a high percentage of facial injuries among young adults .
- Other mechanisms include:
- falls, animal bites
- gunshot wounds and other explosive devices .

Facial trauma sustained from gunshot wounds or explosions is associated with greater morbidity and higher mortality rates . **Associated** head and cervical spine injuries are common in patients with significant facial trauma .

PREHOSPITAL MANAGEMENT

Patients with severe oropharyngeal bleeding who **do not require spinal immobilization** should be allowed to assume a position of comfort. They can sit leaning forward and may be allowed to suction themselves.

If **spinal immobilization is required**, and provided the patient is alert and bleeding is not severe, the backboard may be tilted with the bleeding side down, to protect the airway and allow suctioning.

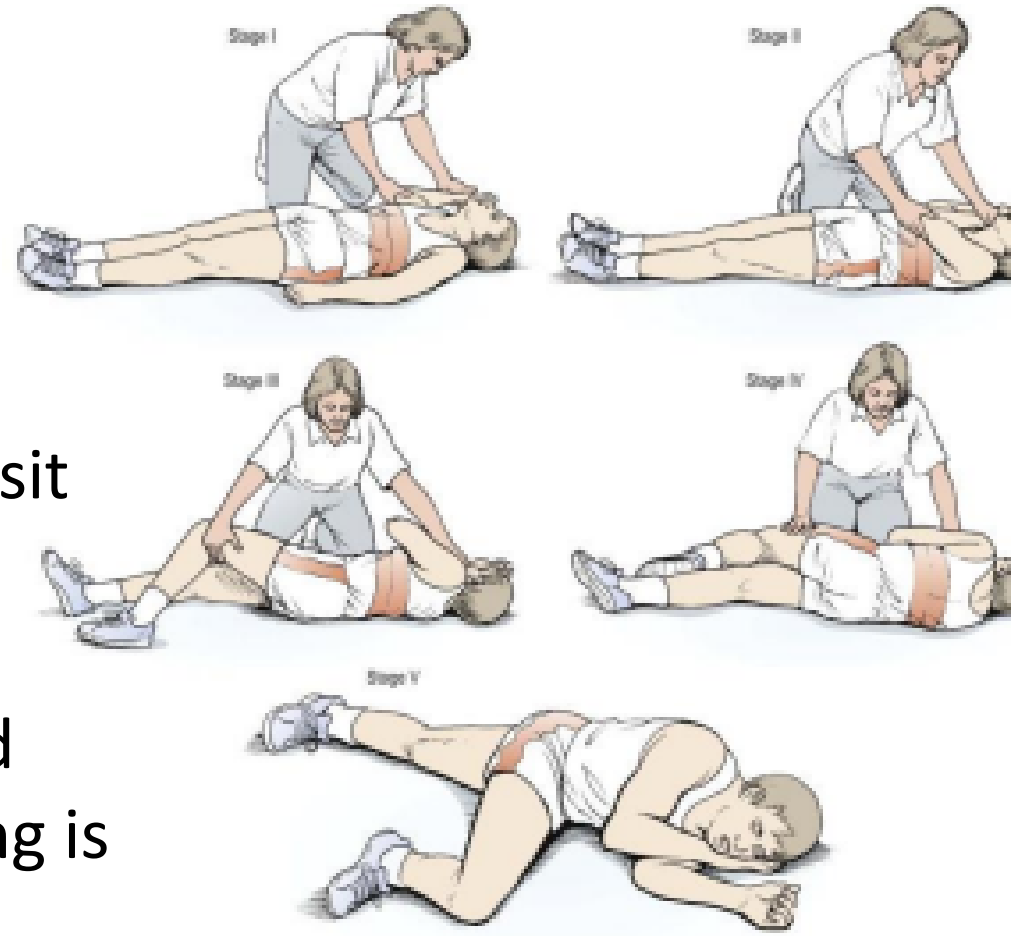
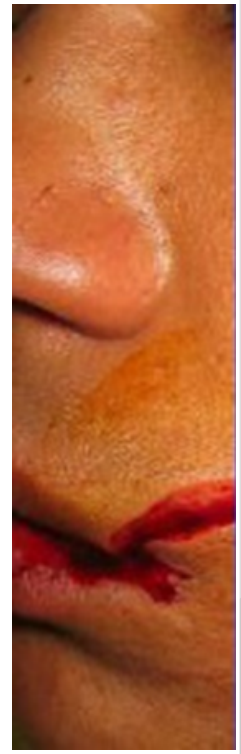


Figure 22 The patient should be nursed in to semiprone postion to allow secreations, blood and foreign bodies to fall from th mouth

- Bleeding in many areas of the face can be controlled during transport with **external compression**.
- In an alert patient with intraoral bleeding, 4 x 4 cm gauze packing may be held firmly, with the fingers pressed against the site of bleeding, or clamped between the jaws if the wound lies along the alveolar ridge. Alert patients may be able to perform these maneuvers themselves

- Complete (ie, "through and through") lacerations of the buccal space may be packed and compression applied externally. Another method is to soak gauze with lidocaine with epinephrine and press it against the bleeding site using a forceps or similar tool. Gauze may also be impregnated with tranexamic acid and applied with direct pressure to the affected area.



- If suspecting a **ruptured globe**, protection to prevent compression of the eye (eg, eye cup or noncontact shielding) should be placed in the field.

- **Avulsed tissue**, including ears, the tip of the nose, or large skin flaps, should be transported with the patient *in saline-soaked gauze*. Full-thickness skin flaps are often more readily reattached to the face than other body parts.

- **Avulsed teeth** should be transported with the patient. Patients with normal mental status who are able to protect their airway may be able to carry avulsed teeth in their mouths, held between the gum and buccal mucosa.

-Patients that should NOT be allowed to carry avulsed teeth in their mouth. In such cases, teeth should be transported in a container of sterile saline. Incompletely avulsed teeth should be left in place and not manipulated.

HISTORY AND PHYSICAL EXAMINATION
Initial assessment

- Disfiguring facial injuries can be distracting to both the patient and the clinician. Nevertheless, clinicians must focus on the basics of trauma care (ie, the **primary survey**) and address all life-threatening injuries before performing a complete facial examination.

- After problems identified during the primary survey are adequately addressed, a **secondary survey**, including careful assessment of facial injuries, must be performed. The secondary survey should include a systematic approach and examination of all major facial structures and functions.

History

- **AMPLE** (A llergies, M edications, P ast medical history, L ast meal or other intake, and E vents leading to presentation)

In addition to it , the clinician should seek answers to the questions below.

- **Timing of trauma ?**
- **Loss of consciousness ?**
- **Can you breathe through both sides of your nose?** Inability to do so is consistent with nasal fracture / septal hematomas .
- **Are you having any trouble speaking?**

Trismus or difficulty speaking suggests a mandibular fracture.

- **Do you have double vision or any other trouble with your vision?**
- **Hearing loss ?**

- **Are you experiencing any numbness of your face?**

Facial paresthesias can occur from a number of facial fractures. As an example, with a zygomatic fracture, a patient could experience numbness related to injury of the infraorbital nerve.

- **Have you had any previous facial injuries or surgeries, including ocular procedures to correct vision (eg, LASIK, cataract surgery)?**

Prior surgery increases the risk for ocular injuries and possible globe rupture.

- **Do your teeth come together the way they did yesterday?** Malocclusion suggests a mandibular fracture.
- **Are any of your teeth painful or loose?**

A positive response should prompt the examiner to evaluate for a mandibular alveolar injury.

- **Have you experienced any vertigo?**

Vertigo is a common symptom in a patient with blunt trauma to the head, face, or neck; but in a patient with significant facial trauma, it raises suspicion for a temporal bone fracture.

ABCD

- Airways :
- Blood and debris must be removed, and the airway secured as necessary. Manual removal of debris and aggressive suctioning with two suction devices may be necessary.
- The general indications for airway management remain unchanged in patients with facial trauma. If intubation must be performed in the field, orotracheal intubation is strongly preferred to blind nasotracheal intubation for patients with facial trauma .

Indications of definitive airway in maxillofacial injury

Absent spontaneous breathing

Comatose patient (glasgow coma scale <9)

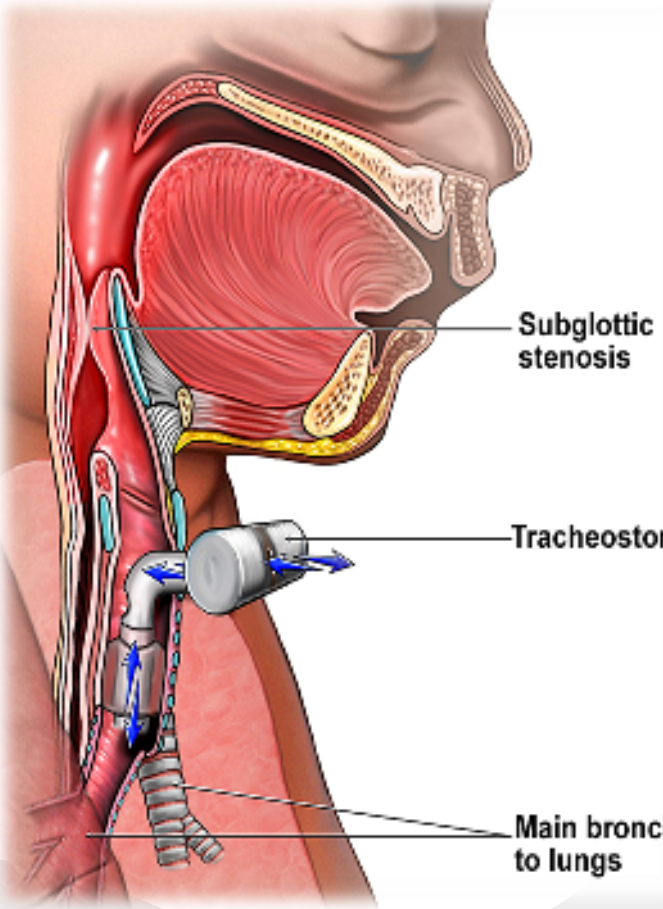
Airway injury or obstruction

Persistent oxygen saturation <90%

High-risk for aspiration

Systemic shock (systolic blood pressure <80)

"Cannot ventilate cannot intubate" situations



C- Spine

The incidence of MFI–CSI ranges from **0.8 to 12%**

TABLE 1. NEXUS Criteria for Imaging of Patients with CSI

NEXUS Criteria	Imaging Recommended
Midline cervical spine tenderness	Yes
Focal neurologic deficit	Yes
Not alert or intoxicated	Yes
Distracting injury	Yes

Circulation

***Control of severe bleeding:**

1- local pressure with dressing
90% its successful
2- clamping and ligation blood vessels
3- approximation of the wound edges.
4- packing of nasal cavity.
5- packing wounds with gauze or haemostatic material.
6- blood replacement if indicated.

Massive, uncontrollable bleeding from facial fractures **occurs rarely** .

Disability

- Alert ? Verbal and painful stimuli ? Unresponsiveness ?
- Pupil symmetry and reaction to light
- Cranial nerve examination (**motor and sensory assessment of trigeminal and motor assessment of facial**)

General examination

***Inspection** :

1-face asymmetry

2- open wounds

3-malocclusion

4-Subtle discrepancies for example: differences in the relative positions of the eyeballs may lead to the diagnosis of orbital fractures.

***Palpation** : general palpation of all face looking for any asymmetry , step off , facial instability

1-palpate for the bony prominences of the face

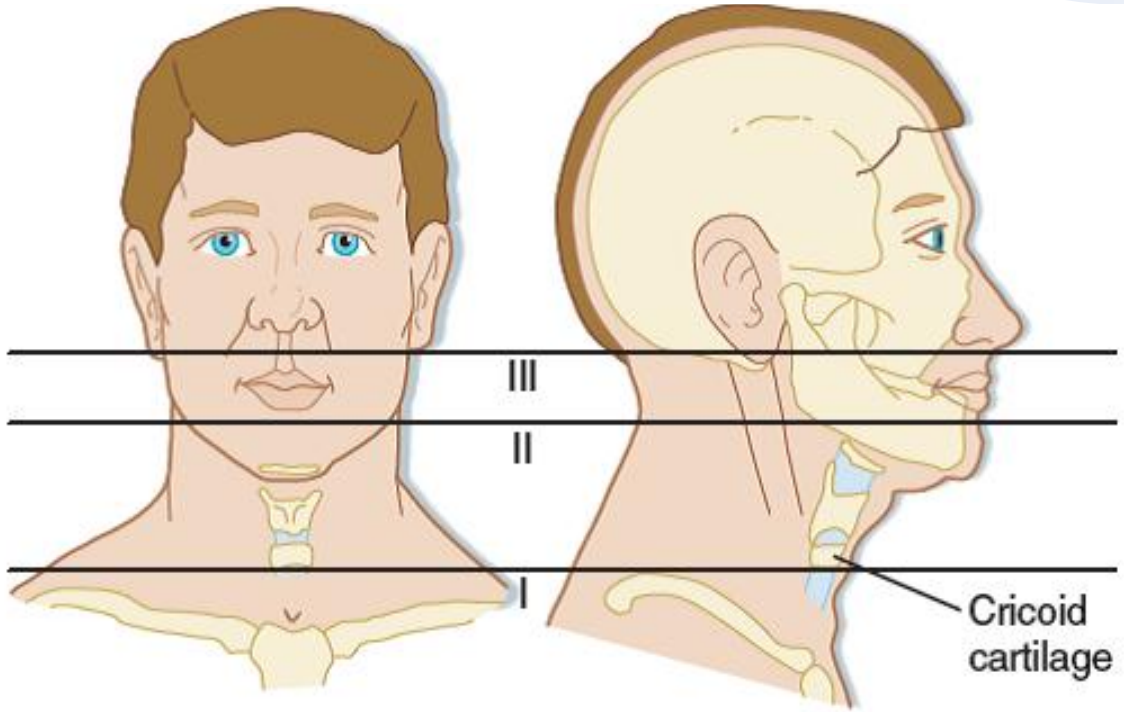
2-feeling for focal tenderness

3-step- off, crepitus

4-abnormal motion.

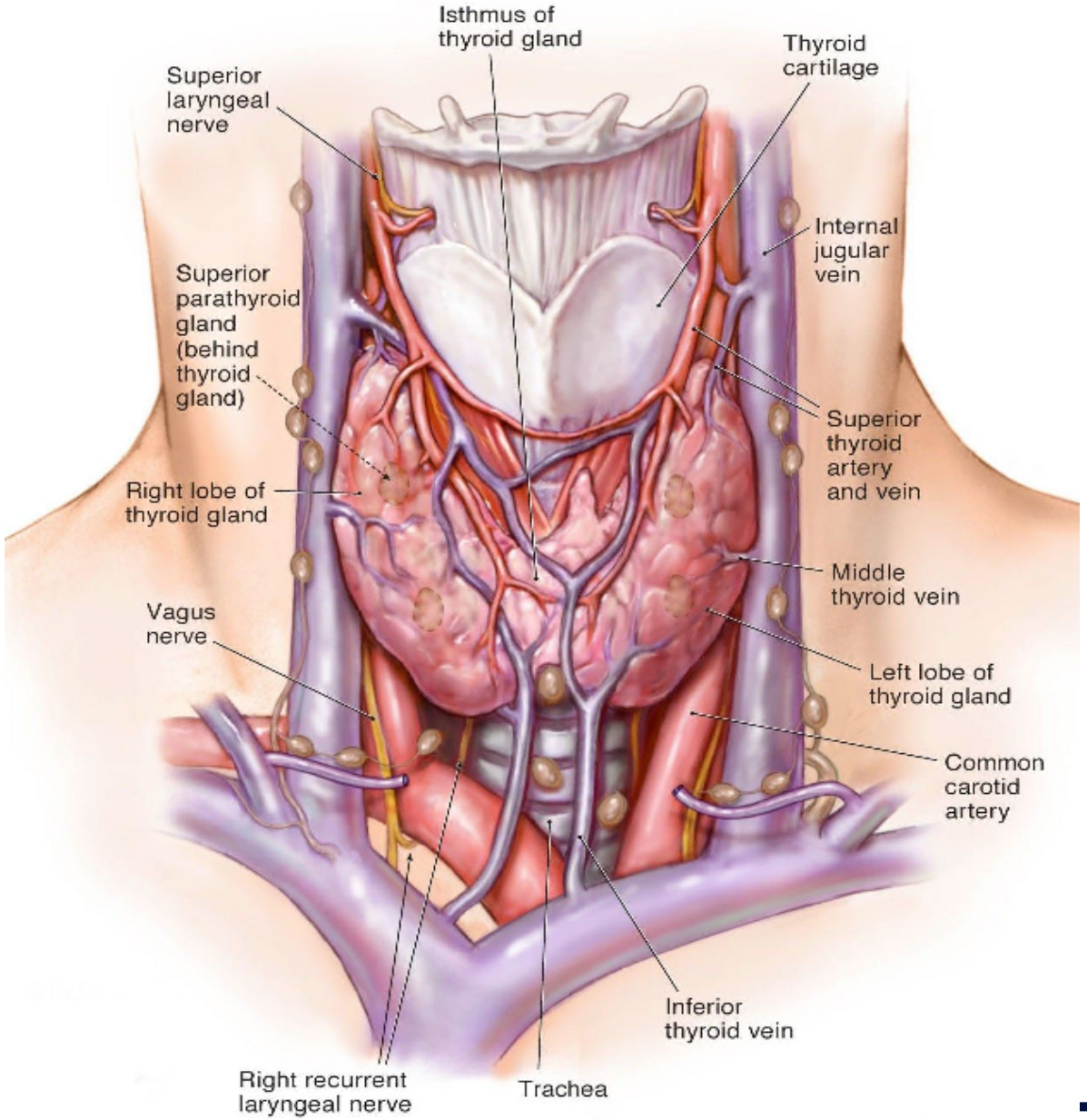
Both facial nerve motor function (CN VII) and sensation (CN V1, V2, V3) should be assessed carefully.

Neck injury



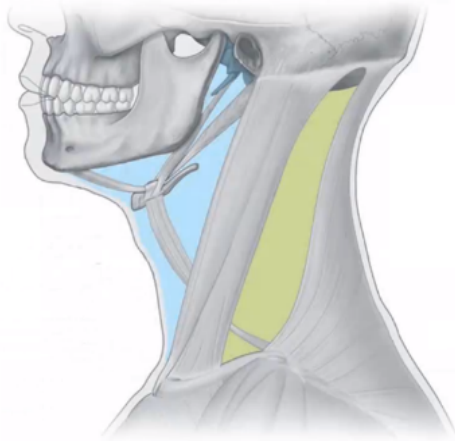
Intro

1. Neck injuries is one of the most critical injuries, Its both an inlet and an outlet containing various structures.
2. Patient may appear normal at first but deteriorate after few hours (either death, paralysis, asphyxia, ..)
3. Neck anatomy is significant to identify the location of trauma and exact place of injury to predict the damaged structure.
4. Neck is divided to Triangles. (Anterior + posterior triangles)
   anterior triangle is also is divided to 3 zones (zone 2 is the most important)
5. Most important information to ask about in a neck trauma:
   1. site
   2. type of injury (blunt/penetrating)
   3. Signs (Hard/soft)

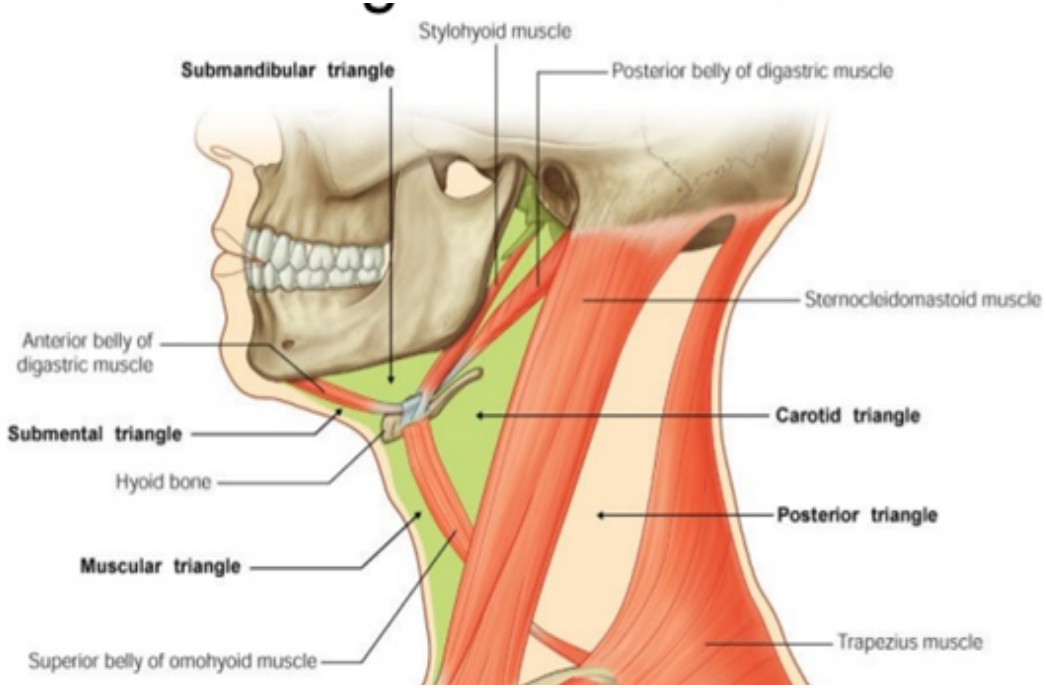

Isthmus of thyroid gland
Thyroid cartilage
Superior laryngeal nerve
Internal jugular vein
Superior parathyroid gland (behind thyroid gland)
Superior thyroid artery and vein
Right lobe of thyroid gland
Middle thyroid vein
Vagus nerve
Left lobe of thyroid gland
Common carotid artery
Inferior thyroid vein
Right recurrent laryngeal nerve
Trachea

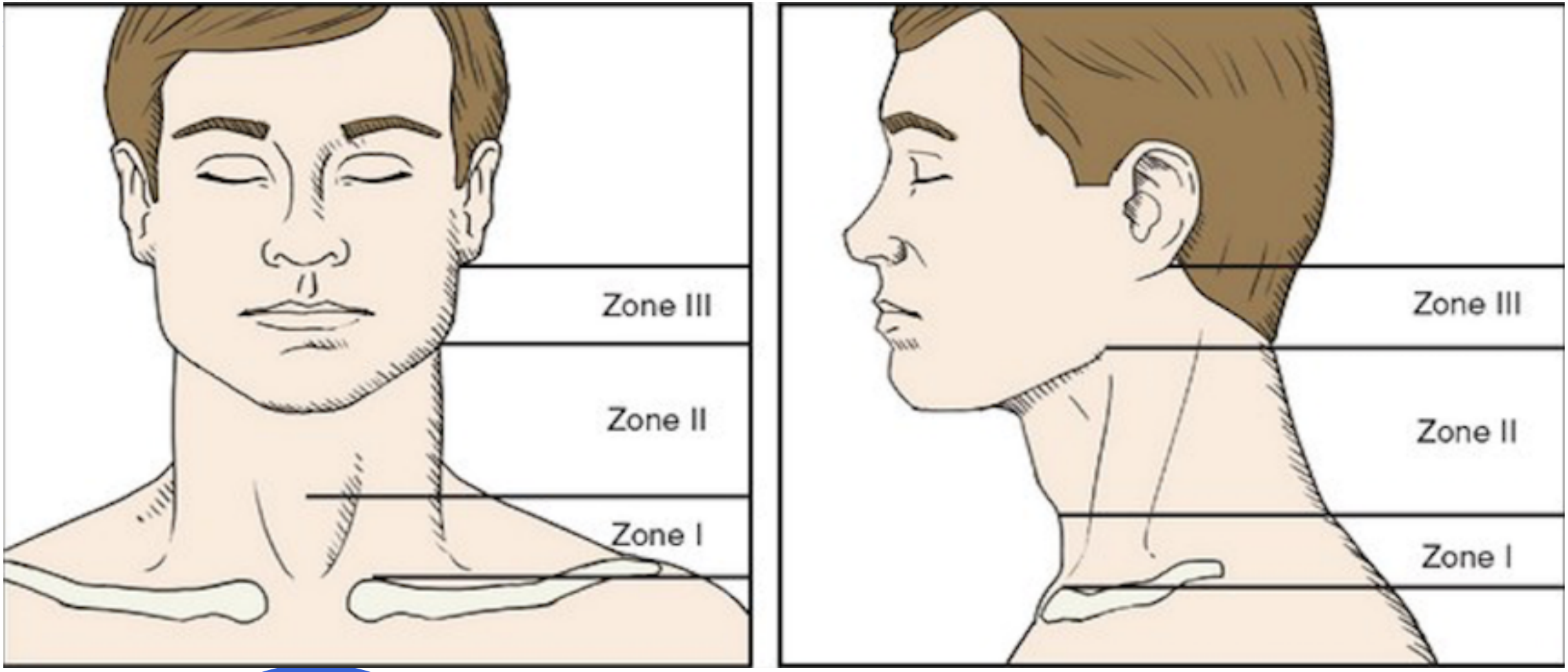
Triangles of the Neck

Two Major Triangles



- Anterior& posterior triangles separated by Sternocleidomastoid muscle.
- Posterior triangle is bordered posteriorly by Trapezius
- Boarders of anterior triangle:
  Superiorly – inferior border of the mandible.
  Laterally – anterior border of the sternocleidomastoid.
  Medially – sagittal line down the midline of the neck.
- Anterior Triangle is divided to:
  1. Submandibular triangle 2. Submental Triangle 3. Carotid 4.Muscular triangle




Zone III
Zone II
Zone I
Zone III
Zone II
Zone I

PENETRATING NECK INJURY

GUNSHOT WOUNDS

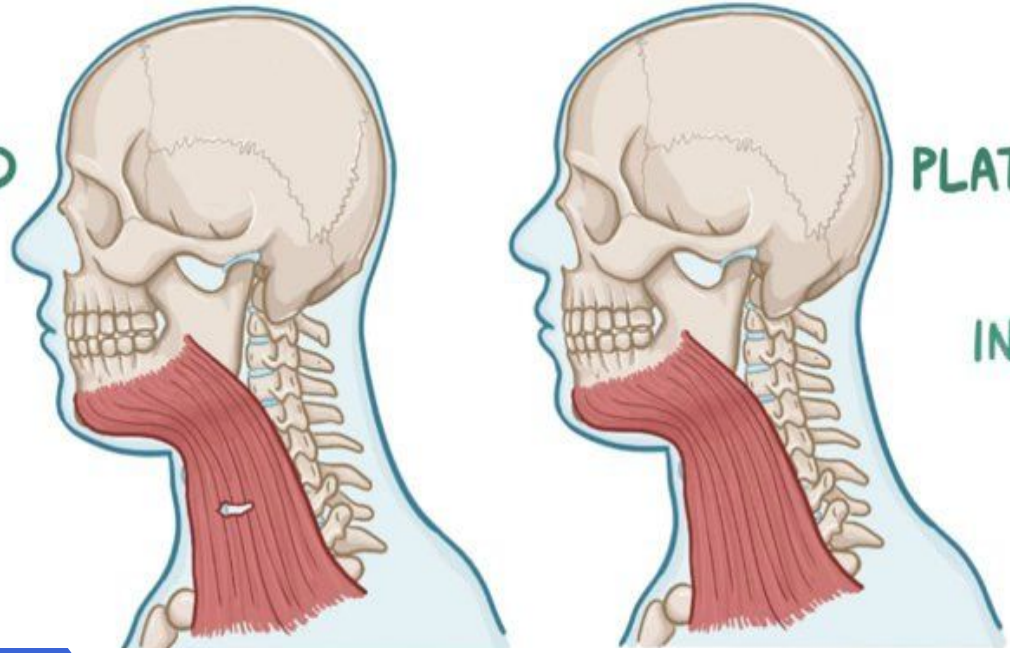
STAB WOUNDS

* PLATYSMA DEFINES INJURY *

PLATYSMA is VIOLATED

↓

INJURY to DEEP AERODIGESTIVE & NEUROVASCULAR STRUCTURES



PLATYSMA is NOT INJURED

↓

INJURY is SUPERFICIAL

Classification of penetrating neck injuries

- Injuries penetrating the platysma are classified to:

Posterior triangle

behind the posterior border of the sternocleidomastoid muscle

Anterior triangle

in front of the anterior border of the sternocleidomastoid muscle

- The anterior triangle is subdivided into zone I, zone II and zone III
  - Zone I- below a horizontal line at the level of cricoid cartilage
  - Zone III- above the angle of mandible
  - Zone II lies in between

Hard Signs	Soft Signs
Airway Compromise	Hemoptysis
Expanding or Pulsatile Hematoma	Oropharyngeal Blood
Active, Brisk Bleeding	Dyspnea
Hemorrhagic Shock	Dysphagia
Hematemesis	Dysphonia
Neurologic Deficit	Nonexpanding Hematoma
Massive Subcutaneous Emphysema	Chest Tube Air Leak
Air Bubbling Through Wound	Subcutaneous or Mediastinal Air
	Vascular Bruit or Thrill
	Crepitus

Primary survey

assessment and management of neck injuries is done according to ATLS primary survey principles

Airway

- Airway compromise may be directly due to injury or blood; or secondary, e.g. oedema associated with a haematoma, or vocal cord paralysis secondary to injury to the recurrent laryngeal nerve.
- If the airway is compromised, oral intubation should be attempted whenever possible but facilities to perform an emergency surgical airway procedure must be present.
- If there is an obvious open injury to the airway, it is better to consider tracheostomy as soon as possible.

Primary survey-ATLS (cont)

Breathing

- The apex of the lung may be involved when a neck wound is present.
- Always do a chest X-Ray to check for a haemo- or pneumothorax.

Circulation

- Vascular injuries may present as neurological complications, e.g. neurological fallout in the distribution of the middle cerebral artery may be secondary to a carotid artery injury.
- A high-flow intravenous line should be set up. Intravenous lines should be avoided in the arm on the side of the neck wound.
- Active external bleeding can be controlled by external digital pressure or by inflating the bulb of a Foley's catheter that has been carefully inserted as deep as possible into the wound. This is an emergency measure that provides temporary control until surgery can be done.

Investigation

- **Chest X-ray**
  - Essential in all patients with neck injuries.
  - Do not sit patient up; if there is an open wound, it may cause a fatal air embolism or complicate a cervical spine injury.

- **Cervical spine X-ray**
  - Look for the presence of fractures, foreign bodies, or air in soft tissues.

- **CT scan or CT angiography**
  - In the stable patient, a spiral CT scan (if available) with intravenous contrast will provide information on soft tissue, bony structures, wound trajectory, and vascular injuries.
  - Specifically look out for intimal injuries of the carotids.
  - Oral contrast can be given if required to identify leaks.

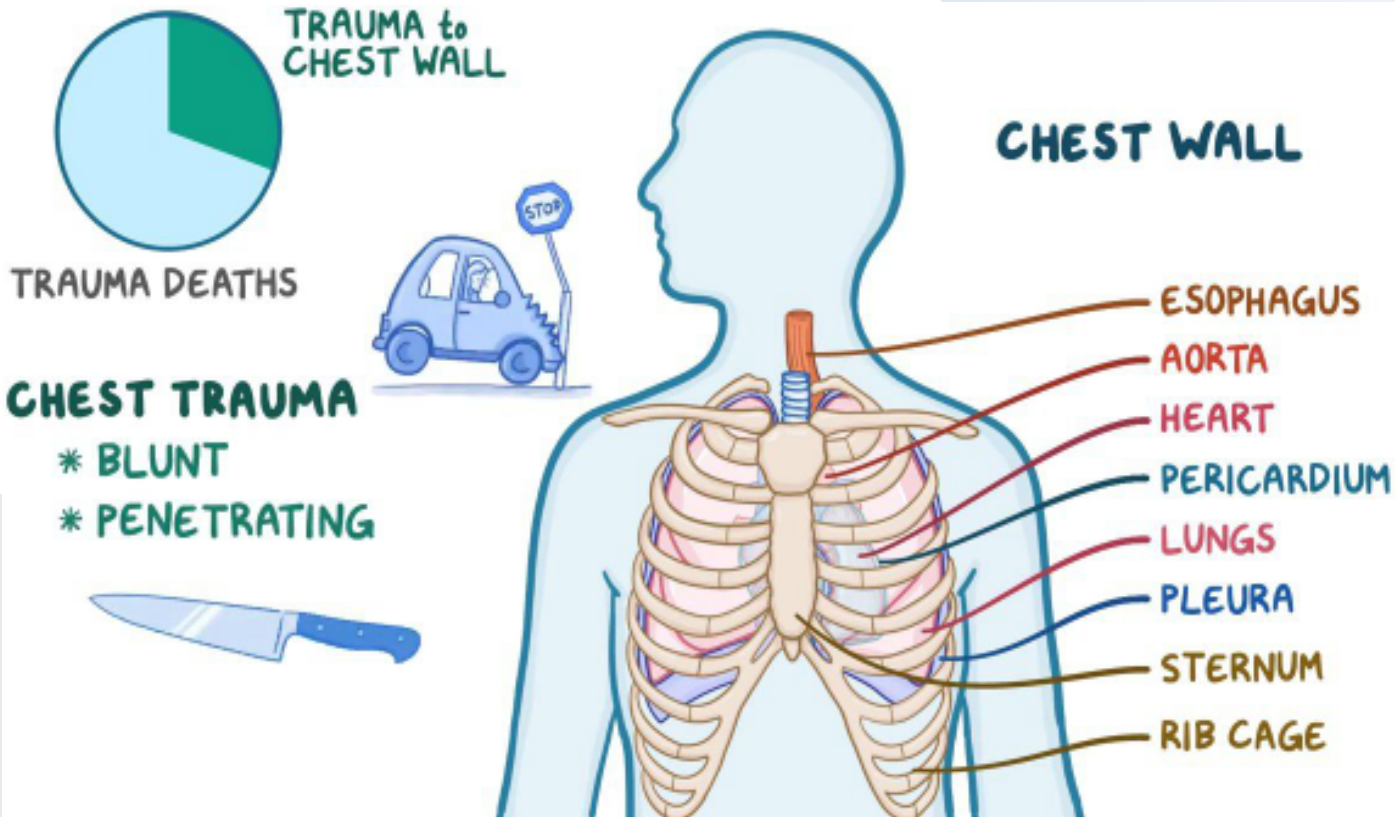
- **Color Flow Doppler (CFD)**
  - Color flow Doppler has been suggested as a reliable alternative to angiography in the evaluation of PNI.

Management

- Consider early intubation or surgical airway
- If all the investigations are normal, the patient may be observed over-night and **discharged home** if there is no deterioration.
- A hemothorax should be managed accordingly.
- If the patient is bleeding or airway compromised or investigations are abnormal, **immediate surgical intervention** is required.
- Small pharyngeal and tracheal injuries can be treated **conservatively**

Group	Symptoms	Sign	Management
Group 1	Minor airway symptoms	Minor hematomas Small Lacerations No detectable fractures	Observation Humidified air Head of bed elevation
Group 2	Airway compromise	Edema/hematoma Minor mucosal disruption No cartilage exposur	Tracheostomy Direct laryngoscopy Esophagoscopy
Group 3	Airway compromise	Massive edema Mucosal tears Exposed cartilage Vocal cord immobility	Tracheostomy Direct laryngoscopy Esophagoscopy **Exploration/repair** **No stent necessary**
Group 4	Airway compromise	Massive edema Mucosal tears Exposed cartilage Vocal cord immobility	Tracheostomy Direct laryngoscopy Esophagoscopy Exploration/repair **Stent required**

Thoracic Trauma



Types of trauma

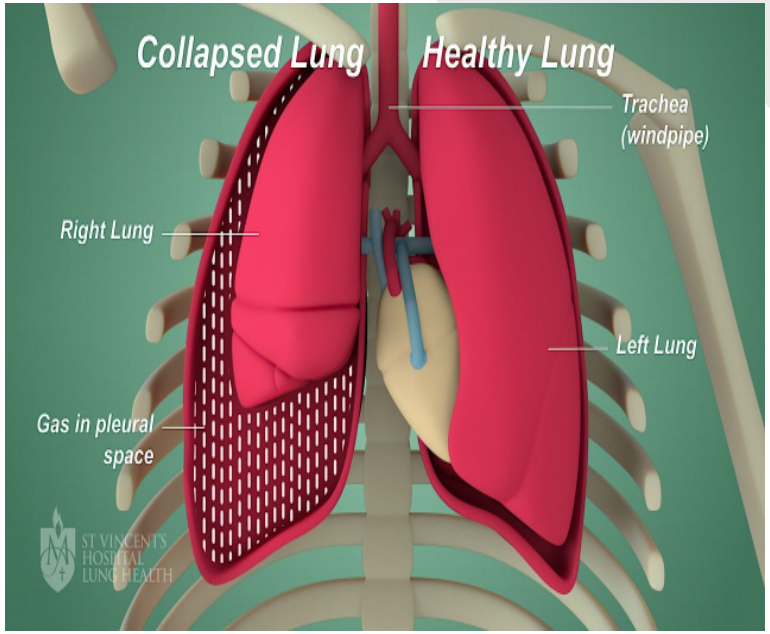
- A- Blunt trauma: non-penetrating, such as car accidents.
- B- Penetrating trauma: (pleura is injured)

Epidemiology

- The most common injuries from both blunt and penetrating thoracic trauma are hemothorax and pneumothorax. More than 85% of patients can be definitively treated with a chest tube.
- Emergent thoracotomy may required, with certain indications
- Great Vessels, Over 90% of thoracic great vessel injuries are due to penetrating trauma. although blunt injury to the innominate, subclavian, or descending aorta may cause a pseudoaneurysm or frank rupture.

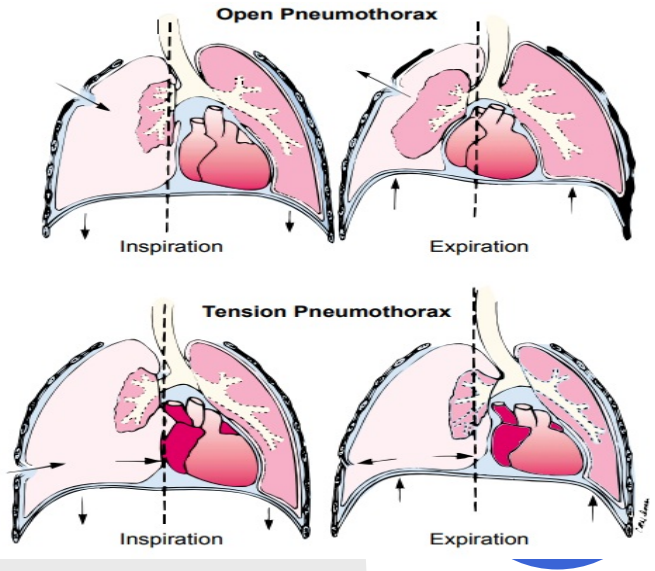
Pneumothorax

- the presence of air or gas in the pleural cavity, which can impair oxygenation or ventilation



Pathological types

- Closed (simple) pneumothorax.
- Open pneumothorax.
- Tension pneumothorax.



Tension pneumothorax

- A tension pneumothorax is a life-threatening condition that develops when air is trapped in the pleural cavity under positive pressure, displacing mediastinal structures and compromising cardiopulmonary function.

- Tension pneumothorax is a clinical diagnosis rather than a radiologic diagnosis.

- Immediate decompression of the thorax is mandatory when tension pneumothorax is suspected. This should not be delayed for radiographic confirmation.

Clinical presentation

- Signs:

-**Inspection**: - decreased movements at the affected side.

-**Palpation**: diminished movements, decreased TVF, but there is NO mediastinal shift in closed pneumothorax.

- **Percussion**: Hyper-resonance.

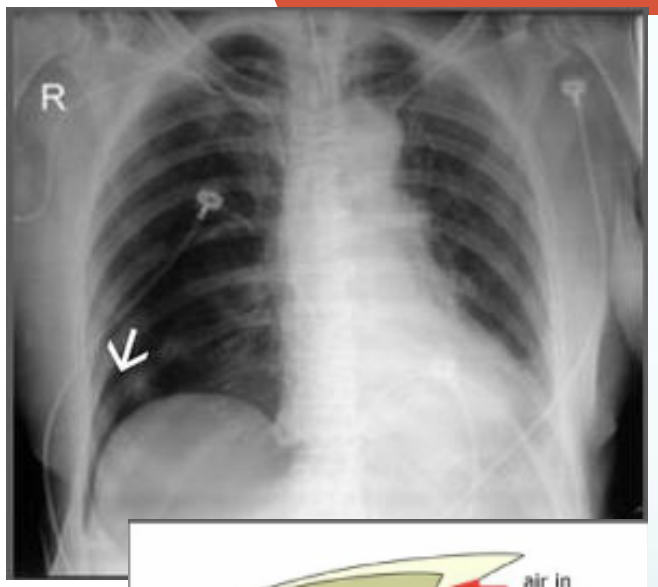
- **Auscultation**: decressed air entry.

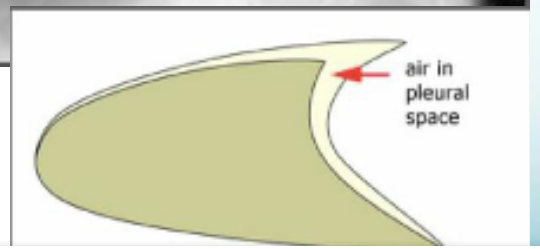
(Tachycardia, Hypotension, Jugular venous distention, Cardiac apical displacement are findings seen in tension pneumothorax).

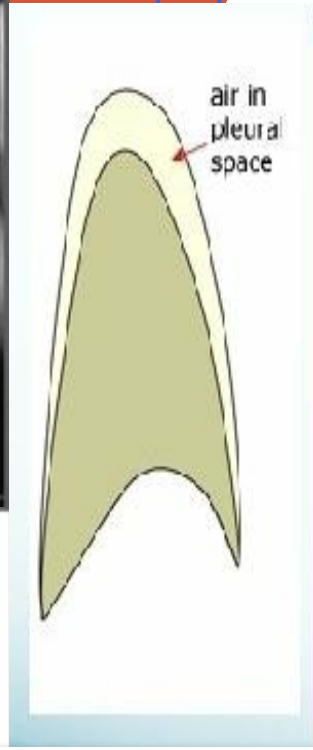
Diagnosis

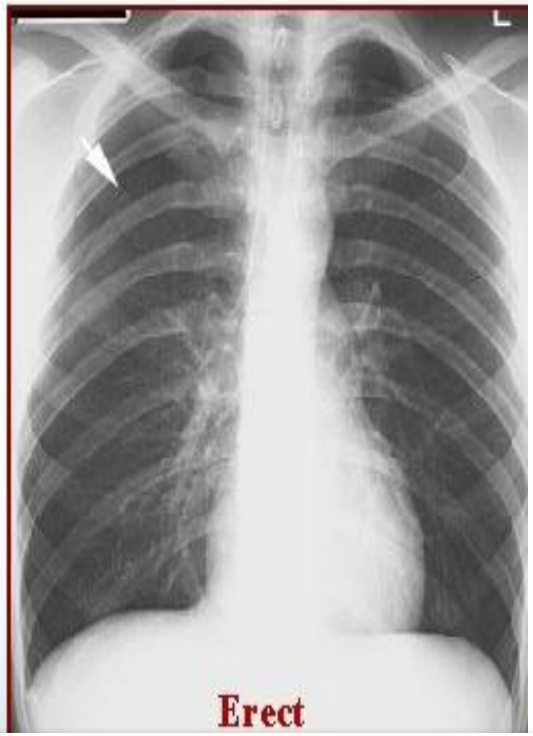
- Chest X ray
- decreased lung markings extending to the chest wall and the lung border may be visible.
- A CT scan
- It is not always necessary, but is another modality available to diagnose a pneumothorax.
- A CT can be more accurate than a chest x-ray, especially for a small pneumothorax. They may also be necessary to better evaluate underlying lung pathology.

Supine vs erect CXR

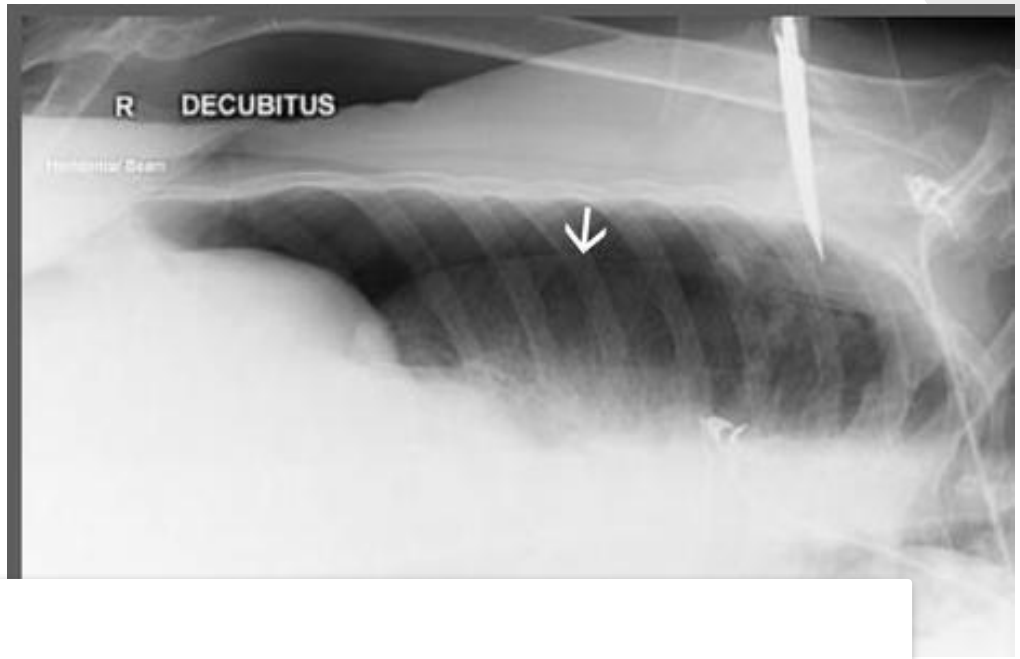








Lateral decubitus

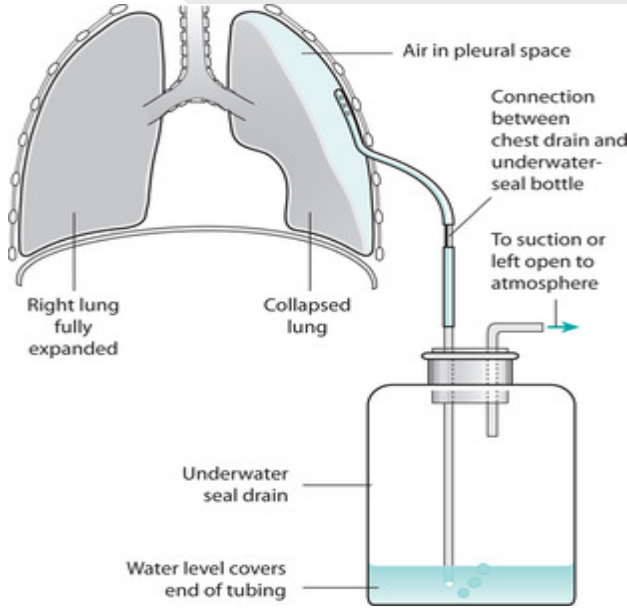


- Findings

- ipsilateral lung collapse at the hilum
- increased thoracic volume
- trachea and mediastinum deviation to the contralateral side
- widened intercostal spaces on the affected side

Treatment

- **immediate** needle thoracostomy decompression with a 14-gauge angiocatheter in the second intercostal space in the midclavicular line may be indicated in the field, tube thoracostomy should be performed immediately in the ED before a chest radiograph is obtained.
- Definitive management is chest tube in the 5th intercostal space anterior axillary line .
- Patients with persistent pneumothorax, large air leaks after tube thoracostomy, or difficulty ventilating should undergo fiber-optic bronchoscopy to exclude a tracheobronchial injury or presence of a foreign body.

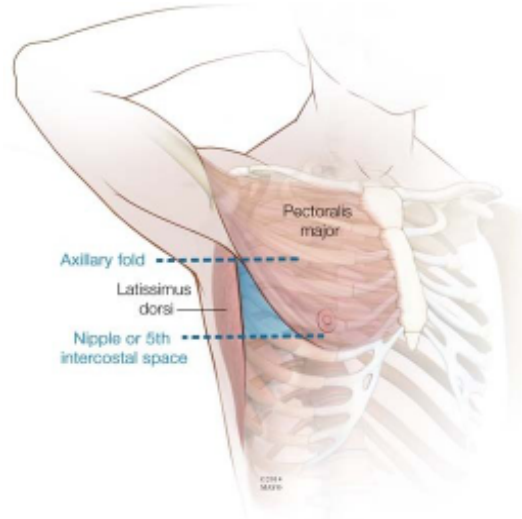


Needle Decompression:

- Use a large-bore, 14- to 16-gauge angiocatheter.
- Insert it in the anterior second intercostal space (midclavicular line) or fifth intercostal space (midaxillary line).

Chest Tube Placement:

- If chest tube available promptly, no need for needle decompression.
- Place it in the zone of safety outlined by pectoralis major lateral border, nipple line (men).



Open pneumothorax

- also known as a sucking chest wound, occurs when there is a loss of a portion of the chest wall, leading to a disruption of the normal negative pressure in the pleural space. This condition is often caused by high-velocity bullets or close-range shotgun blasts. The loss of negative pressure prevents the lung from expanding properly, resulting in difficulty with ventilation.

Temporary Treatment During Transport:

As a temporary measure, especially during transport, a partially occluding dressing can be applied. This dressing is sealed in a way that allows air to escape from a corner, while preventing atmospheric air from entering the pleural space. This dressing helps to manage the situation until definitive treatment can be performed.

Definitive Treatment in Trauma Operating Room:

Upon reaching the trauma bay or operating room, the trauma surgeon's primary goal is to close the chest wall defect. This closure is essential for restoring negative pressure within the pleural space. To facilitate lung reexpansion, a chest tube is placed in a separate space, allowing the creation of the necessary negative pressure.

Massive Hemothorax

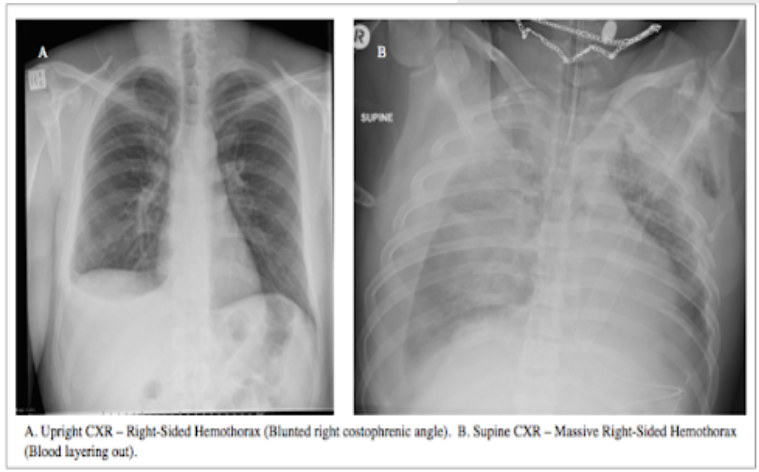
is a medical condition characterized by the accumulation of blood in the pleural cavity, the space between the lungs and the chest wall.

- **Hemodynamic changes** vary, depending on the amount of bleeding and the rapidity of blood loss. Blood loss of up to 750 mL in a 70-kg man should cause no significant hemodynamic change. Loss of 750-1500 mL in the same individual will cause the early symptoms of shock (ie, tachycardia, tachypnea, and a decrease in pulse pressure).
- Significant signs of shock with signs of poor perfusion occur with loss of blood volume of 30% or more (1500-2000 mL).
- The volume of blood required to produce **respiratory** symptoms in a given individual varies depending on a number of factors, including organs injured, severity of injury, and underlying pulmonary and cardiac reserve.

Sources of bleeding
1) Intercostal vessels
2) Internal mammary artery
3) Pulmonary parenchymal injuries
4) Major pulmonary vessels
5) Injury to the heart or great vessels

- Diagnosis :Chest pain and dyspnea are common symptoms. Symptoms and physical findings associated with hemothorax in trauma vary widely, depending on the amount and rapidity of bleeding, the existence and severity of underlying pulmonary disease, the nature and degree of associated injuries.

- Tachypnea is common; shallow breaths may be noted. Findings include diminished ipsilateral breath sounds and a dull percussion note// sign and symptoms of shock depends on the amount of blood loss



A. Upright CXR – Right-Sided Hemothorax (Blunted right costophrenic angle). B. Supine CXR – Massive Right-Sided Hemothorax (Blood layering out).

CT shows a right sided hemothorax related to fracture of 10th rib posteriorly.

- Blood in the pleural space should be removed as completely and rapidly as possible to prevent ongoing bleeding, an empyema or fibrothorax later.

The initial treatment consists of

- correcting the hypovolaemic shock,
- insertion of an intercostal drain
- and, in some cases, intubation.

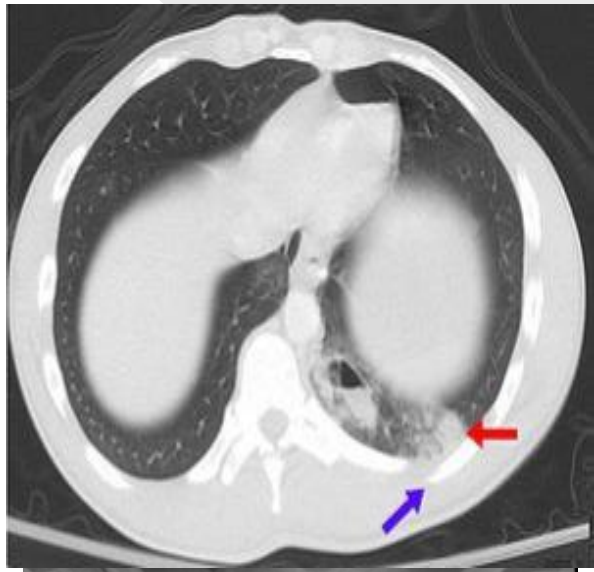
- Initial drainage of more than 1500 mL of blood or ongoing haemorrhage of more than 200 mL/h over 3–4 hours is generally considered an indication for urgent exploratory thoracotomy. Thoracotomy is also indicated when there is progressive opacification on chest X-ray that is consistent with findings of progressive hemothorax on examination.

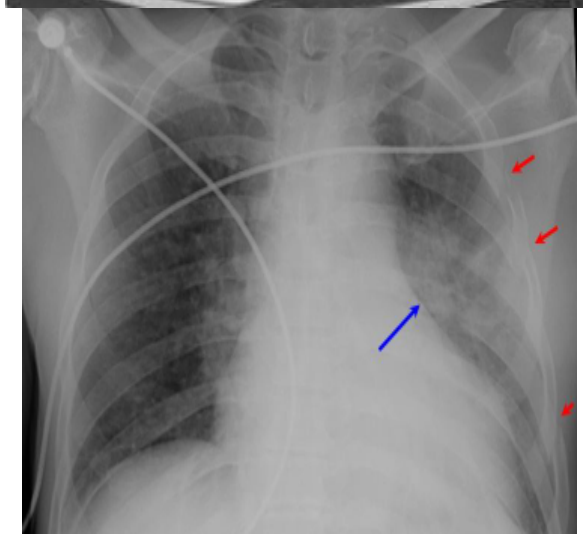
Pulmonary contusion

Hemorrhage into the alveolar and interstitial spaces.

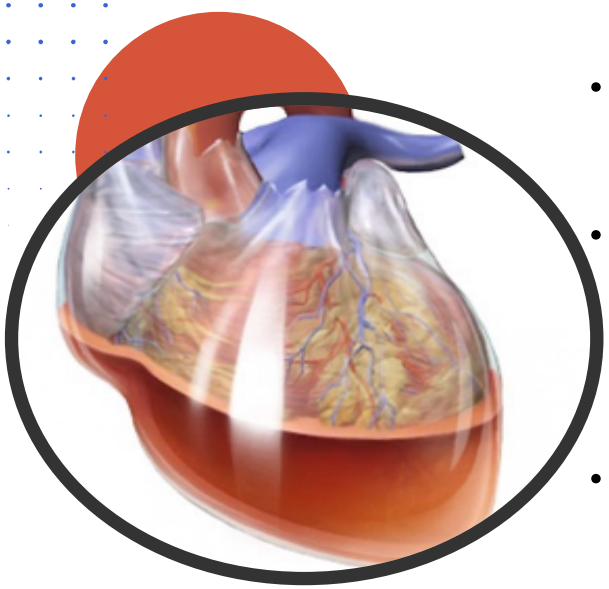
- **Pulmonary contusion** is a bruise of the lung, caused by chest trauma.
- **Pulmonary laceration** is a chest injury in which lung tissue is torn or cut. An injury that is potentially more serious than pulmonary contusion, pulmonary laceration involves disruption of the architecture of the lung.
- **Dx** :by CXR

Tx: Can often be treated with just supplemental oxygen, ventilation, and drainage of fluids from the chest cavity





Pericardial tamponade

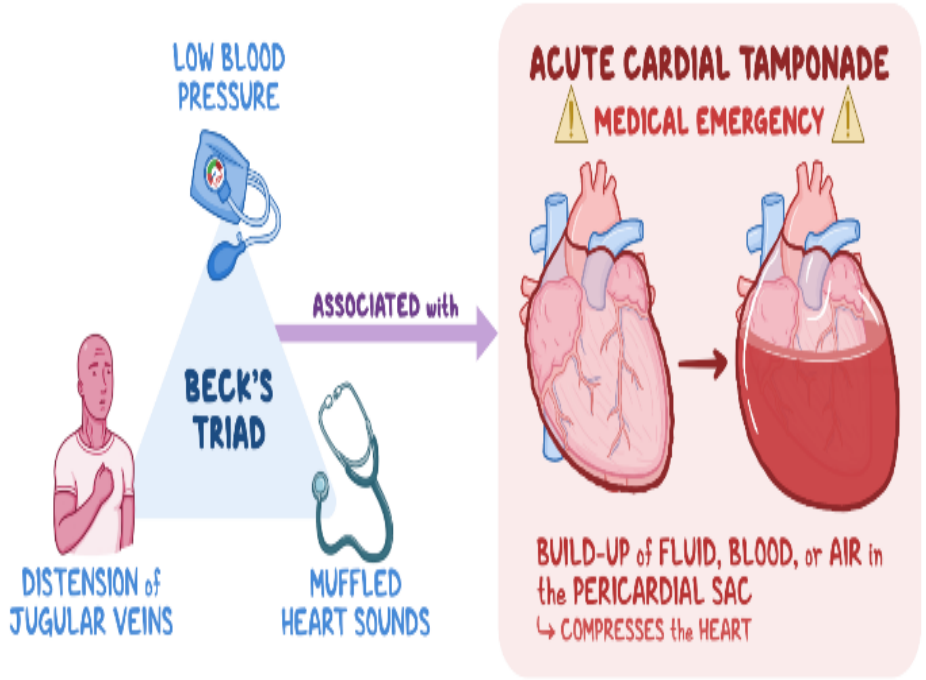


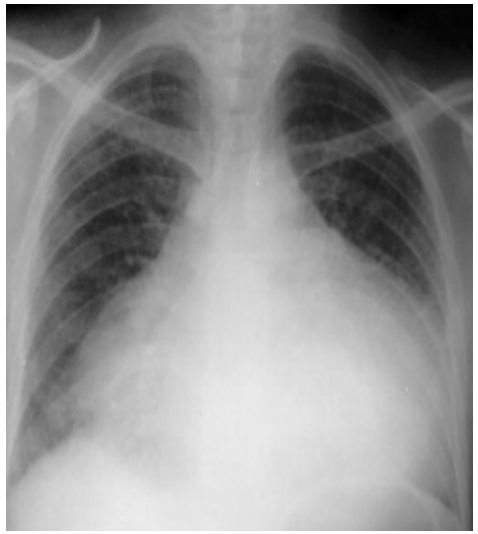
- Cardiac tamponade life threatening injury, occurs most commonly after penetrating thoracic wounds.
- Acutely<100ml of blood in pericardial area causes tamponade

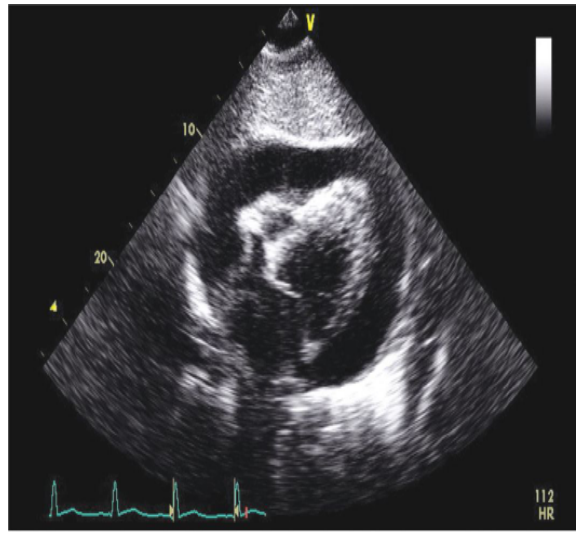
Clinically manifest by classical becks triad (hypotension , distended neck veins and muffled heart sounds)

- the pressure in the pericardial sac will rise to match that of the injured chamber. When this pressure exceeds that of the right atrium, right atrial filling is impaired and right ventricular preload is reduced. This ultimately leads to decreased right ventricular output. Additionally, increased intrapericardial pressure impedes myocardial blood flow, which leads to subendocardial ischemia and a further reduction in cardiac output.

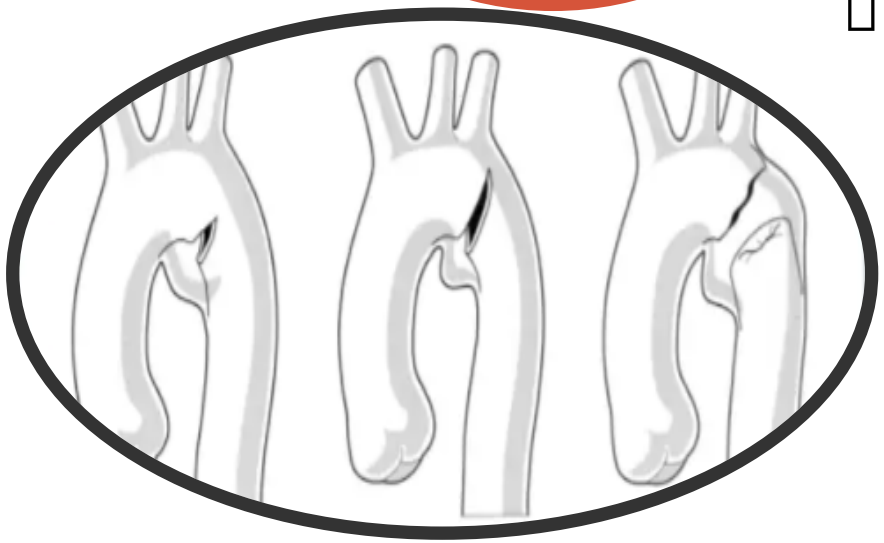
- diagnosis of hemopericardium is best achieved by bedside ultrasound of the pericardium. Clinically: becks triad+ intial improvement of hypovolemia with fluid administration due to increased central venous pressure followed by deterioration.
- Management : patients with any hemodynamic disturbance, emergent pericardiocentesis then a pericardial drain is placed using ultrasound guidance . Removing as little as 15 to 20 mL of blood will often temporarily stabilize the patient's hemodynamic status.
- Patients with a SBP <60 mm Hg warrant resuscitative thoracotomy (RT) with opening of the pericardium for rapid decompression and to address the injury







Thoracic aortic disruption



- Traumatic aortic rupture is a common cause of sudden death after an automobile accident or fall from a great height. The vessel is relatively fixed distal to the ligamentum arteriosum, just distal to the origin of the left subclavian artery. The shear forces from a sudden impact disrupt the intima and media.

Aortic disruption should be clinically suspected in

1)patients with gross asymmetry in systolic blood pressure (between the two upper limbs, or between upper and lower limbs)

2)widened pulse pressure

3)chest wall contusion.

- Erect chest radiography can also suggest thoracic aortic disruption, the most common radiological finding being a widened mediastinum
- The diagnosis is confirmed by a CT scan of the mediastinum, or possibly by transoesophageal echocardiography, in unstable patients who cannot be moved to the scanner

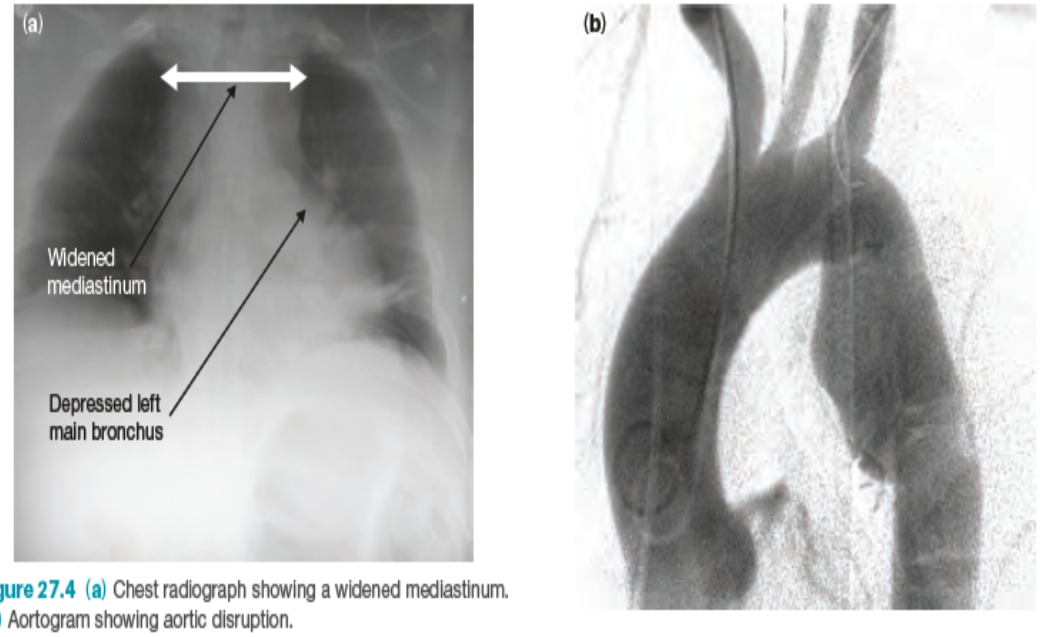


Figure 27.4 (a) Chest radiograph showing a widened mediastinum. (b) Aortogram showing aortic disruption.

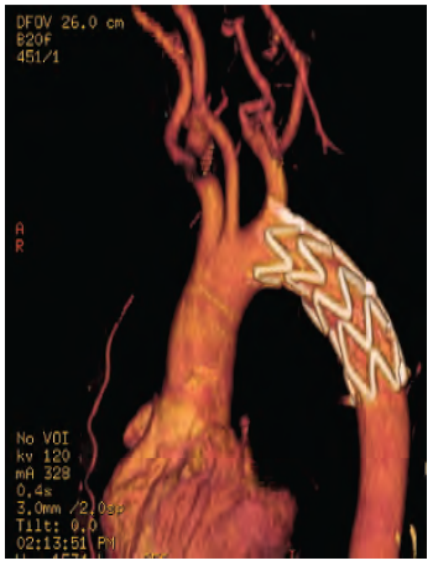
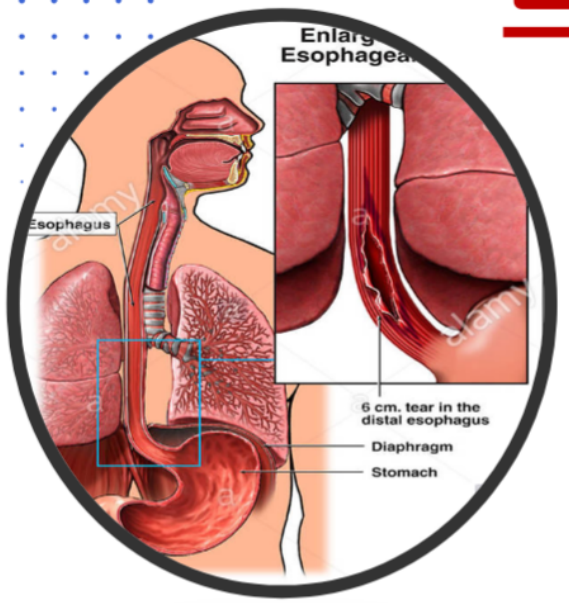


Figure 27.6 Aortic tear showing the presence of a stent.

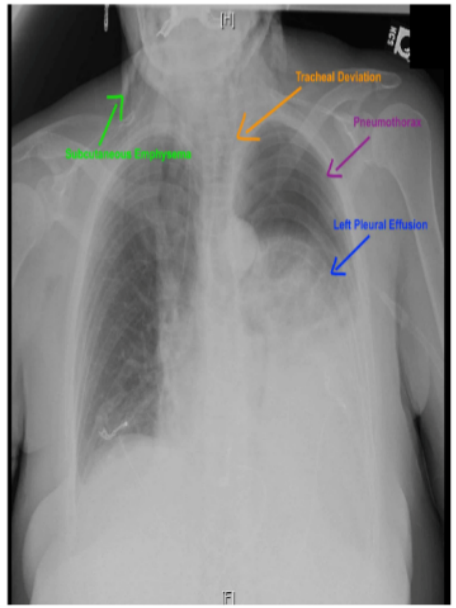
- Initially, management consists of control of the systolic arterial blood pressure (to less than 120 mmHg). Thereafter, an endovascular intra-aortic stent can be placed, or the tear can be operatively repaired by direct repair or excision and grafting using a Dacron graft.

Esophageal Rupture



- Most esophageal injuries result from penetrating trauma; blunt injury is rare.
- The concern with esophageal rupture is the development of mediastinitis and septic shock secondary to invasion of bacteria from the esophagus into the mediastinum and so pleural effusion and pneumothorax may develop, causing pnuemohydrothorax.

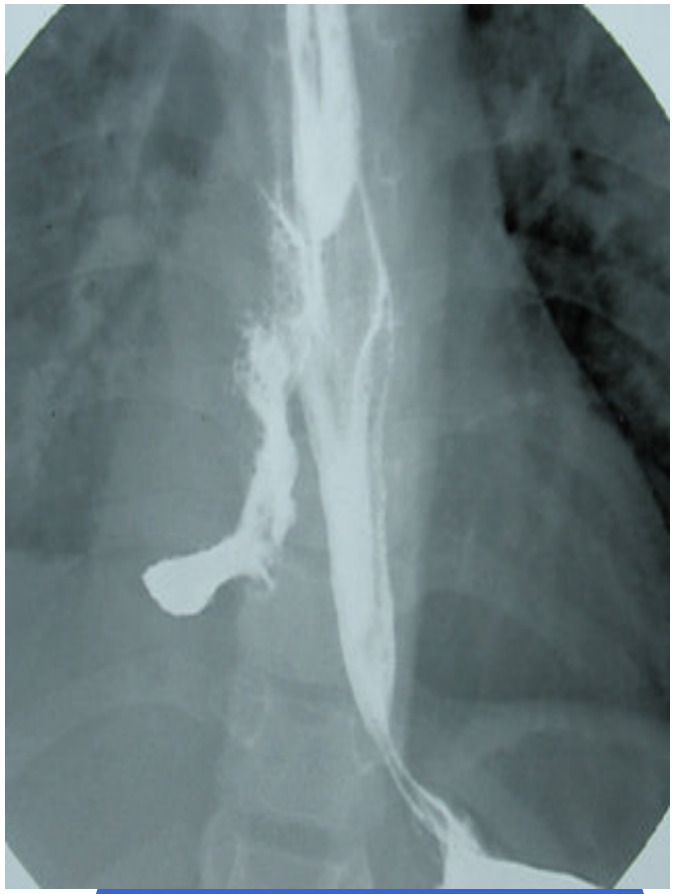
Dissection of air from the esophagus through the soft tissues can cause subcutaneous (surgical) or mediastinal emphysema, especially when the cervical esophagus is involved.
The patient can present with: shock, dyspnea, cyanosis and history may reveal the presence of sudden severe epigastric, chest, or lower back pain.

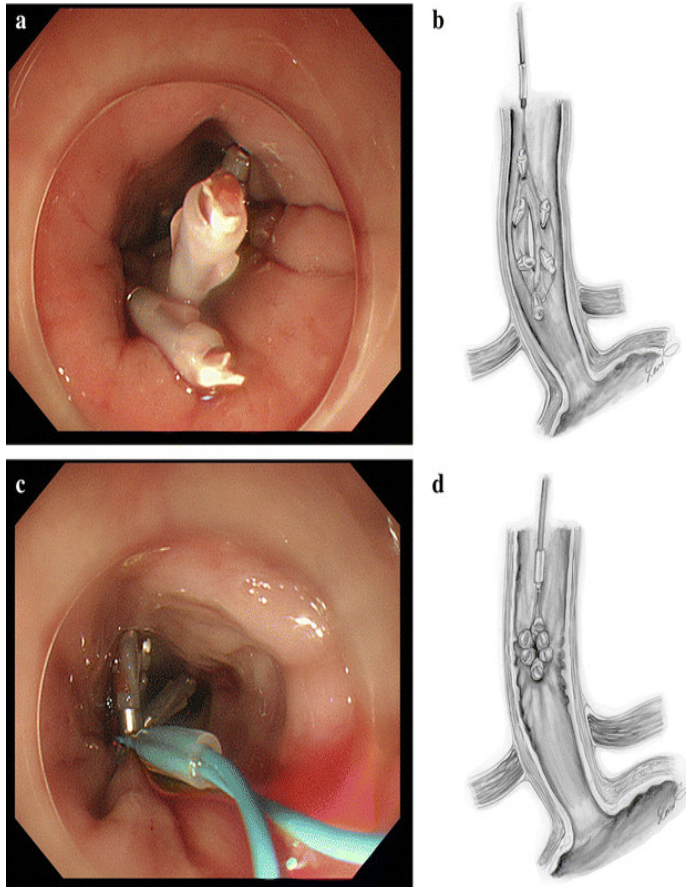


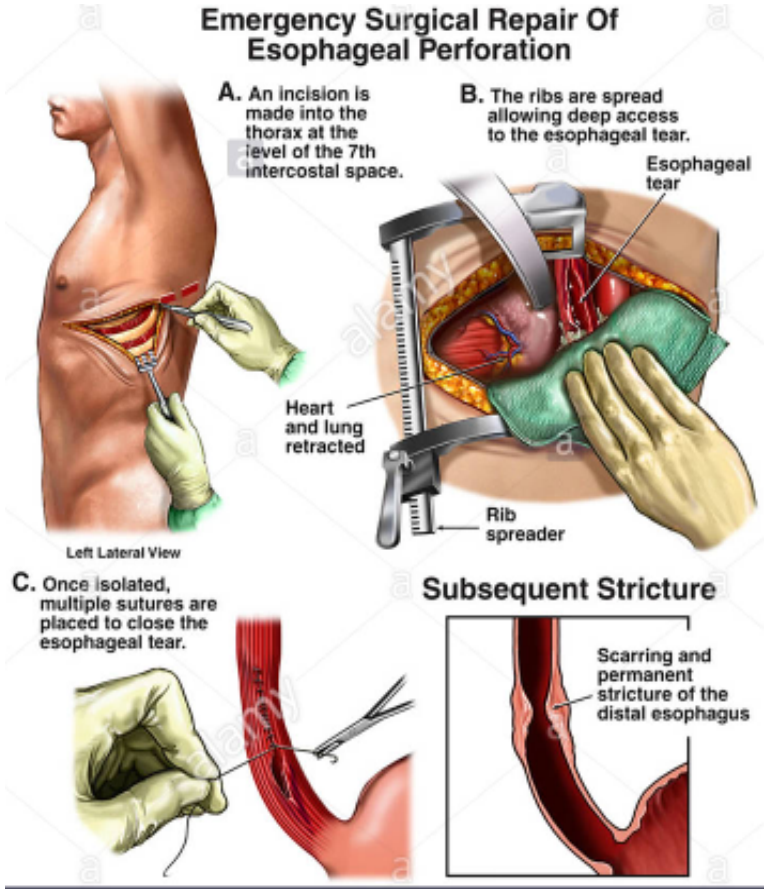
On examination subcutaneous emphysema may be evident which may give rise to crackling sensation over gas containing tissue.

- Mediastinal and deep cervical emphysema are evidence of an aerodigestive injury until proven otherwise.

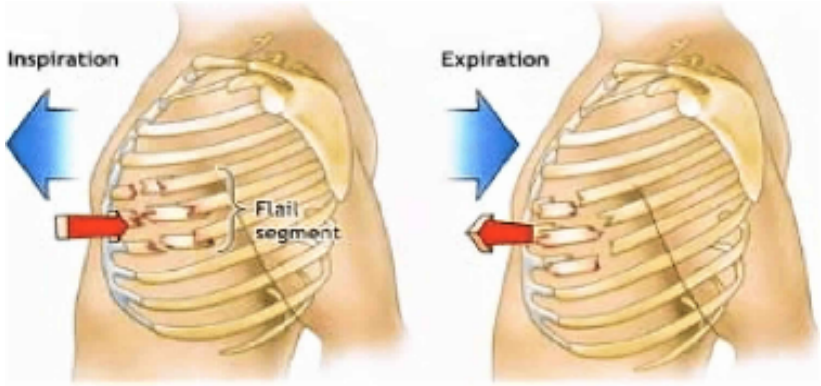
- The mortality rate rises exponentially if treatment is delayed.
- A combination of esophagogram in the decubitus position and esophagoscopy confirm the diagnosis in the majority of cases.
- Treatment involves resuscitation (the patient should be kept NPO), antibiotics, treatment of pneumothorax a surgical closure of the defect and drainage

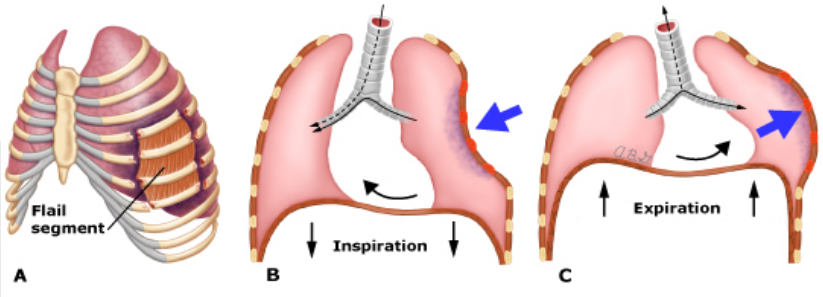






Flail chest





Flail chest occurs when three or more contiguous ribs are fractured in at least two locations.

Paradoxical movement of this free-floating segment of chest wall is usually evident in patients with spontaneous ventilation, it rarely results in respiratory compromise. Instead, it is the decreased compliance and increased shunt fraction caused by the associated pulmonary contusion that is the source of acute respiratory failure. Pulmonary contusion often progresses during the first 12 hours.

No emergent intervention is needed, close monitoring of the patient .

oxygen administration, adequate analgesia (including opiates) and physiotherapy

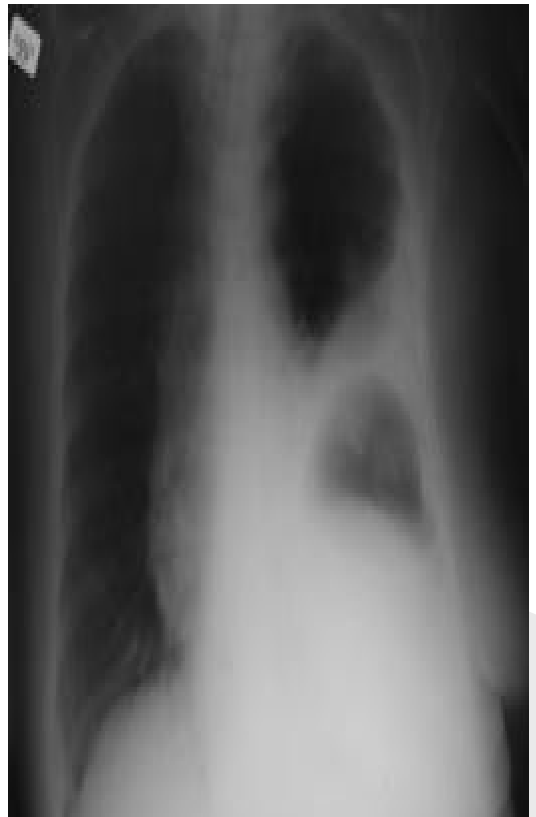
Surgery to stabilise the fail segment using internal fxation of the ribs may be useful in a selected group of patients with isolated or severe chest injury and pulmonary contusion

Diaphragmatic injury

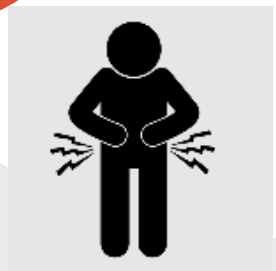
- The left hemidiaphragm is involved in 65% to 80% of cases.
- **Blunt > Penetrating**
- These injuries do not heal spontaneously and can produce herniation ,so need operative repair when diagnosed

- Diagnosis
- CXR is diagnostic in only 25% to 50% of cases of blunt trauma.
- Possible **findings** include:
  - Hemidiaphragmatic elevation.
  - Stomach, colon, or small bowel in chest.
- CT scan may miss diaphragmatic injury in the absence of gross hollow visceral herniation.

- Direct visualization of the injury by laparotomy, laparoscopy, or thoracoscopy remains the **gold standard for diagnosis.**

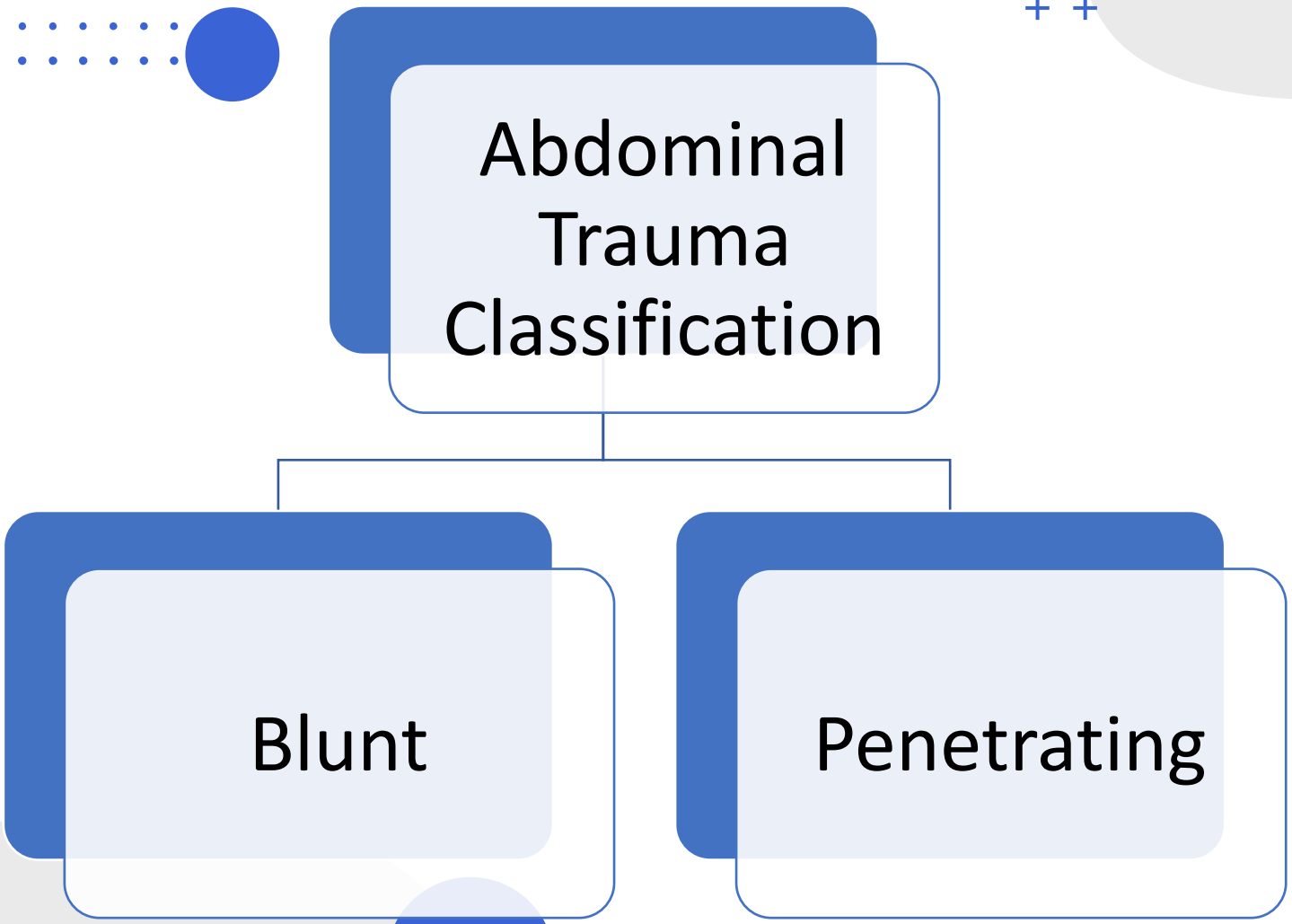


Abdominal Trauma

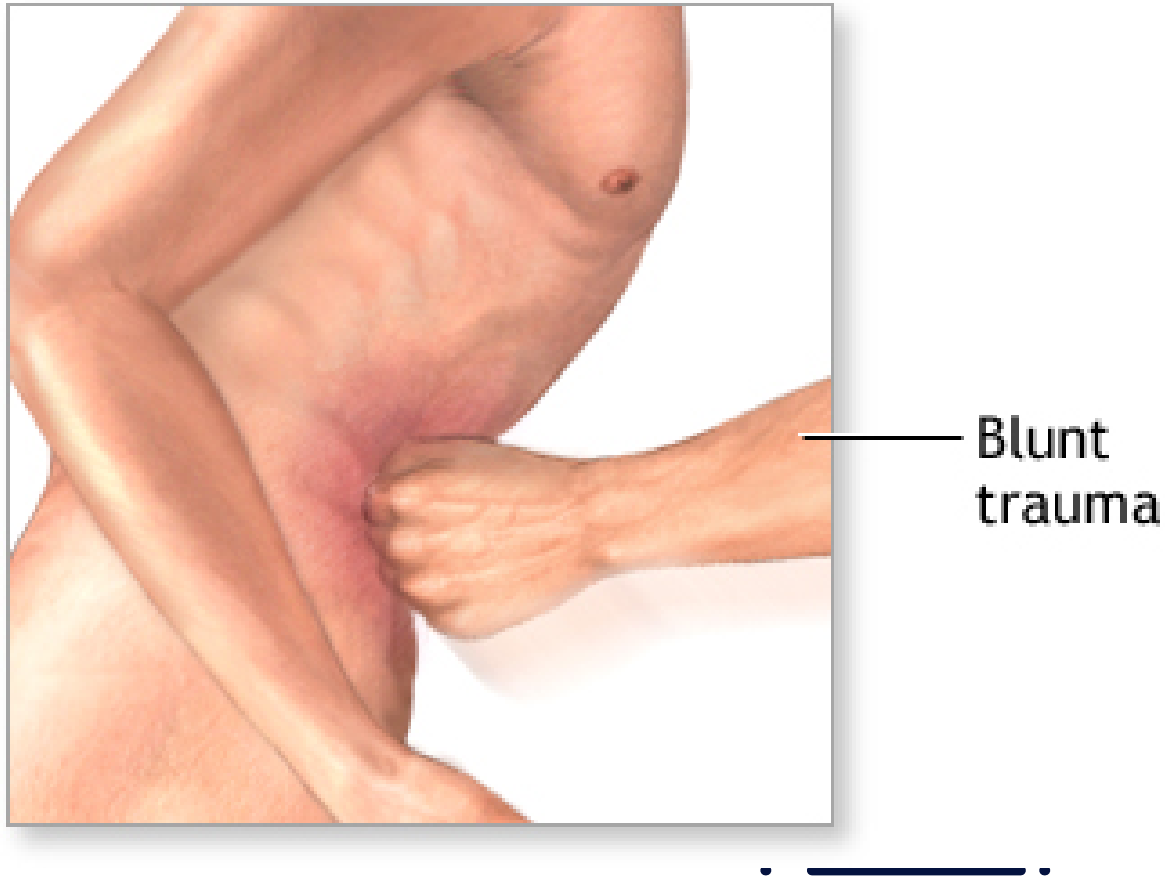


The abdomen remains a high-risk cavity with the potential to hide occult but life-threatening injuries.

Unlike the extremity or neck for example, where bleeding occurs externally, for the abdomen, significant bleeding and enteric spillage can occur with minimal symptoms until late.


Abdominal Trauma Classification
Blunt
Penetrating

A sudden and pronounced rise in intra-abdominal pressure created by outward forces

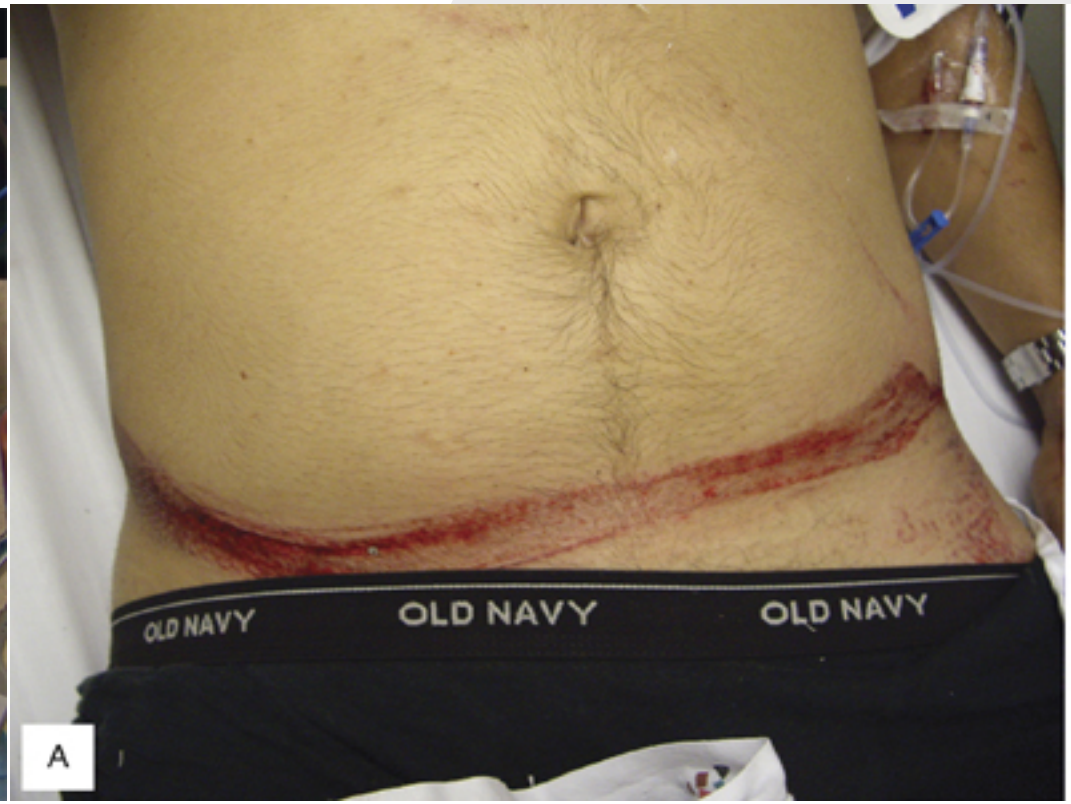


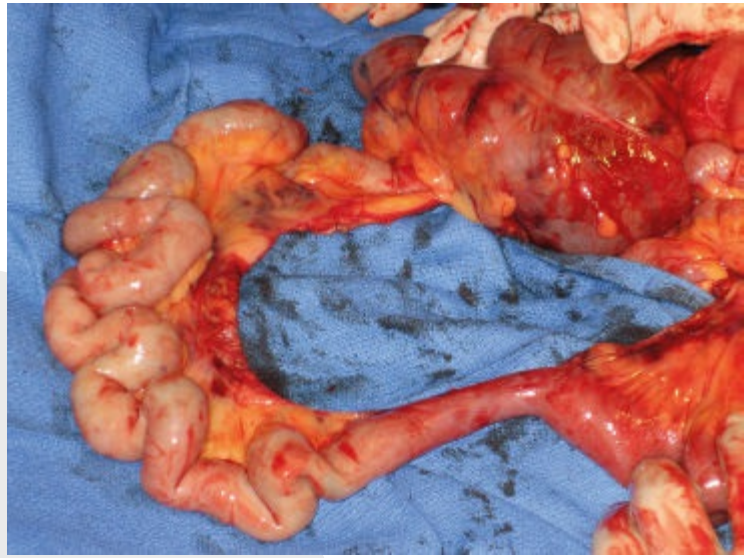
- The **spleen** and **liver** are the most commonly injured solid organs

- **Absence** of **abdominal pain** or **tenderness** on physical examination does **NOT** rule out the presence of **significant intra-abdominal injury.**

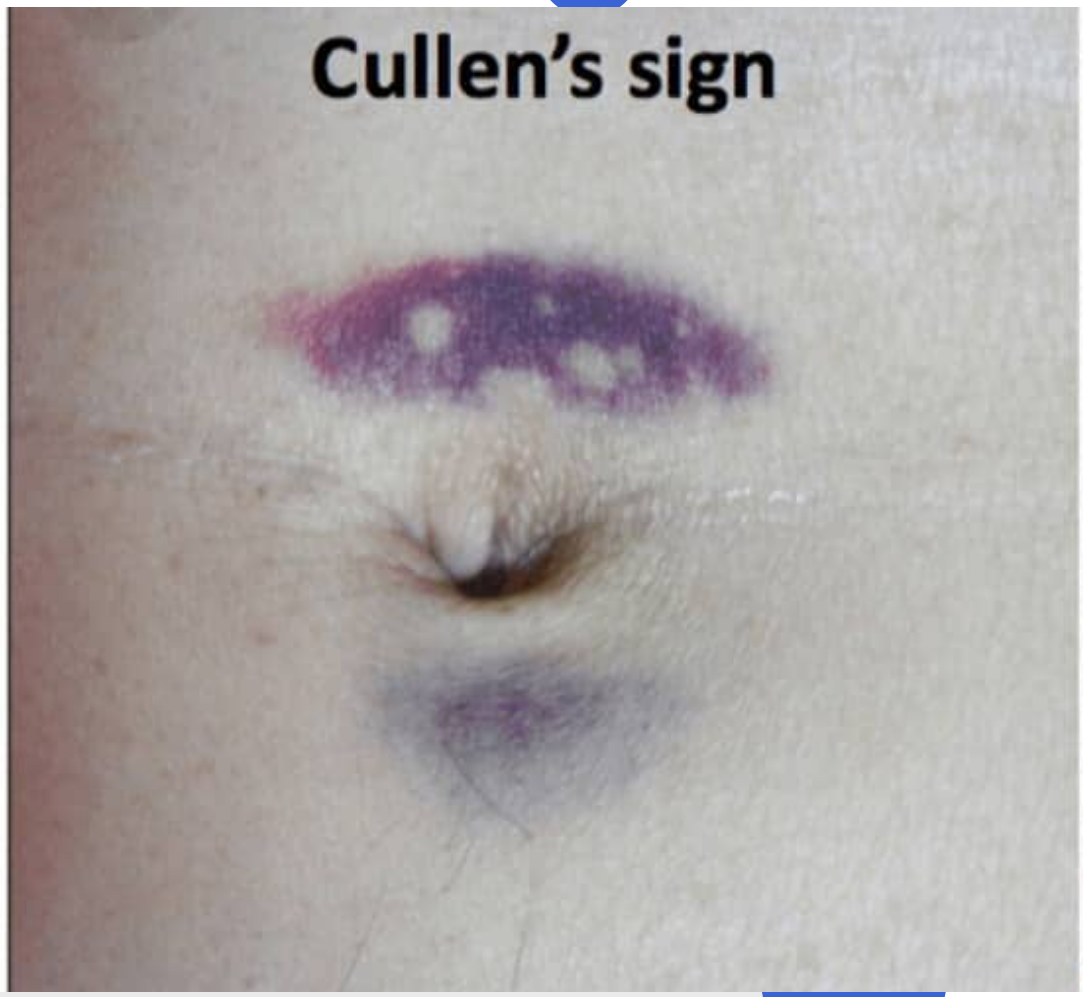
Physical Examination Findings

- Seatbelt sign
- Rebound tenderness
- Hypotension
- Abdominal distension
- Abdominal guarding
- Concomitant femur fracture





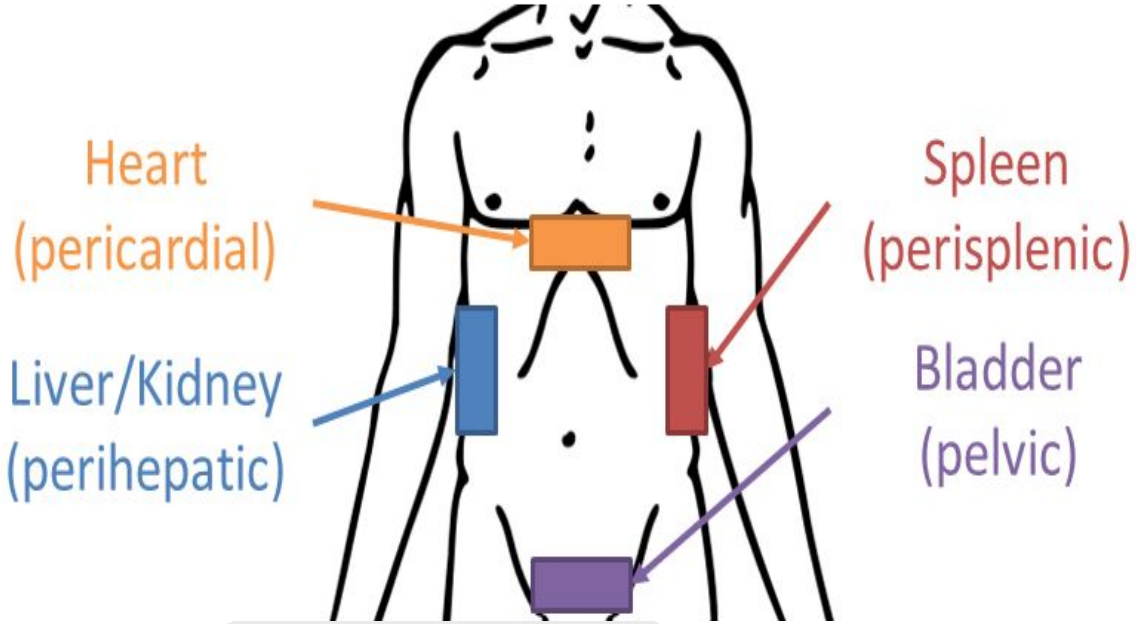
- **Bucket handle–type injury of small bowel.**


Cullen’s sign


Grey Turner’s sign

Unstable Patients :

- **Focused assessment with sonography in trauma (FAST)**
  - FAST is positive emergent laparotomy



PENETRATING INJURY

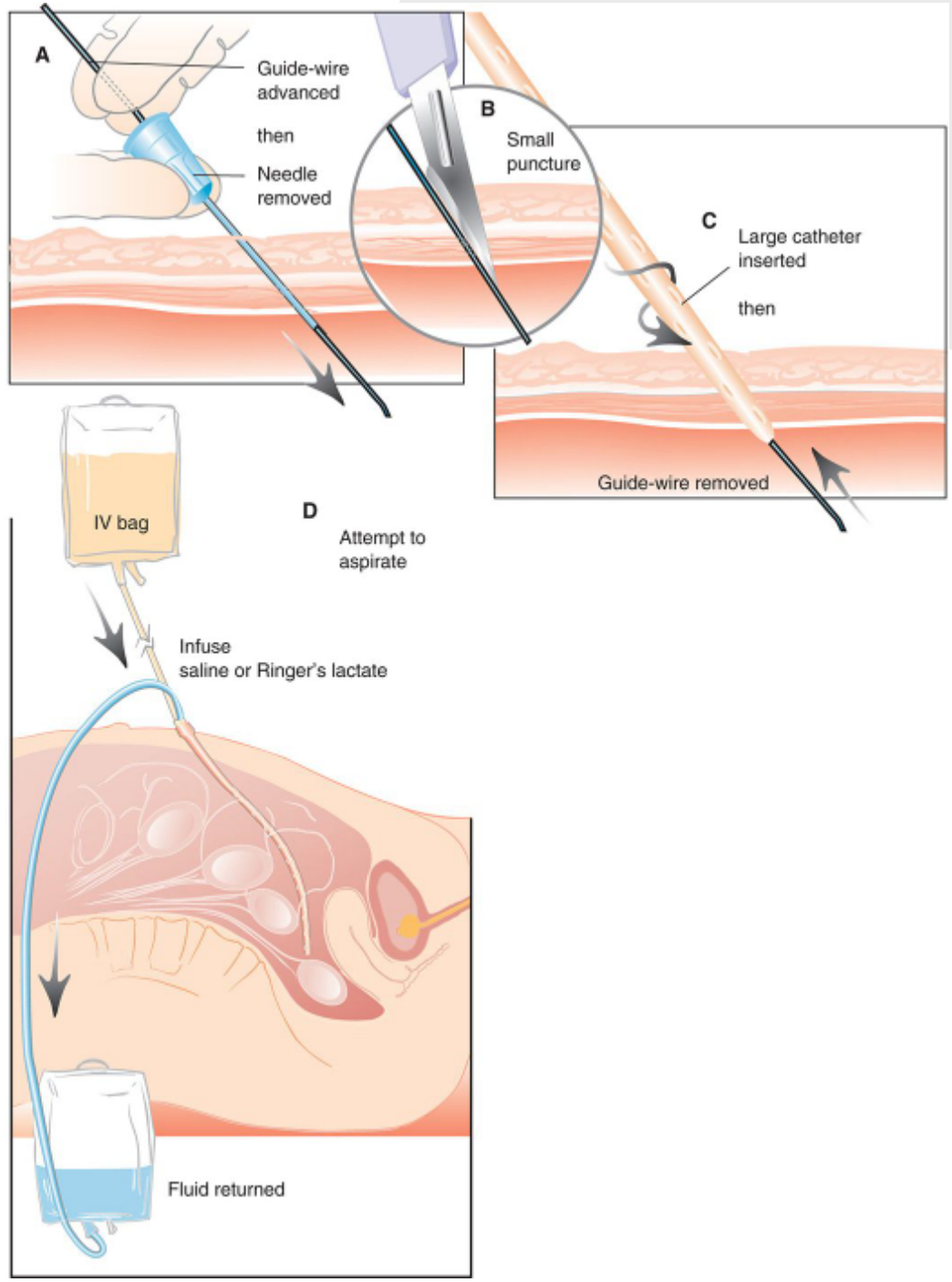
- An Injury that occurs when an object pierces the skin and enters tissue of the abdomen. Most commonly the liver, stomach and small intestines.

Diagnostic peritoneal lavage (DPL)

- Replaced by the combination of US and CT
- Used When unstable can't send him to CT & FAST is negative

- Aspiration of **10 mL of gross blood** confirms the presence of a significant intra-abdominal wound.

  - DPA is positive laparotomy.
  - DPA is negative alternative sources for the hemorrhage are sought



Stable patients :

- **Low risk patients ?**

observation :

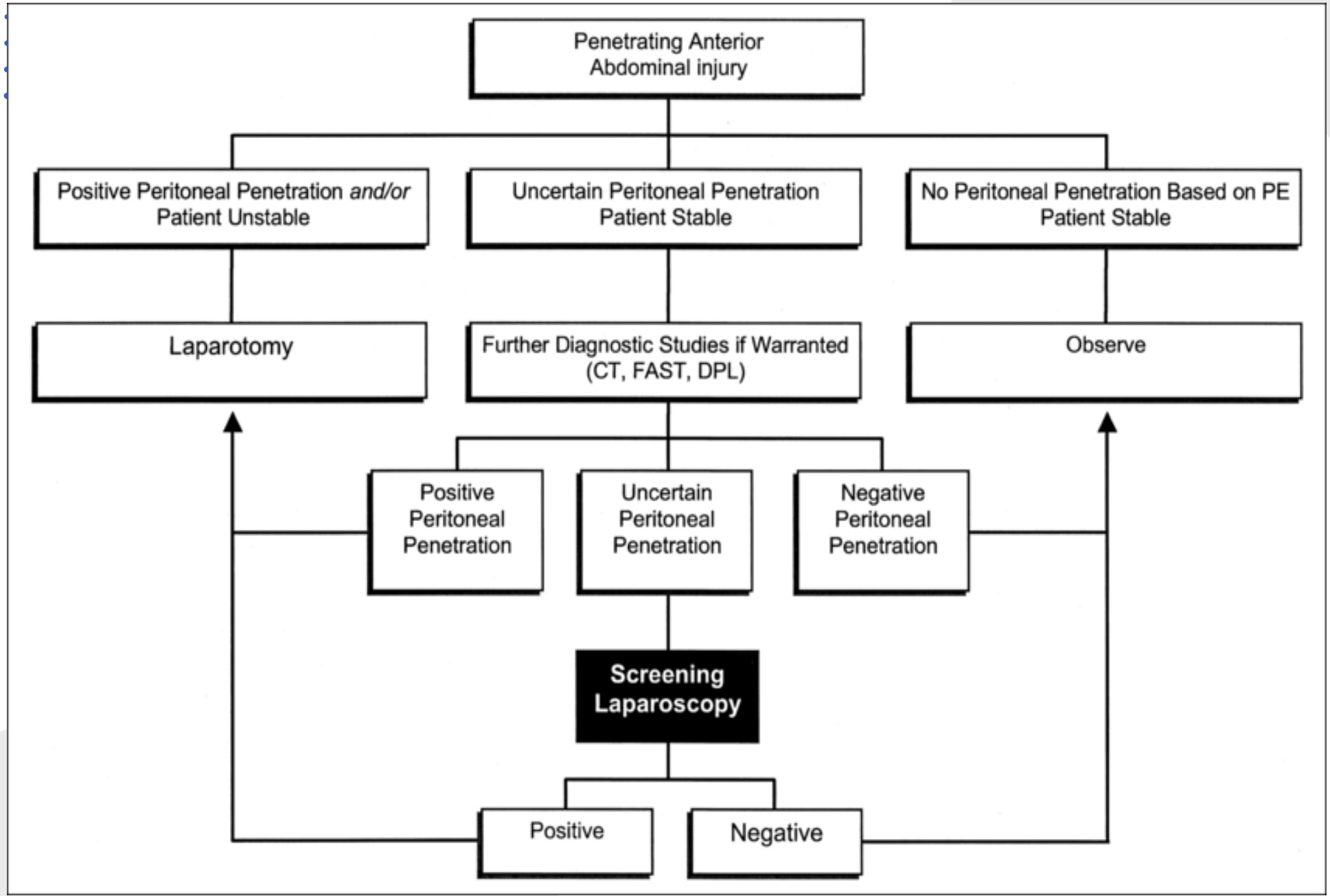
  - serial vital signs
  - abdominal examinations

- CT is the preferred modality

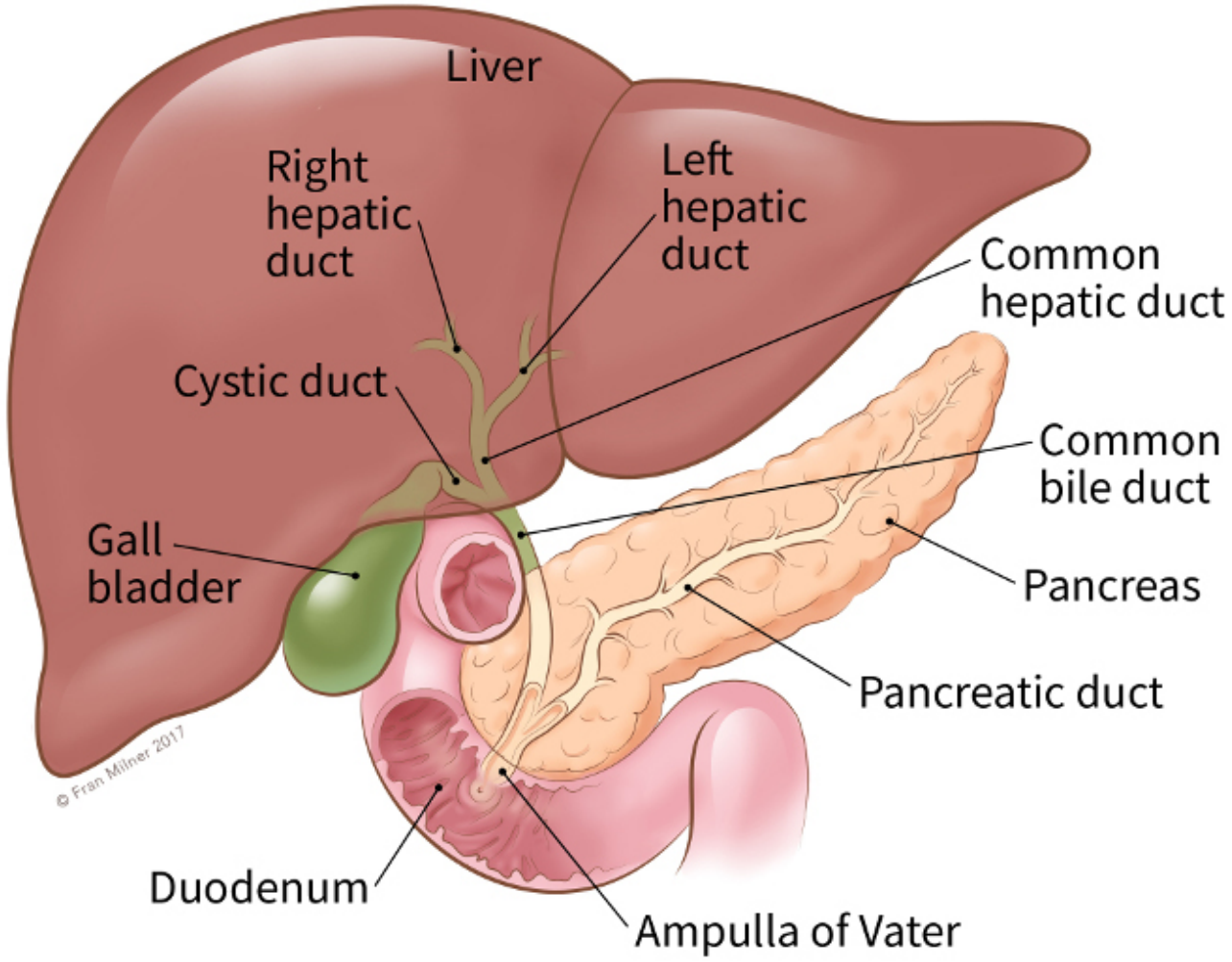
- External wounds **do not** always correspond to internal injury

- **Indications for IMMEDIATE exploratory laprotomy :**

  ✔ Hemodynamic Instability
  ✔ Peritonitis
  ✔ evisceration


Penetrating Anterior Abdominal injury
Positive Peritoneal Penetration *and/or* Patient Unstable
Uncertain Peritoneal Penetration Patient Stable
No Peritoneal Penetration Based on PE Patient Stable
Laparotomy
Further Diagnostic Studies if Warranted (CT, FAST, DPL)
Observe
Positive Peritoneal Penetration
Uncertain Peritoneal Penetration
Negative Peritoneal Penetration
Screening Laparoscopy
Positive
Negative

LIVER AND BILIARY TRACT



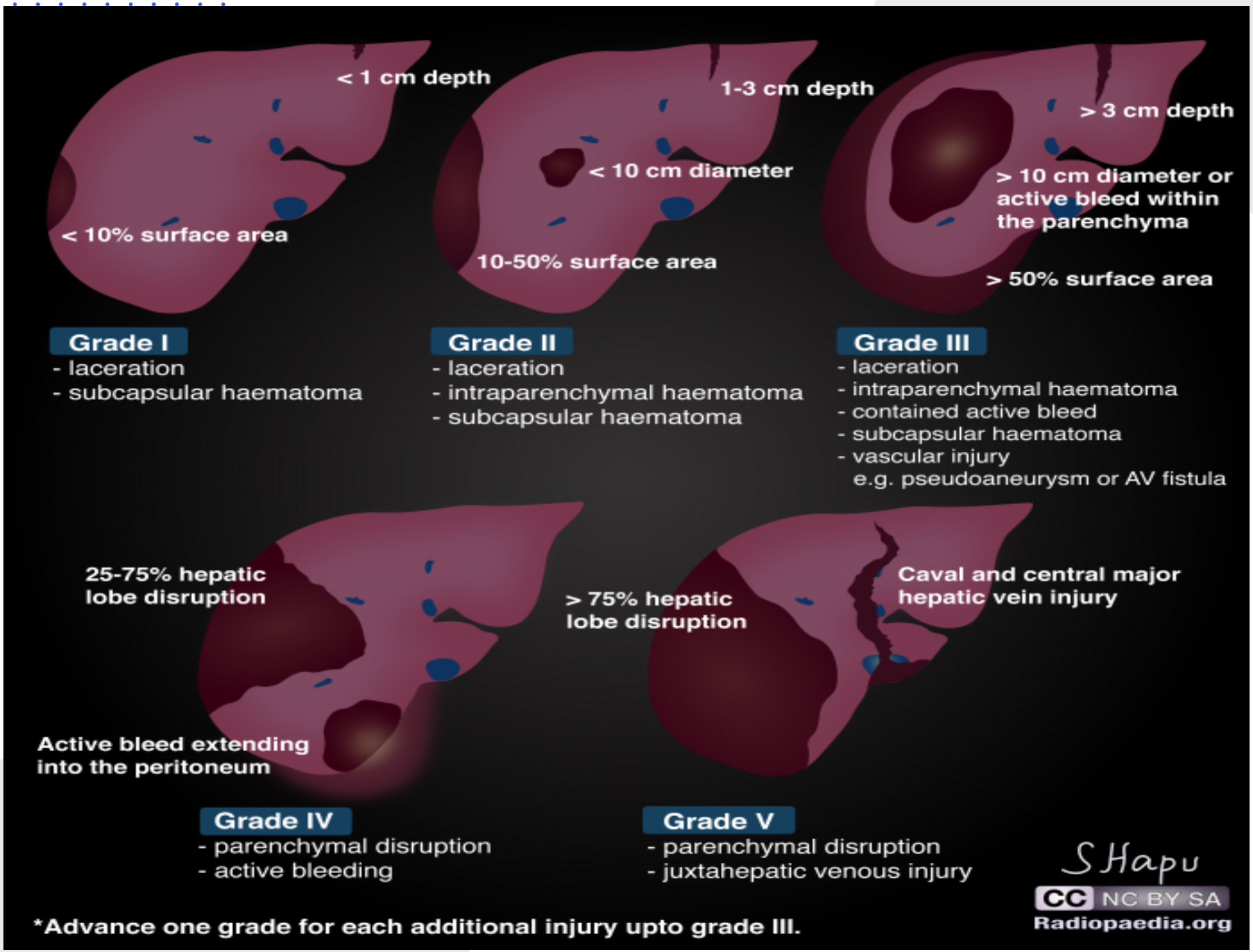
- The liver’s large size makes it the organ most susceptible to Penetrating Trauma and it is frequently involved in upper torso penetrating wounds.
- Diagnosis:
  - diagnosis of liver injury may be suspected in the hemodynamically stable patient based upon mechanism of injury, physical examination, or laboratory findings.
  - However, imaging using intravenous contrast-enhanced computed tomography (CT) of the abdomen definitively confirms the injury and defines the injury grade. Pooling of intravenous contrast in or around the liver implies ongoing bleeding and the need for intervention. CT scanning also identifies associated intra-abdominal and chest injuries. CT scan with IV contrast is the most widely used and highest-yield modality .

- The Focused Assessment with Sonography in Trauma (FAST) exam (signs of liver injury include findings of a hypoechoic (ie, black) rim of subcapsular fluid, intraperitoneal fluid around the liver, or fluid in Morrison's pouch) is more commonly used in hemodynamically unstable patients.

- However, a negative FAST examination is not adequate to exclude liver injury, particularly intraparenchymal injury.

OIS-AAST Grading Scale for the Liver

Grade[a]	Type	Injury Description
I	Hematoma Laceration	Subcapsular, <10% surface area Capsular tear, <1 cm parenchymal depth
II	Hematoma Laceration	Subcapsular, 10–50% surface area; intraparenchymal, <10 cm in diameter 1–3 cm parenchymal depth, <10 cm in length
III	Hematoma Laceration	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma, >10 cm or expanding >3 cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25–75% of hepatic lobe or 1–3 Couinaud segments within a single lobe
V	Laceration Vascular	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud segments within a single lobe Juxtahepatic venous injuries; that is, retrohepatic vena cava/ central major hepatic veins
VI	Vascular	Hepatic avulsion


< 1 cm depth
< 10% surface area
Grade I
- laceration
- subcapsular haematoma
1-3 cm depth
< 10 cm diameter
10-50% surface area
Grade II
- laceration
- intraparenchymal haematoma
- subcapsular haematoma
> 3 cm depth
> 10 cm diameter or active bleed within the parenchyma
> 50% surface area
Grade III
- laceration
- intraparenchymal haematoma
- contained active bleed
- subcapsular haematoma
- vascular injury
e.g. pseudoaneurysm or AV fistula
25-75% hepatic lobe disruption
Active bleed extending into the peritoneum
Grade IV
- parenchymal disruption
- active bleeding
> 75% hepatic lobe disruption
Caval and central major hepatic vein injury
Grade V
- parenchymal disruption
- juxtahepatic venous injury
*Advance one grade for each additional injury upto grade III.
S Hapu
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Radiopaedia.org

Management

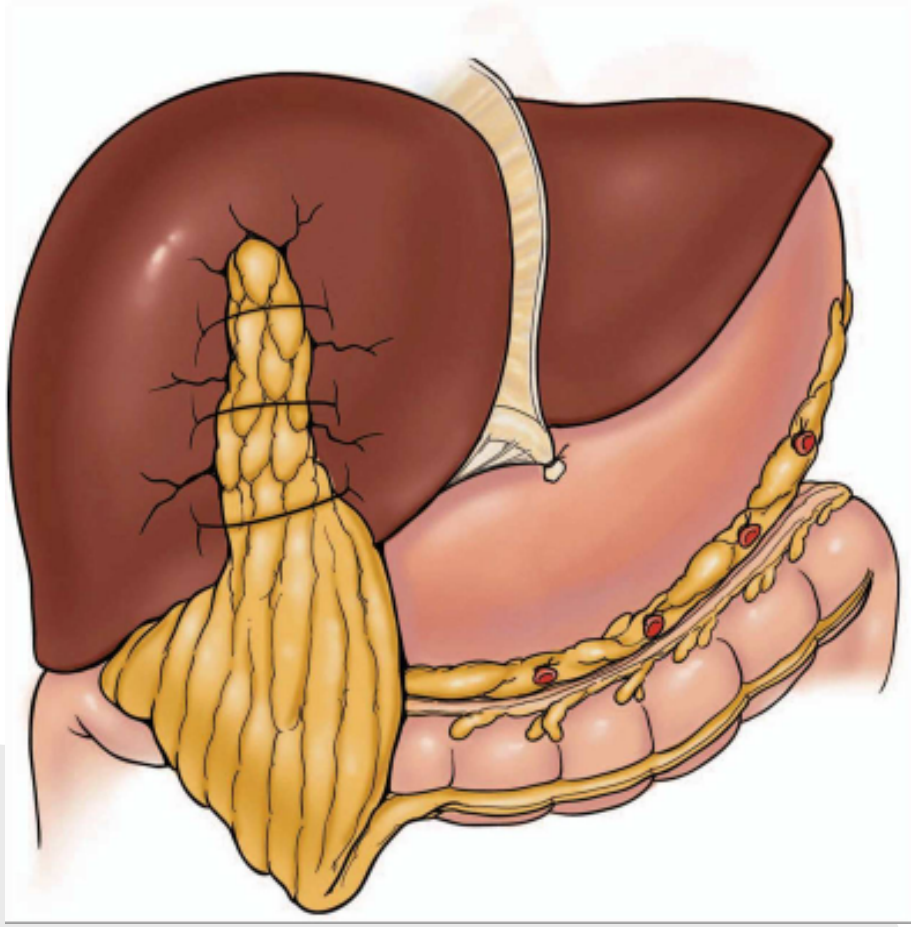
- Nonoperative management of solid organ injuries is pursued in hemodynamically stable patients who do not have overt peritonitis or other indications for laparotomy.
- Patients should be admitted with frequent hemodynamic monitoring, determination of hemoglobin, and abdominal examination.
- Factors such as high-grade injury, large hemoperitoneum, contrast extravasation, or pseudoaneurysms may predict complications or failure of nonoperative management.
- Angioembolization and endoscopic retrograde cholangiopancreatography (ERCP) are useful adjuncts that can improve the success rate of nonoperative management.

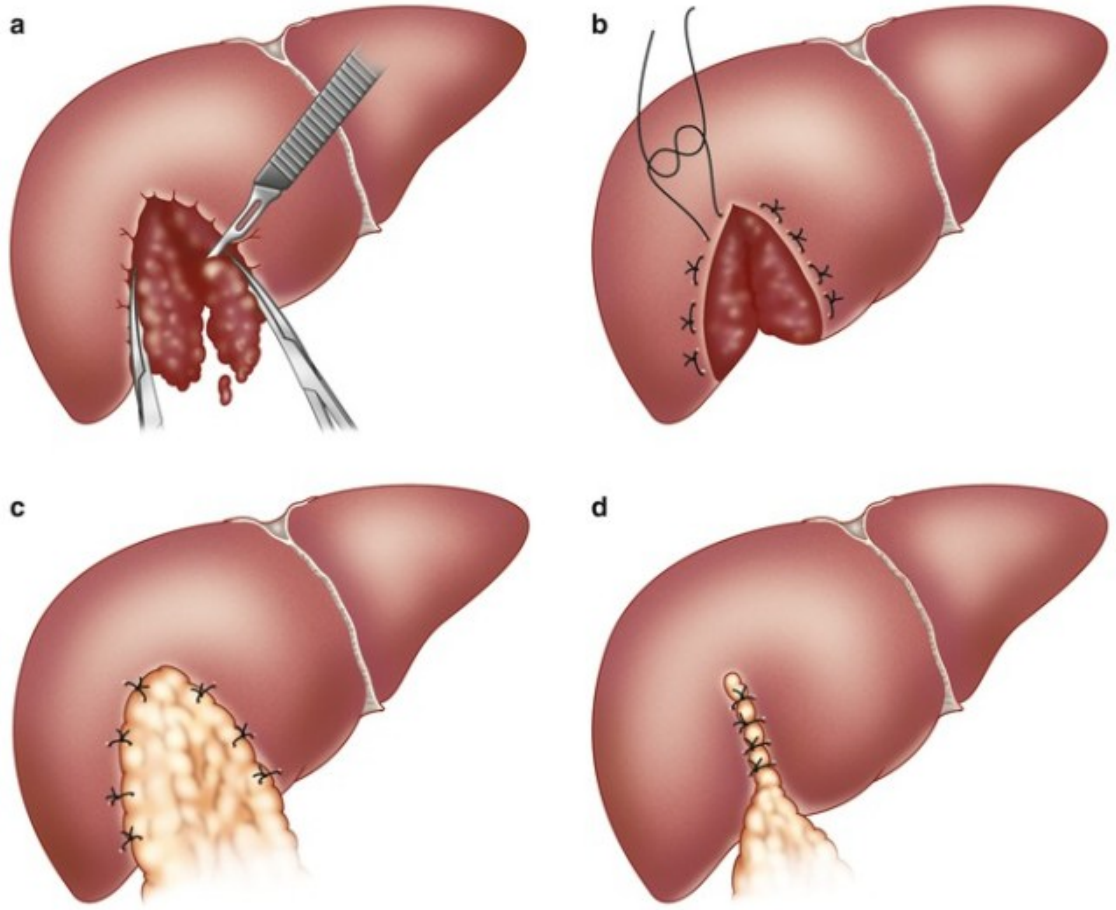
Operative management

- Minor lacerations may be controlled with manual compression applied directly to the injury site. Topical hemostatic techniques include the use of an electrocautery (with the device set at 100 watts), argon beam coagulator, microcrystalline collagen, thrombin-soaked gelatin foam sponge, fibrin glue, BioGlue and liver suture.

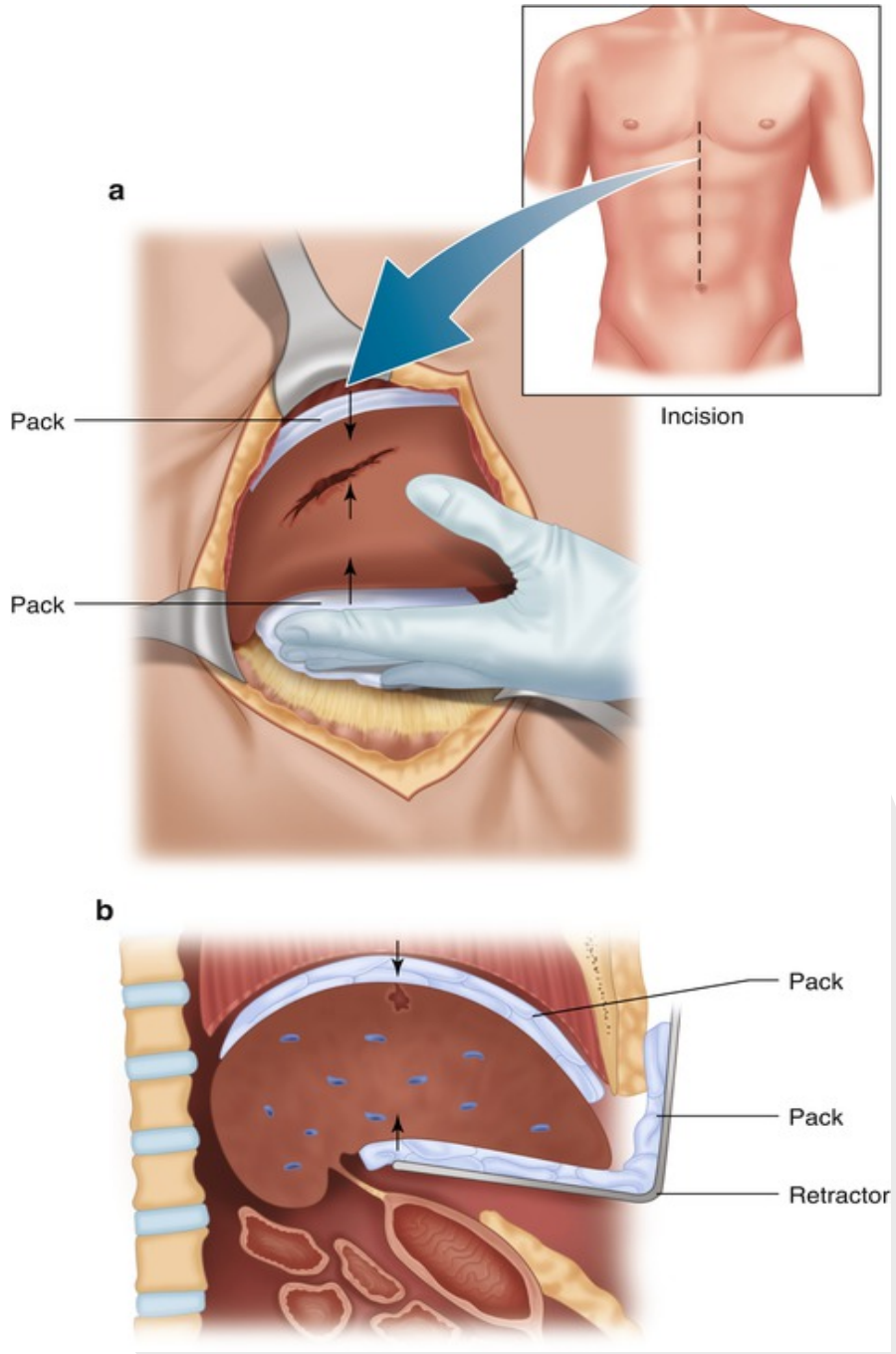
- A running suture is used to approximate the edges of shallow lacerations, whereas deeper lacerations are approximated using interrupted horizontal mattress sutures placed parallel to the edge of the laceration.

- Omentum can be used to fill large defects in the liver. The tongue of omentum not only obliterates potential dead space with viable tissue but also provides an excellent source of macrophages.





- Hemorrhage from most major hepatic injuries can be controlled with effective **perihepatic packing**. The right costal margin is elevated, and the pads are strategically placed over and around the bleeding site
- Additional pads should be placed between the liver, diaphragm, and anterior wall until the bleeding has been controlled. Sometimes 10 to 15 pads may be required to control the hemorrhage from an extensive right lobar injury.

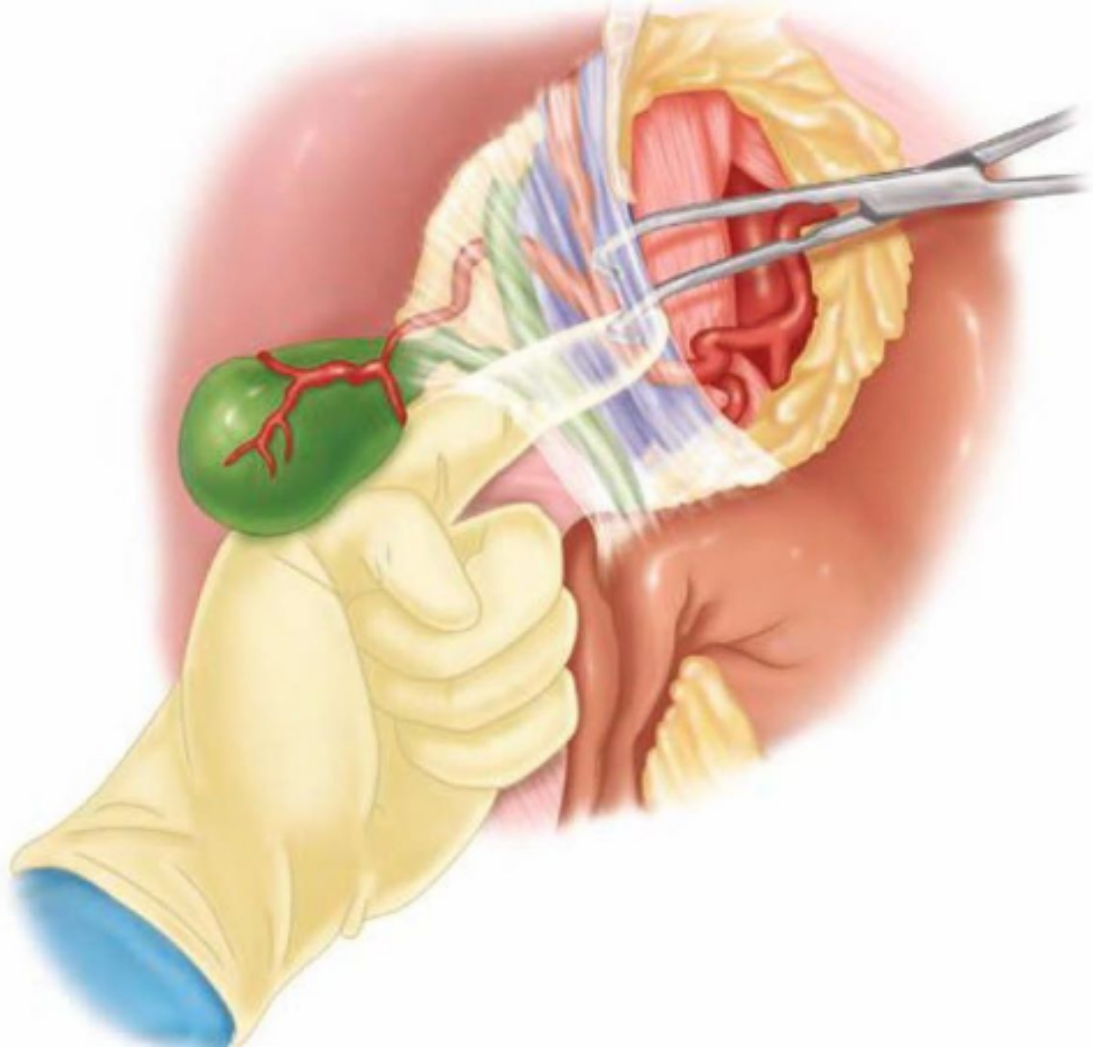


If the patient has persistent bleeding despite packing, injuries to the hepatic artery, portal vein, and retro hepatic vasculature should be considered. **Pringle maneuver** can help delineate the source of hemorrhage. In fact, hemorrhage from hepatic artery and portal vein injuries will halt with the application of a vascular clamp across the portal triad; whereas bleeding from the hepatic veins and retro hepatic vena cava will continue.

If bleeding continues , then direct repair, with or without hepatic vascular isolation, should be attempted.

Three techniques have been used to accomplish hepatic vascular isolation: (a) direct repair with suprahepatic and infrahepatic clamping of the vena cava and stapled assisted parenchymal resection (b) temporary shunting of the retrohepatic vena cava; and (c) venovenous bypass

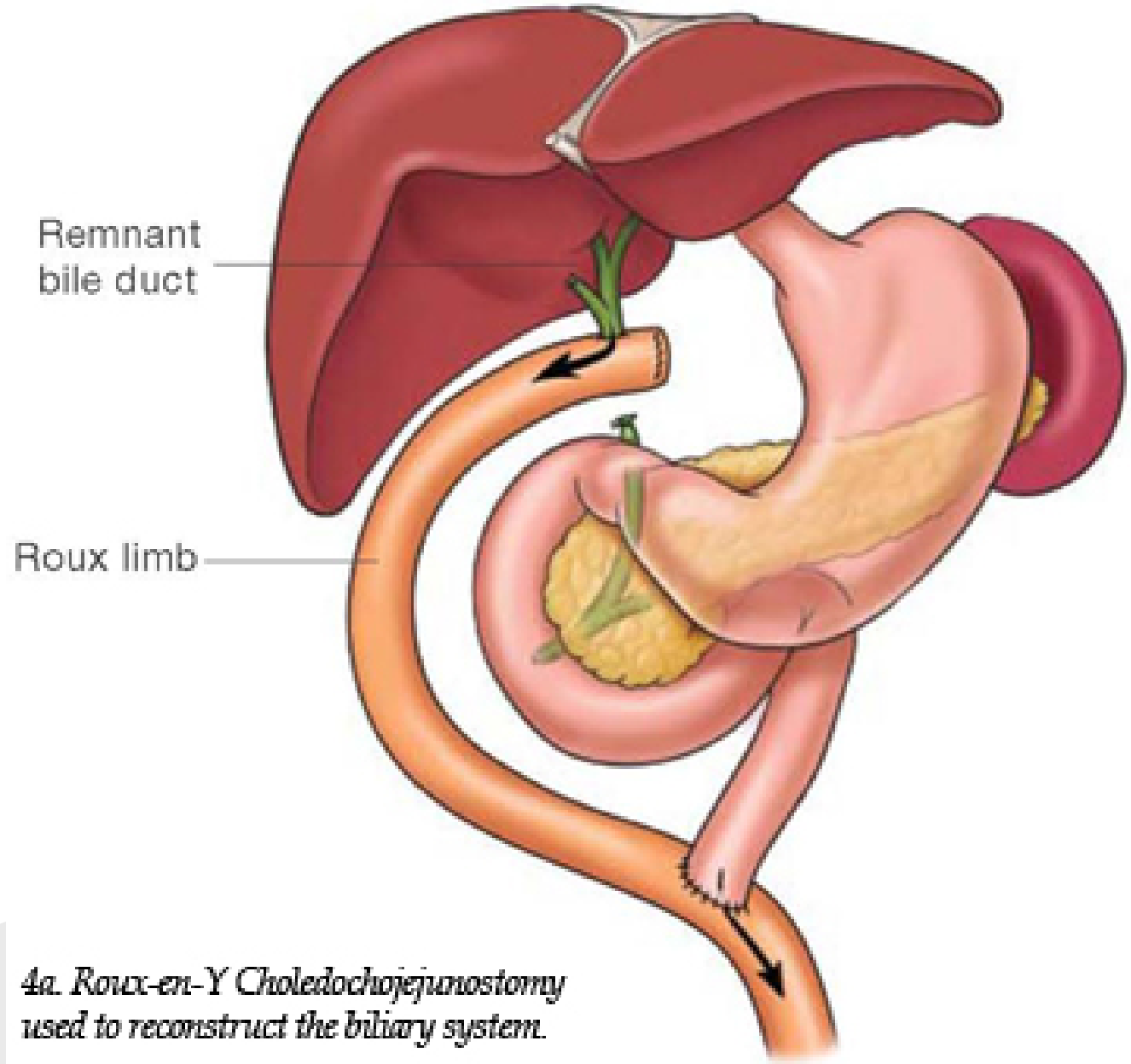
the Pringle maneuver, performed with a vascular clamp, occludes the hepatic pedicle containing the portal vein, hepatic artery, and common bile duct.



Extrahepatic Biliary Tract Injury

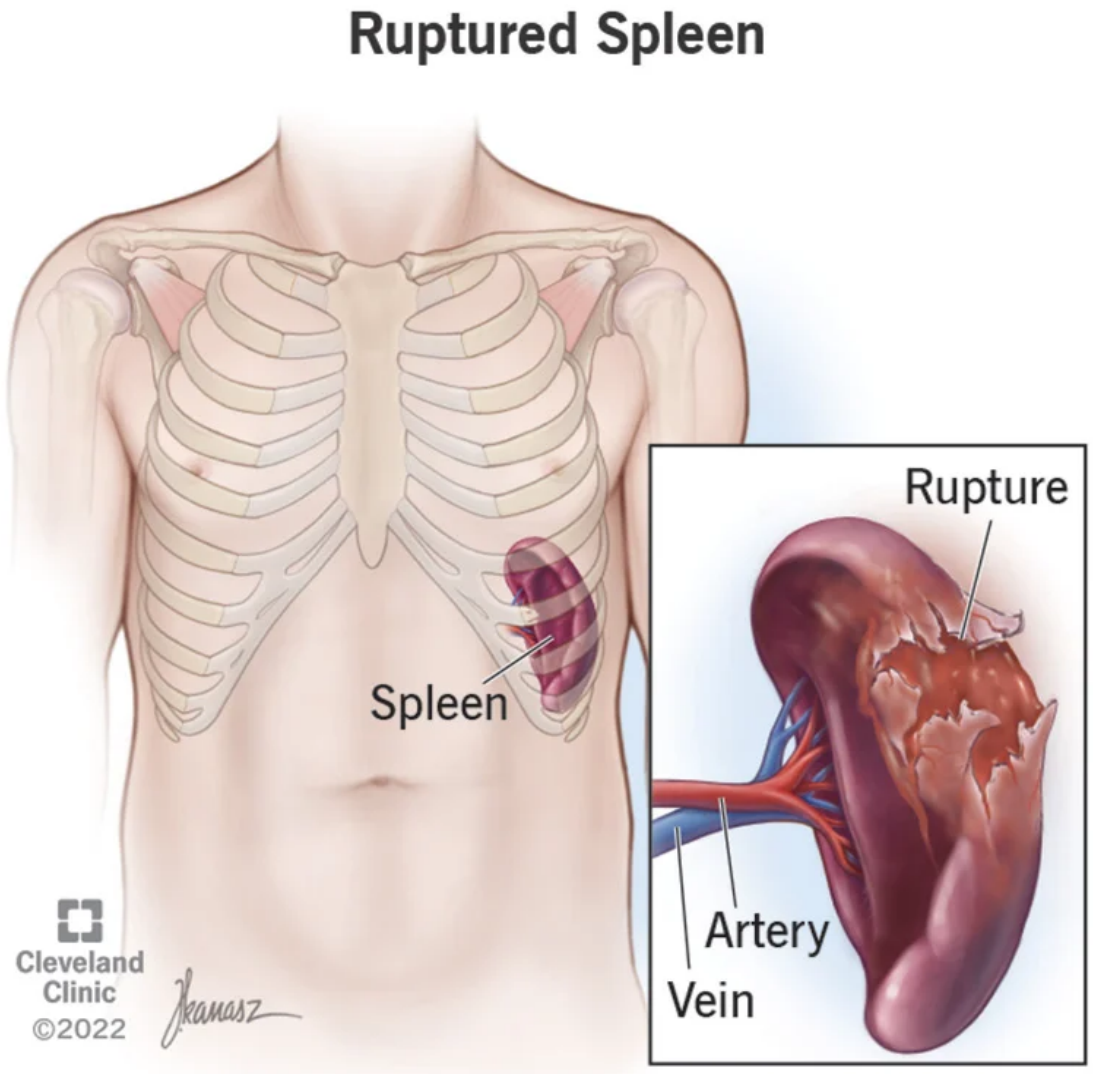
- Rare , usually a penetrating mechanism.
- **Diagnosis** : during laparotomy
- **Management:**
  - Complete transections roux-en-y biliary-enteric anastomosis
  - Incomplete injuries :
    - Less than 50% of the duct circumference primary repair
    - More than 50% of the duct circumference as complete

- All repairs should be drained externally with **closed suction drains**.



4a. Roux-en-Y Choledochojejunostomy used to reconstruct the biliary system.

THE SPLEEN


Ruptured Spleen
Spleen
Rupture
Artery
Vein
Cleveland Clinic
©2022

- One of the most commonly injured intra-abdominal organs
- Blunt > Penetrating

  The most common abdominal organ affected in blunt Trauma
- prompt management of potentially life-threatening hemorrhage is the primary goal.
- The preservation of functional splenic tissue is secondary

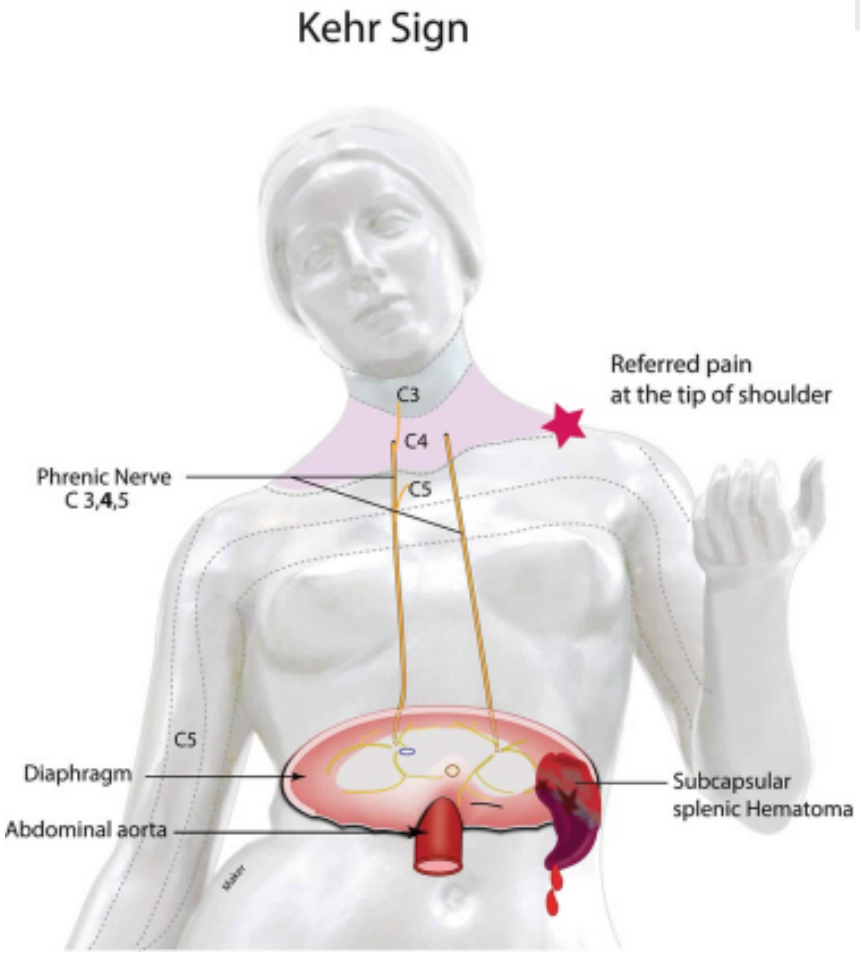
Diagnosis

Presentation depends on the volume of blood loss and the presence of associated injuries:

1. Asymptomatic Or Minor Local Tenderness
   - low-grade splenic injuries

2. Tachycardia And Hypotension
   - significant blood loss

3. Pain In The Left Upper Quadrant, radiating to the left shoulder (Kehr sign), especially when placed in the Trendelenburg position
   - large splenic hematomas



IMAGING :

1. **FAST :** free fluid around the spleen.
2. **Abdominal CT scan with intravenous contrast :** is the most widely used and highest yield investigation

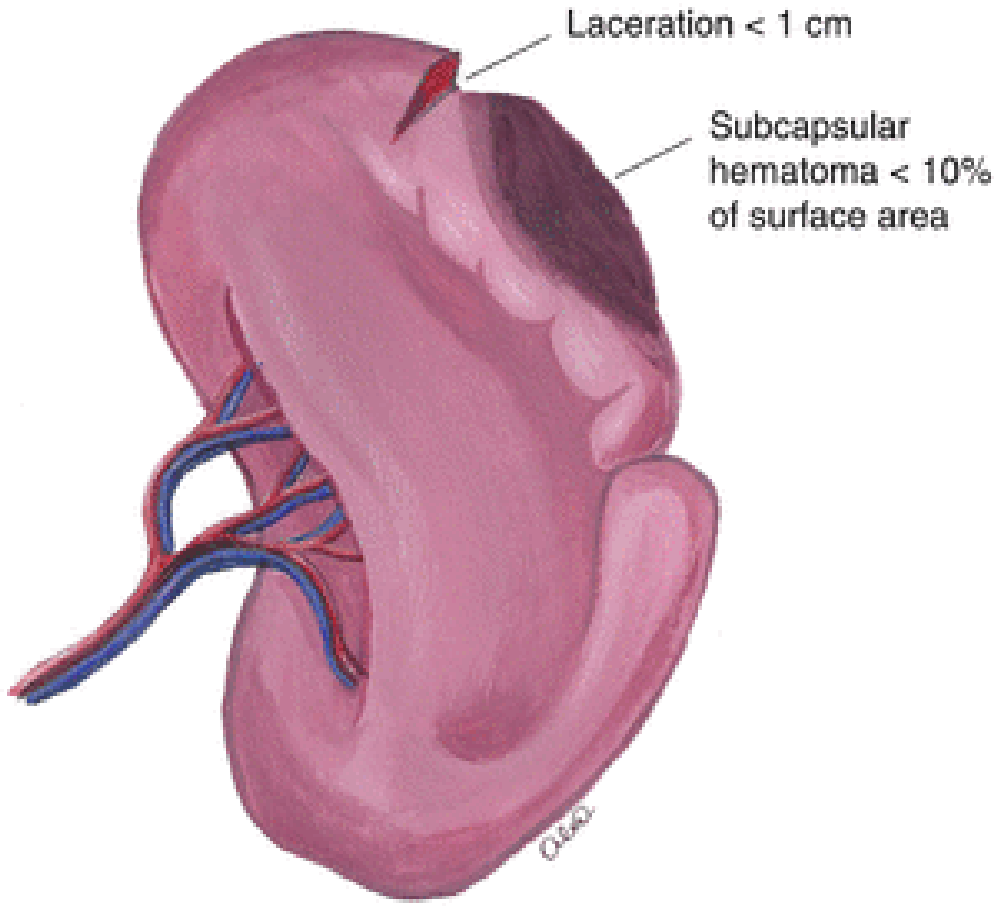
- The severity of splenic injury is graded by the **OIS-AAST spleen injury scale:**
  - Grades I And II Minor Injuries,
  - Grade III Moderate Injury,
  - Grades IV And V Severe Injuries.

Table 25-2 OIS-AAST Grading Scale for the Spleen

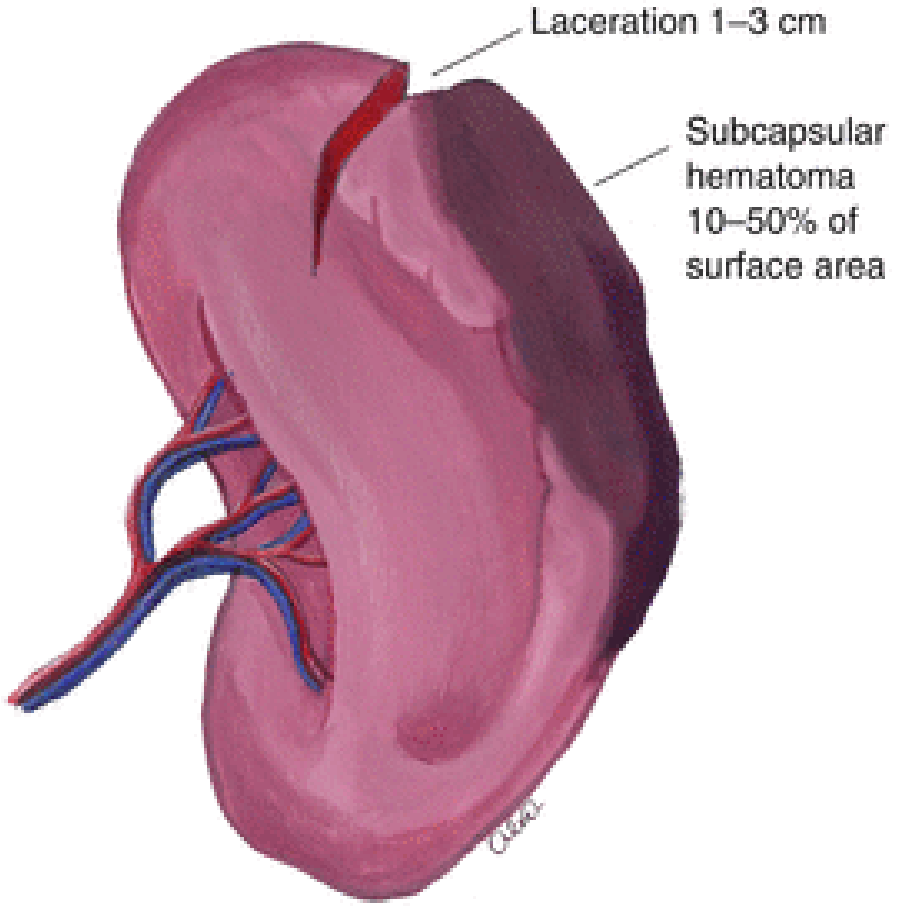
Grade[a]	Type	Injury Description
I	Hematoma Laceration	Subcapsular, <10% surface area Capsular tear, <1 cm parenchymal depth
II	Hematoma Laceration	Subcapsular, 10–50% surface area, <5 cm in diameter 1–3 cm parenchymal depth not involving a trabecular vessel
III	Hematoma Laceration	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma, ≥5 cm or expanding >3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of the spleen)
V	Laceration Vascular	Shattered spleen Hilar vascular injury with devascularized spleen

[a]Advance one grade for multiple injuries, up to grade III.

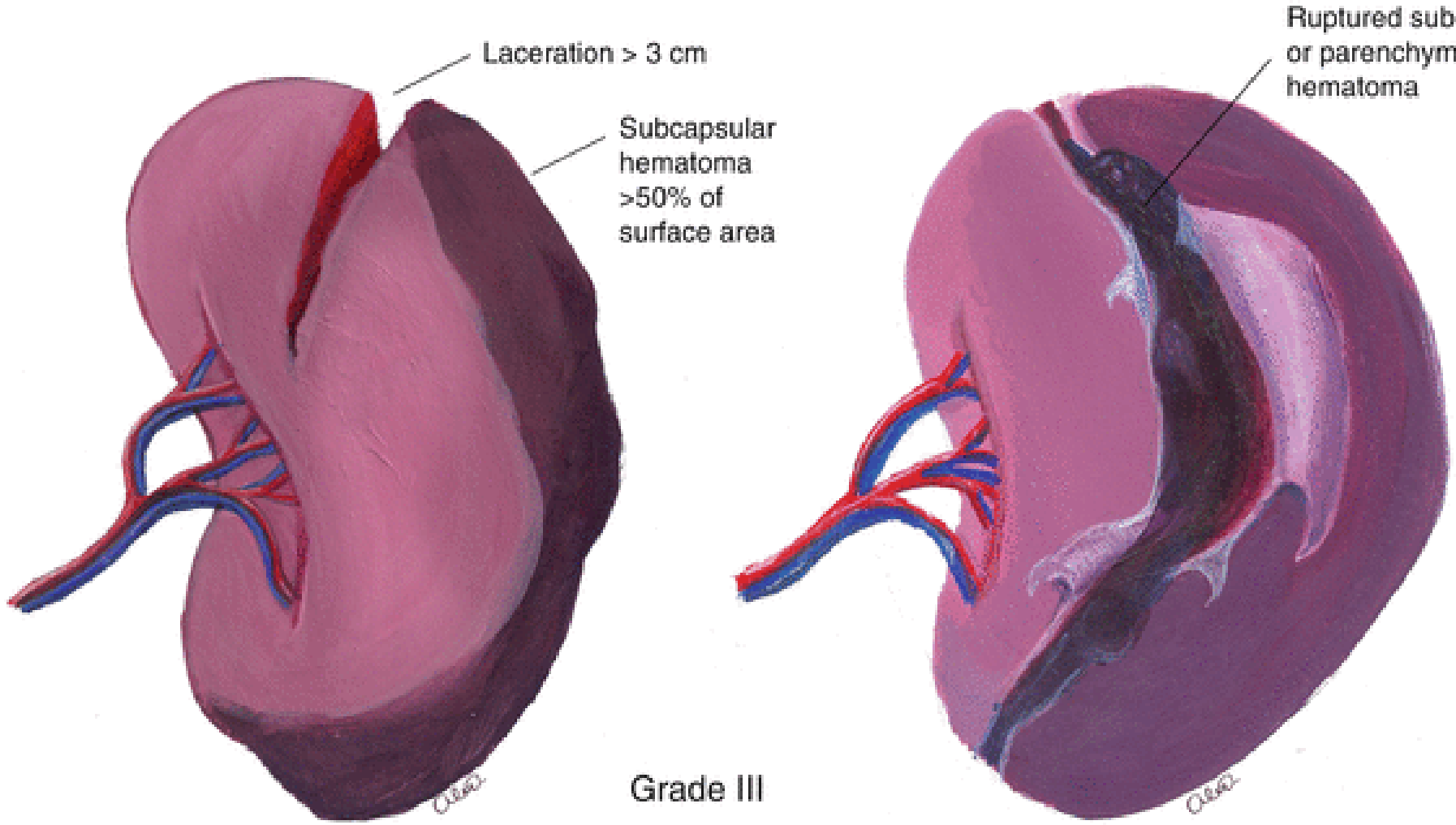
Moore EE, Cogbill TH, Jurkovich GJ, et al. Organ injury scaling: spleen and liver (1994 revision). *J Trauma* 1995;38:323–324.



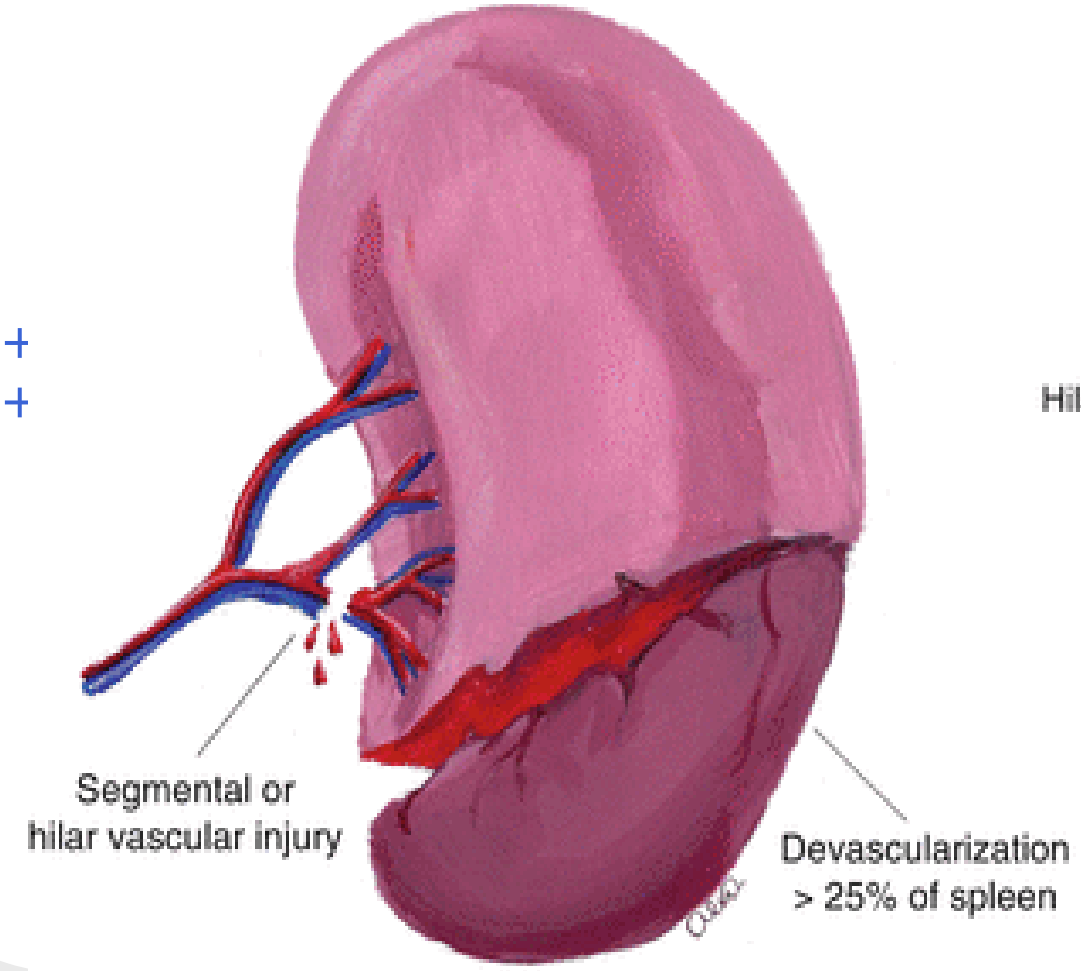
Grade I



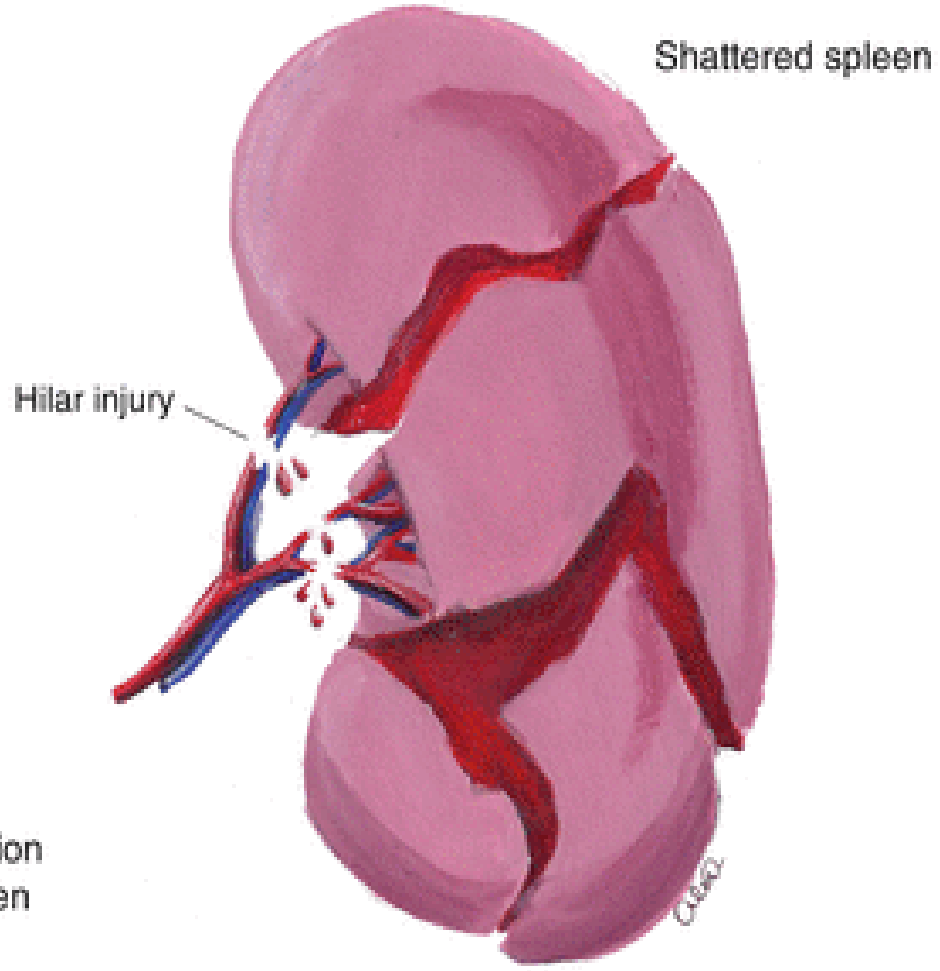
Grade II


Laceration > 3 cm
Subcapsular hematoma >50% of surface area
Ruptured subcapsular or parenchymal hematoma

Grade III



Grade IV



Grade V

Treatment

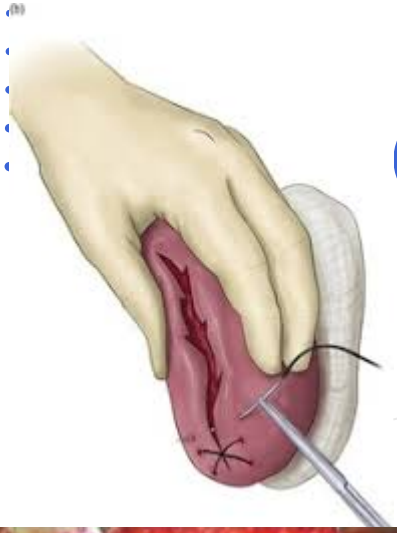
Non-operatively

- Approximately 80% in adults.
- Delayed bleeding may occur **days to weeks** after the injury.
- Development of hemodynamic instability, peritonitis or the need for blood transfusion should trigger operative exploration.

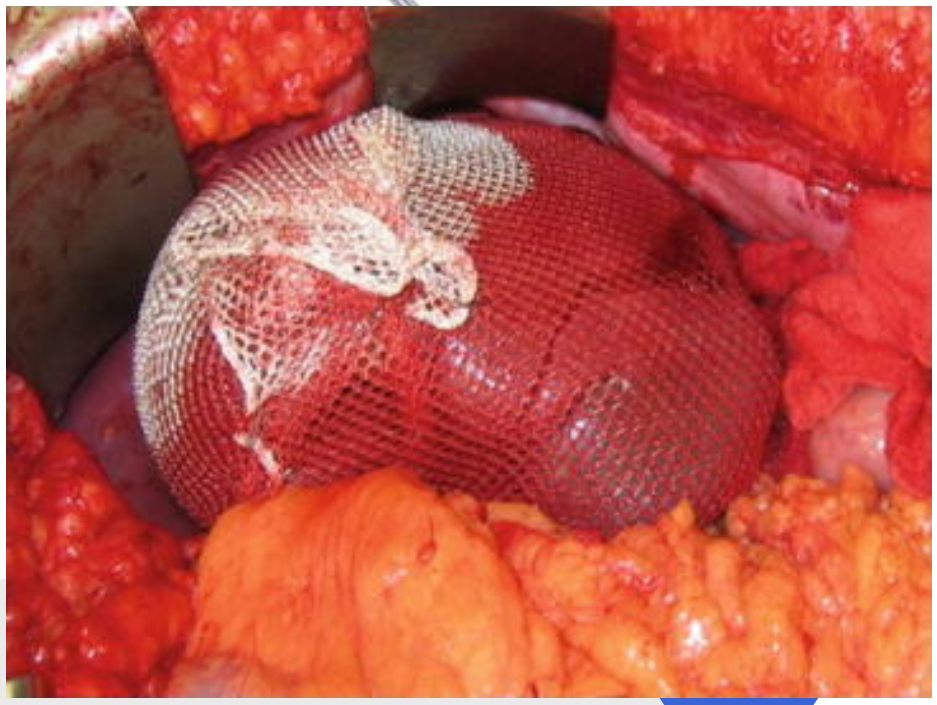
Operatively

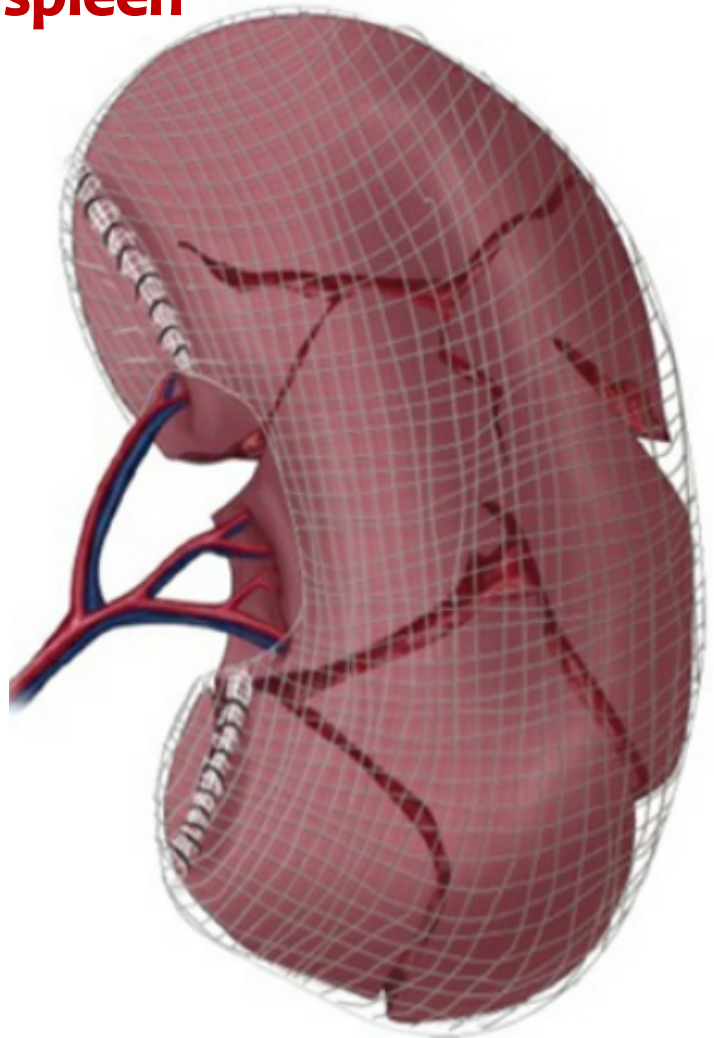
- Splenic injuries are managed operatively by splenectomy, partial splenectomy, or splenic repair (splenorrhaphy), based on the extent of the injury and the physiologic condition of the patient.
- Splenectomy is indicated for hilar injuries, pulverized splenic parenchyma, or any >grade II injury in a patient with coagulopathy or multiple injuries.
- Partial splenectomy can be employed in patients in whom only the superior or inferior pole has been injured.
- splenorrhaphy hemostasis is achieved by topical methods (electrocautery; argon beam coagulation; application of thrombin-soaked gelatin foam sponges, fibrin glue, or BioGlue), envelopment of the injured spleen in absorbable mesh, and suture repair.

Preservation of the spleen



Lacerations suture





splenic mesh

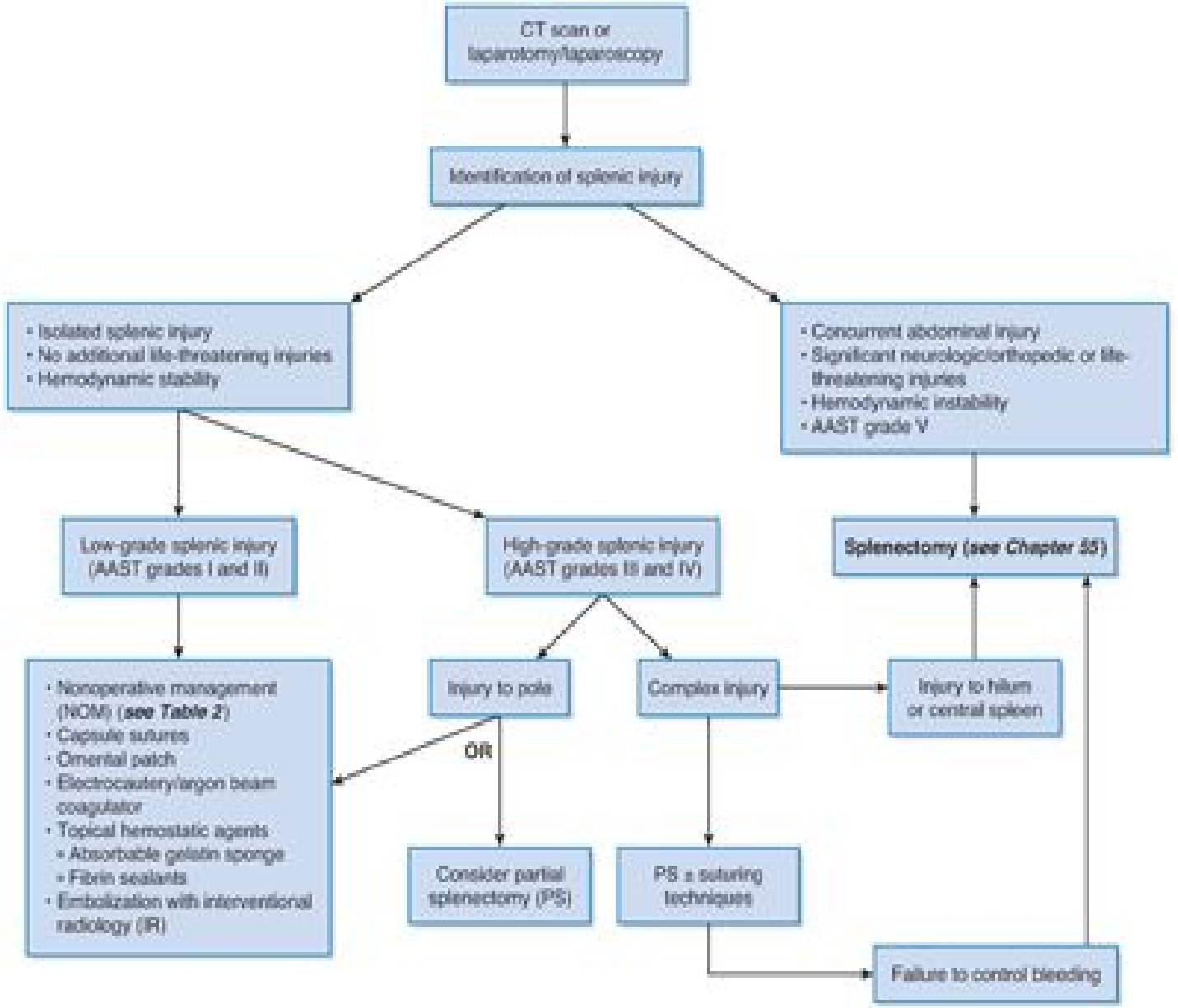


FIG 1 • Treatment algorithm for splenic injury outlining various options based on grade of injury. AAST, American Association for the Surgery of Trauma.

post-splenectomy or splenorrhaphy complications

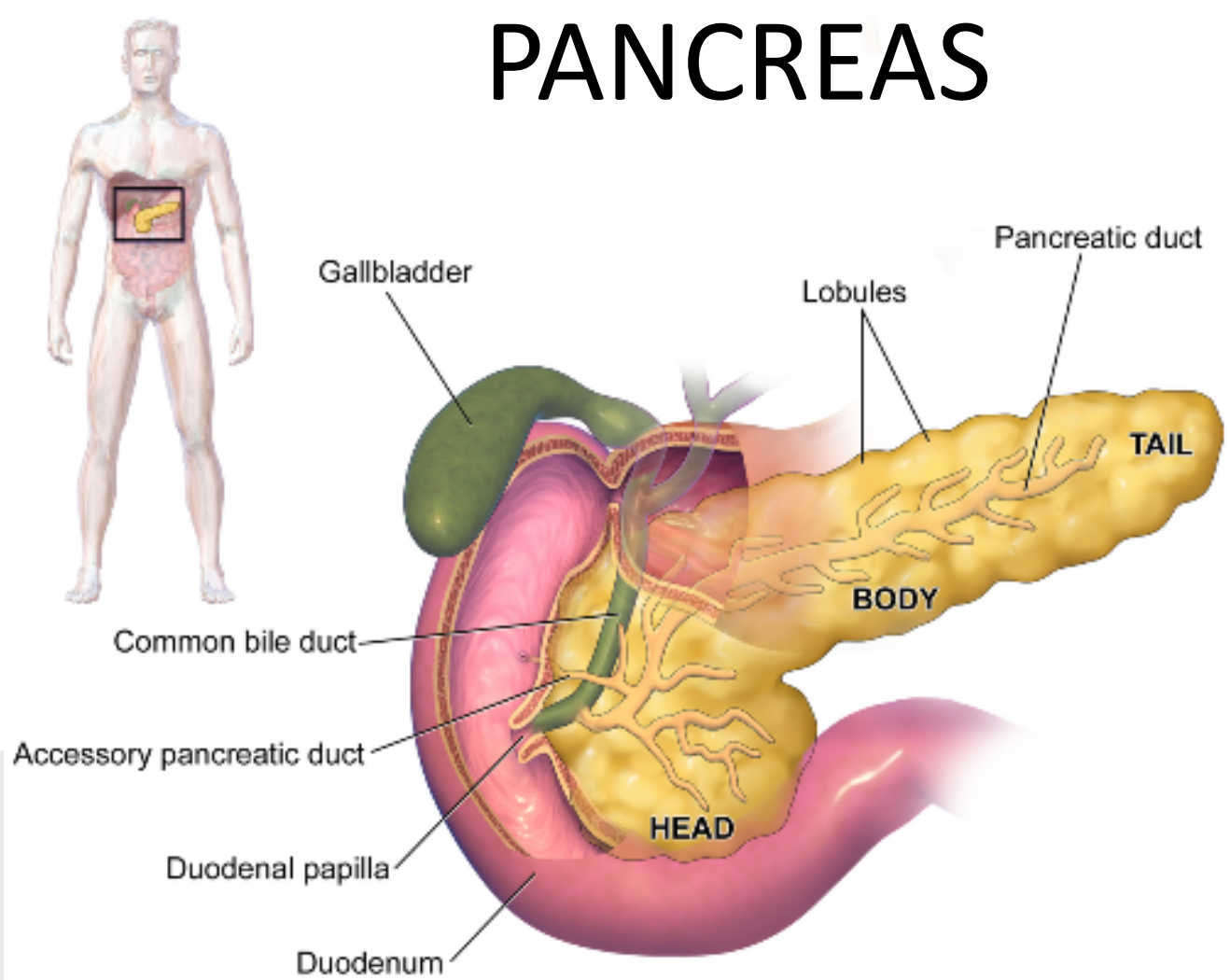
1. postoperative hemorrhage: may be due to loosening of a tie around the splenic vessels, an improperly ligated or unrecognized short gastric artery, or recurrent bleeding from the spleen if splenic repair was used.
2. iatrogenic injury to the pancreatic tail during rapid splenectomy resulting in pancreatic ascites or fistula.
3. a gastric perforation during short gastric ligation.
4. Subphrenic abscess,
5. An immediate postsplenectomy increase in platelets and WBCs is normal; however, beyond postoperative day 5, a WBC count above 15,000/mm3 and a platelet/WBC ratio of <20 are strongly associated with sepsis and should prompt a thorough search for underlying infection.1
6. Overwhelming postsplenectomy infection (OPSI)

Overwhelming postsplenectomy sepsis is caused by encapsulated bacteria (S. pneumonia, H. influenzae, N. meningitidis).

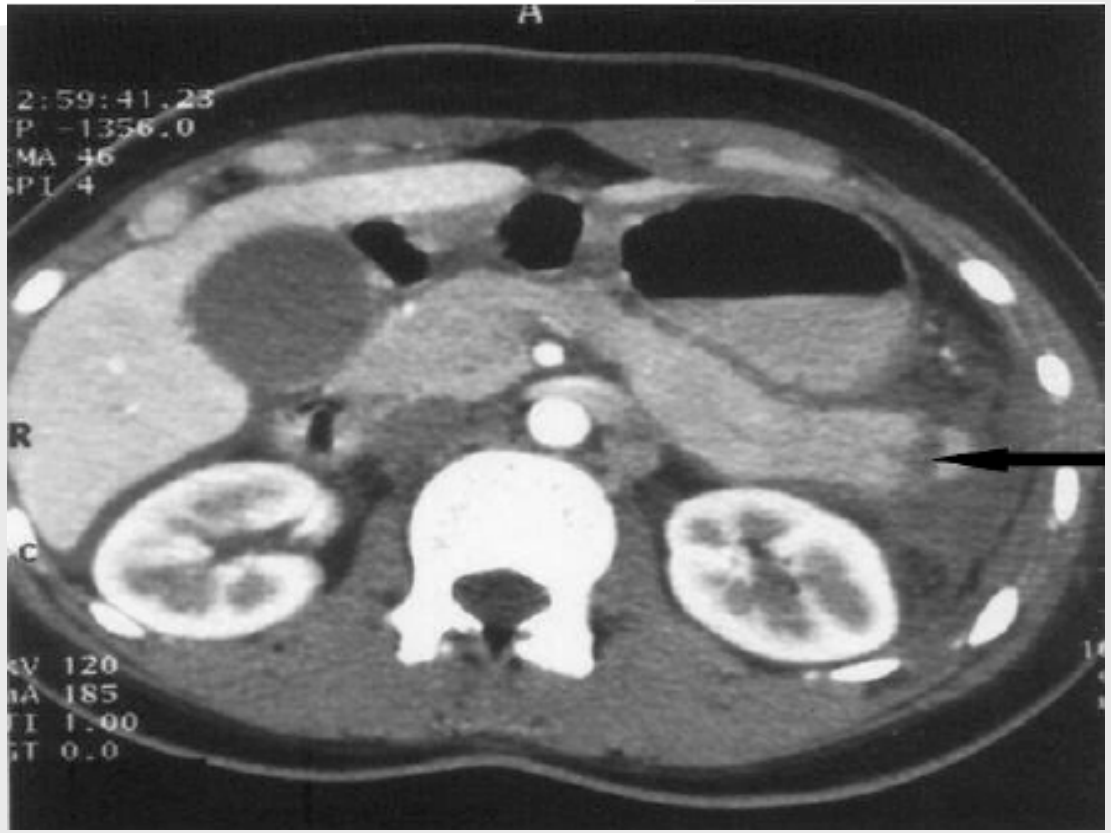
A rare but often fatal complication.

Prophylaxis against these bacteria is provided via vaccines administered optimally at 14 days.

THE PANCREAS



- Rare (0.2% of blunt trauma and 1% of penetrating trauma)
- Difficult to diagnose (retroperitoneal organ)
- Contrast-enhanced CT scan is the investigation of choice

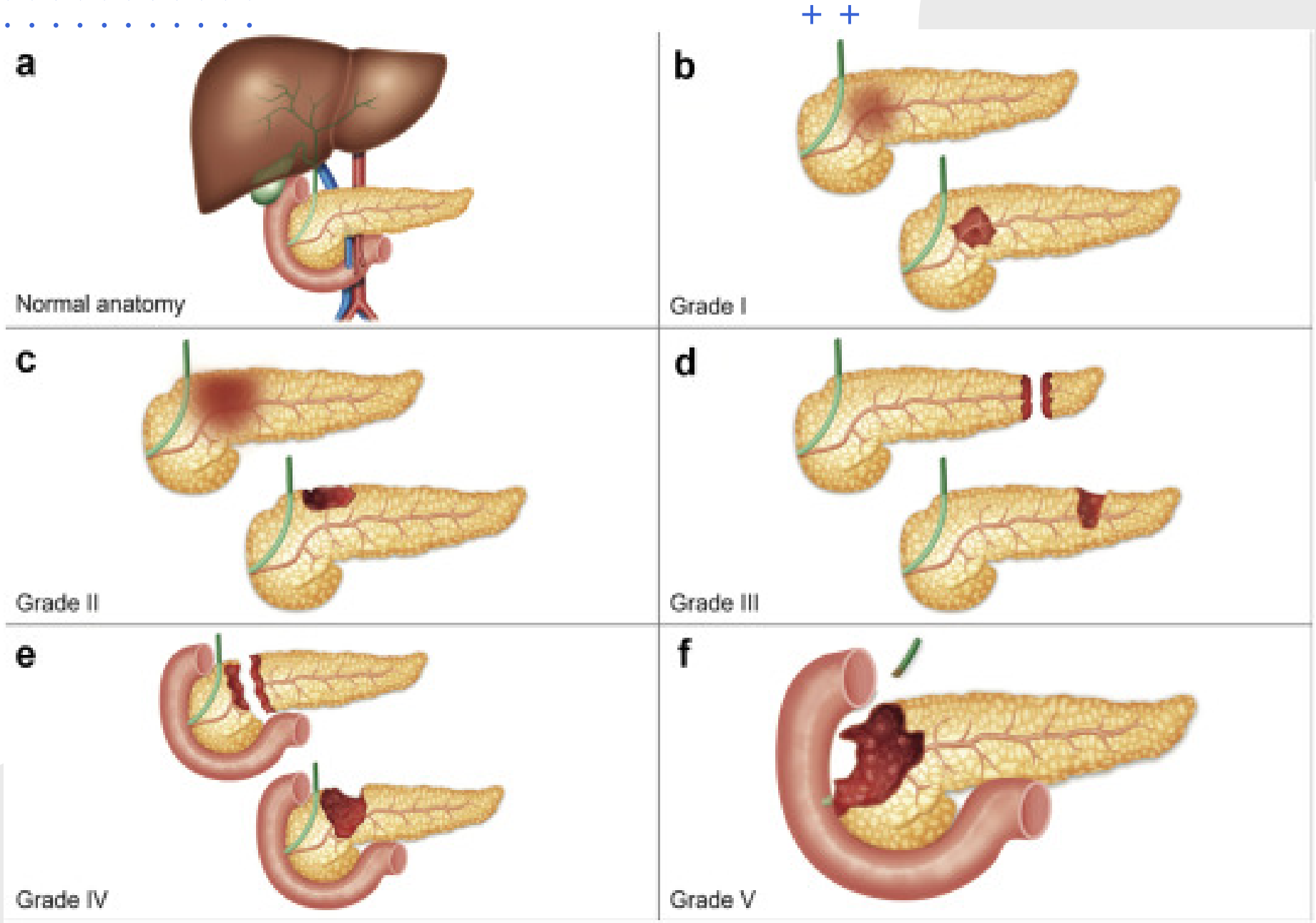


Grading system :

- A concomitant major vascular injury increases the likelihood of a poor outcome

OIS-AAST Grading Scale for the Pancreas

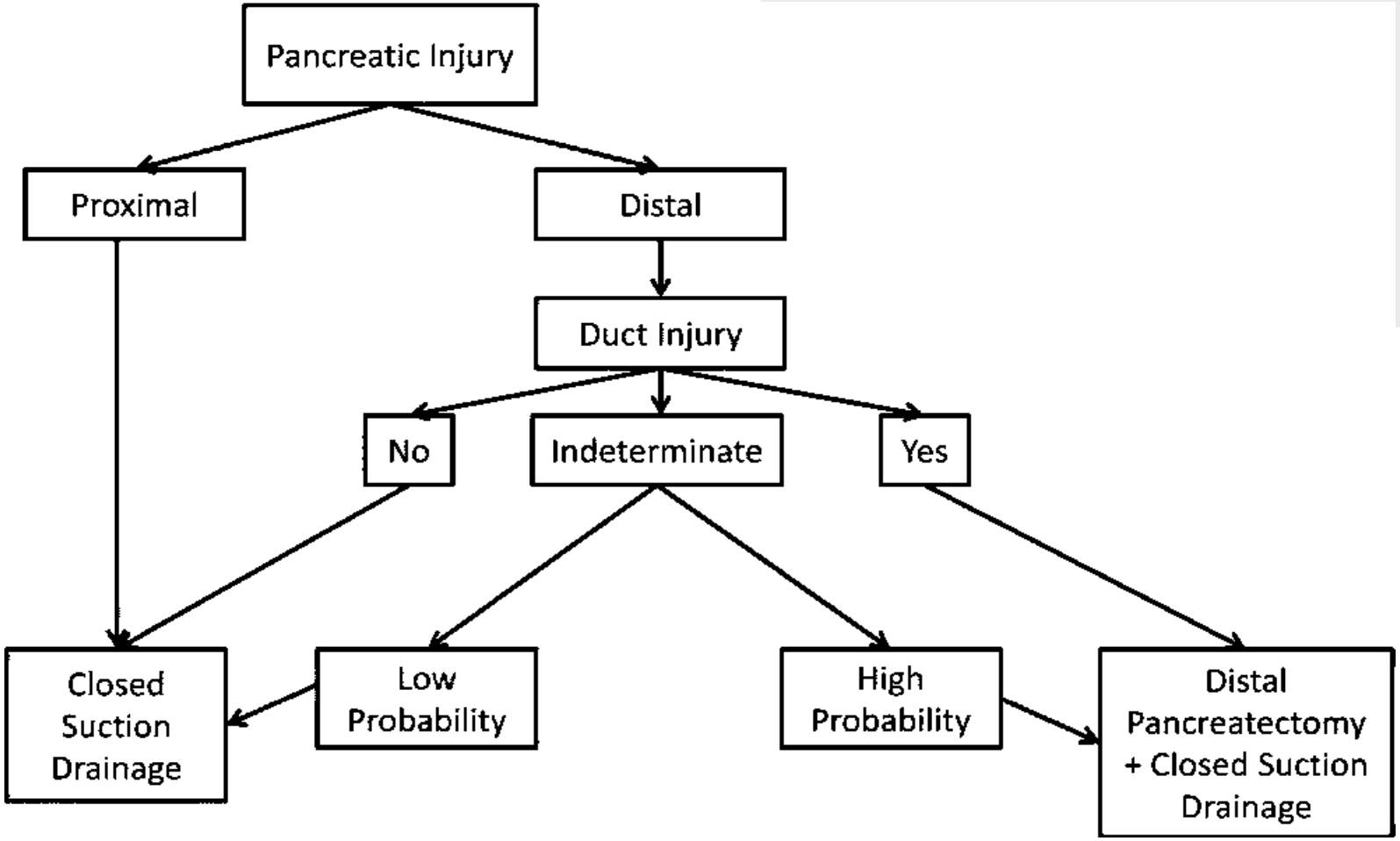
Grade[a]	Type	Injury Description
I	Hematoma	Minor contusion without duct injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal transection or parenchymal injury involving ampulla
V	Laceration	Massive disruption of pancreatic head


a
Normal anatomy
b
Grade I
c
Grade II
d
Grade III
e
Grade IV
f
Grade V

Management

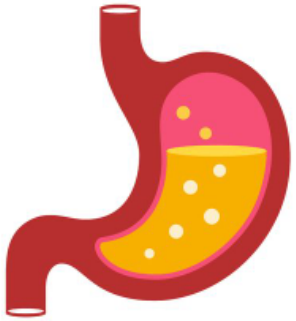
- The management of pancreatic trauma is determined by the mechanism of injury and the presence or absence of pancreatic duct injury. All penetrating injuries require operative management. However, most patients with isolated blunt trauma to the pancreas with an intact pancreatic duct can safely be managed non-operatively.
- Nonoperative management is safe for patients with blunt Grade I or Grade II injuries (contusion, superficial laceration)
- Surgery is generally recommended for patients who have ductal injury identified on computed tomography or cholangiopancreatography.

when injury to the pancreas is identified during abdominal exploration, the integrity of the main pancreatic duct should be evaluated and the location of the injury



Patients with significant injury to the head of the pancreas involving the proximal ducts may require debridement, or, rarely, more extensive surgery such as pancreaticoduodenectomy or pyloric exclusion.

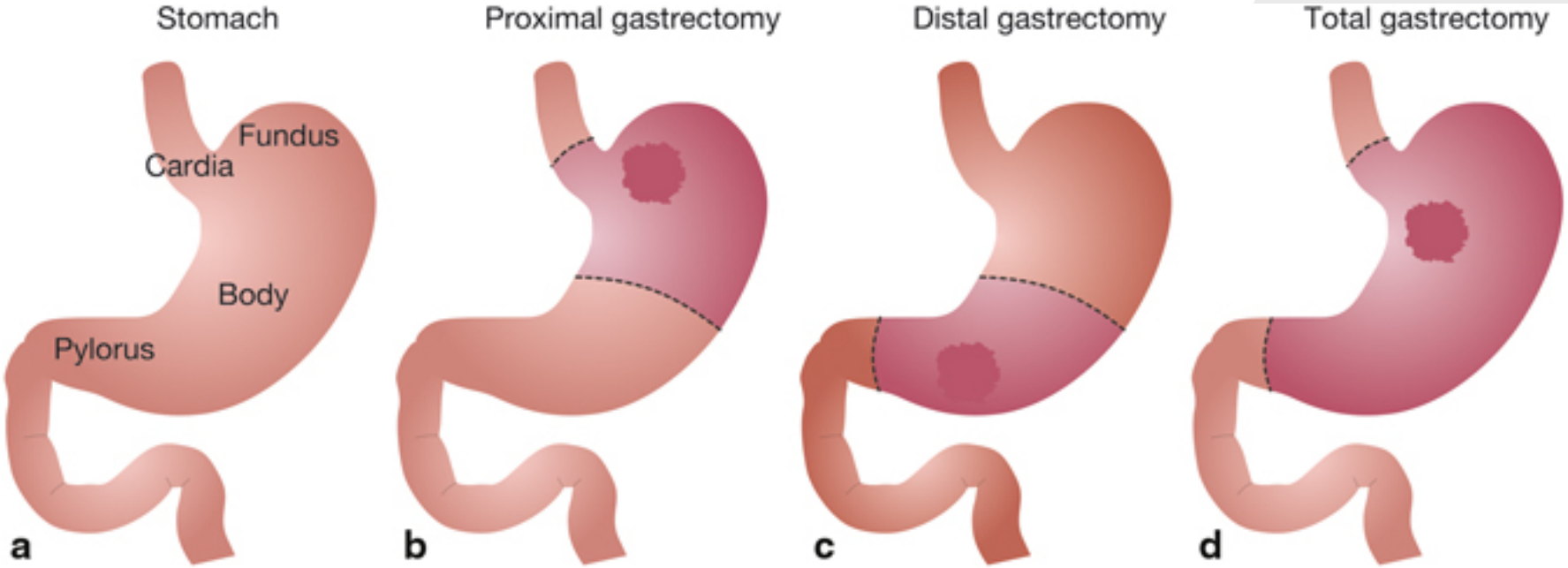
STOMACH



- Most of stomach injuries are penetrating trauma.
- Presence of blood upon placement of an NG tube is concerning for gastric injury. The majority of patients with full thickness gastric injury after trauma will present with spillage of gastric contents and peritonitis resulting in direct transfer to the operating room.
- Blunt injury to the stomach can cause local contusion with gastric wall hematoma or hollow viscus rupture, with a large full-thickness defect.

- After blunt or penetrating trauma, in the absence of peritonitis or hemodynamic instability, additional diagnostic workup with CT imaging is appropriate.
- CT scan findings concerning gastric injury include extraluminal contrast, air, blood, or fluid, or localized thickening, or enhancement and discontinuity of the gastric wall.

- After penetrating injury, if a single gastric injury is identified, the operating surgeon must assume there is an additional injury corresponding to the entry or exit site.
- Low-grade injuries including hematomas and contusions should be evaluated and evacuated as appropriate. After hematoma evacuation and hemostasis is achieved, the area may be reinforced with Lembert sutures. Fullthickness injuries can be repaired in one or two layers. A two-layered repair includes an inner layer of running absorbable suture and an outer layer of Lembert sutures.
- Significant destructive injuries or those involving the GE junction or pylorus may require a proximal or distal gastrectomy with reconstruction.


Stomach
Proximal gastrectomy
Distal gastrectomy
Total gastrectomy
Fundus
Cardia
Body
Pylorus
a
b
c
d

DUODENUM

- Rare , with high morbidity and mortality
- Additional intra-abdominal injury, most commonly of the liver, pancreas, and small bowel
- Majority are penetrating.
- Diagnosis made by imaging studies, typically computed tomography (CT) of the abdomen or exploratory laparotomy, as indicated by the clinical scenario (stable or unstable)

CT findings :

- Duodenal wall thickening
- Peri duodenal fluid
- Extraluminal air or contrast indicate duodenal perforation

Treatment :

- Most low-grade duodenal hematomas secondary to blunt trauma without perforation can be managed conservatively with NG tube decompression and supplemental nutrition.
- Lacerations need primary repair after debridement of dead tissue.
- Destructive injuries or multiple penetrating injuries need segmental resection followed by end-to end anastomosis.

COLON & RECTUM

- Relatively uncommon
- Definitive diagnosis is almost always **intraoperatively**

❑ Non-destructive colon and intraperitoneal rectal injuries:

 Primary closure

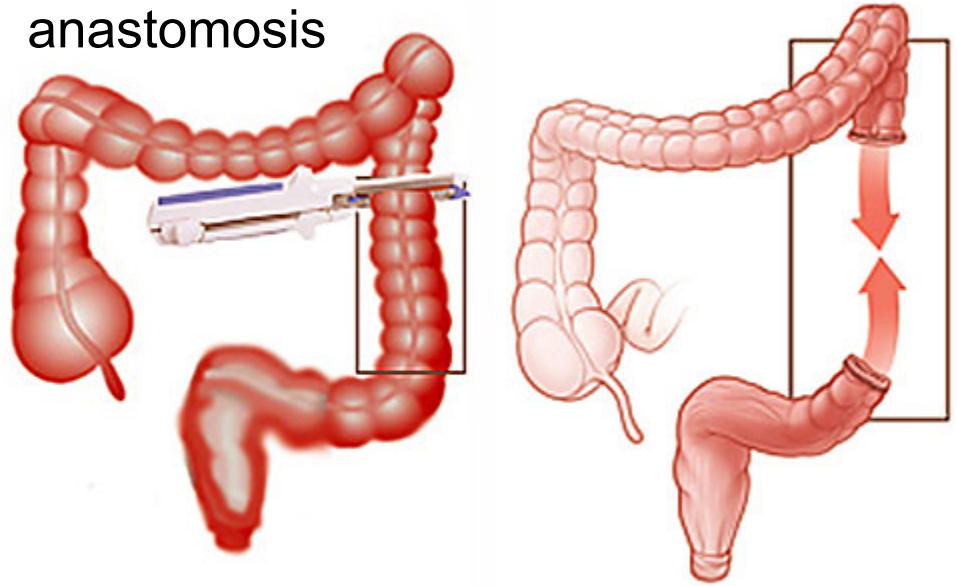
❑ Extra-peritoneal rectal injuries:

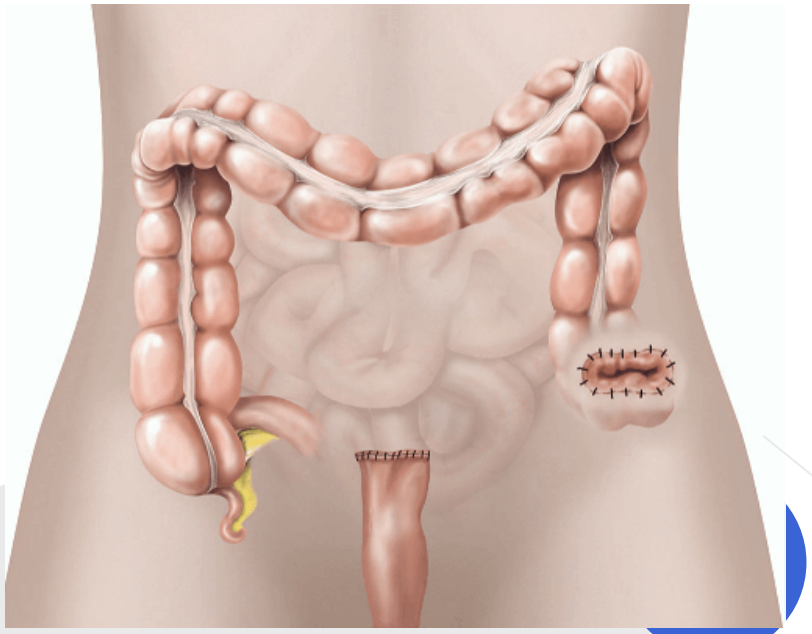
 Diverting colostomy alone may be adequate

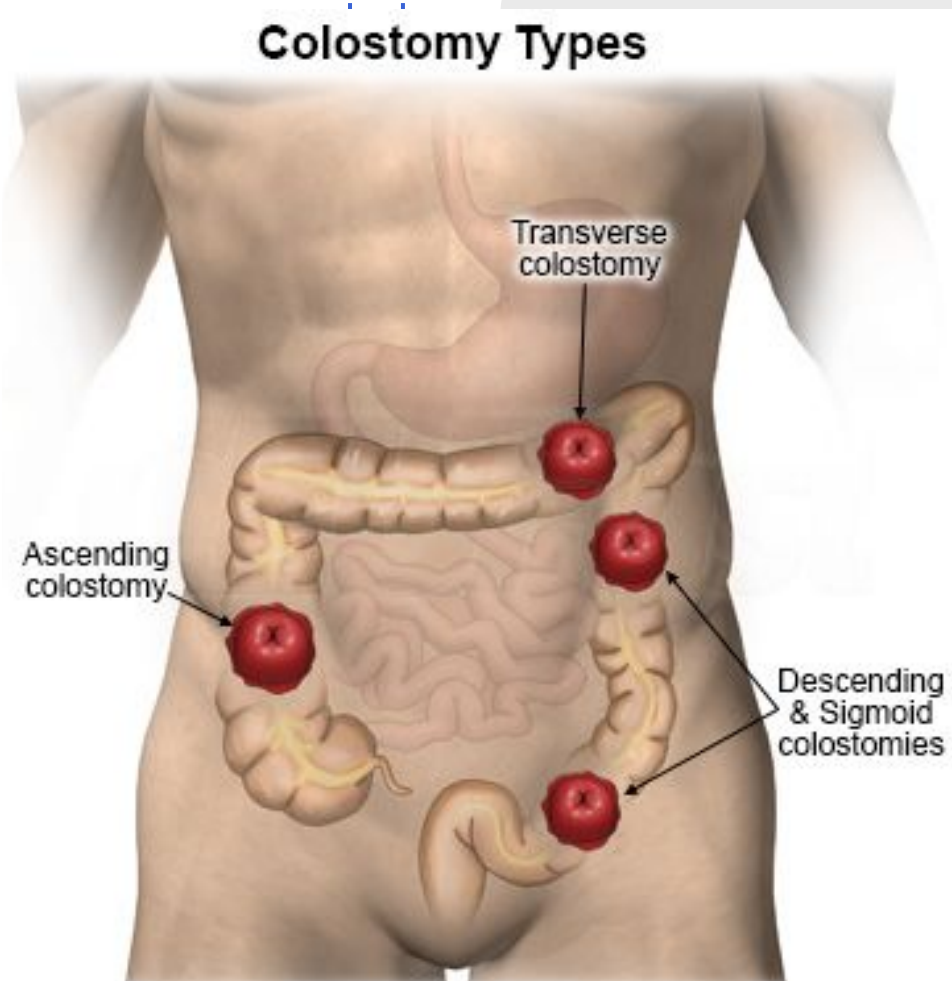
❑ Colon injuries not amenable to primary repair:

colon resection with primary anastomosis

colon resection with primary anastomosis







Hartmann Procedure

Rectal and genitourinary Trauma

RECTUM & GENITOURINARY

- Inspect the perineum of all patients for signs of injury.
- Traditionally, the digital rectal examination (DRE) was considered an essential part of the physical examination for all trauma patients.
- However, the sensitivity of the DRE for injuries of the spinal cord, pelvis, and bowel is poor, and false positive and negative results are common.
- Thus, **routine performance is unnecessary and generally unhelpful**.
- The examination is warranted in cases where urethral injury or penetrating rectal injury is suspected.
- If the examination is performed, **check for the presence of gross blood (sign of bowel injury), a high-riding prostate (sign of urethral injury), abnormal sphincter tone (sign of spinal cord injury), and bone fragments (sign of pelvic fracture).**

References

-The 10th edition of the Advanced Trauma Life Support (ATLS) Student Course Manual
-Bailey & Love's Short Practice of Surgery - 28th Edition
-Royal College of Surgeons of England
-NICE Guidelines
-Annual report of traffic accidents in Jordan for the year 2023, Public Security Directorate of Jordan

Thank you