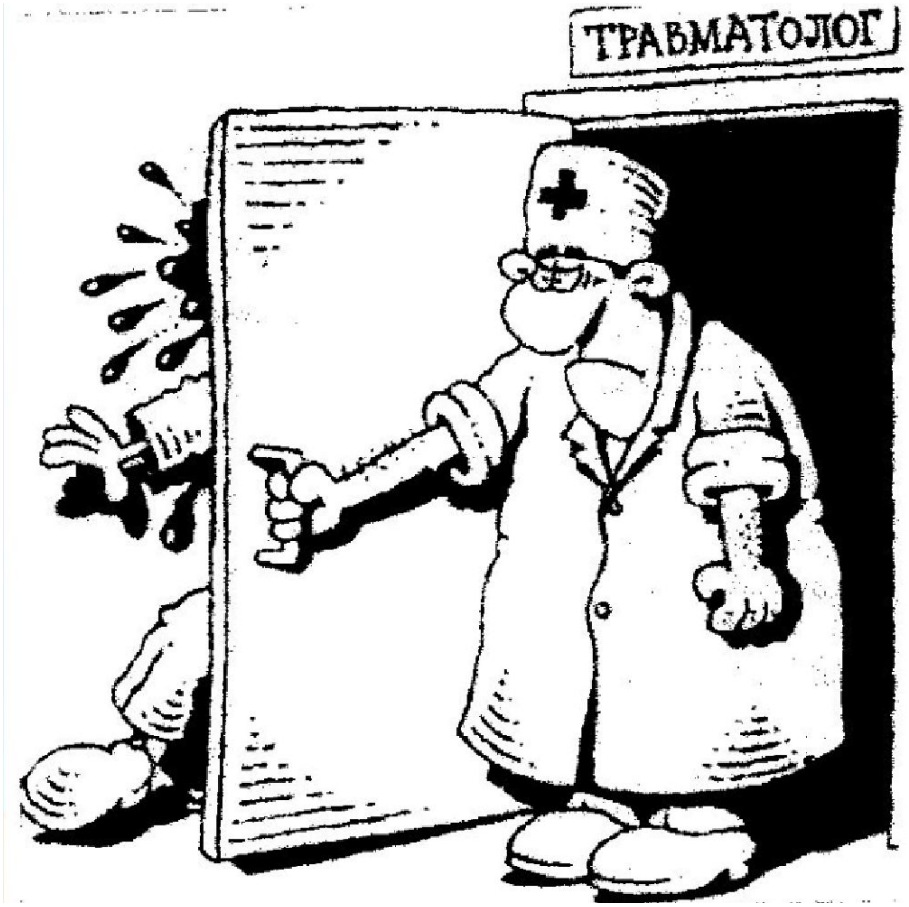
Trauma + ATLS



The Advanced Trauma Life Support (ATLS)

Safe and reliable method for the immediate treatment of injured patients

1. Assess a patient's condition rapidly and accurately

2. Resuscitate and stabilize patients according to priority

3. Determine whether a patient's needs exceed a facility's resources and/or a doctor's capabilities

4. Arrange appropriately for a patient's interhospital or intrahospital transfer (what, who, when, and how)

5. Ensure that optimal care is provided and that the level of care does not deteriorate at any point during the evaluation, resuscitation, or transfer processes

:ABCDE

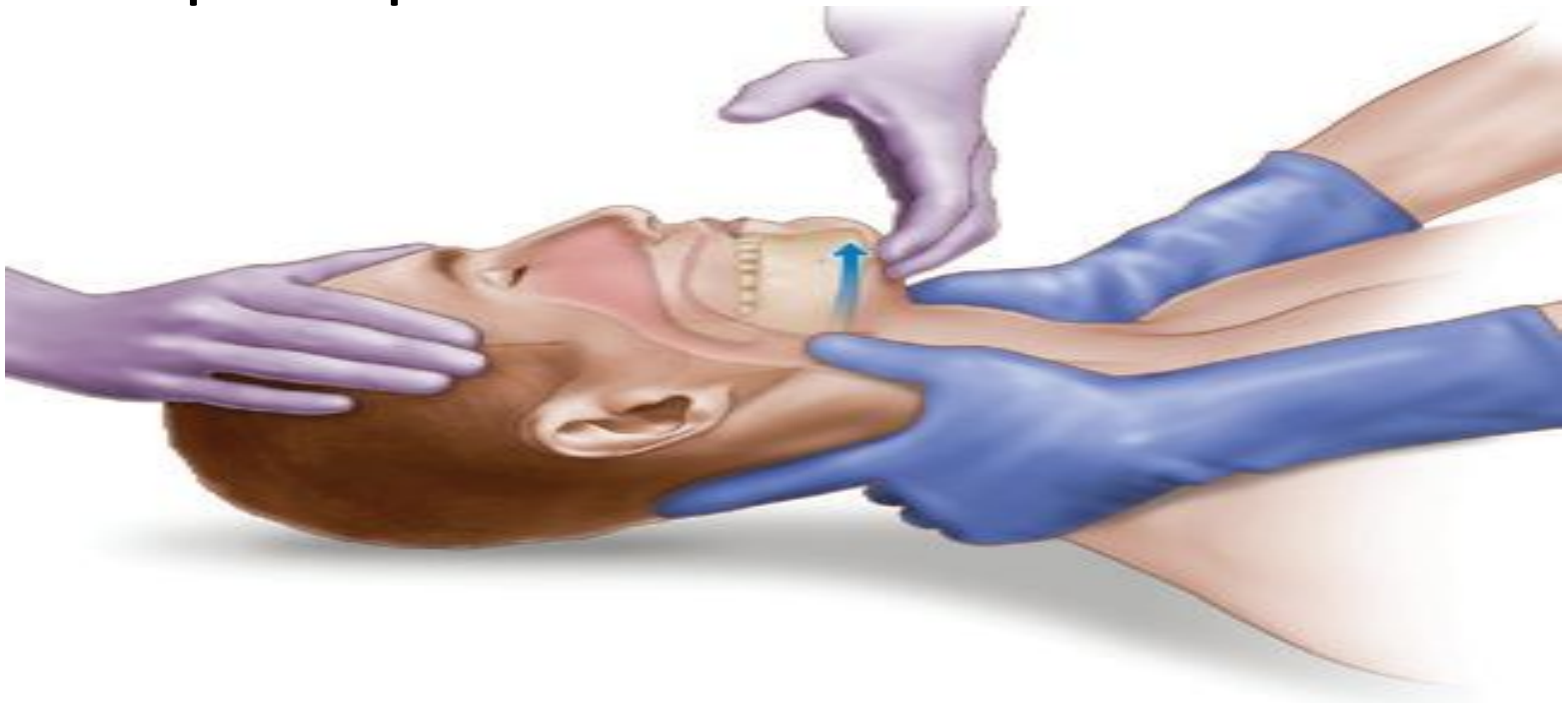
- Airway with cervical spine protection
- Breathing
- Circulation, stop the bleeding
- Disability or neurologic status
- Exposure (undress) and Environment (temperature control)

:A and B

- Speech


000#
00#
0#
1#
2#
3#
4#
5#
6#

- **Chin-Lift Maneuver:**
- In the chin-lift maneuver, the fingers of one hand are placed under the mandible, which is then gently lifted upward to bring the chin anterior. The thumb of the same hand lightly depresses the lower lip to open the mouth.



- **Jaw-Thrust Maneuver :** The jaw-thrust maneuver is performed by grasping the angles of the lower jaw, one hand on each side, and displacing the mandible forward

Rapid sequence intubation (RSI)

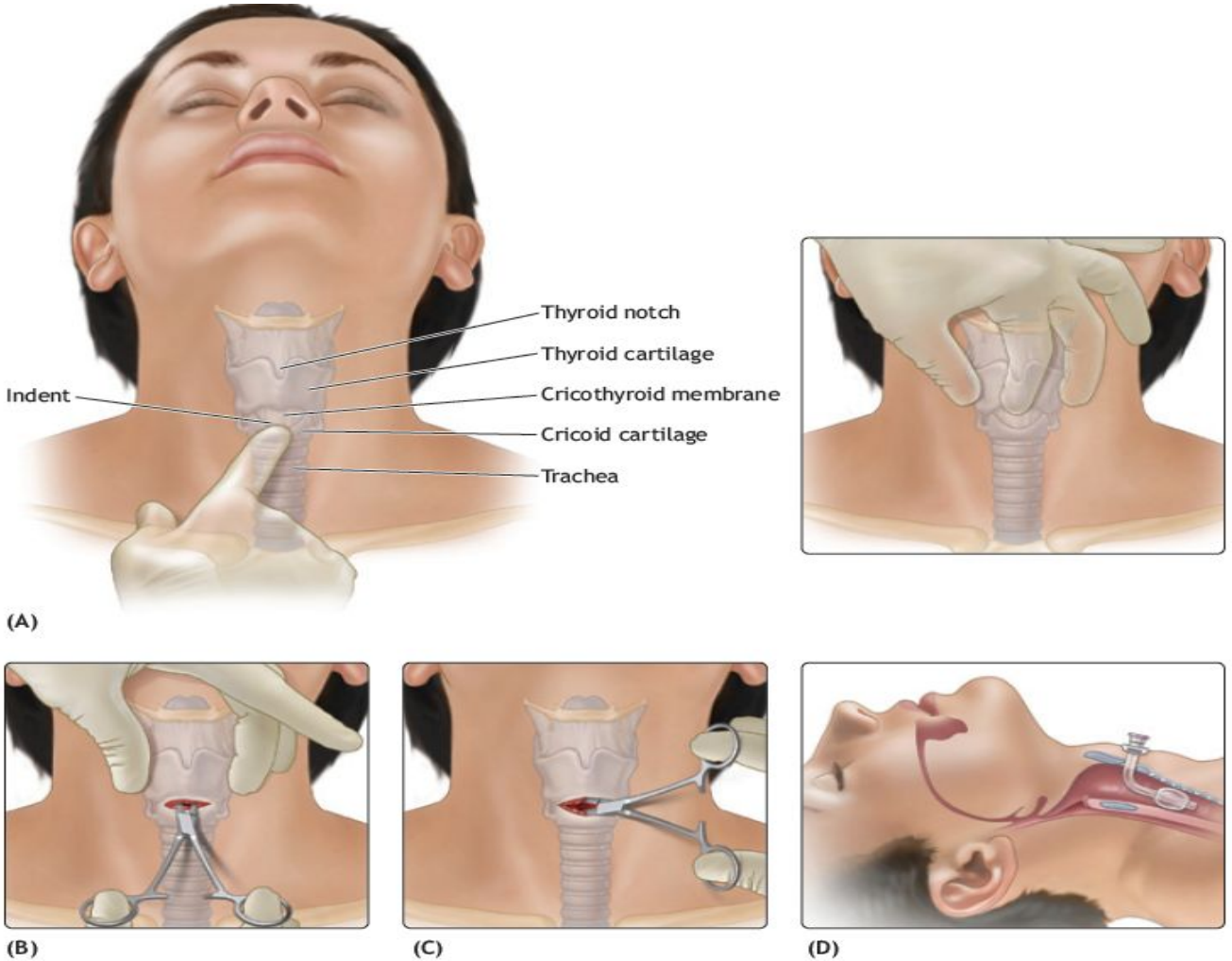
The technique for rapid sequence intubation (RSI) is as follows:

- **1.** Have a plan in the event of failure that includes the possibility of performing a surgical airway.
- **2.** Ensure that suction and the ability to deliver positive pressure ventilation are ready.
- **3.** Preoxygenate the patient with 100% oxygen.
- **4.** Apply pressure over the cricoid cartilage.
- **5.** Administer an induction drug (e.g., etomidate, 0.3 mg/kg) or sedate, according to local practice.
- **6.** Administer 1 to 2 mg/kg succinylcholine intravenously (usual dose is 100 mg).
- **7.** After the patient relaxes, intubate the patient
- **8.** Inflate the cuff and confirm tube placement by auscultating the patient's chest and determining the presence of CO2 in exhaled air.
- **9.** Release cricoid pressure.
- **10.** Ventilate the patient.

- Approximate PaO2 Versus O2 Hemoglobin Saturation Levels

PaO2 LEVELS	**O2 HEMOGLOBIN SATURATION LEVELS**
90 mm Hg	100%
60 mm Hg	90%
30 mm Hg	60%
27 mm Hg	50%

Surgical Cricothyroidotomy



B: Breathing

- Evaluation:
  - visualizing chest movement
  - auscultating breath sounds
  - measuring oxygen saturation

What if problematic ?

THINK ON:

- **Tension pneumothorax**
- **Massive hemothorax**
- **Flail chest with pulmonary contusion**

Tension pneumothorax:

- **deviation of the tracea,**
- **unilaterally diminisched / abscent breathing sound**

 Large needle or thoracostomy!

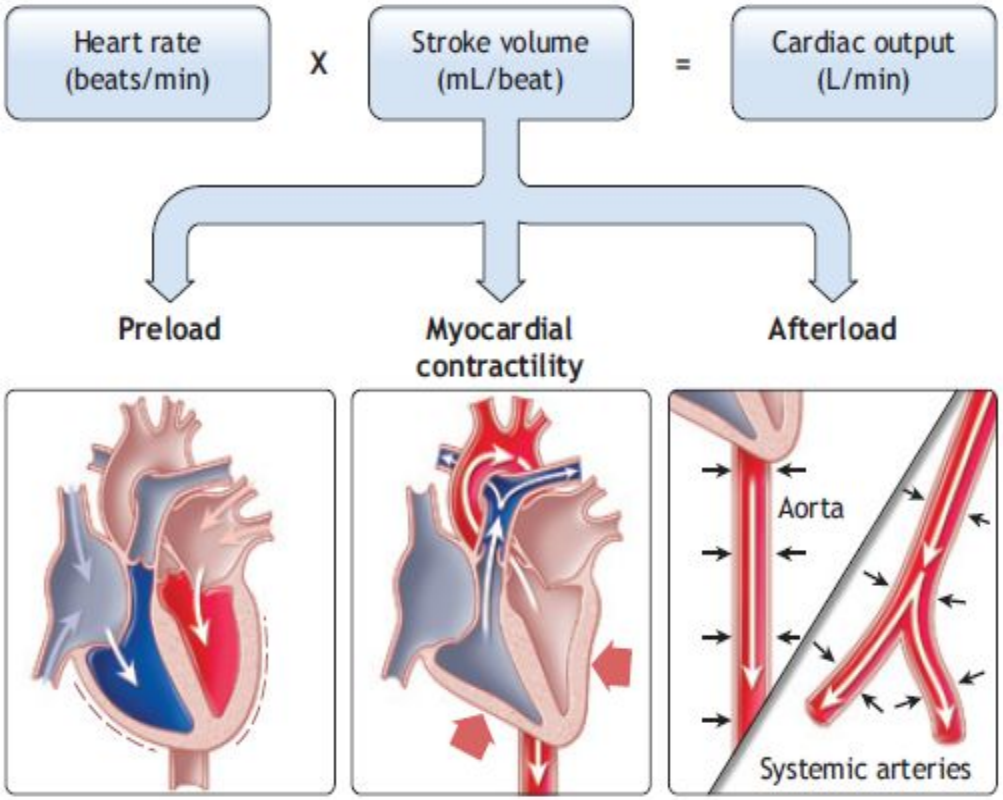
:Massice hemothorax

Thoracostomy evacuation of blood re-expansion of the .lung

:Severe pulmonary Contusion

aggressive mechanical ventilation, often with elevated levels of positive end expiratory .pressure

C-circulation



■ FIGURE 3-1 Cardiac Output.

- In most cases, tachycardia is the earliest measurable circulatory sign of shock

BOX 16-3 Indicators of Shock in the Injured Patient

Agitation or confusion
Tachycardia
Tachypnea
Diaphoresis
Cool, mottled extremities
Weak distal pulses
Decreased pulse pressure
Decreased urine output
Hypotension

CLASSIFICATION	SPECIFIC CLINICAL CAUSES
Hypovolemic	Hemorrhage, trauma, third-space loss (burns, pancreatitis, bowel obstruction)
Obstructive	Pericardial tamponade, tension pneumothorax, pulmonary embolus
Cardiogenic	Myocardial infarct, cardiac failure, arrhythmias, blunt cardiac injury
Distributive	sepsis, neurogenic, anaphylaxis
Endocrine	Adrenal insufficiency

TABLE 3.1 Estimated Blood Loss[1] Based on Patient's Initial Presentation

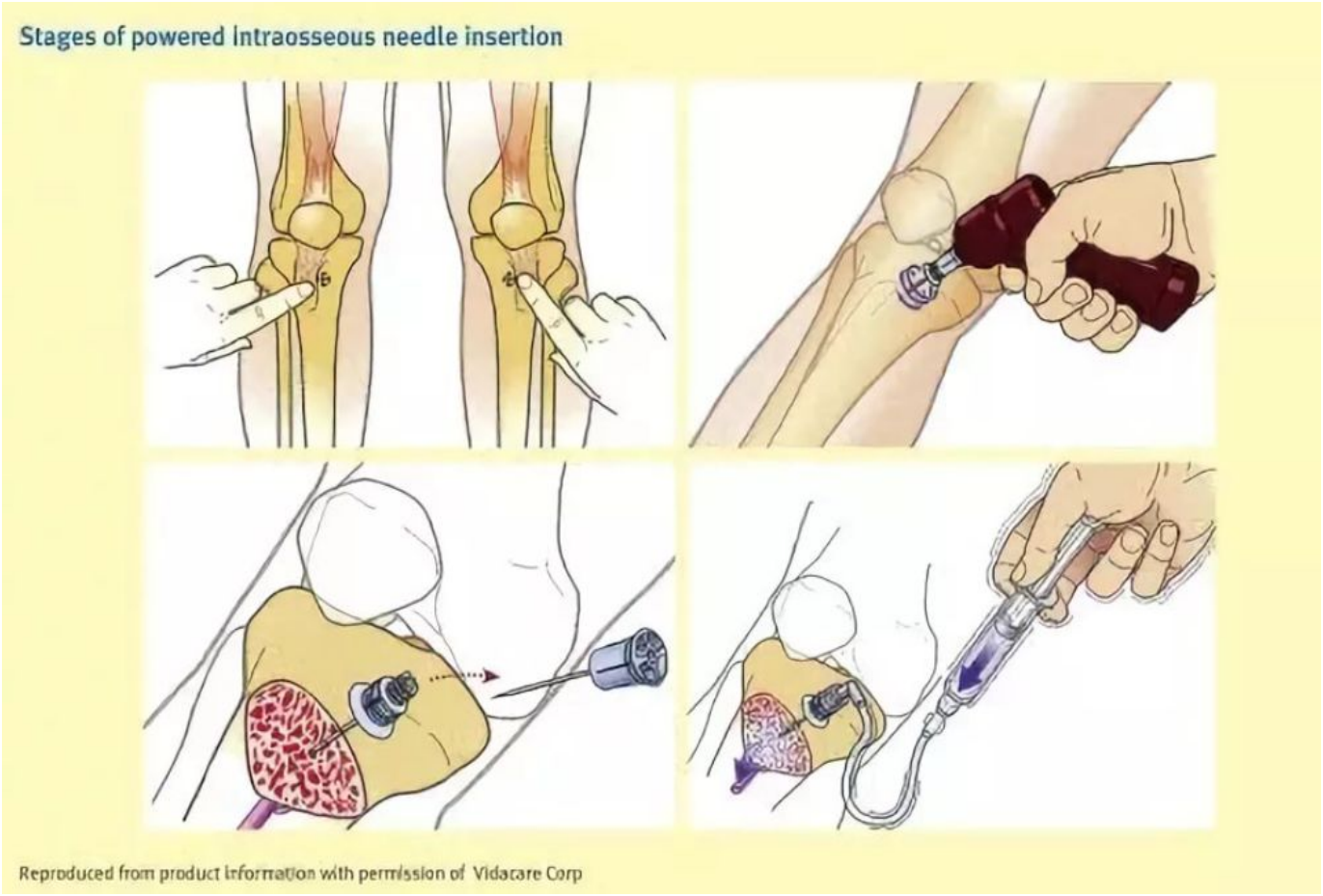
	CLASS I	CLASS II	CLASS III	CLASS IV
Blood loss (mL)	Up to 750	750–1500	1500–2000	>2000
Blood loss (% blood volume)	Up to 15%	15%–30%	30%–40%	>40%
Pulse rate (BPM)	<100	100-120	120-140	>140
Systolic b pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mm Hg)	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate	14–20	20–30	30–40	>35
Urine output (mL/hr)	>30	20–30	5–15	Negligible
CNS/mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic
Initial fluid replacement	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

TABLE IV.1 INITIAL ASSESSMENT AND SHOCK MANAGEMENT

CONDITION	ASSESSMENT (PHYSICAL EXAMINATION)	MANAGEMENT
Tension pneumothorax	• Tracheal deviation • Distended neck veins • Tympany • Absent breath sounds	• Needle decompression • Tube thoracostomy
Massive hemothorax	• Tracheal deviation • Flat neck veins • Percussion dullness • Absent breath sounds	• Venous access • Volume replacement • Surgical consultation/thoracotomy • Tube thoracostomy
Cardiac tamponade	• Distended neck veins • Muffled heart tones • Ultrasound	• Venous access • Volume replacement • Thoracotomy • Pericardiocentesis
Intraabdominal hemorrhage	• Distended abdomen • Uterine lift, if pregnant • DPL /ultrasonography • Vaginal examination	• Venous access • Volume replacement • Surgical consultation • Displace uterus from vena cava
Obvious external bleeding	• Identify source of obvious external bleeding	• Direct pressure • Splints • Closure of actively bleeding scalp wounds

:C

- Venous access
- Intraosseous



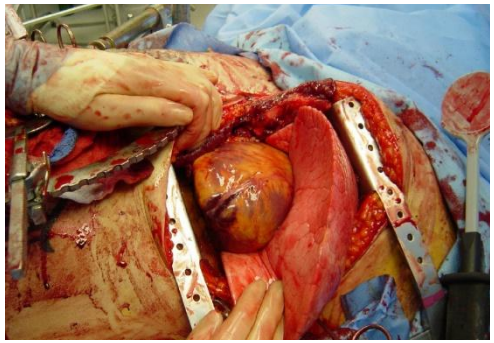
C: Circulation

5 Life-threating blood loss causes:

- external blood loss
- chest
- abdomen,
- Retroperitoneum (pelvi fracture)
- multiple long bone fractures

- **5 Life-threating blood loss causes:**
  - external blood loss
  - Chest Tube thoracostomy
  - Abdomen ustable = operation
    - Retroperitoneum (pelvic fracture) stabilization of the Fx
    - pelvic volume with a binder
    - pelvic angiography +/- embolization
  - multiple long bone fractures

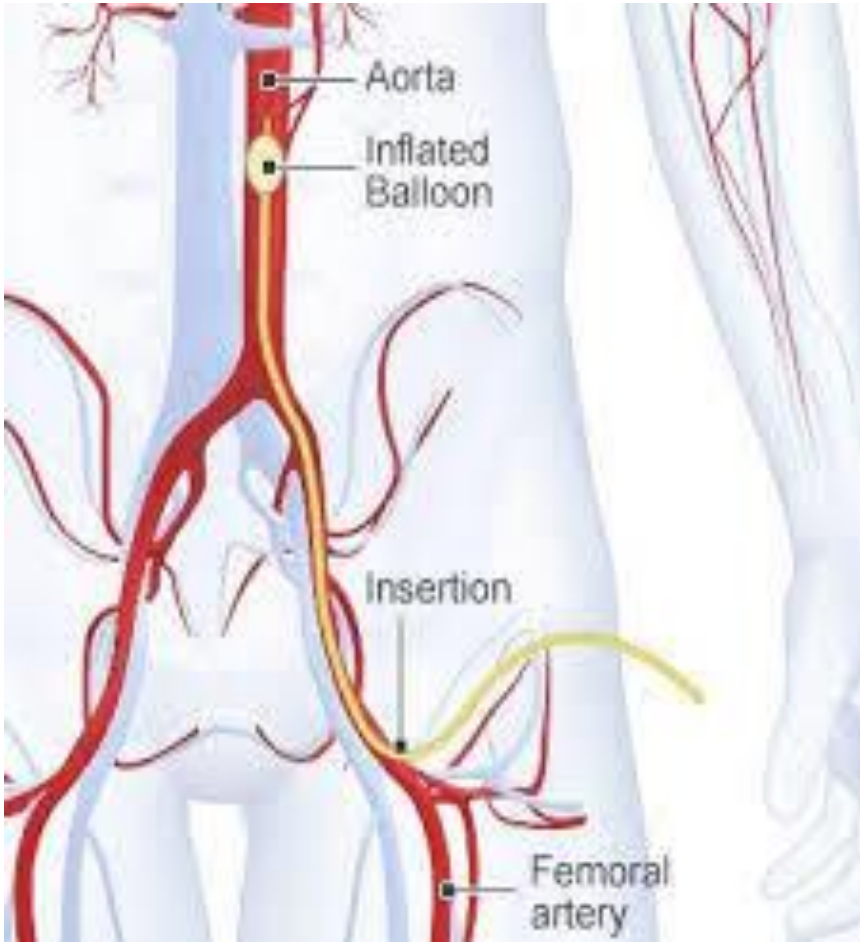
Resuscitative Thoracotomy



- When? □ critic injury and Cardiac arrest
- For what?
  - Opportunity to open pericardium □ relieves tamponade
  - internal cardiac massage
  - cross-clamp the distal thoracic aorta (better perfusion for Brain and heart)
  - manage intrathoracic bleeding
- who profits?
  - The most: penetrating thoracic injury + sign of life on arrival 35% success rate

REBOA
resuscitative endovascular balloon occlusion of the aorta

- Obtainig temporary hemorrhage control in the agonal patient
- Used in setting of aortic aneurysms rupture



D

TABLE 16-2 Glasgow Coma Scale		
Eye Opening	Spontaneous	4
	To voice	3
	To pain	2
	None	1
Verbal Response	Oriented	5
	Confused	4
	Inappropriate	3
	Incomprehensible	2
	None	1
Motor Response	Obeys commands	6
	Localizes pain	5
	Withdraws to pain	4
	Flexion	3
	Extension	2
	None	1
Total Glasgow Coma Scale Score		3-15

Шкала Глазго для оценки степени угнетения сознания

Критерии	Характер реакции	Оценка
Открывание глаз	Спонтанное	4
	В ответ на словесный приказ	3
	В ответ на болевое раздражение	2
	отсутствует	1
Двигательная активность	Целенаправленная на словесный приказ	6
	Целенаправленная на болевое раздражение	5
	Нецеленаправленное на болевое раздражение	4
	Патол. тоническое сгибание в ответ на болевое раздраж.	3
	Патол. тоническое разгибание в ответ на бол. раздраж.	2
	Отсутствие двигательной реакции на болевое раздраж.	1
Словесные ответы	Сохранность ориентировки, быстрые прав. ответы	5
	Спутанная речь	4
	Отдельные невнятные слова, неадекватные ответы	3
	Нечленораздельные звуки	2
	Отсутствие речи	1

D: Disability

Neurological function evaluation:

Neurogenic shock?

Spinal cord injury?

Body temprature?

Keep the patient warm!

E:

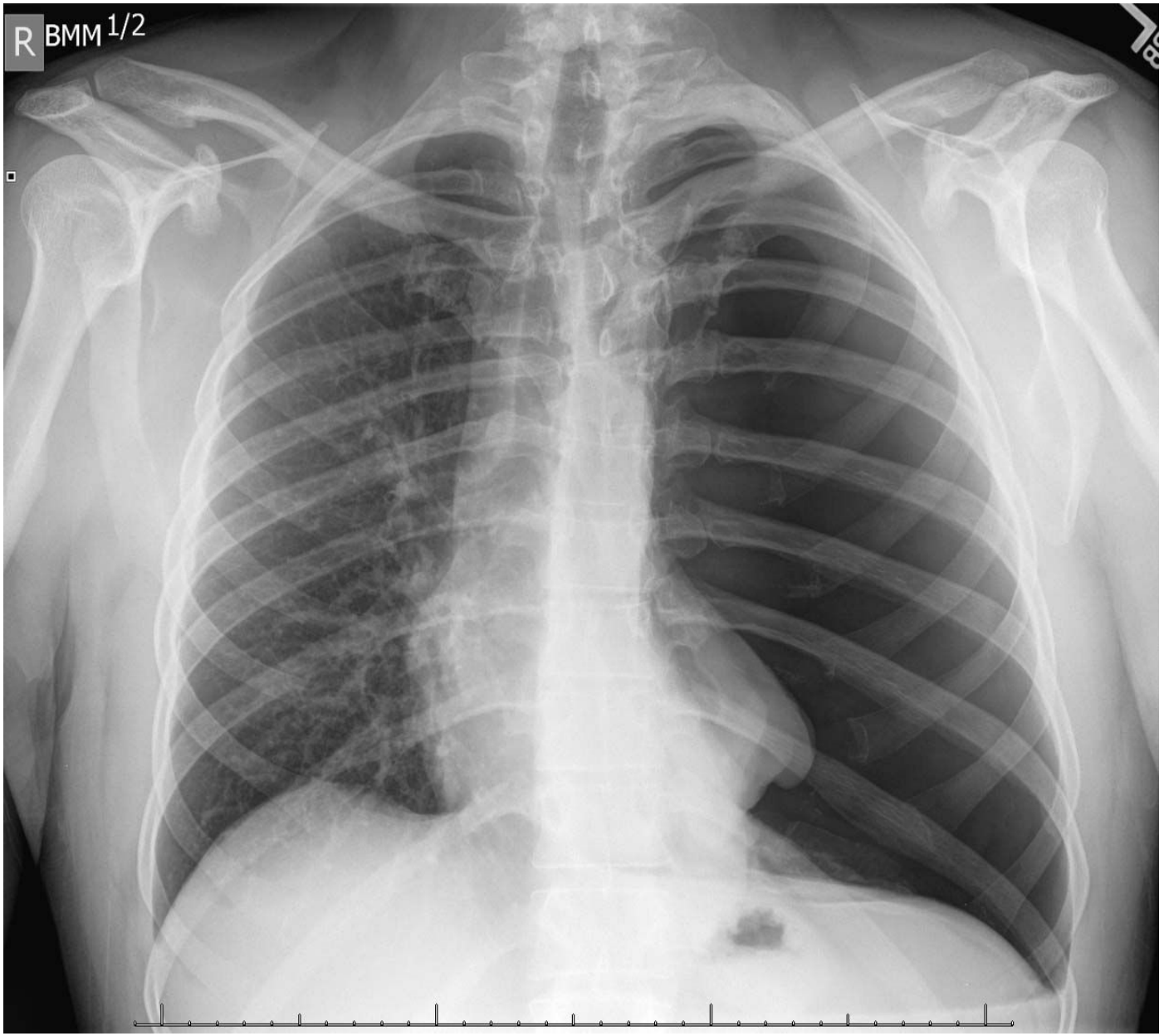
- Head to toe
- PR
- Xray
- FAST
- NGT
- Urine catheter

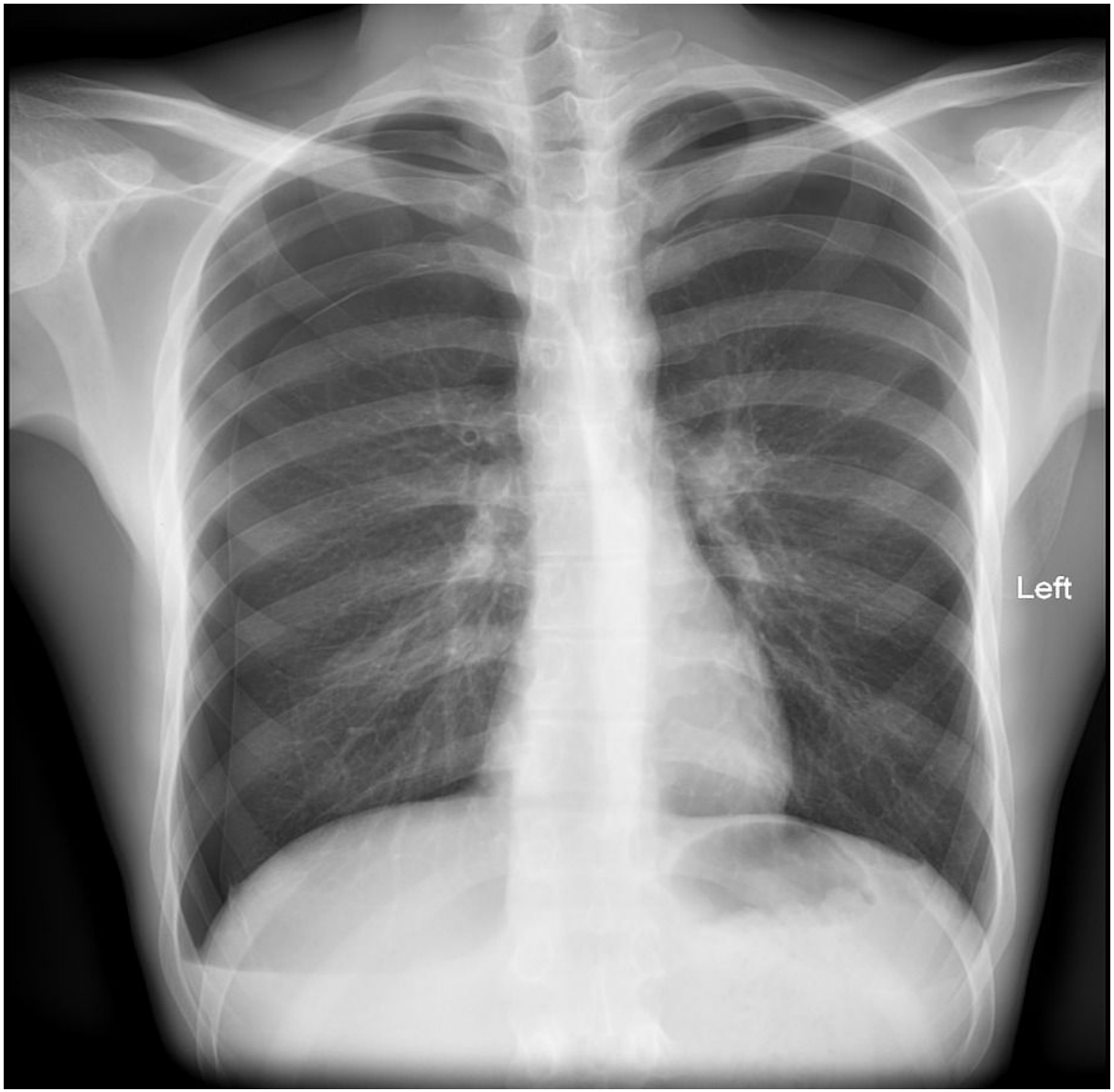

A

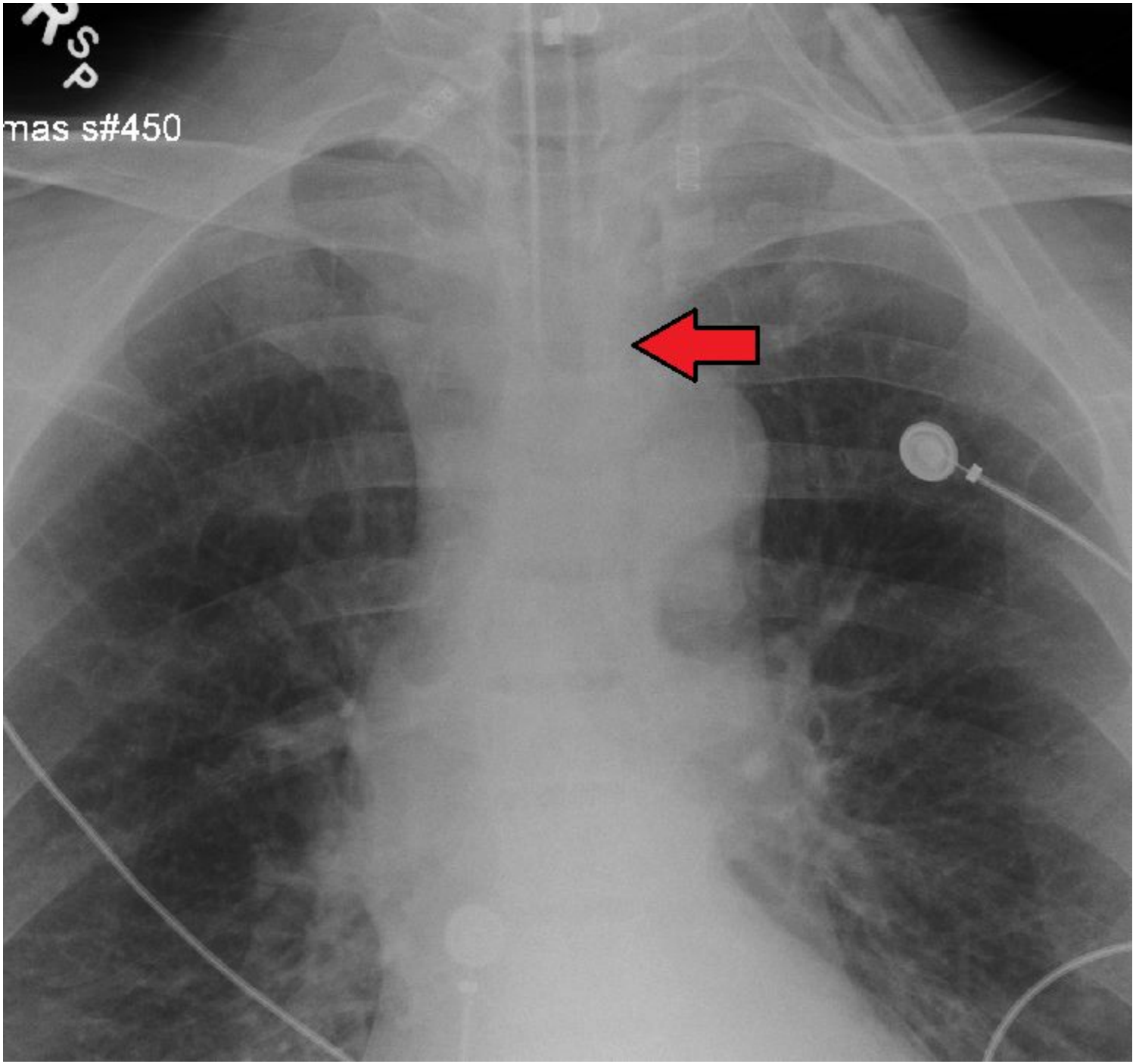

B


C


D


R
BMM 1/2


Left


SP
mas s#450


C


A


B

FAST

- Focused abdominal sonography in trauma:

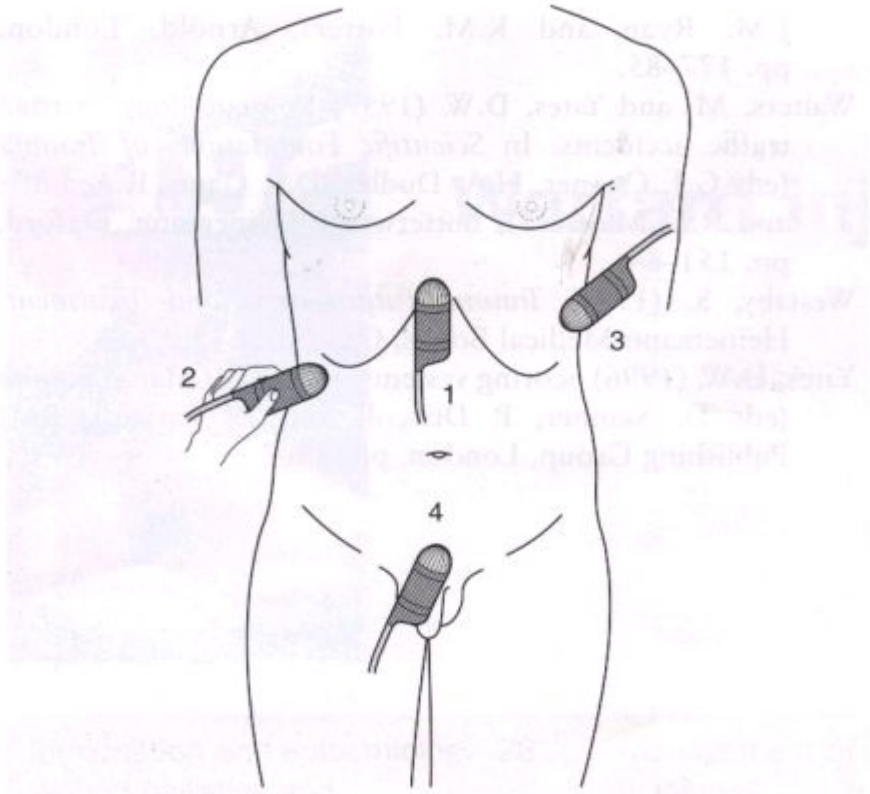
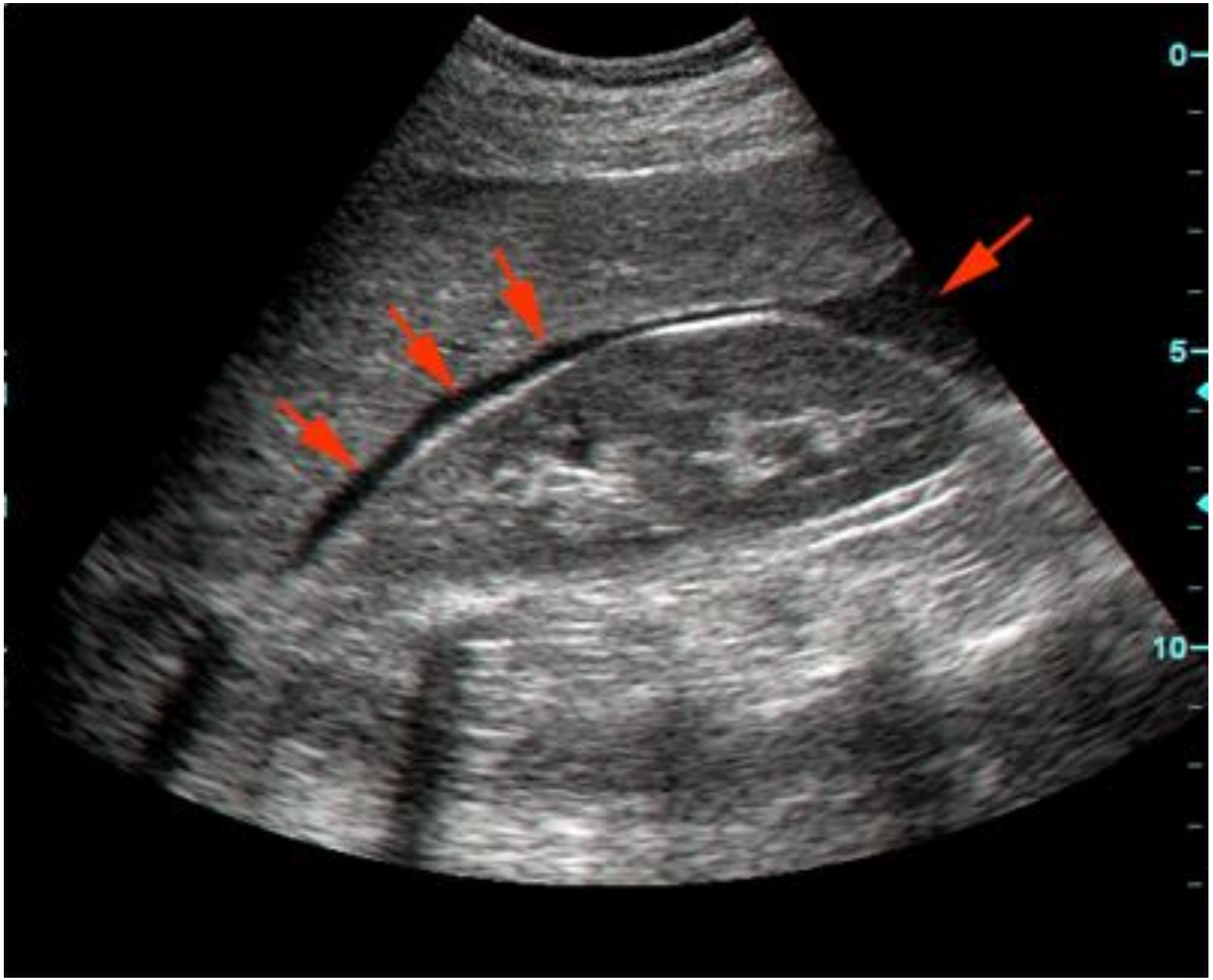
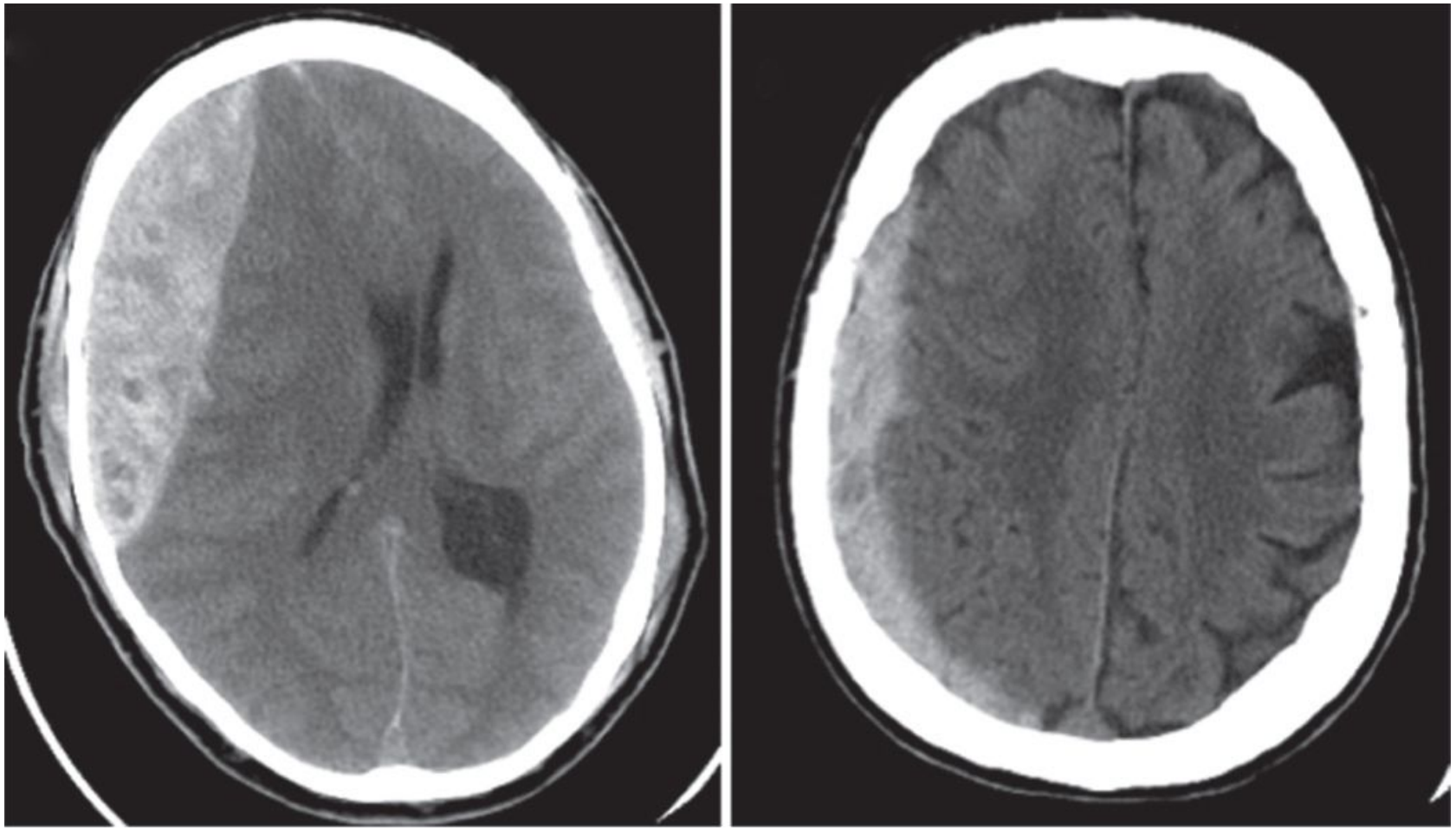


Fig. 18.5 The four areas to be scanned during focused abdominal sonogram for trauma (FAST). The aim is to rule out cardiac tamponade, the presence of free blood and solid organ disruption.

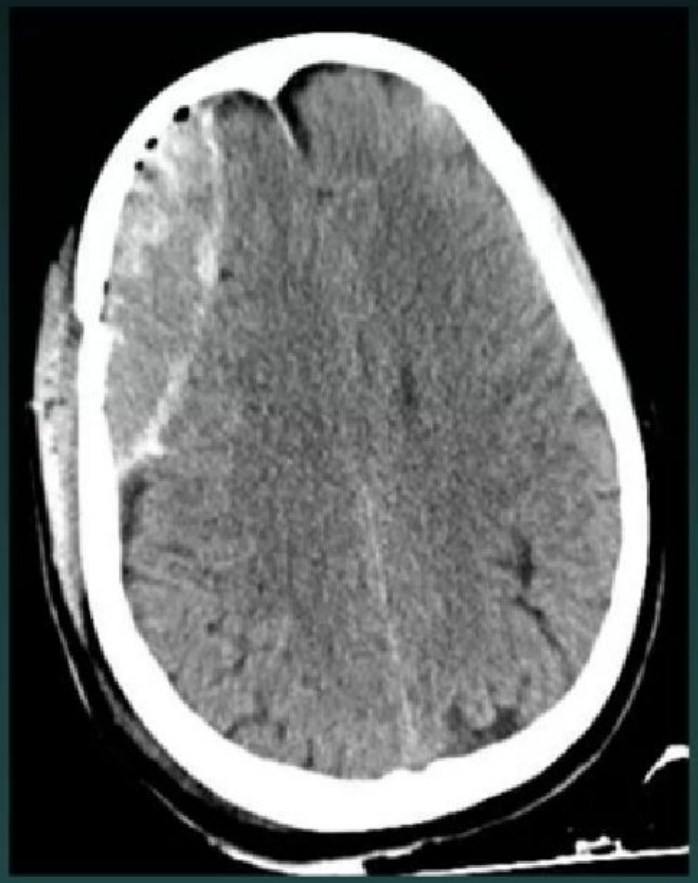

0
5
10

Initial Assessment

HEAD INJURY



Epidural Hematoma



- Injury to epidural vessel
  - Arterial bleeding
- Lentiform shape
- Does not cross sutures
  - May cross falx or tentorium
- Look for:
  - FRACTURE
  - RAPID EXPANSION

- Epidural hematomas typically result from a lateral fracture of the cranium causing bleeding from the middle meningeal artery or a nearby vessel.

- Classically, the clinical course consists of an initial loss of consciousness followed by a lucid interval, during which time the hematoma is expanding. On reaching a significant size, the epidural hematoma causes profound neurologic deterioration.

- Treatment with decompression
- Underlying brain tissue is often not severely injured in the setting of an epidural hematoma.

- Subdural hematomas are commonly caused by tearing of the bridging veins between the dura mater and the cerebral cortex.

- Although the hematoma itself can be compressive, it is usually the underlying brain contusion and axonal injury that predict the outcome after these injuries which commonly are associated with severe underlying brain tissue injury


ge:45 years
0 Oct 2010
8:20:57
ER/OSA/IC
3 cm
VP:120
nA:250
nsec:1000
nAs:250
hk:5 mm
Vitrea
W/L:104/
P

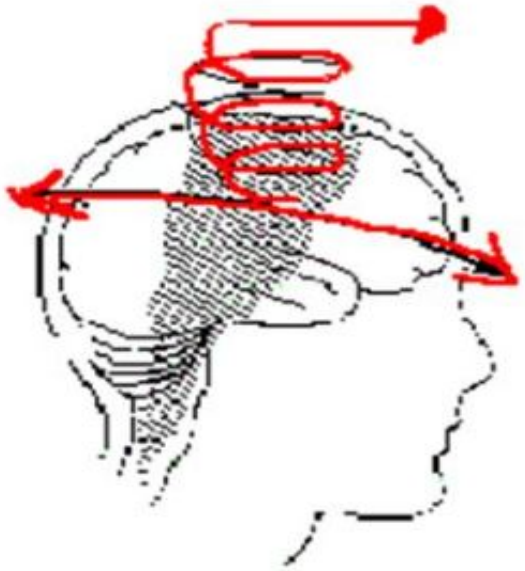
- Parenchymal contusions of brain tissue result from the direct transmission of energy to the cranium and underlying brain as well as from movement of the brain within the rigid cranial vault, resulting in injury on the opposite side

- Secondary brain injury resulting from cerebral edema is the greatest cause of morbidity after intraparenchymal contusion.

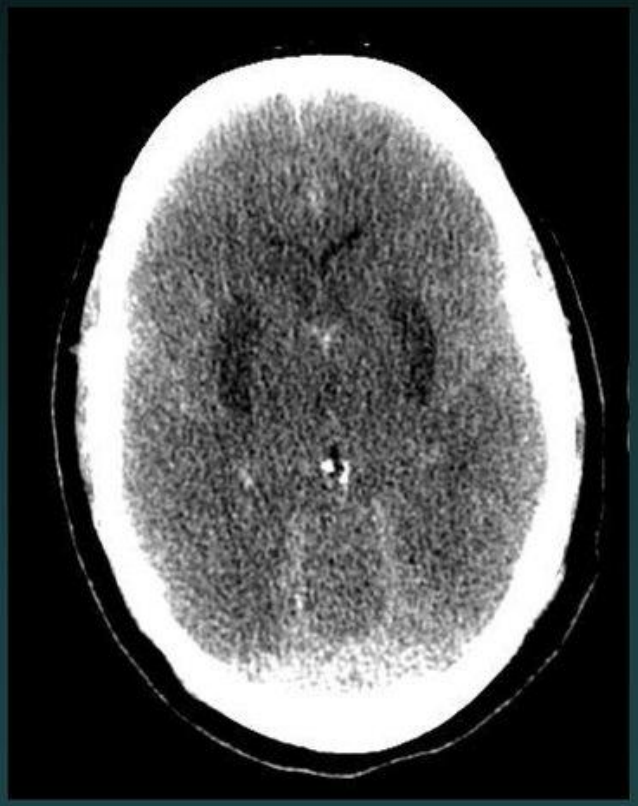
Diffuse axonal injury describes the phenomenon of disruption of the axon from the neuronal body secondary to severe rotational forces that are believed to create a shearing effect

Diffuse Axonal Injury

Brain injury does not require a direct head impact. During rapid acceleration of the head, some parts of the brain can move separately from other parts. This type of motion creates shear forces that can destroy axons necessary for brain functioning.

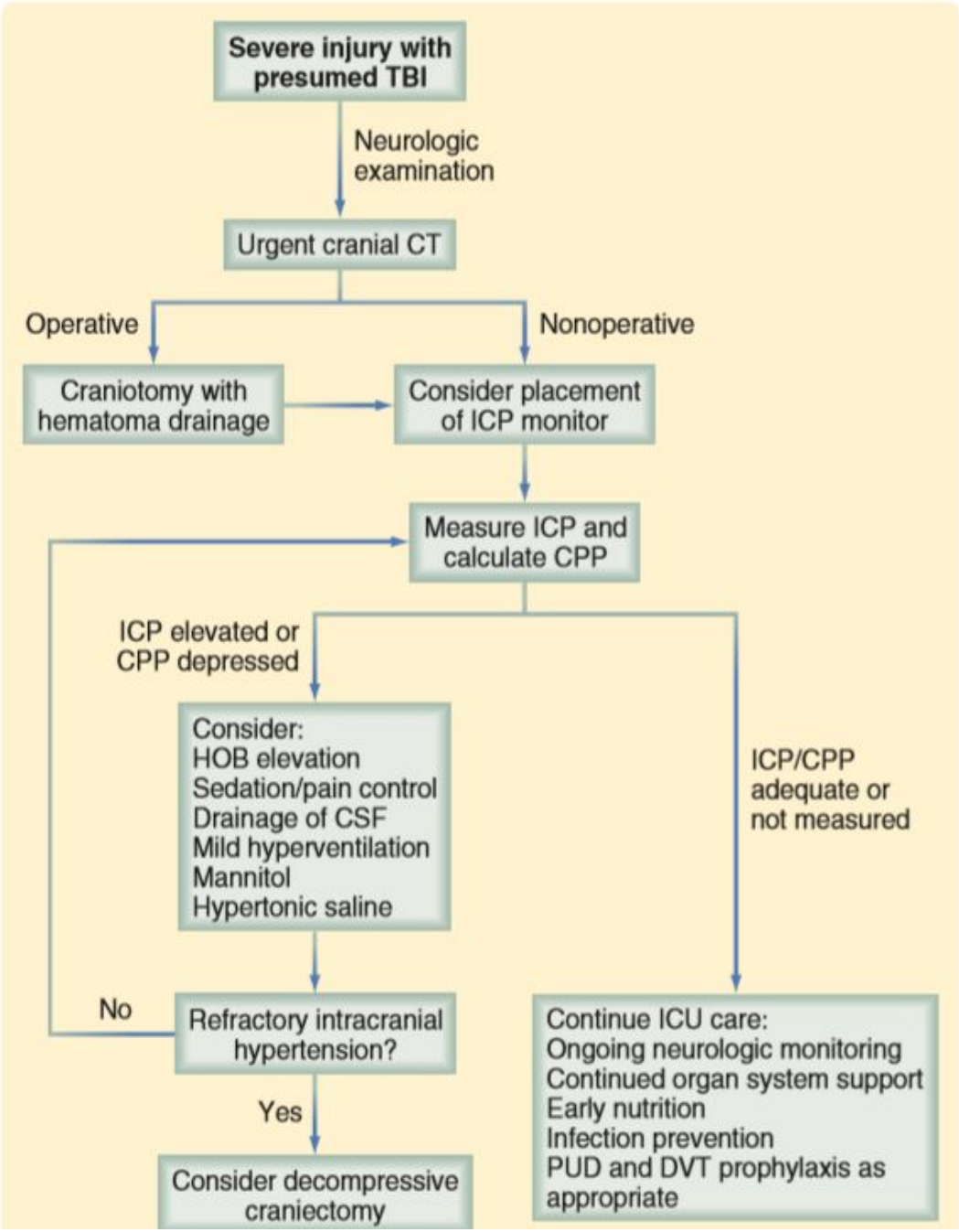


Anoxic brain injury



- Loss of Gray-White
- Progresses with worsening edema
- PseudoSAH
- Hydrocephalus
- Cisterns compressed

Traumatic Brain Injury



- pupils reactivity
- A, B, C management
- CT without Contrast agent
- Usually Epi-/ subdural OP!
- ICP- Monitoring
- ICU
- CV + Pul. Func. Opt.
- CCP = MAP-ICP
- Guide of severe TBI
- Ventriculostomy
- Hyperventilation
- Sedation + pain control
- Hyperosmolar therapy = hypertonic saline Mannitol
- Paralysis + barbiturate coma

Cerebral Perfusion Pressure

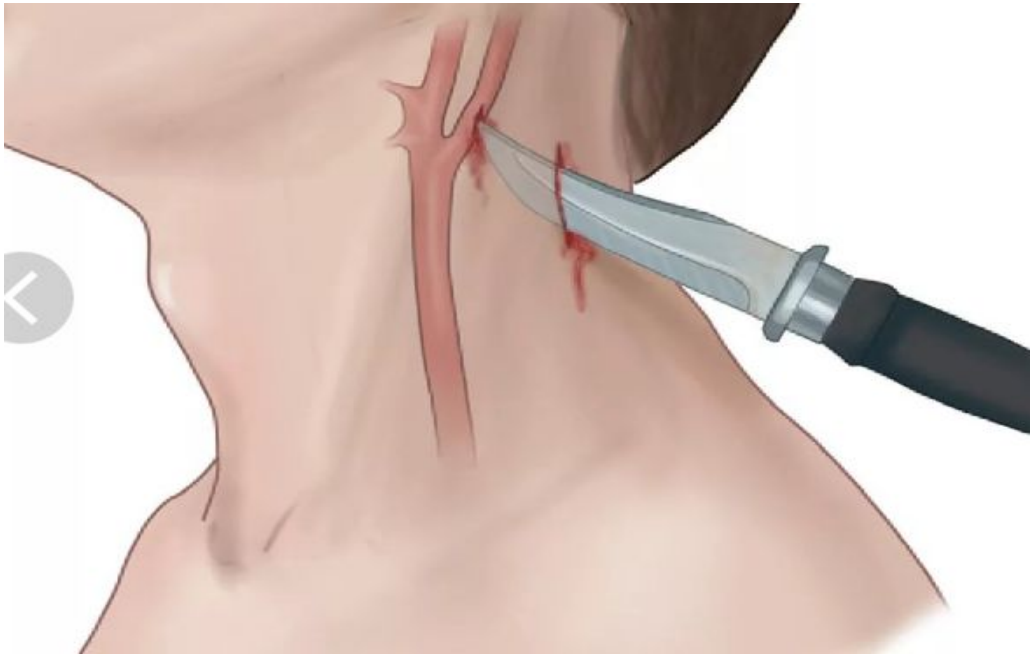
- CPP = MAP – ICP
- More important than ICP value

- Normal CPP range is 70 – 100 mmHg
  - CPP < 60 = ischemia
  - CPP < 40 = infarct
  - CPP – 0 = brain death

Injuries to the Neck

- Neck injuries are uncommon but result in the highest mortality rate of all body regions (20.0% mortality)

- Penetrating injuries from gunshot and stab wounds are the most common mechanism of injury. Penetrating injuries can directly lacerate vascular and aerodigestive structures.



- Blunt mechanisms can cause compression, with fracture of the larynx or trachea. Blunt pharyngeal or esophageal injuries are even less common.

- Blunt force to the neck can cause injury to the carotid or vertebral arteries. These blunt cerebrovascular injuries (BCVIs) result from seat belt compression or severe flexion-extension mechanisms.

- BCVI severity ranges from intimal tears, with or without thrombosis, to full-thickness injury with pseudoaneurysm formation.

- The morbidity associated with a BCVI predominantly includes stroke secondary to thromboembolism that is caused by the disrupted vessel wall

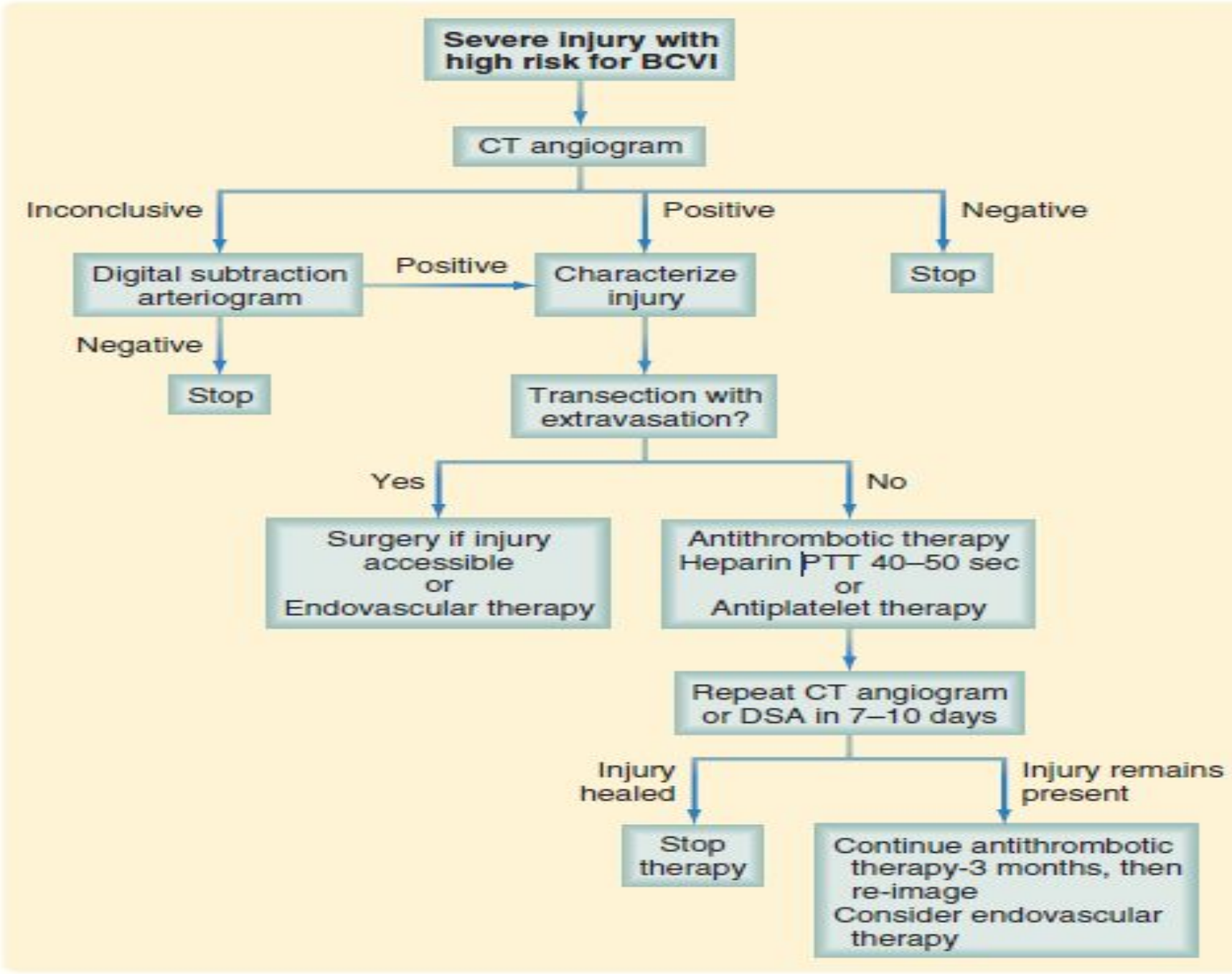
BOX 16-4 Indicators of High Risk for Blunt Cerebrovascular Injury

Signs and Symptoms

Expanding neck hematoma
Arterial hemorrhage from neck, nose, or mouth
Focal neurologic deficit
Cervical bruit (patient < 50 years old)
Stroke on CT or MRI
Neurologic deficit unexplained by CT findings

Risk Factors

Severe midface fracture, Le Fort II or III
Basilar skull fracture involving the carotid canal
Diffuse axonal injury and GCS score ≤ 6
Significant cervical spine fracture or ligamentous injury
Significant soft tissue injury to anterior neck (i.e., seat belt mark)
Near-hanging with anoxia


Severe injury with high risk for BCVI
CT angiogram
Inconclusive
Positive
Negative
Digital subtraction arteriogram
Positive
Characterize injury
Stop
Negative
Stop
Transection with extravasation?
Yes
No
Surgery if injury accessible or Endovascular therapy
Antithrombotic therapy Heparin PTT 40–50 sec or Antiplatelet therapy
Repeat CT angiogram or DSA in 7–10 days
Injury healed
Injury remains present
Stop therapy
Continue antithrombotic therapy-3 months, then re-image
Consider endovascular therapy

Neck Injury

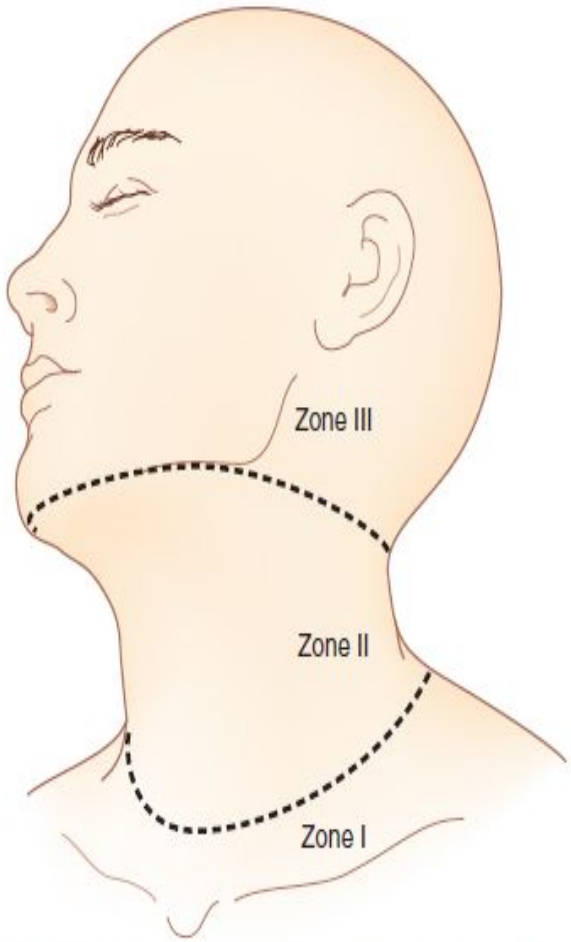
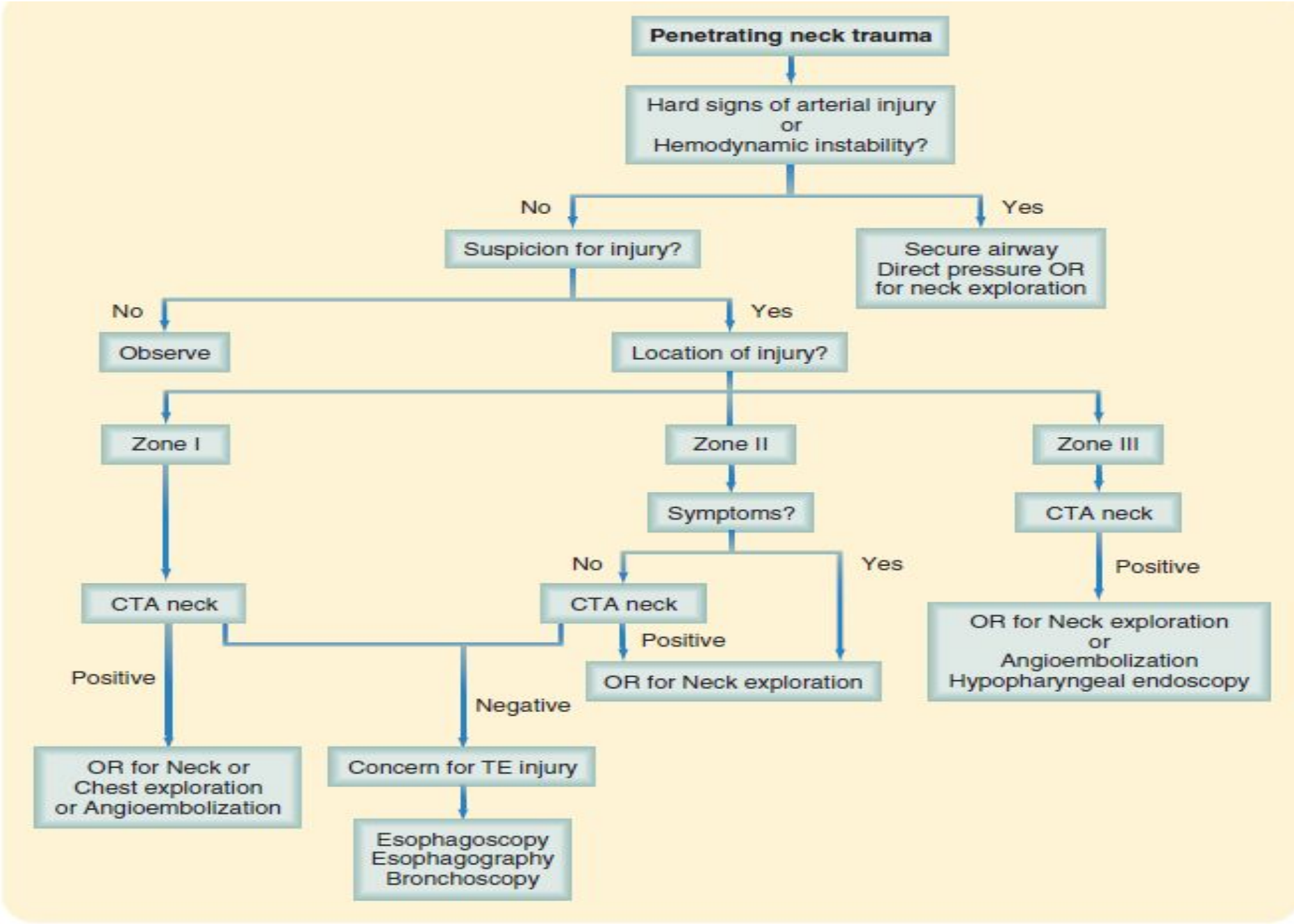


FIGURE 16-12 **Zones of the Neck.** Zone 1 extends from the thoracic inlet to the cricoid cartilage. Zone 2 is between the cricoid cartilage and the angle of the mandible. Zone 3 extends from the angle of the mandible to the skull base.

- Zone I: from the thoracic inlet to the cricoid cartilage and contains large vascular structures as well as the trachea and esophagus.
- Zone II: contains the carotid and vertebral arteries, jugular veins, and structures of the aerodigestive tract.
- Zone III: blood vessels that are difficult, to expose surgically.


Penetrating neck trauma
Hard signs of arterial injury or Hemodynamic instability?
No
Yes
Suspicion for injury?
Secure airway Direct pressure OR for neck exploration
No
Yes
Observe
Location of injury?
Zone I
Zone II
Zone III
Symptoms?
CTA neck
No
Yes
CTA neck
CTA neck
Positive
Positive
OR for Neck exploration
OR for Neck exploration or Angioembolization Hypopharyngeal endoscopy
Negative
OR for Neck or Chest exploration or Angioembolization
Concern for TE injury
Esophagoscopy Esophagography Bronchoscopy

CHEST INJURY

- With more than 65% of blunt trauma patients sustaining one or more rib fractures, chest wall injuries are the most common thoracic injury.

- The mortality rate associated with chest wall injuries after blunt trauma is approximately 7%, whereas it exceeds 19% for penetrating injuries

- **Flail Chest :** This condition usually results from trauma associated with multiple rib fractures—that is, two or more adjacent ribs fractured in two or more places.

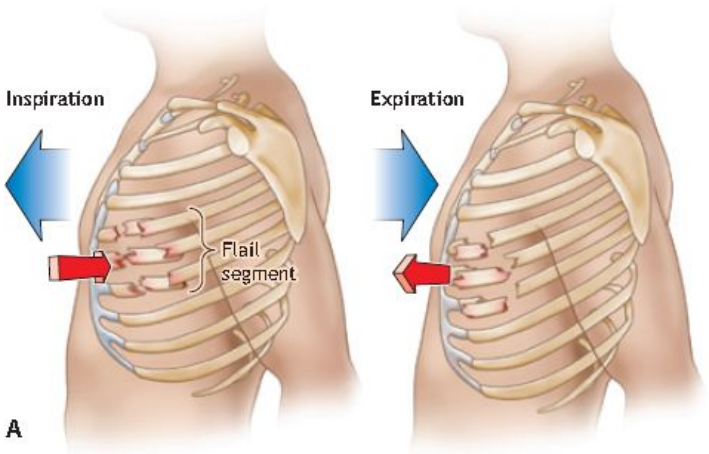
- The presence of a flail chest segment results in disruption of normal chest wall movement. Although chest wall instability can lead to paradoxical motion of the chest wall during inspiration and expiration, this defect alone does not cause hypoxia.

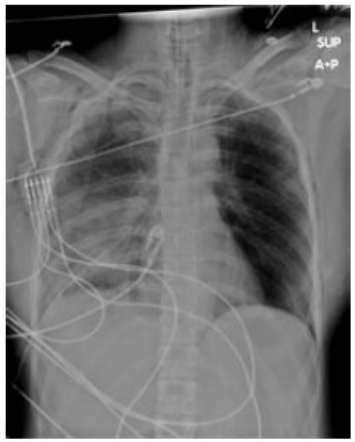
Flail chest

- > Solitary independent movement of the Fx
- Paradoxical breathing
- Hypoxemia due to pulmonary contusion
- High mortality rate - 33% - especially old patients

Management:

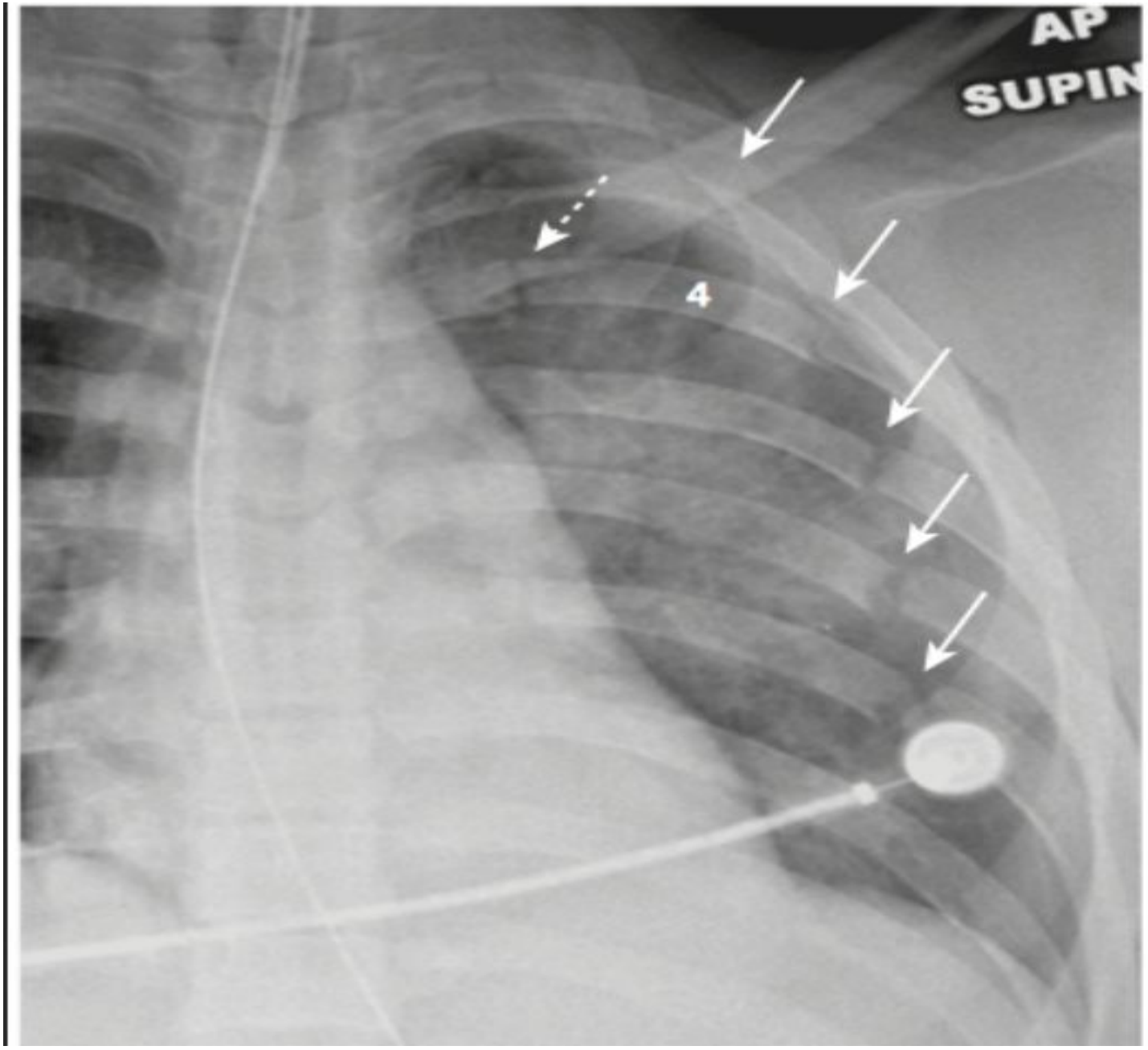
- Pain management – epidural ?
- Consider – good ventilation and oxygenation





Indications for an Intubation:

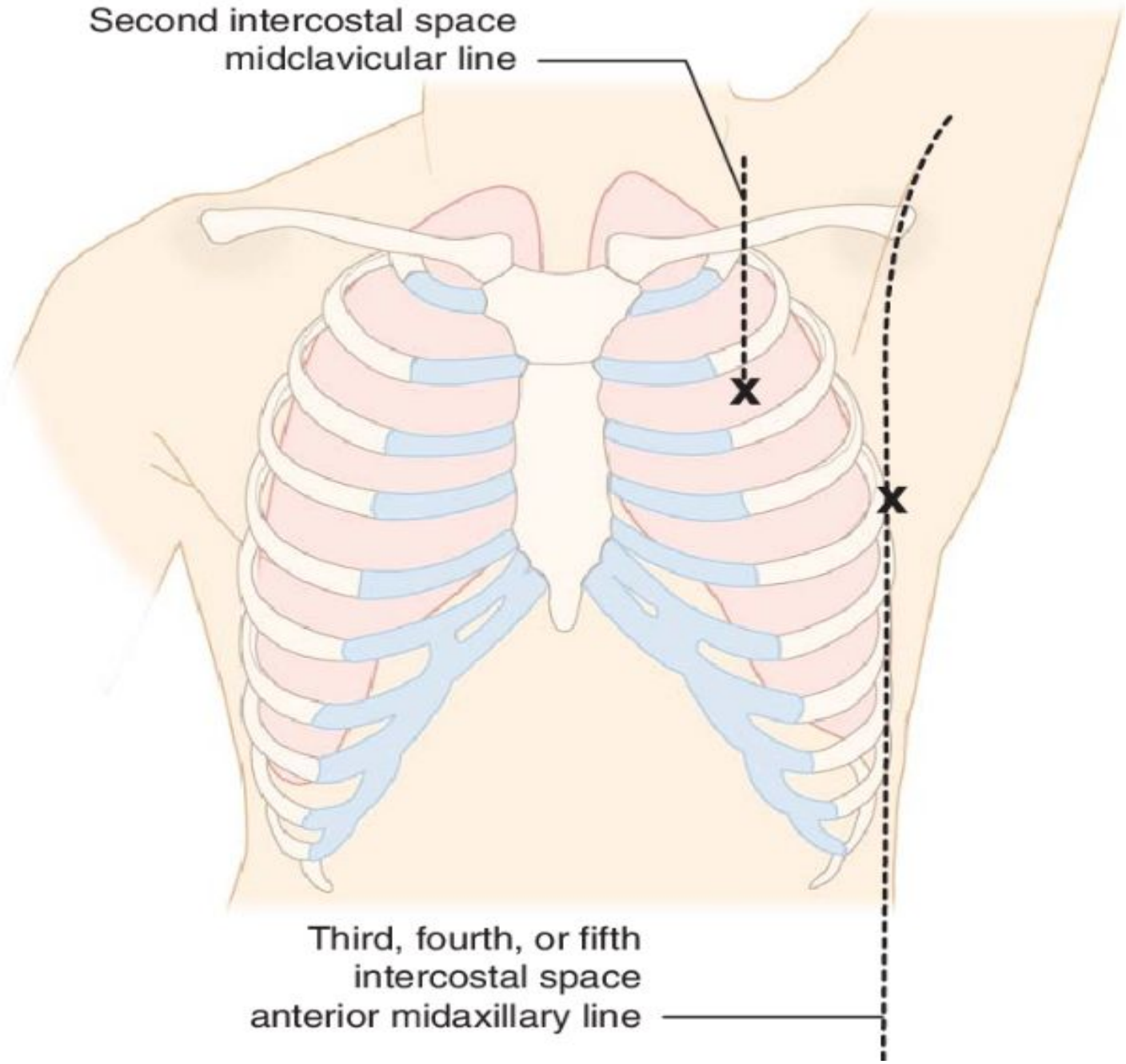
- Tachypnea > 40/min
- PaO2 <60%
- Multiple injuries, multiple Fx

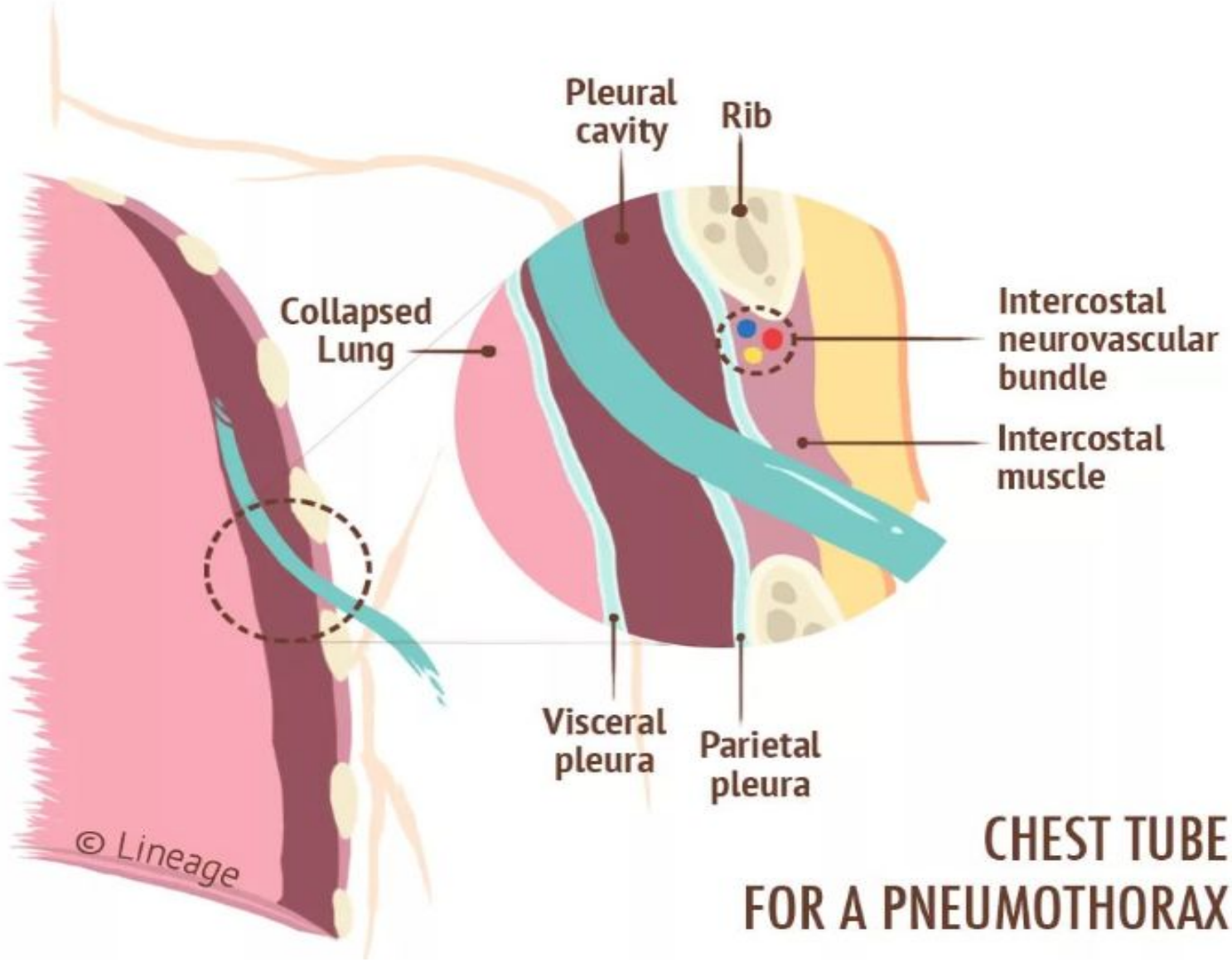

AP
SUPIN
4

Thoracic injury

Thoracic injury

- **Tension pneumothorax is a clinical diagnosis reflecting air under pressure in the affected pleural space.**
- **Treatment should not be delayed to wait for radiologic confirmation.**


Second intercostal space
midclavicular line
Third, fourth, or fifth
intercostal space
anterior midaxillary line

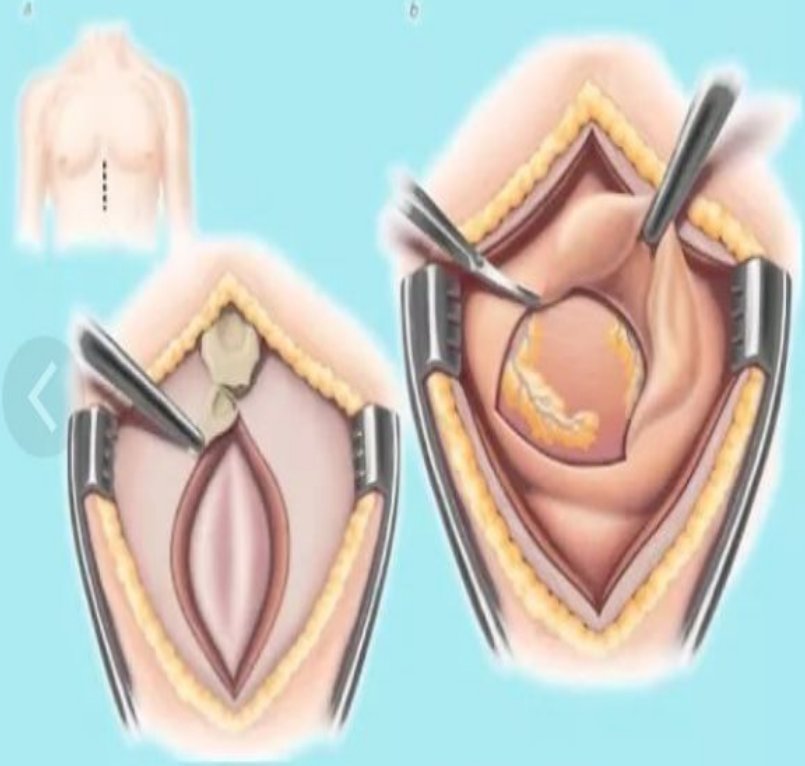


CHEST TUBE FOR A PNEUMOTHORAX

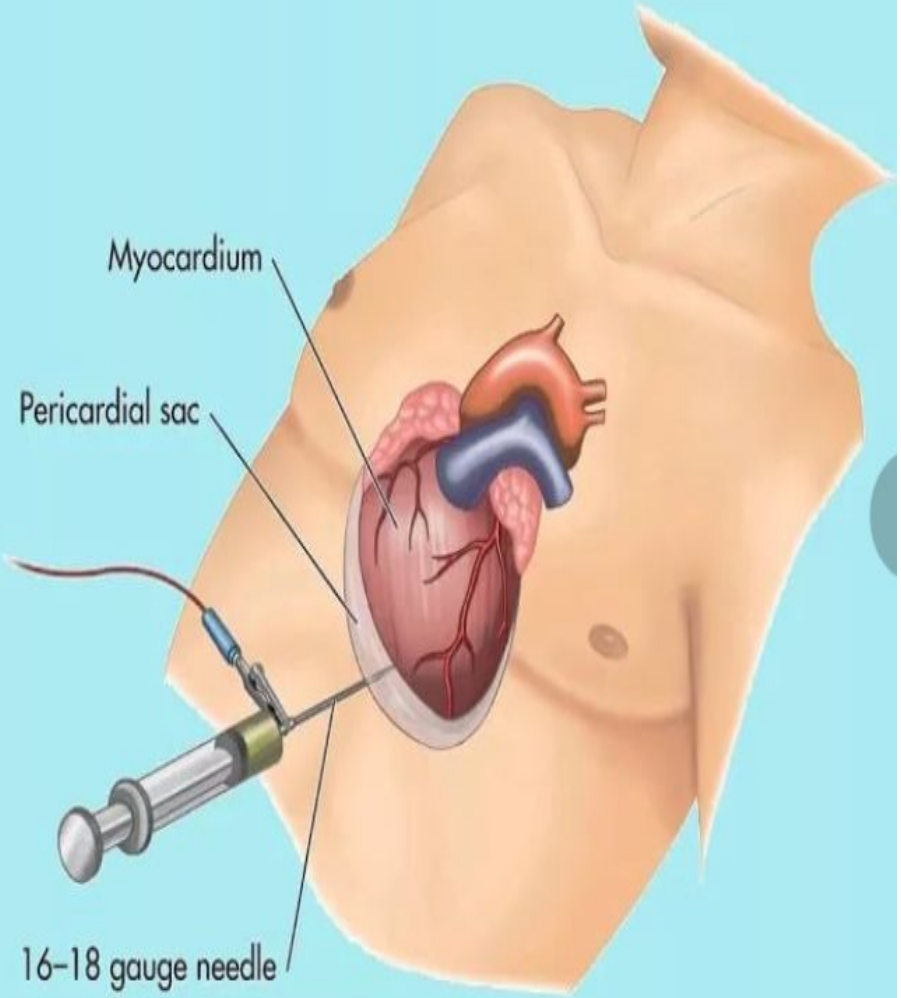
- Cardiac tamponade is indicated by the presence of the classic diagnostic Beck's triad: venous pressure elevation, decline in arterial pressure, and muffled heart tones.

- **If surgical intervention is not possible, pericardiocentesis can be diagnostic as well as therapeutic, but it is not definitive treatment for cardiac tamponade**

Cardiac Tamponade



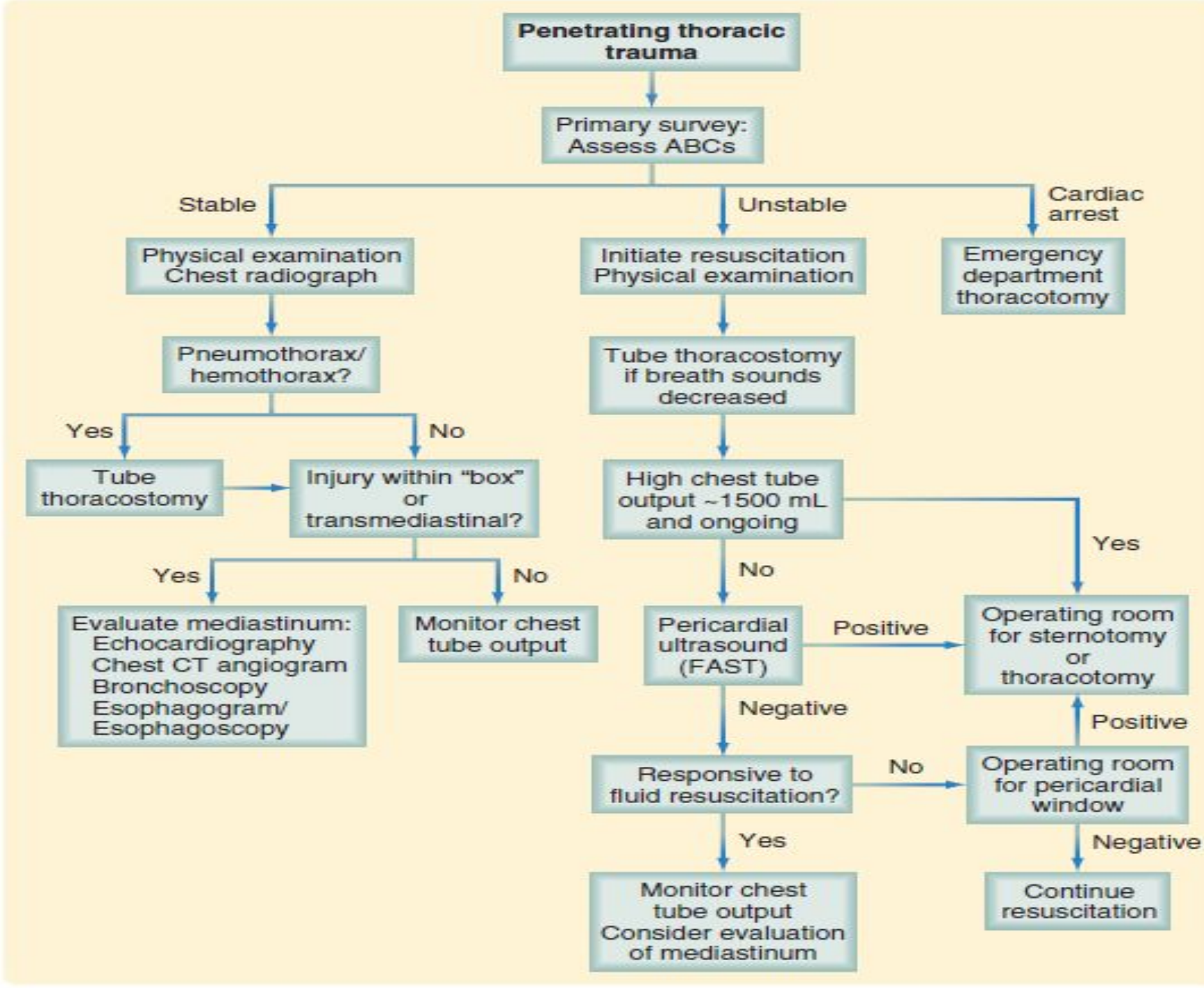
Pericardial Window



Pericardiocentesis

- Massive hemothorax results from the rapid accumulation of more than 1500 mL of blood or one-third or more of the patient's blood volume in the chest cavity

- Patients who have an initial output of less than 1500 mL of fluid, but continue to bleed, may also require thoracotomy.
- This decision is not based solely on the rate of continuing blood loss (300 mL/hr for 3hours), but also on the patient's physiologic status


Penetrating thoracic trauma
Primary survey: Assess ABCs
Stable
Unstable
Cardiac arrest
Physical examination Chest radiograph
Initiate resuscitation Physical examination
Emergency department thoracotomy
Pneumothorax/ hemothorax?
Tube thoracostomy if breath sounds decreased
Yes
No
Tube thoracostomy
Injury within "box" or transmediastinal?
High chest tube output ~1500 mL and ongoing
Yes
No
Yes
No
Evaluate mediastinum: Echocardiography Chest CT angiogram Bronchoscopy Esophagogram/ Esophagoscopy
Monitor chest tube output
Pericardial ultrasound (FAST)
Positive
Operating room for sternotomy or thoracotomy
Negative
Positive
Responsive to fluid resuscitation?
No
Operating room for pericardial window
Yes
Negative
Monitor chest tube output Consider evaluation of mediastinum
Continue resuscitation

Thoracic injury

- ***Pulmonary injuries.*** Lung injuries are common after chest trauma, with 31.9% of patients

- Mortality after pulmonary contusion is approximately 10%, predominantly as a result of respiratory failure from the acute respiratory distress syndrome or pneumonia.

- ***Cardiac injuries*** uncommon, but most severe injuries sustained by patients after penetrating and blunt trauma.
- Penetrating injury to the heart occurred in 1.8% of patients with penetrating trauma and in 8.7% of the subset with penetrating chest trauma alone.

- These statistics likely underestimate the true incidence of penetrating cardiac injuries because most are immediately lethal and never present to a hospital.
- For those penetrating cardiac injuries that do present to the emergency department the mortality rate is 72.9%.

- Blunt injury to the heart occurs less commonly, being seen in only 2.2% of blunt chest trauma cases.

- Most of these cases represent a contusion of the myocardium that results in arrhythmias and are frequently self-limited.

- In rare cases, blunt cardiac injury results in heart failure with cardiogenic shock.

Tracheobronchial injuries

Tracheobronchial tree injuries are uncommon but are associated with significant morbidity and mortality.

Penetrating mechanisms are the most common cause, although these injuries still represent only 0.4% of all penetrating chest.

Despite this low incidence, the associated mortality was significant at 57.9%.

Blunt injury to the tracheobronchial tree can occur but is extraordinarily rare, representing only 0.07% of blunt thoracic injuries

Esophageal injuries:

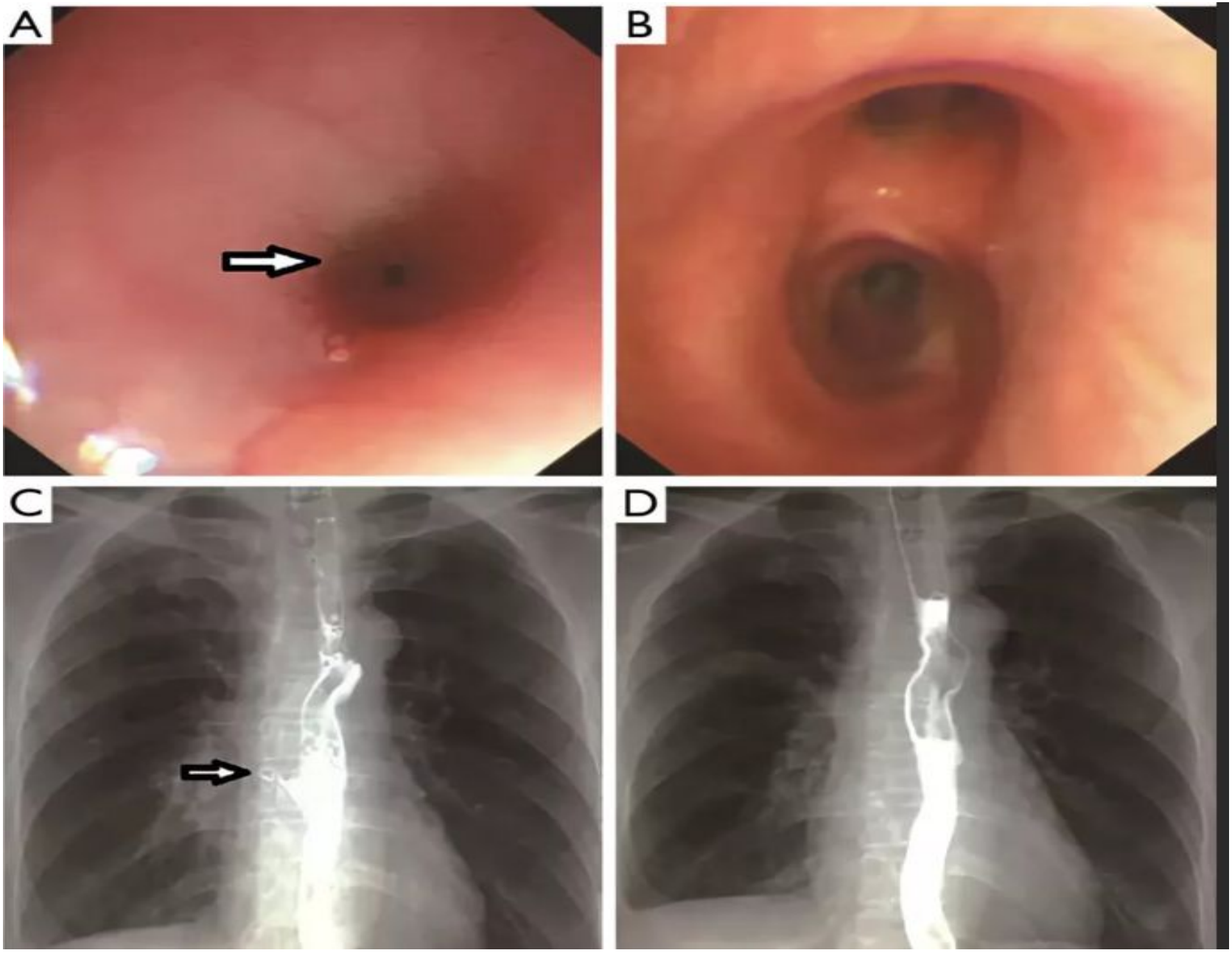
- The thoracic esophagus is uncommonly injured
- Penetrating injury is more common, but only 1.6% of penetrating chest injuries had involvement of the esophagus. Most of these are caused by gunshot wounds, followed by stab wounds in less than 20% of cases

- The mortality associated with penetrating esophageal injuries is substantial at 35.6% as a result of mediastinal sepsis and because of the adjacent vital structures that can also be injured along with the esophagus.
- Blunt esophageal injury is exceedingly rare, identified in only 0.02% of blunt trauma patients

- The esophagus is best evaluated through a combination of contrast esophagography and esophagoscopy

- Together these two modalities result in a sensitivity of almost 100% for esophageal injury

- Esophageal injuries with associated mediastinal contamination require immediate identification and repair because delays are associated with worse outcomes.


A
B
C
D

- The upper and midthoracic esophagus is best approached through a right posterolateral thoracotomy through the fourth or fifth interspace, whereas the lower esophagus is exposed from the left through the sixth or seventh interspace.

- *Creation of a vascularized intercostal muscle flap*
- *Wide drainage of the mediastinum and chest is extremely important to control any leak that may develop.*
- *A gastrostomy and feeding jejunostomy are frequently performed to allow gastric decompression and early nutritional support.*

Diaphragmatic injury

- 1.6% of blunt trauma
- 20% mortality (due to high energy?)
- Rapid increase in IAP drug on anterior impact blow out of the diaphragm
- Usually LT (75%)
- Rt side covered by liver

Diagnostic: CXR / CT

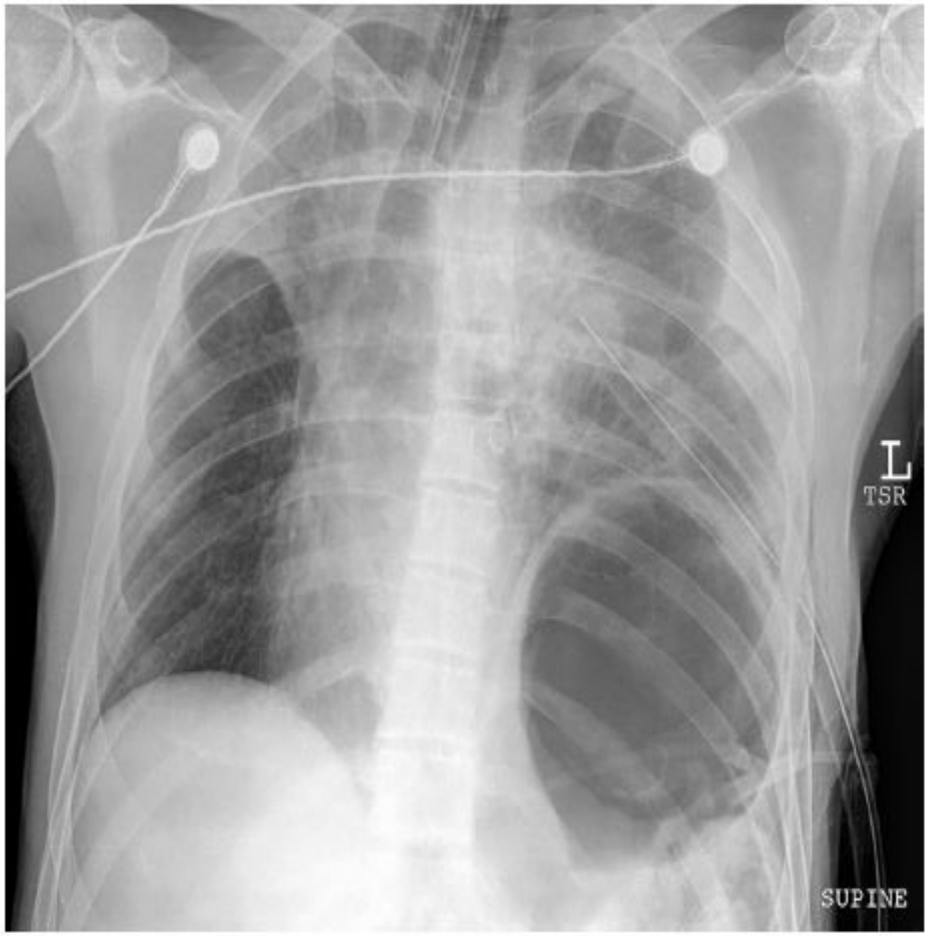
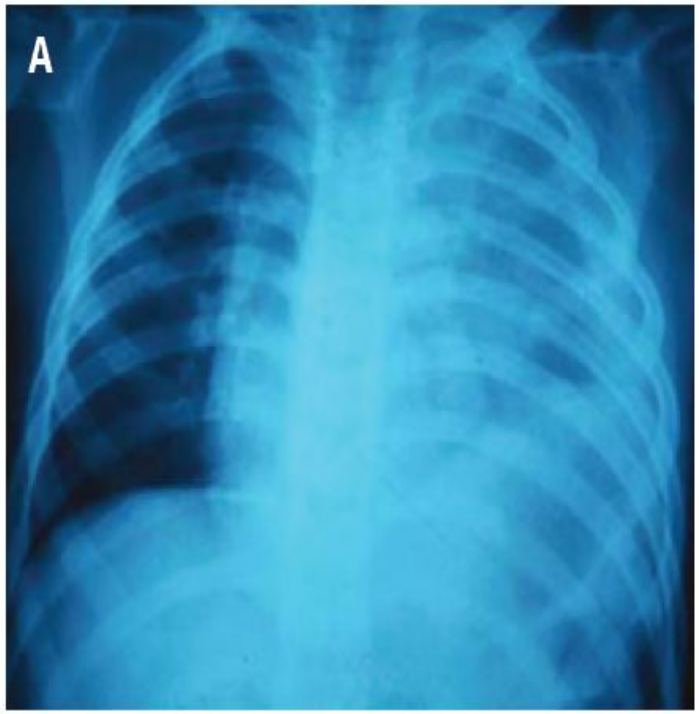
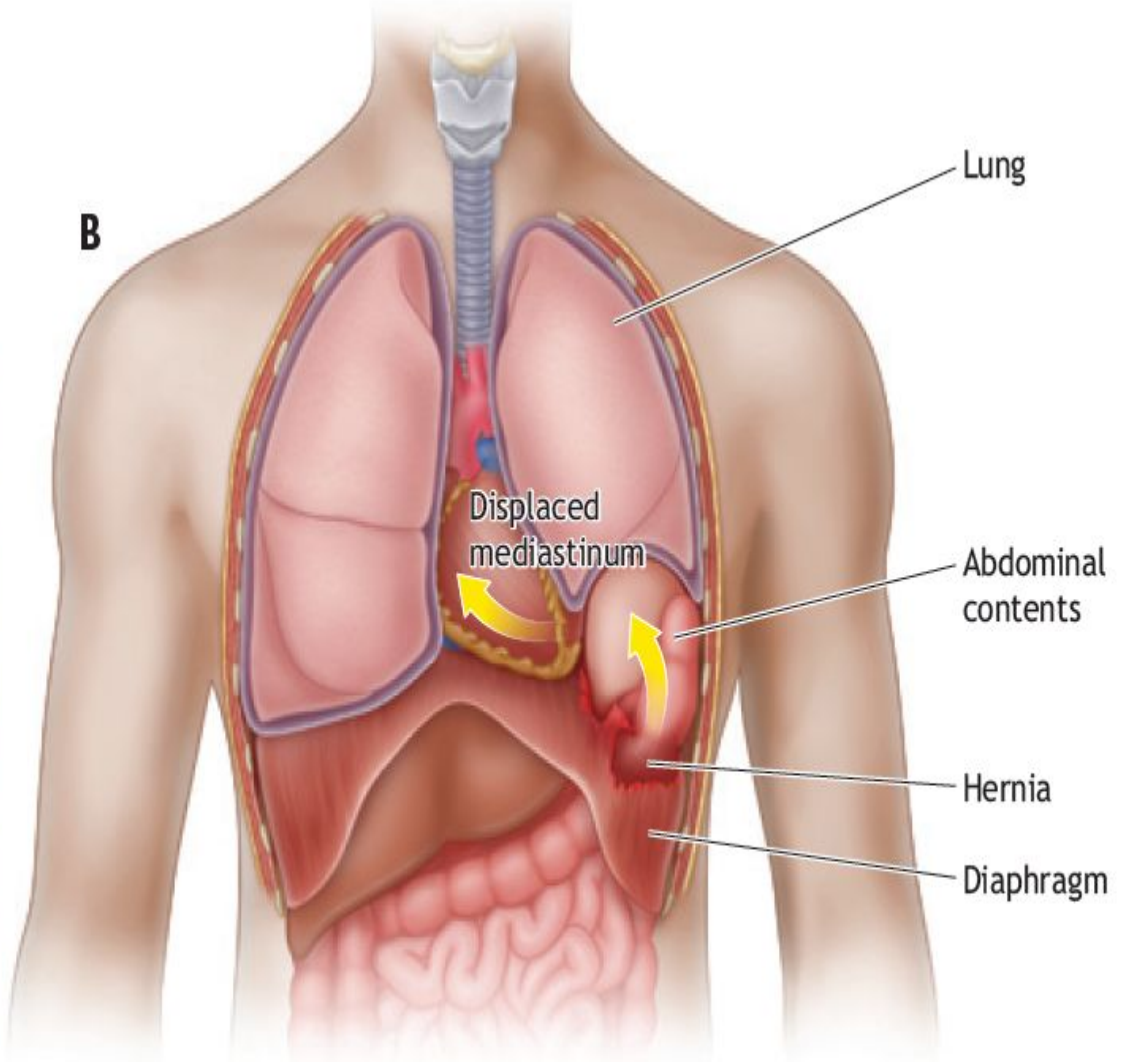


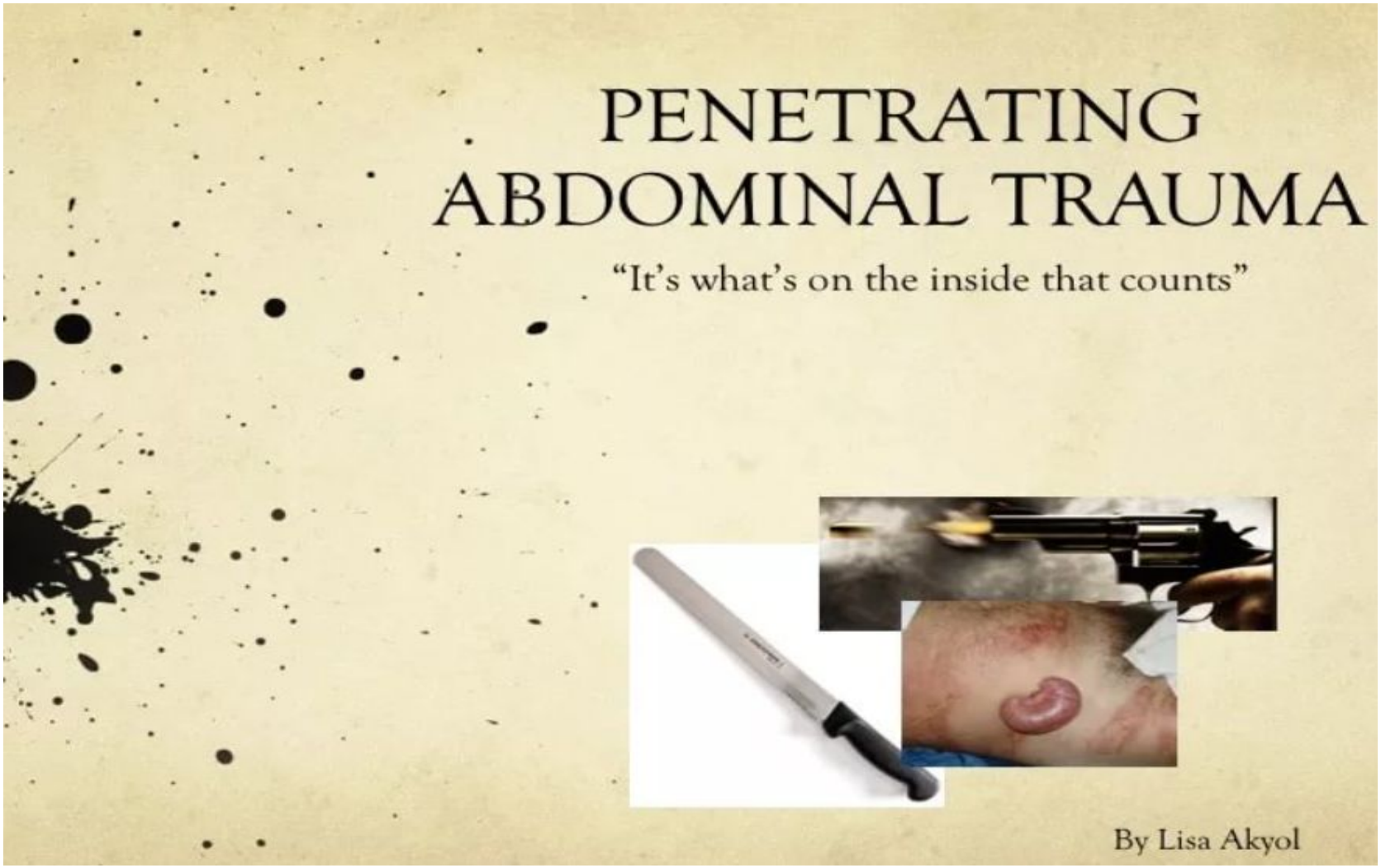
FIGURE 16-19 Left-sided diaphragmatic injury on plain chest radiograph. The gas-filled stomach can be visualized on the left side of the chest because of herniation through a large diaphragmatic laceration.

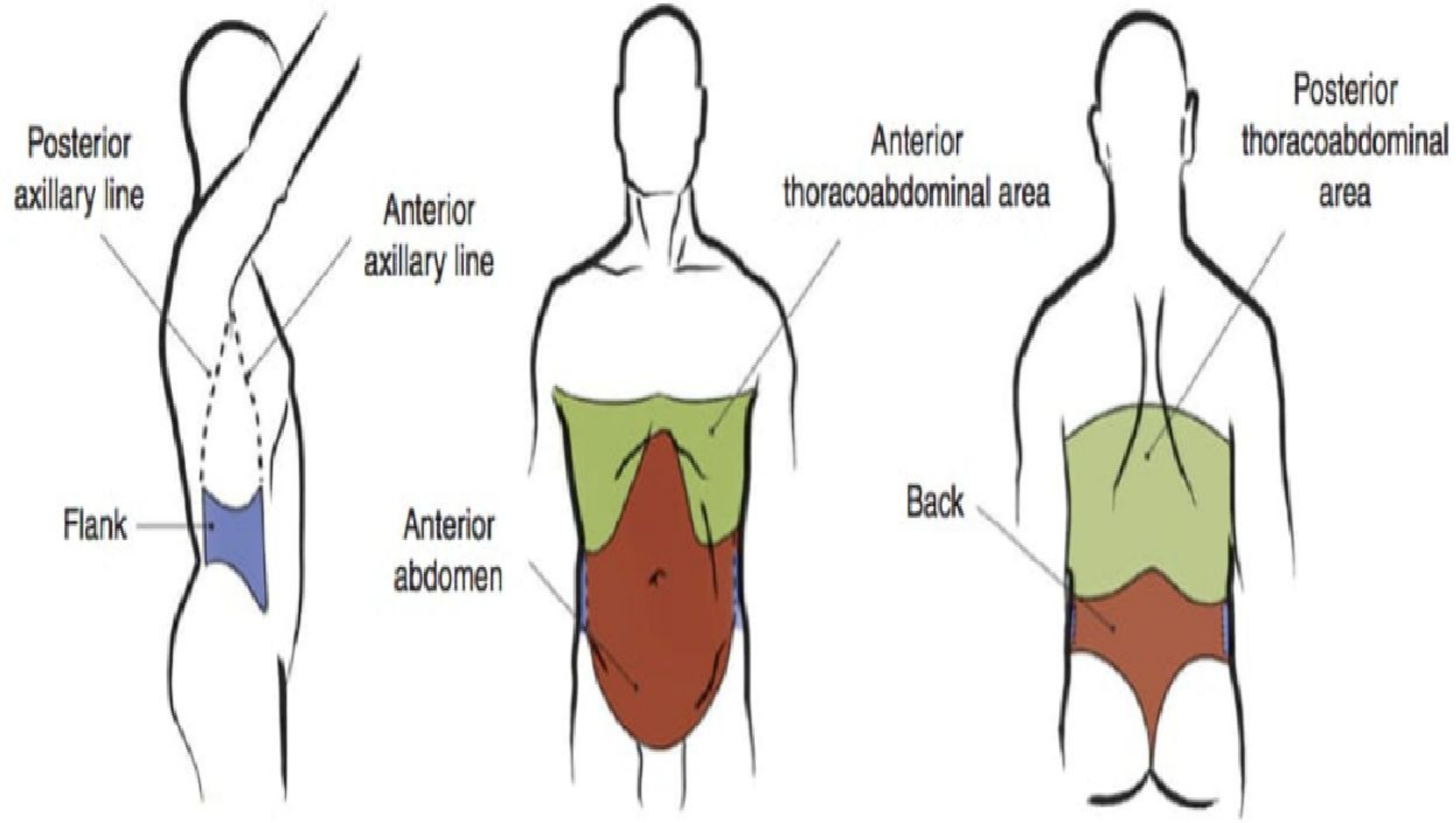




■ FIGURE 4-10 **Diaphragmatic Rupture. (A)** Radiograph view. **(B)** Blunt trauma produces large radial tears that lead to herniation, whereas penetrating trauma produces small perforations that can take time, sometimes even years, to develop into diaphragmatic hernias.

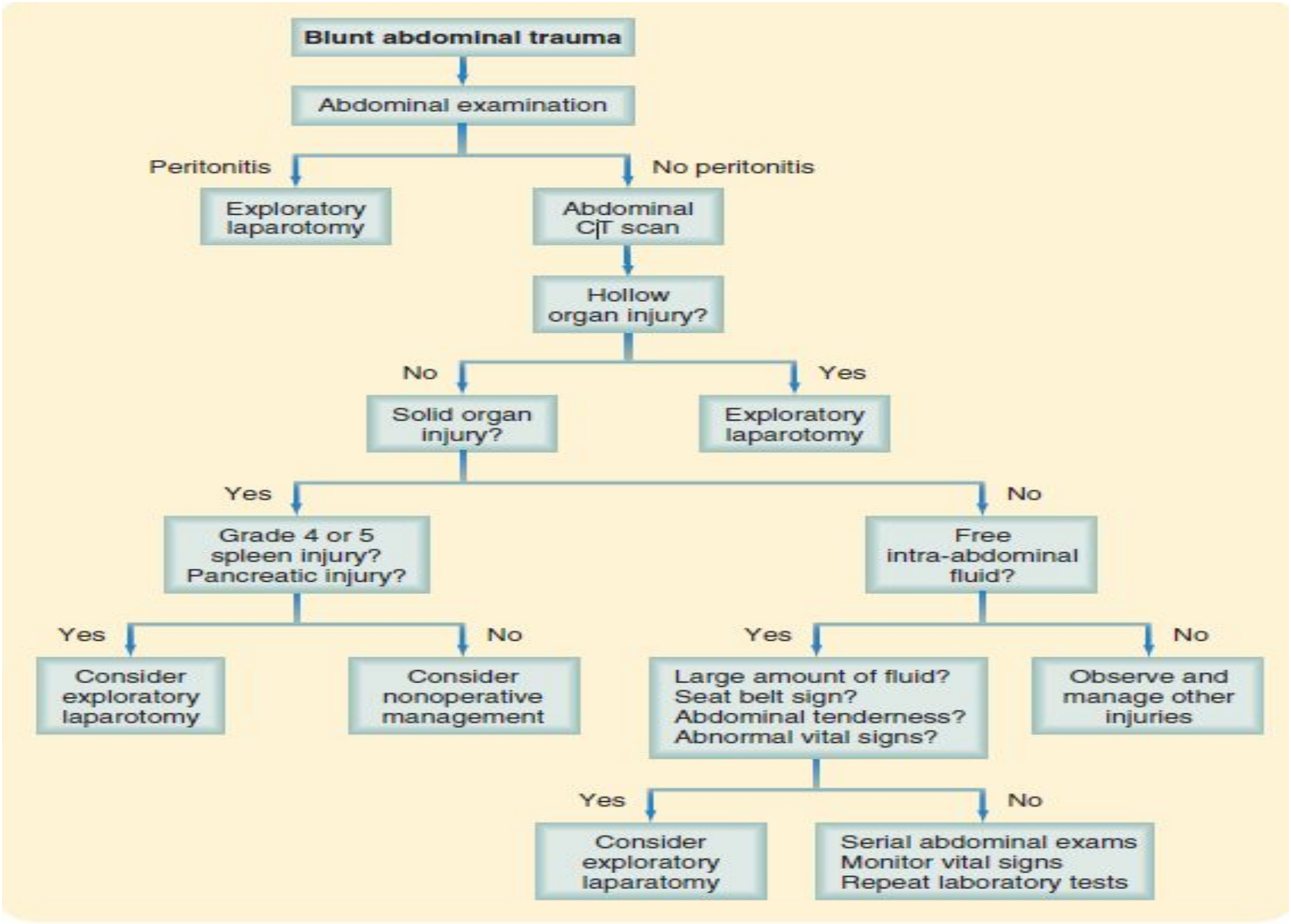
Abdominal trauma




Posterior
axillary line
Flank
Anterior
axillary line
Anterior
abdomen
Anterior
thoracoabdominal area
Back
Posterior
thoracoabdominal
area

Indication for OR

- Penetration of fascia
- Unstable patient
- NGT-blood
- PR- blood


Blunt abdominal trauma
Abdominal examination
Peritonitis
No peritonitis
Exploratory laparotomy
Abdominal C|T scan
Hollow organ injury?
No
Yes
Solid organ injury?
Exploratory laparotomy
Yes
No
Grade 4 or 5 spleen injury? Pancreatic injury?
Free intra-abdominal fluid?
Yes
No
Yes
No
Consider exploratory laparotomy
Consider nonoperative management
Large amount of fluid? Seat belt sign? Abdominal tenderness? Abnormal vital signs?
Observe and manage other injuries
Yes
No
Consider exploratory laparatomy
Serial abdominal exams Monitor vital signs Repeat laboratory tests

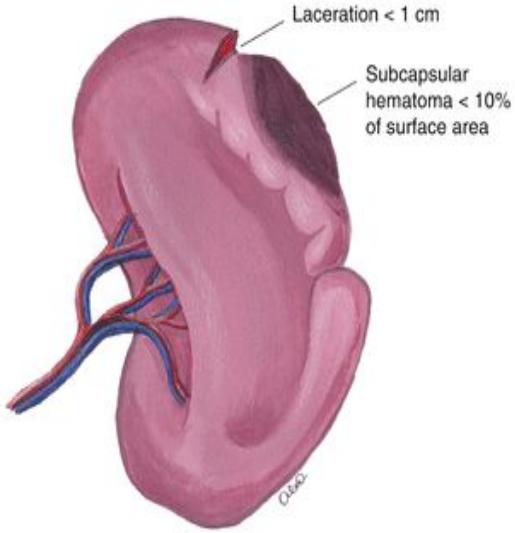
SPLEEN

- The spleen is the most commonly injured abdominal organ with 23.8% of patients with abdominal trauma demonstrating splenic injuries.

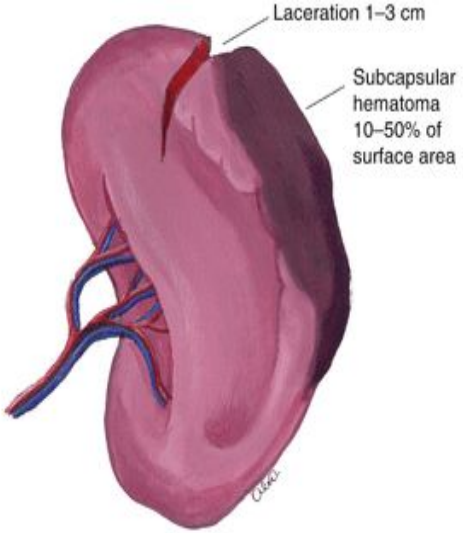
- Many splenic injuries are self-limited, demonstrating no evidence of ongoing bleeding;
-
- The mortality after blunt splenic injury 9.3%.

INJURY GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal, <5 cm in diameter
	Laceration	Capsular tear, 1 to 3 cm parenchymal depth that does not involve a trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma ≥5 cm or expanding
	Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Hematoma	Completely shattered spleen
	Laceration	Hilar vascular injury devascularizes spleen

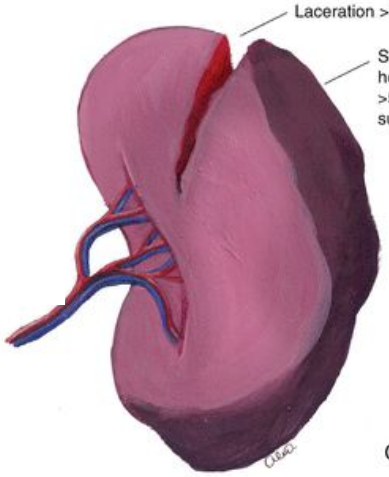
AAST Spleen Injury Scale

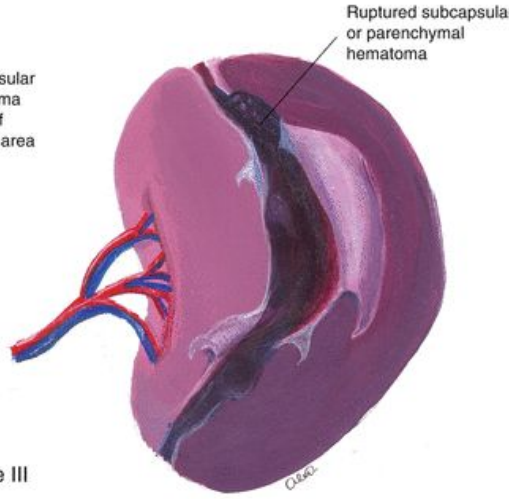


Grade I

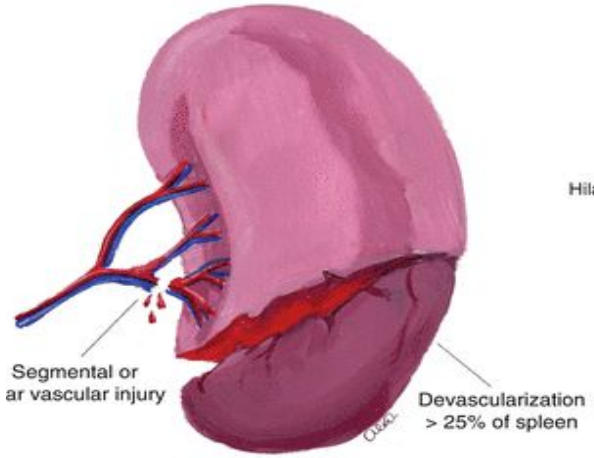


Grade II

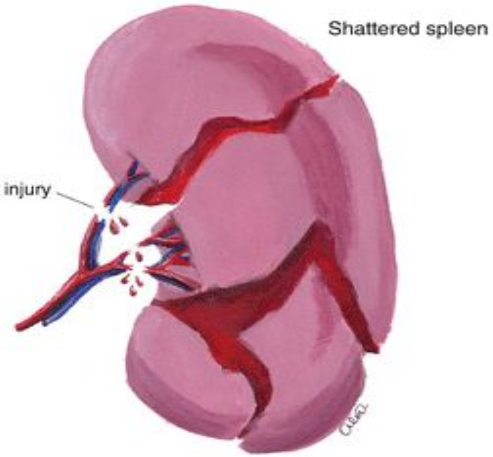




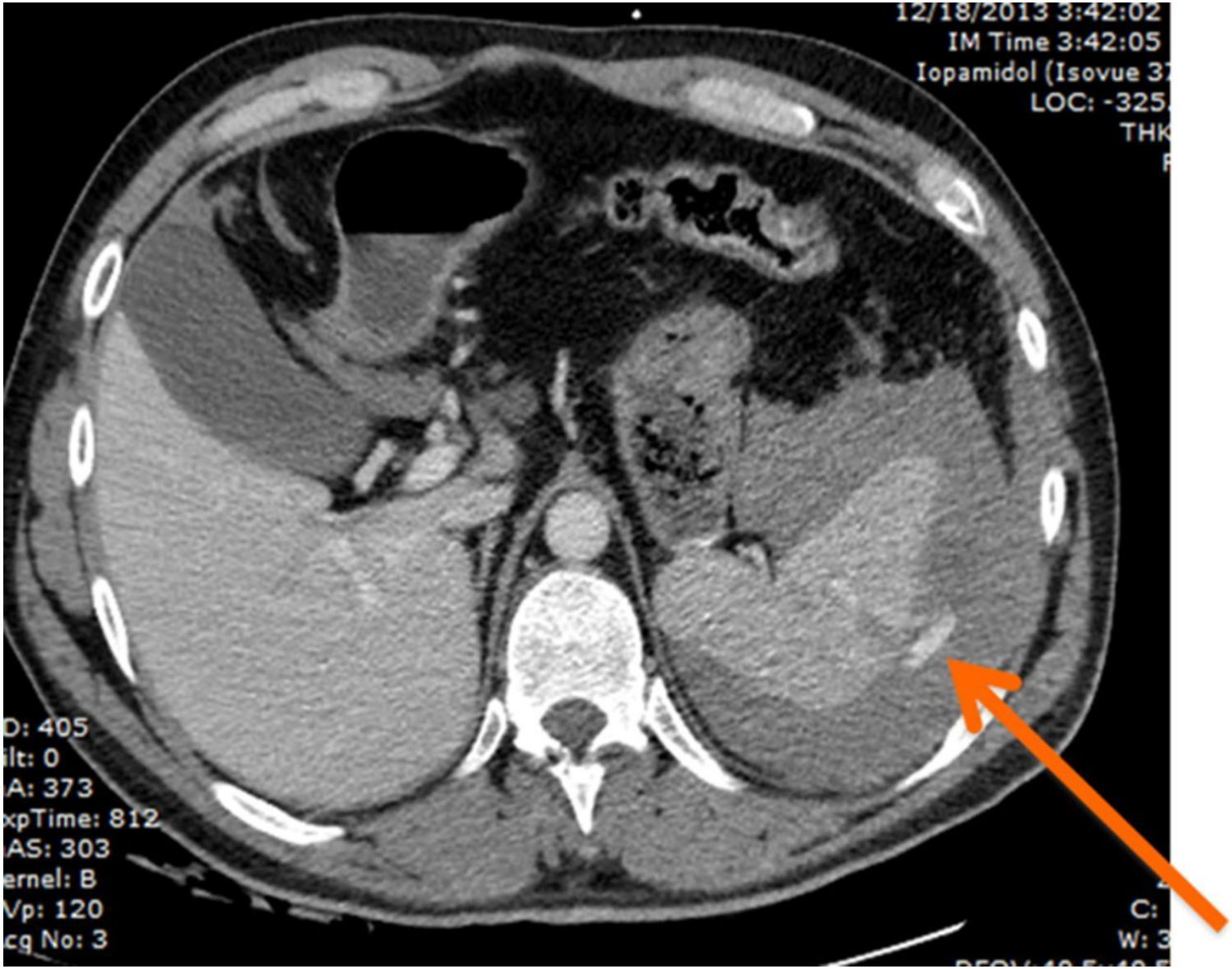
Grade III



Grade IV



Grade V


12/18/2013 3:42:02
IM Time 3:42:05
Iopamidol (Isovue 3
LOC: -325
THK
D: 405
ilt: 0
A: 373
xpTime: 812
AS: 303
ernel: B
Vp: 120
cg No: 3
C:
W: 3

Management of spleen Injury

- No preferable management
- Depends on surgeon's preference
- Recommended:
  - I, II, III nonoperative + Angio for bleeding
  - IV , V OP!

- post splenectomy vaccinations: Encaupsulated bacteria:
  - Streptococcus pneumoniae
  - Hemophilus influanzea
  - Neiseria meningitidis

Hepatic injuries:

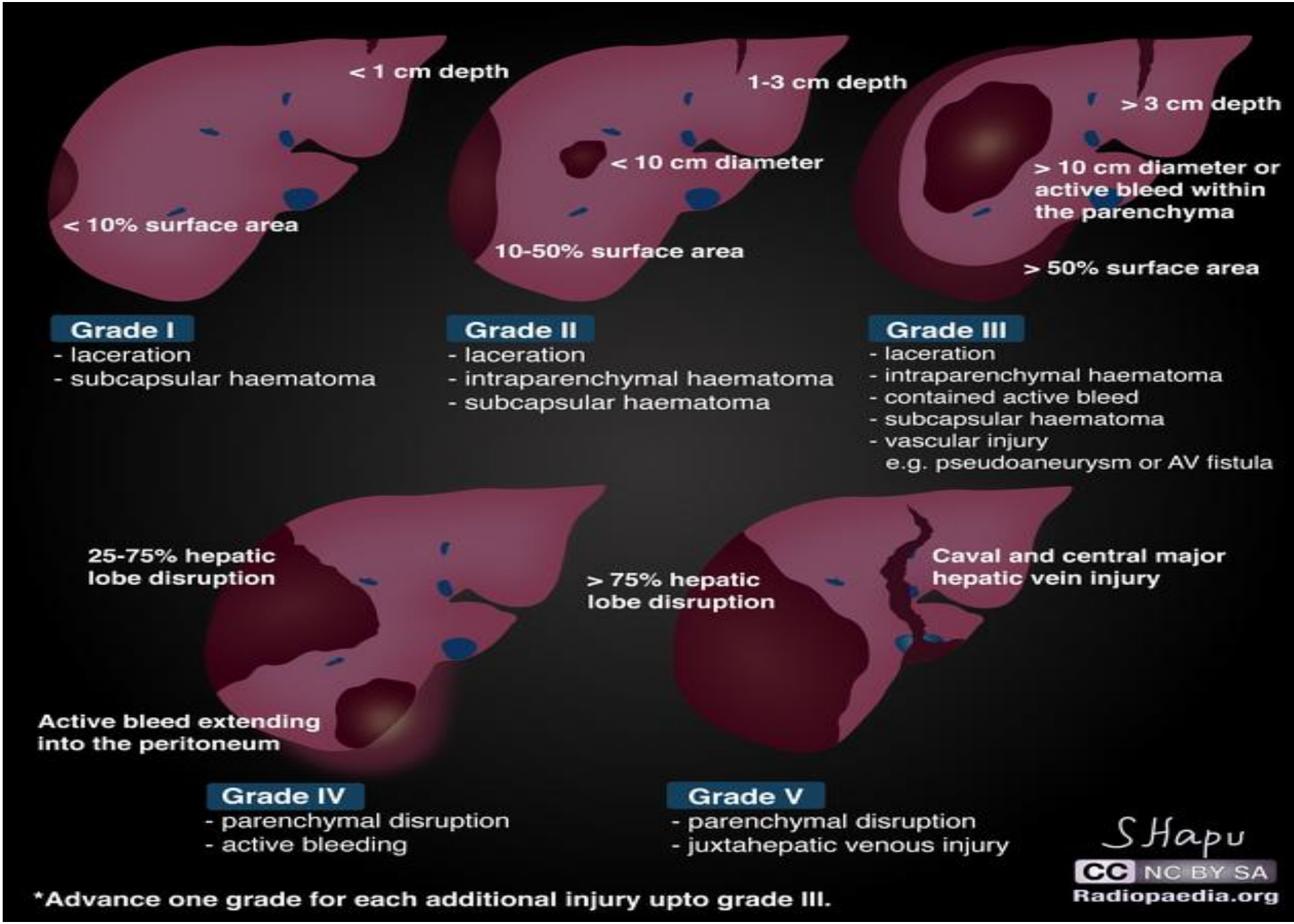
- Liver injuries are extremely common after blunt trauma; only the spleen demonstrates a higher incidence

- liver injuries occurred in 3.0% of all patients, whereas 22.2% of patients with blunt mechanisms

- blunt liver injury, associated mortality rate down to 12.5%

TABLE 16-6 AAST Liver Injury Scale

INJURY GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal, <10 cm in diameter
	Laceration	Capsular tear, 1 to 3 cm parenchymal depth, <10 cm in length
III	Hematoma	Subcapsular, >50% surface area of ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma >10 cm or expanding
	Laceration	>3 cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25% to 75% hepatic lobe or 1 to 3 Couinaud segments
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud segments within a single lobe
	Vascular	Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins)
VI	Vascular	Hepatic avulsion

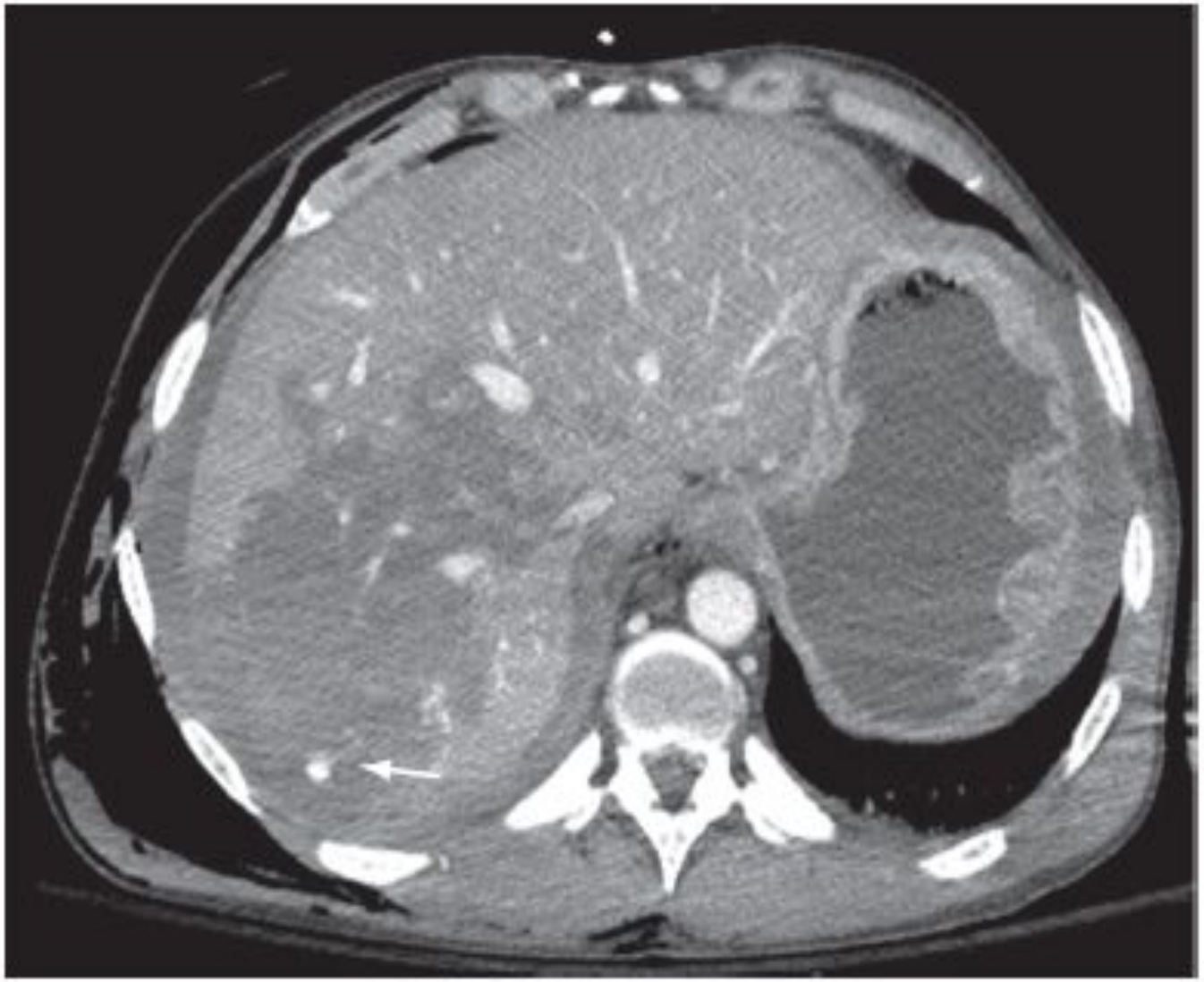

< 1 cm depth
< 10% surface area
1-3 cm depth
< 10 cm diameter
10-50% surface area
> 3 cm depth
> 10 cm diameter or active bleed within the parenchyma
> 50% surface area
Grade I
- laceration
- subcapsular haematoma
Grade II
- laceration
- intraparenchymal haematoma
- subcapsular haematoma
Grade III
- 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
> 75% hepatic lobe disruption
Caval and central major hepatic vein injury
Grade IV
- parenchymal disruption
- active bleeding
Grade V
- parenchymal disruption
- juxtahepatic venous injury
*Advance one grade for each additional injury upto grade III.
S Hapu
CC NC BY SA
Radiopaedia.org

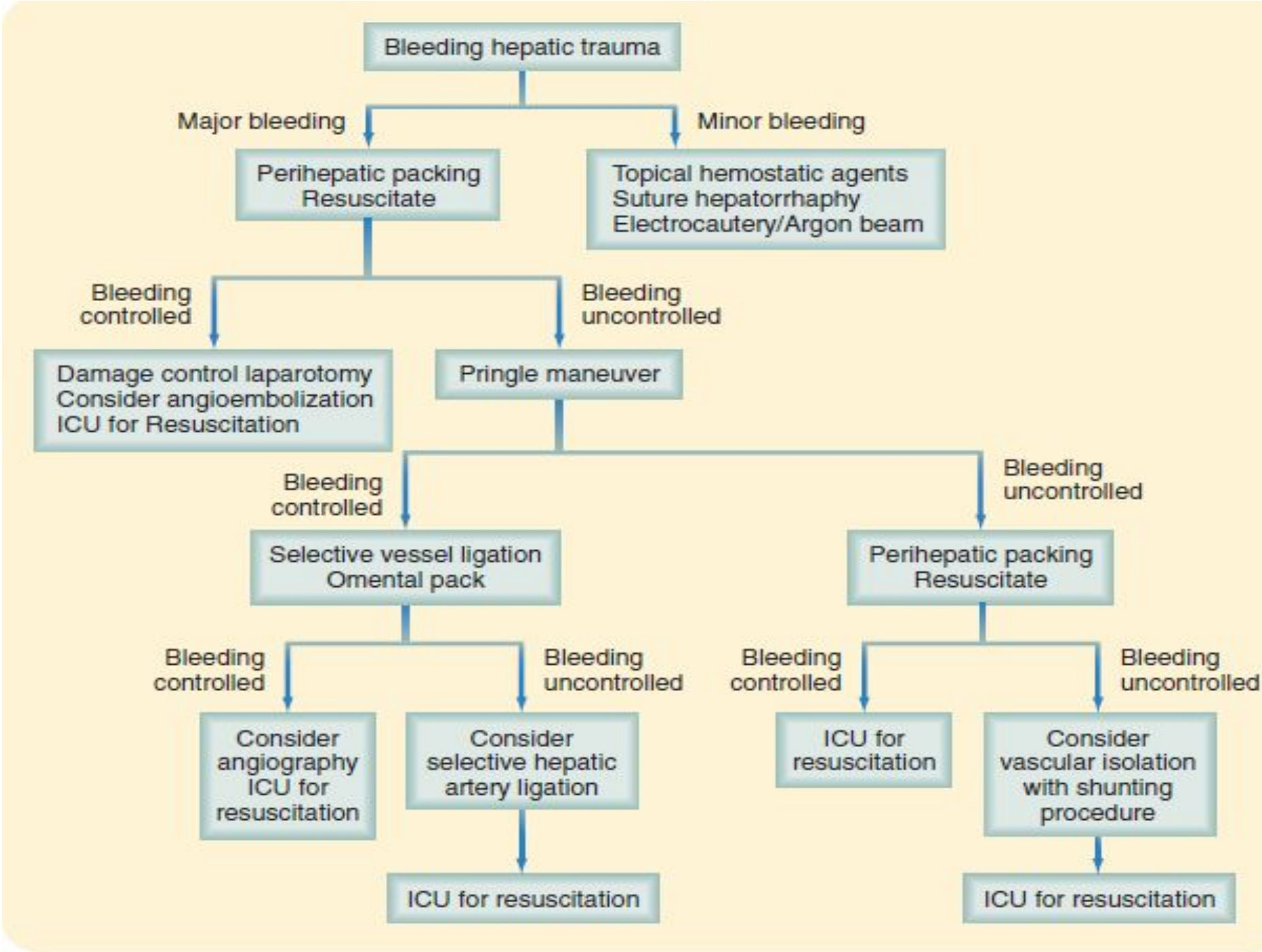
Hepatic Injury

- Mechanism: compression with direct parenchymal damage and shearing forces tears in hepatic tissues disruption of vascular and ligamentous attachements.

- 2nd mechanism: penetrating trauma – higher morbidity with vascular /biliary injury

- Diagnostic:
- FAST ,
- instability,
- CT ,
- expl. Laparotomy due to + FAST




Bleeding hepatic trauma
Major bleeding
Minor bleeding
Perihepatic packing
Resuscitate
Topical hemostatic agents
Suture hepatorrhaphy
Electrocautery/Argon beam
Bleeding controlled
Bleeding uncontrolled
Damage control laparotomy
Consider angioembolization
ICU for Resuscitation
Pringle maneuver
Bleeding controlled
Bleeding uncontrolled
Selective vessel ligation
Omental pack
Perihepatic packing
Resuscitate
Bleeding controlled
Bleeding uncontrolled
Bleeding controlled
Bleeding uncontrolled
Consider angiography
ICU for resuscitation
Consider selective hepatic artery ligation
ICU for resuscitation
ICU for resuscitation
Consider vascular isolation with shunting procedure
ICU for resuscitation

Hepatic Injury - Management

- Hemodynamically instable patient OPERATION
- Conditions or non-operative management:

  No tachycardia, no hypotension, no Metabolic acidosis

  No evidence of shock

  – Slow decreasing in Hb-levels with HD stability transfusions

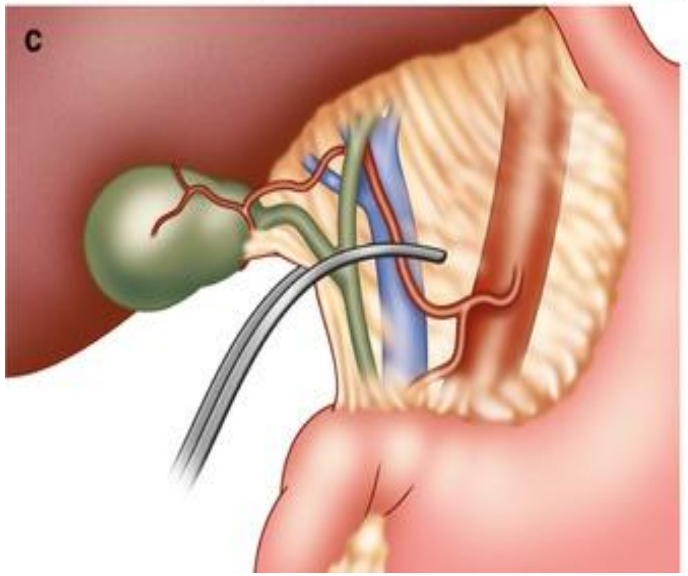
  – Angioembolization for blush when stable

Non-surgical hepatic injury treatment Complications

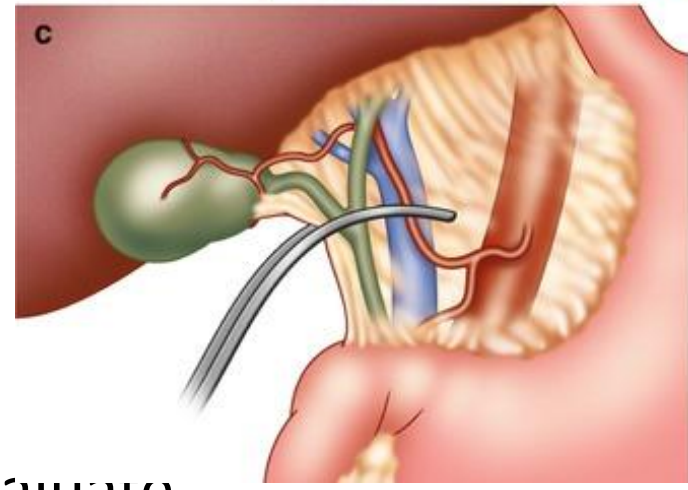
- abdominal compartment syndrome
- bile duct injury leading to bile peritonitis or biloma
- delayed hemorrhage
- intra-abdominal abscess formation
- acute acalculous cholecystitis
- hemobilia

Surgical management of liver Injury options

- Packing
- Pringle
- Push
- Plug

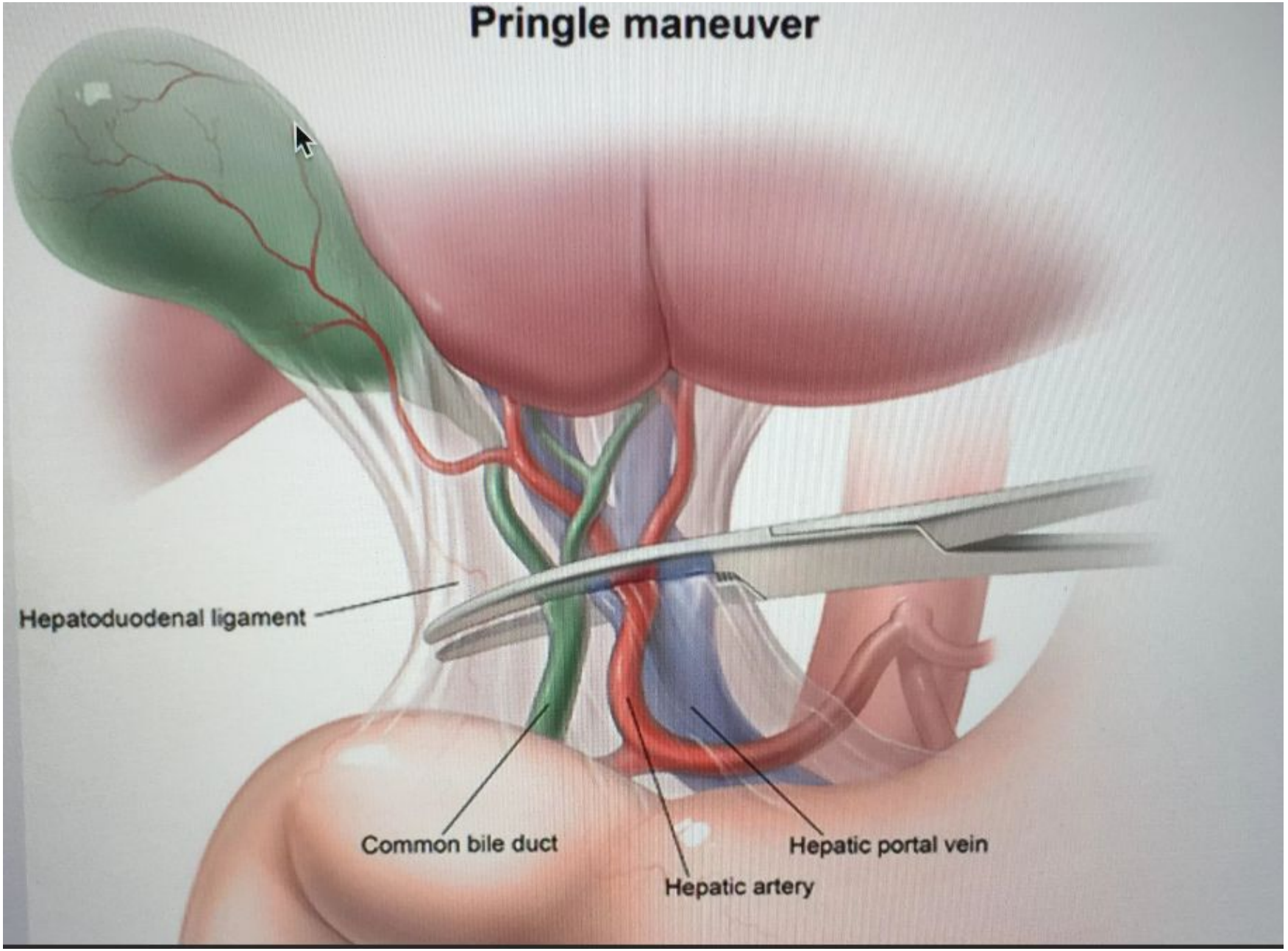


Surgical management of liver Injury



- Perihepatic sponges
- Manual pressure

- When stable – remove packing and reevaluate
- Mild injuries:
  - compression
  - Topical hemostasis agents
  - Suture hepatorrhaphy
- severe bleeding:
  - Pringle maneuver: encircling of the hepatoduodenal ligament (hepatic artery + portal vein)
    - Hepatic vein bleeding will continue after binding! (helps distinguishing)
- Post Packing – consider angioembolization


Pringle maneuver
Hepatoduodenal ligament
Common bile duct
Hepatic artery
Hepatic portal vein

Gastric injuries

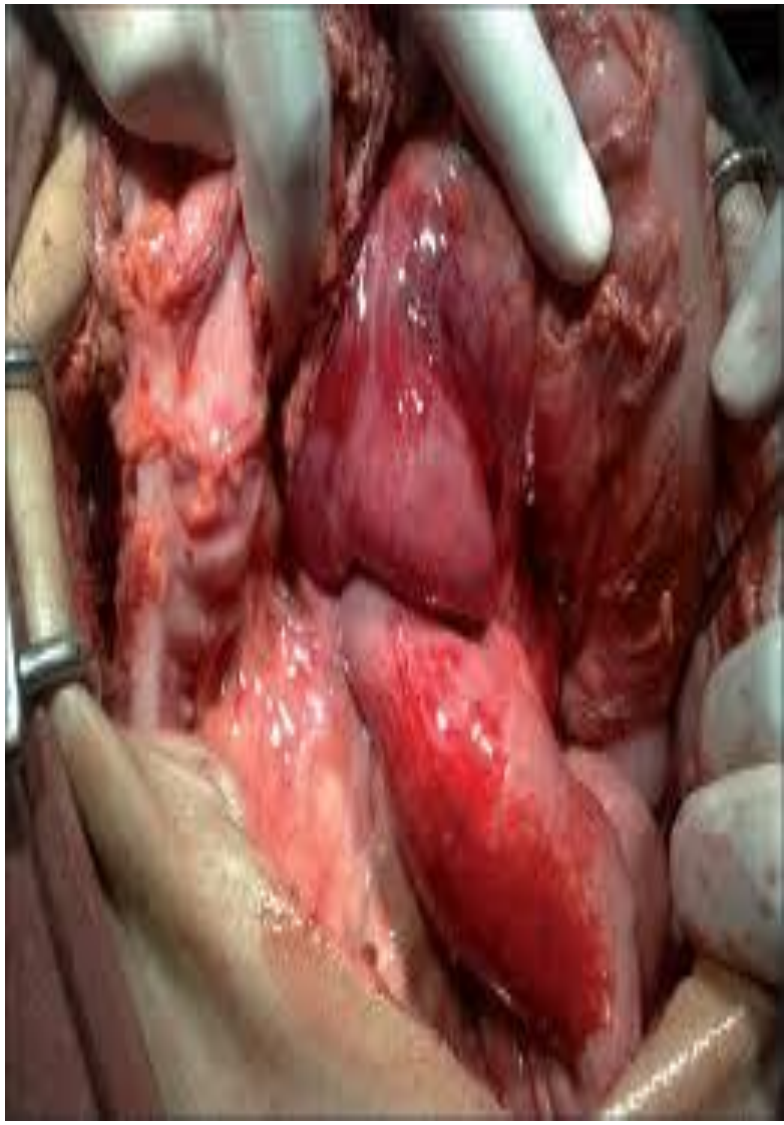
- Penetrating mechanisms are the most common cause of injuries to the stomach, with these being present in 12-17.6%. With associated mortality is 21.5%.

- Frequently, penetrating gastric injuries cause full-thickness perforations with likely spillage of gastric contents into the abdomen.

- Conversely, blunt gastric injuries are rare, occurring in 0.05% of all blunt trauma patients and 4.3% of patients with any blunt hollow visceral

Traumatic Gastric Injury

- Blunt injury – due to high energy mechanism
- Clinical signs: Peritonitis
- Diagnostic – CT (but limited)
- Management:
  - If perforation: absorbable suture and another layer of non absorbable
  - Hematoma – evacuation
  - More challenging: GEJ, lesser curvature, fundus, posterior wall
  - Major tissue loss – partial or total agstrectomy



Duodenal injuries

- Duodenal injuries are uncommon after blunt and penetrating trauma but can pose a diagnostic and therapeutic challenge.
- Because of the retroperitoneal location of the duodenum, most injuries are due to penetrating mechanisms, occurring in 4.0% of cases. Gunshot wounds are the predominant cause, and the associated mortality is significant at 24.5%

- Blunt duodenal injuries are much less common, occurring in 0.1% of cases

Duodenal injury

- Children bicycle handlebar or steering wheel stucking in drivers
- Clinic:
  - Do not expect peritonitis! (extraperi)
- Diagnostic: CT (Also for low grade injuries – hematoma)

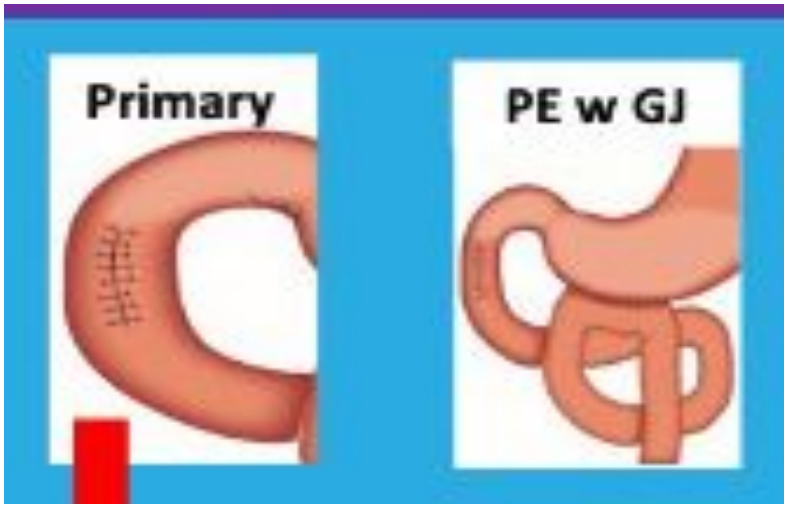
Management:

- perforation: immediate surgery
- Hematoma: resolve without intervention
  - if GOO – NGT, TPN
  - 5-7 D reevaluation

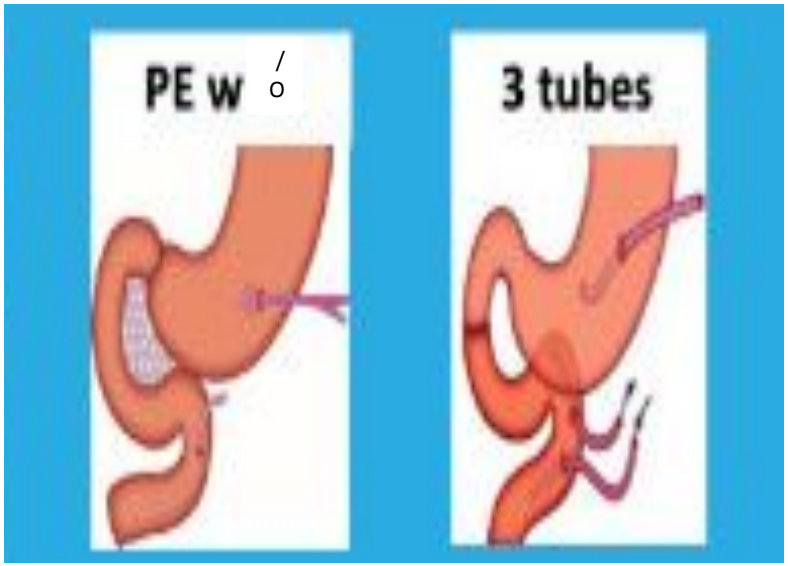
Duodenal injury

Management:

- Operation:
  - Kocher-Maneuver – mobilization of the duodenum
  - Primary repair in single or double layer
  - Greater injuries / tissue loss :
    Ampulla not involved → resection and primary anastomosis
  - Ampulla involved: enteric bypass with Roux-en Y



- PE – pyloric exclusion
- GJ- gastrojejunostomy
- PE /o GJ- pyloric exclusion without gastrojejunostomy
- tubes: gastrojejunostomy, 3 duodenostomy for drains +jejunostomy for feeding



Small bowel injuries

- The small intestine is one of the more frequently injured organs after penetrating abdominal trauma.
- Incidence to be as high as 60%
- Mortality rates range from 15% to 20%, with most caused by associated vascular injuries

- Penetrating injuries can range from tiny perforations to large destructive injuries that devitalize circumferential segments of small bowel.
- Blunt injuries of the small bowel are less common, present in 1.7% of all blunt abdominal are associated with a significant mortality rate of 14.0%.

Small bowel injury

- Management:
  - Primary repair – when no stricture
  - Resection with anastomosis
  - Resection without anastomosis (instable, shock)
    - Temporarily abdominal closure

Colon injuries

- Colon and rectal injuries occur most commonly after penetrating abdominal trauma and rarely after blunt mechanisms.

- After penetrating abdominal trauma, injury to the colon is second only to small bowel trauma, occurring in 36.4%

- Despite this, the associated mortality for colon and rectal injuries is the lowest of all the abdominal viscera in the NTDB at 12.3%.

- Colon and rectal injuries occur in less than 1% of all blunt trauma patients, demonstrating an associated mortality of 13%. When only patients with blunt hollow visceral injury are considered, the colon or rectum is involved in 30.2%

Colon Injury

- Retroperitoneal location of asc. Desc. obscure indings and injury
- CT has limited capability
- Usually detecting by laparotomy in unstable patient

- Rectum injury – may need rigid recto-sigmoidoscopy
- Management:
  - Primary
    - Stable
    - < 50% of circumference
  - Resection + anastomosis !
    - >50% circumeference
    - Injuries prox to MCA : rt hemi + ileocolostomy anastomosis
  - Resection + colostomy
    - Unstable
- Rectal injury: fecal diversion+ presacral drain + colostomy
  - Pelvic sepsis

Pancreatic injuries

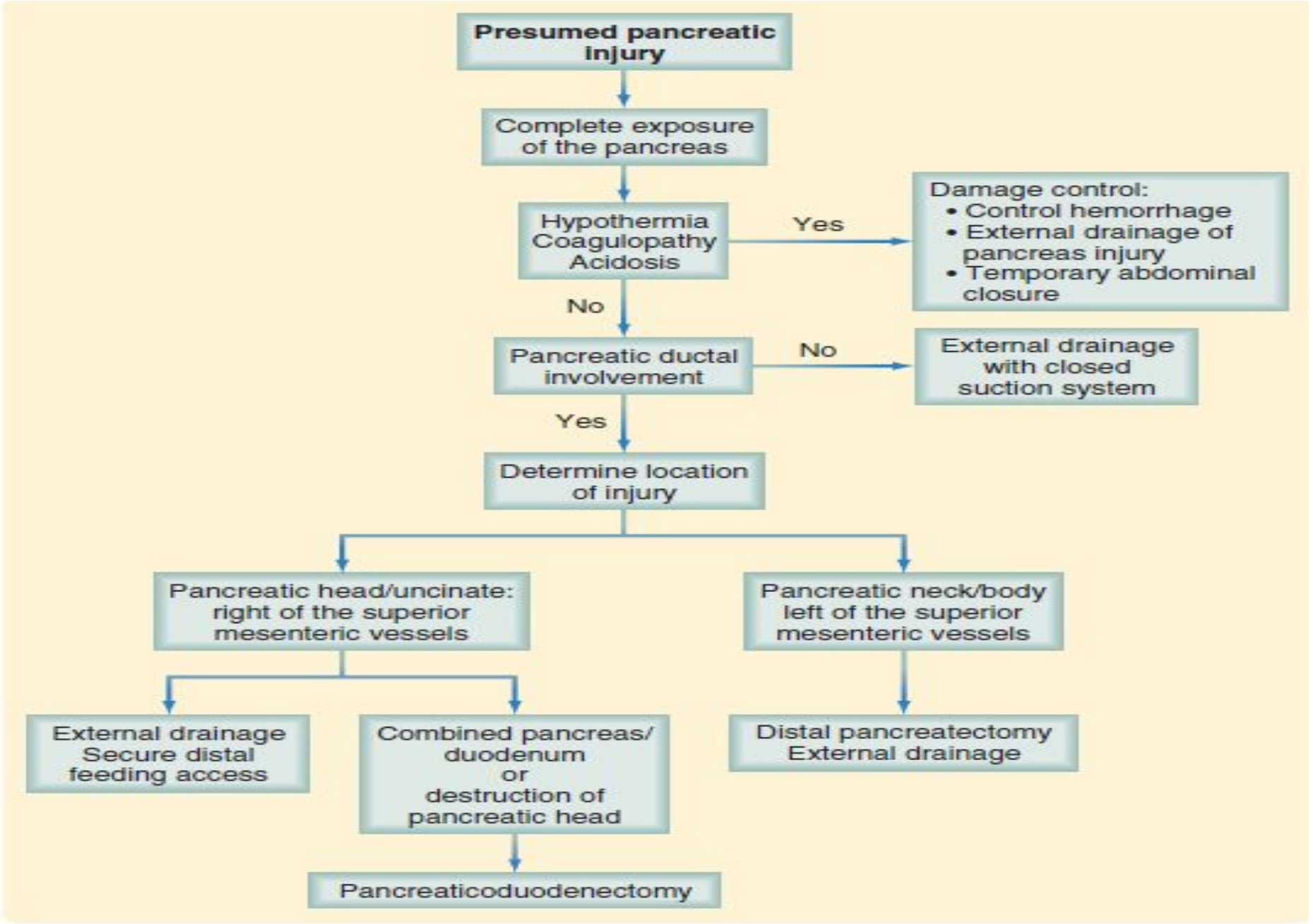
- Pancreatic injuries commonly occur in association with injury to the duodenum because of their proximity.
- A penetrating mechanism is more commonly the cause, 4.4%.
- Mortality rates of 15.3% and 29.8% for blunt and penetrating mechanisms, respectively.

- Delays in diagnosis and management are believed to contribute to these significant mortality rates. Pancreatic enzymes are caustic, making delays in management of the injuries a source of massive systemic inflammation and subsequent poor outcomes.

- Pancreas tissue injury can result from direct laceration of the organ or through the transmission of blunt force energy to the retroperitoneum

- A common mechanism of blunt pancreatic injury involves the crushing of the body of the pancreas between a rigid structure, such as a steering wheel or seat belt, and the vertebral column

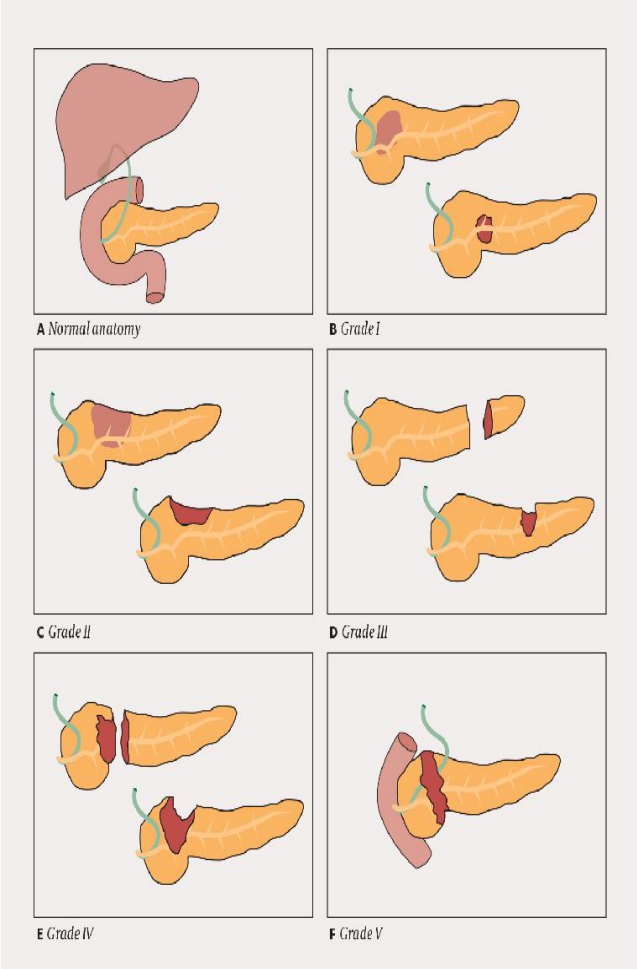
- The impact to the pancreas causes injury that ranges from mild contusion to complete transection with ductal disruption


Presumed pancreatic injury
Complete exposure of the pancreas
Hypothermia
Coagulopathy
Acidosis
Yes
Damage control:
• Control hemorrhage
• External drainage of pancreas injury
• Temporary abdominal closure
No
Pancreatic ductal involvement
No
External drainage with closed suction system
Yes
Determine location of injury
Pancreatic head/uncinate: right of the superior mesenteric vessels
Pancreatic neck/body left of the superior mesenteric vessels
External drainage
Secure distal feeding access
Combined pancreas/ duodenum
or
destruction of pancreatic head
Distal pancreatectomy
External drainage
Pancreaticoduodenectomy

Management of Pancreatic Injury

- Operation in any significance
- Location of injury determines the surgical plan:
  - Left to SMA distal pancreatectomy
  - Pancreas head :
    - Limited tissue destruction: controlled fistula
    - Massive destruction of the head / additional duodenal Injury whipple - pancreaticoduodenectomy

Grade	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



Abdominal great vessel injuries

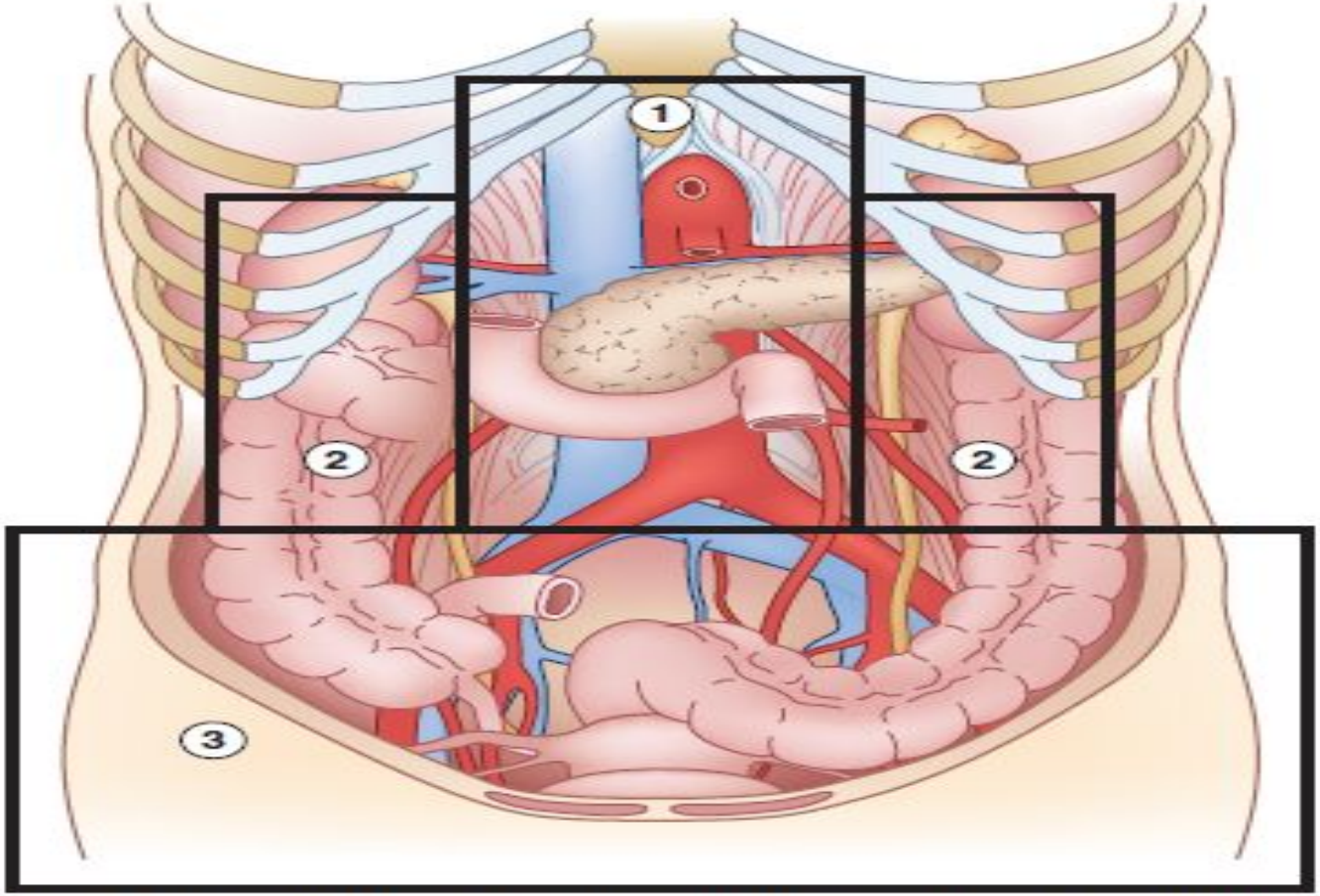


FIGURE 16-29 Zones of the retroperitoneum visualized at the time of laparotomy. Zone 1 includes the central vascular structures, such as the aorta and vena cava. Zone 2 includes the kidneys and adjacent adrenal glands. Zone 3 describes the retroperitoneum associated with the pelvic vasculature.

- The major blood vessels of the abdomen are predominantly located within the retroperitoneum, with some larger vessels also in the intestinal mesenteries

- Most commonly, major abdominal vascular injuries are secondary to penetrating mechanisms

- In the setting of blunt trauma, hematomas within the retroperitoneum are often secondary to pelvic fractures with bleeding from pelvic blood vessels that dissect

The retroperitoneum can be divided into three zones:

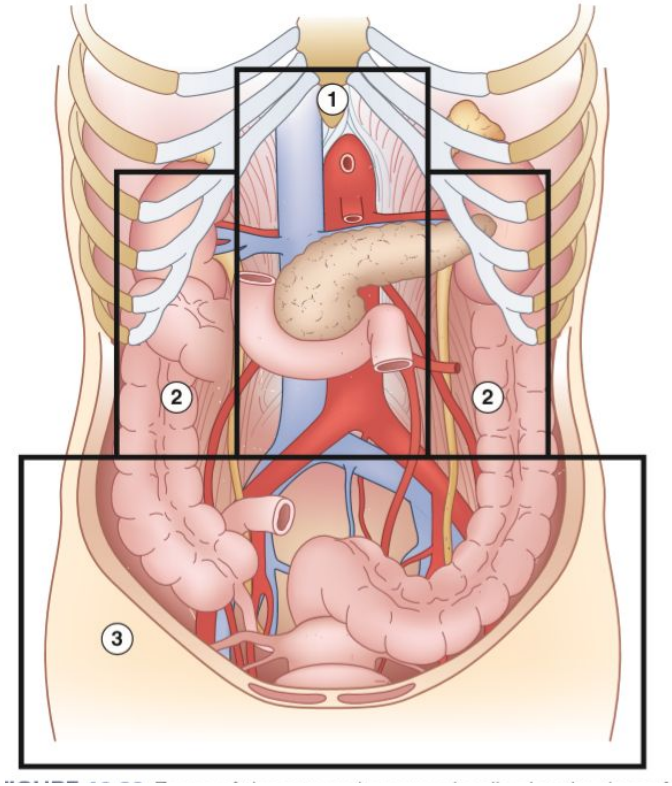
- Zone 1 hematomas require exploration because these frequently involve the aorta, proximal visceral vessels, or inferior vena cava, although an exception may be the dark hematoma behind the liver, which suggests a retrohepatic vena cava injury.

- Injuries to the retrohepatic vena cava are best served by not exposing the contained, low-pressure injury and by gently packing the surrounding area

- A hematoma in the region of zone 2, which predominantly contains the kidneys, should be explored only if it appears that the hematoma is expanding and continuing to lose blood

- A hematoma in zone 3 is usually secondary to pelvic fracture bleeding and should not be explored unless exsanguinating hemorrhage is obvious

Abdominal great vessel Injuries



- I – central hematoma
  - Aorta, prox. visceral vessels, inferior vena cava
  - Always demands exploration
  - But not when dark retrohepatic – vena cava – no exposure- packing
- II - Kidney
  - Exploration only if hematoma is expanding + blood loss
- III - pelvic fracture no exploration unless exsanguinating hemorrhage is obvious (↓ Hb)

Genitourinary injuries

- The genitourinary organs include the kidneys, ureters, bladder, and urethra, all of which are contained within the retroperitoneum

- Bleeding and extravasation of urine are the major concern with injuries to these structures

- Blunt mechanisms can result in renal laceration or bladder rupture

- Intraperitoneal bladder injuries can be repaired in two layers of absorbable suture and the bladder drained with a Foley catheter or suprapubic cystostomy tube.

- Extraperitoneal bladder ruptures require only decompression with a urinary catheter, followed by cystography to confirm healing after a period of recovery.

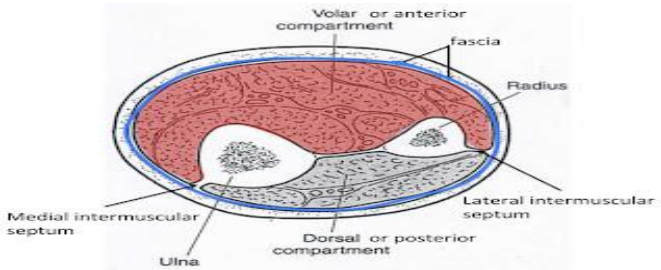
Genitourinary Injury

- Kidney ureter bladder urethra
- Clinic: (gross hematuria), Bleeding , extravasation of urine
- Mechanism: energy transmission to urine-filled bladder
- Diagnostic:
  - Usually during laparotomy
  - CT cystogram
- Management:
  - Ongiong bleeding in shock: nephrectomy
  - Intraperitoneal Bladder wall injury suturing
  - Extraperitoneal bladder rupture : Foley catheter
  - Pseudoaneurysm – angioembolization
  - Expanding hematoma in Zone II – expl lap.

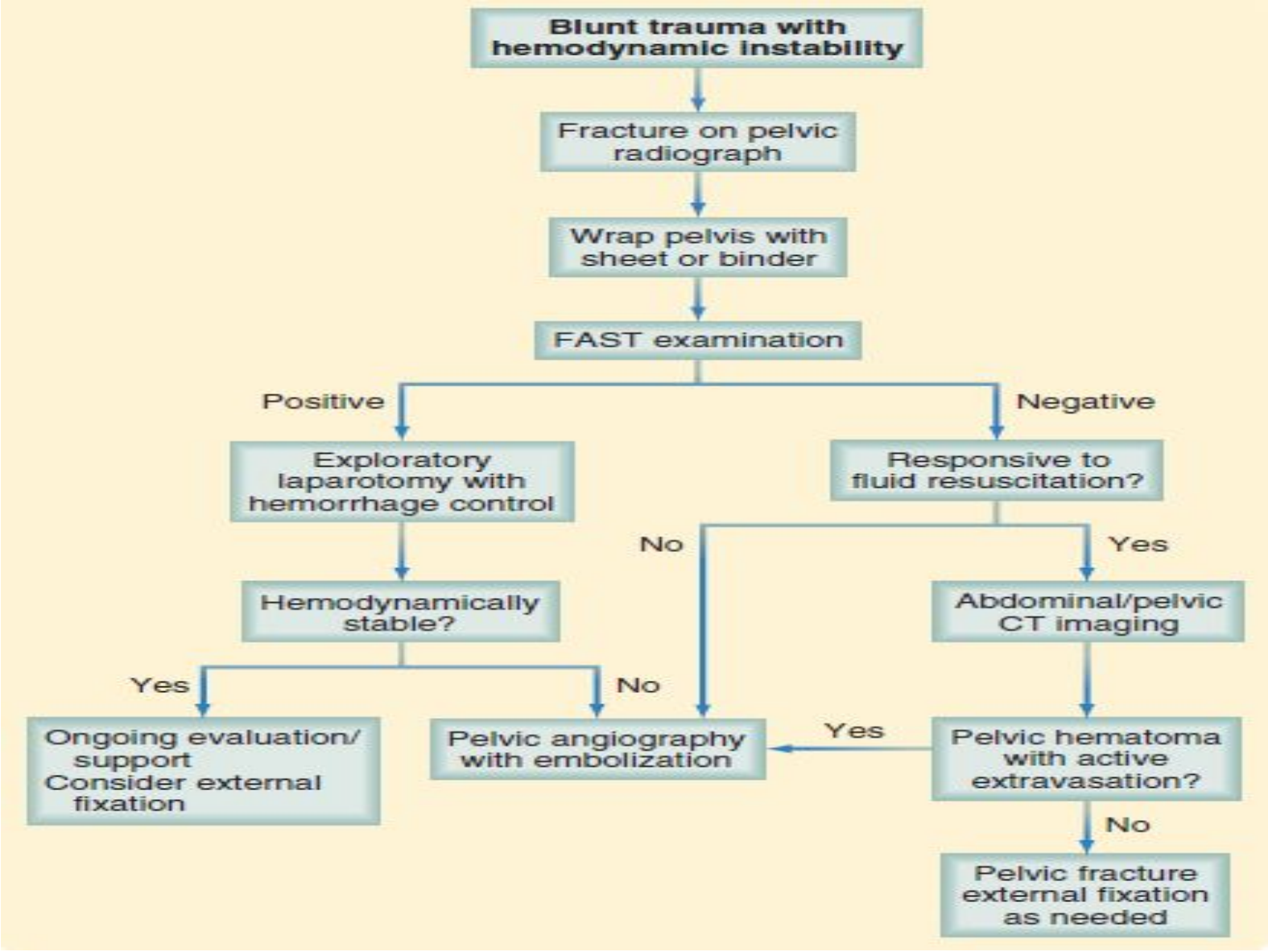
Pelvis and extremities injuries

- Danger of retroperitoneal hematoma
- Low mortality but long-term morbidity and functional implications
- Pelvic Fx – commonly after MV-Accidents and falls
- Diagnostic – physical examination
  - X-RAY
  - CT

- Extremity –
  - compartment syndroms!
    - 6P's rules:
      - Pale
      - Pulseless
      - Pain
      - Parasthesia
      - Paralysis
      - Poikilothermia (temp difference)
  - Peripheral vascular injury – CTA



Injuries to the Pelvis and Extremities



In which of the following the pulse pressure is normal?

A. Shock class I
B. Shock class II
C. Shock class III
D. Shock class IV

A 30 - year - old male is brought to the trauma unit due to chest trauma . Blood pressure is low and heart rate of 122 / minute . Chest X - ray shows wide mediastinum . What is the most likely diagnosis ?

a. Cardiac tamponade
b. Tension pneumothorax
c. Sepsis
d. Head trauma

year - old male is brought to the trauma unit - 22 following a gun - shot wound to the pelvis . He rapidly deteriorates and one of your colleagues is lethal concerned that the patient may suffer from the ? triad . What is the lethal triad

a. Acidosis , hyperthermia , coagulopathy
b. Acidosis , hypothermia , coagulopathy
c. Alkalosis , hypothermia , coagulopathy
d. Alkalosis , hyperthermia , coagulopathy

A 36 years old male was involved in a vehicle accident on exam at the ER -alert blood pressure 150/90 , pulse 130 , room air saturation 94% , diffuse tenderness of left chest wall with decrease breathing sound on that side , chest X-ray demonstrates the following, when is there an indication for thoracotomy?

A) Chest tube draining over 800ml of fresh blood .

B) saturation of 80%

C)chest tube that drains fresh blood of 300ml/h over several hours

D)evidence of heart contusion on top of the lung contusion.

E) Sternal fracture.

21-years
old man arrives in the emergency department wit
h a stab wound to the left chest located 1 cm
to the middle line
of the left nipple. He is awake, diaphoretic, tachy
cardic and hypotensive. Bilateral breath sounds are
present and equal. Chest X-ray show no evidence of a hemopne
shows pericardial fluid. What is the next best step?

a. CT of the chest

b. Pericardiocentesis

c. Bilateral chest tube placement

d. Sternotomy

e. Pericardial window

A 40 years old male is status post-splenectomy following a motor vehicle accident 10 years ago, present to the ER with high fever, chills and productive cough. During his treatment he rapidly deteriorates with decrease in blood pressure. Which of the following immunizations could have prevented his current presentation?

A. Varicella
B. Pertussis
C. Pneumococcus
D. Tetanus

A 15-years-old girl fall while cycling. in the ER. 8 hours later she complains of left upper quadrant and shoulder pain. Her BP is 110/70, HR 95 /min RR 18 breaths per minute. She has tenderness to palpation in the left upper quadrant without peritoneal sign . FAST shows some fluid in the left upper quadrant window and trace of fluid in the pelvic. A CT scan shows a grade 3 spleen laceration with no blush. What is the next step in her management?

a. Splenectomy
b. Splenorrhaphy
c. Angioembolization
d. Observation

A 40 year old male is admitted to the ER following stab wound to the abdomen. on exam alert without distress hemodynamic stable stab wound 5 cm lateral and inferior to the umilicus with omentum protrouding out of skin. no signs of peritonitis, what is the most appropriate next step in management?

A. Abdominal CT

B. Explorative laparotomy

C. Local wound exploration

D. Focused assessment with sonography in trauma (fast)

E. Diagnostic peritoneal lavage.

45 years old female is involved as a pedestrian in motor vehicle accident and is brought to the ER, her blood pressure 130/80 pulse 100 .focused assessment with sonography in trauma (fast) is negative for abdominal fluid, pelvic X-ray demonstrated multiple pelvic fractures (open book).

All of the following can assist in patient stabilization except :

A. Pelvic binder

B. Angiography

C. Extra peritoneal packing

D. External Pelvic fixation

E. Explorative laparotomy