SHAHRZAD TALEBINEJAD MD

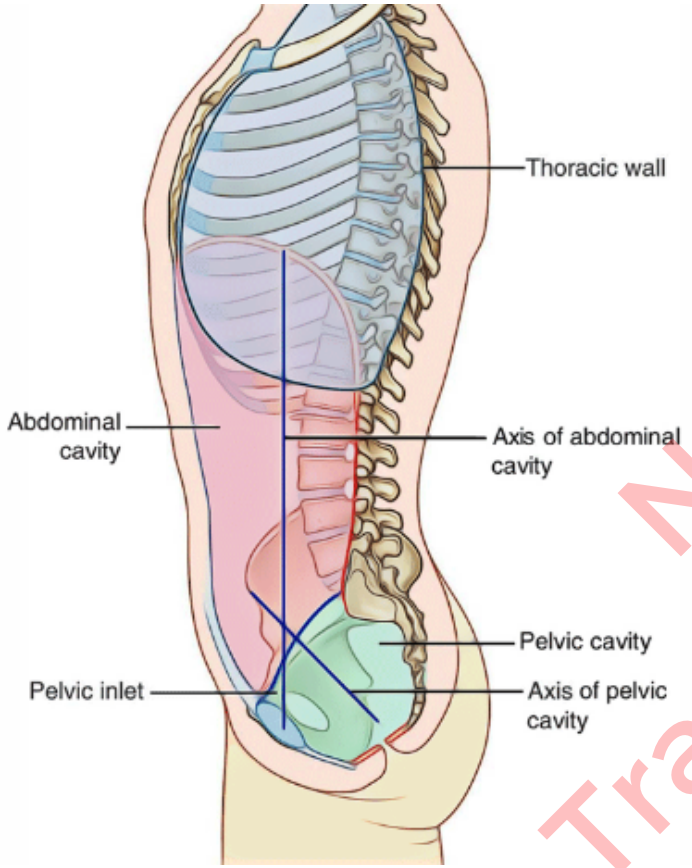
NOVEMBER 1ST 2019 ANNUAL TRAUMA SYMPOSIUM

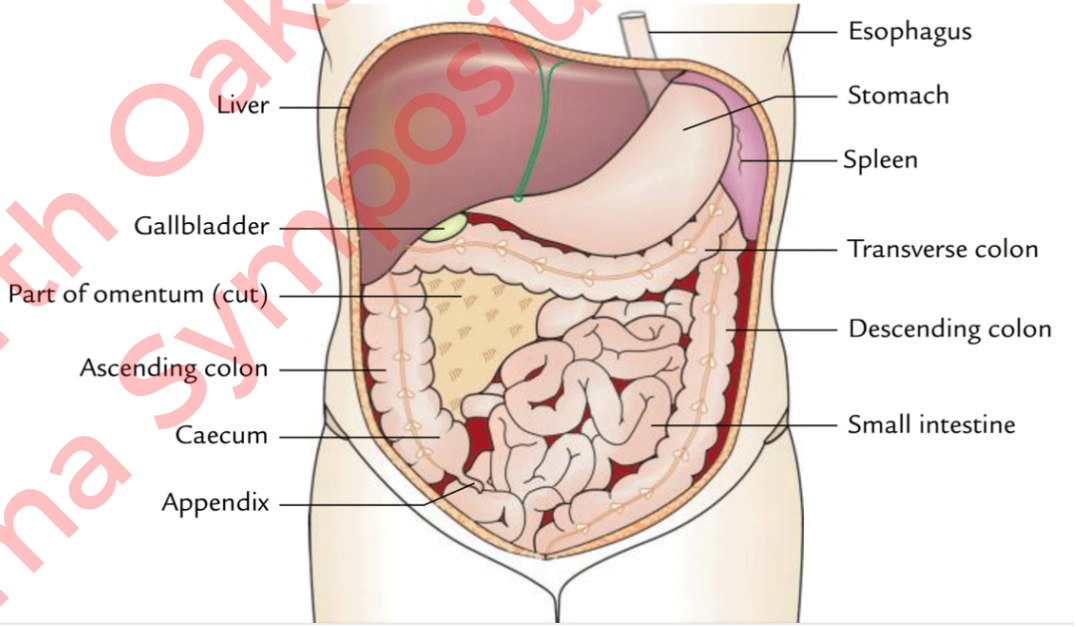
Abdominal trauma

Objectives

1. **Approach to the patient with abdominal trauma**
2. Diagnosis / Management of Splenic, Hepatic, and Pancreatic Injuries.
3. Diagnosis / Management of Intraabdominal Vascular Injuries
4. Diagnosis / Management of hollow viscus organ injuries
5. Diagnosis / Management of genitourinary injuries

Abdominal Cavity “STOMACH”





Penetrating Abdominal Trauma

Affects 35% of those patients admitted to urban trauma centers and up to 12% of those admitted in suburban or rural centers. 90% are males.

Stabbing (knives, ice picks, broken bottle)

Do not remove foreign body unless you are in the operating room.

GSW (90% of the deaths)

Most common injured organ is small intestine > colon> liver

Blunt Abdominal trauma (BAT)

80% of abdominal injuries

75% related to MVC or MPC

13% of those presenting to ED with BAT have intra-abdominal injury

Spleen and liver are most commonly injured

Other common causes…

Seat belt if worn without shoulder attachment

Blunt force to anterior abd wall injuring the intra-abdominal organs against the posterior thoracic vertebral column

Elderly or alcoholic patients with lax abdominal wall

Sudden deceleration causing shear force leading to laceration at points of attachment to the peritoneum

Fractured ribs or pelvic bones lacerating intra-abdominal tissue

“Seat belt sign” highly correlated with intraperitoneal injury. Also spinal injury!

Pre- hospital

Patient stability

Open wounds

Permissive hypotension

What is TXA

Transexamic acid is an anti-fibrinolytic that blocks the action of plasmninogen (an enzyme that dissolves blood clots).

It has been safely used for decades to minimize blood loss in planned surgeries, control oral bleeding in people with hemophilia and treat heavy menstrual periods.

Prehospital TXA

CRASH 2 (2010)- efficacy of in hospital TXA. Reduction in all cause mortality by 1.5%

Given <1 hour after injury more protective than given 1-3 hours and increased mortality >3 hours

Most significant benefit when in severe shock SBP <75

MATTERs – retrospective review, UK

Marked overall survival benefit 17 vs 24%,

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

Prehospital tranexamic acid: what is the current evidence?

TXA was provided by 20 of the 35 air rescue helicopters during the 3-year study period.

(90%) had sustained blunt trauma and had a mean ISS of 24.

Early mortality was significantly lower in the TXA cohort

- 6 hour mortality 1.9 vs 9.3%, p<0.001;
- 12 hour mortality 3.5% vs 10.9%, p=0.002;
- 24 hour mortality 5.8% vs 12.4%, p=0.01.
- Overall in-hospital mortality was similar in both group

- Limitations: exact time and dose not recorded, no algorithm, cause of death not specified

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

A single-center study (University of Texas Health Science Center-Houston) - TXA did not reduce in-hospital mortality (OR 0.74; 95% CI 0.38 to 1.40; p=0.80) in patients with documenta- tion of viscoelastic hyperfibrinolysis

Another single-center prospective cohort study (Queen Mary University, London, UK→This study concluded “it is difficult to recommend TXA use in nonshock patients within mature civilian trauma systems”

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

Box 1 Prehospital TXA recommendations from European guidelines (from Rossaint *et al*[23])

Antifibrinolytic agents (Recommendation 25)

We recommend that tranexamic acid be administered as early as possible to the trauma patient who is bleeding or at risk of significant hemorrhage at a loading dose of 1 g infused over 10 min, followed by an intravenous infusion of 1 g over 8 hours. (Grade 1A)

We recommend that tranexamic acid be administered to the bleeding trauma patient within 3 hours after injury. (Grade 1B)

We suggest that protocols for the management of bleeding patients consider administration of the first dose of tranexamic acid en route to the hospital. (Grade 2C)

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

TXA added to the military Joint Trauma System Damage Control resuscitation Clinical Practice Guidelines 10/2011- “the early use of TXA should be strongly considered for any pt requiring blood products in the treatment of combat-related hemorrhage”

International Trauma Life Support (ITLS)- “there is sufficient evidence to support the use of TXA in the management of traumatic hemorrhage, following initial control of external bleeding and stabilization of airway.”

- Signs of hemorrhage
- Tachycardia >110 BPM
- SBP <100
- <3 hours from injury

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

American College of Surgeons Committee on Trauma, The American College of Emergency Physicians and the National Association of EMS Physicians

Box 2 Prehospital TXA recommendations from US guidelines (from Fischer *et al*[26])

TXA administration to bleeding patients

Objective measurements should be used to guide prehospital TXA administration protocols. The focus for management of compressible, external bleeding should be on direct pressure, tourniquets, hemostatic agents, and/or wound packing. Evidence of injury consistent with non-compressible hemorrhage (eg, penetrating thoracoabdominal trauma or unstable pelvis fractures) along with heart rate >120 bpm and SBP <90 mm Hg are suggested criteria. Agencies may consider vital sign adjustments for the geriatric population.

Don't forget the basics

In the bleeding patient, hemorrhage control and appropriate resuscitation remain the priority. Prehospital TXA use should never supersede field bleeding control techniques, rapid transport to a trauma center or the administration of blood or plasma.

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056

Ongoing Clinical Trials

Two Ongoing to examine the efficacy of TXA in the prehospitall setting

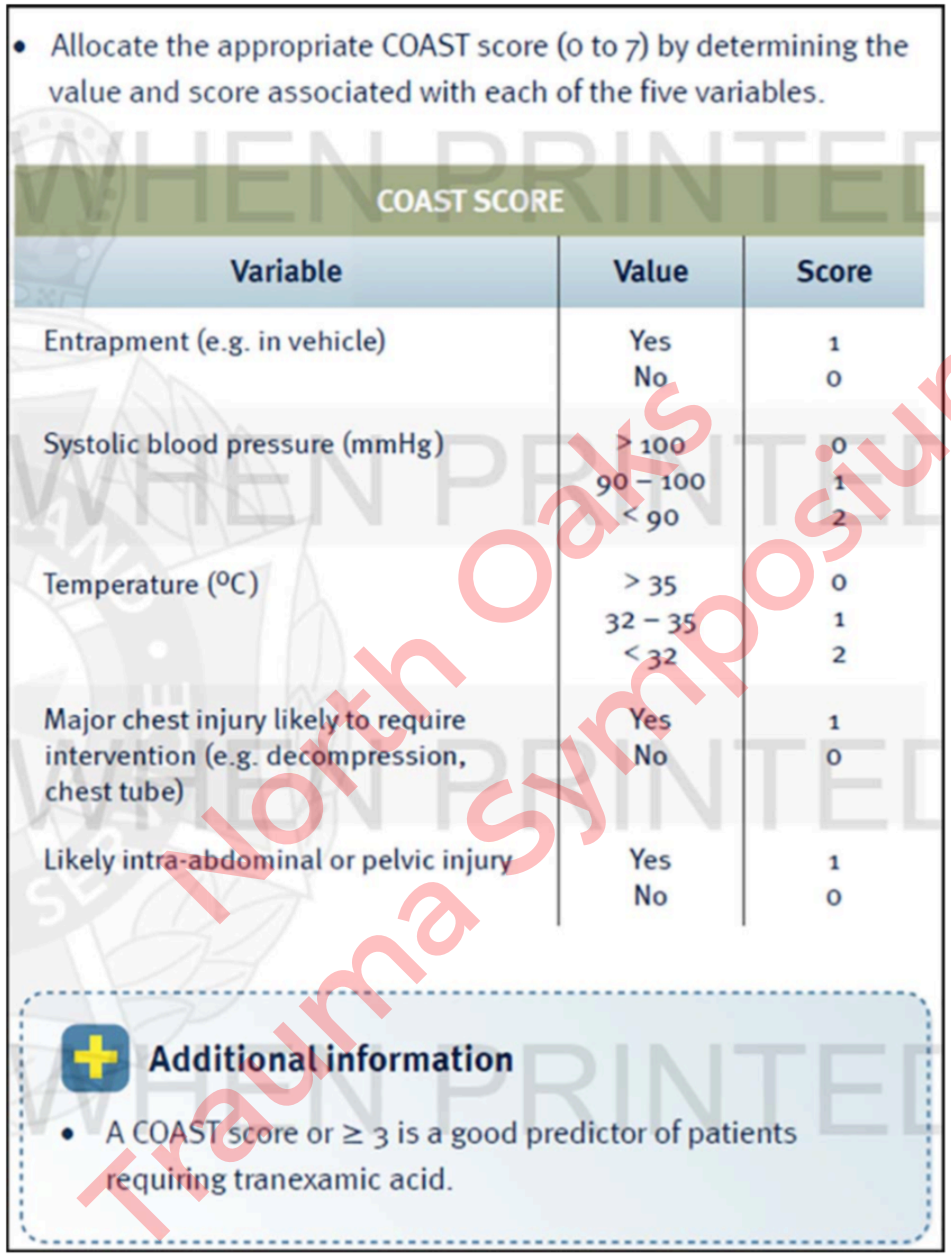
STAAMP (study of TXA during air medical prehospital transport)

- Adult, airmed, SBP <90, or HR >110 within 2 hours of injury
- Multicenter, university of Pittsburg, 3 year enrollment, ~994 pts, RCT

PATCH (Prehospital Antifibrinolytic for Traumatic Coagulatophy and Hemorrhage)

- International study, multicenter RCT (Australia and New Zealand)

Napolitano LM. Trauma Surg Acute Care Open 2017;2:1–7. doi:10.1136/tsaco-2016-000056



- Allocate the appropriate COAST score (0 to 7) by determining the value and score associated with each of the five variables.

COAST SCORE

Variable	Value	Score
Entrapment (e.g. in vehicle)	Yes	1
	No	0
Systolic blood pressure (mmHg)	> 100	0
	90 – 100	1
	< 90	2
Temperature (°C)	> 35	0
	32 – 35	1
	< 32	2
Major chest injury likely to require intervention (e.g. decompression, chest tube)	Yes	1
	No	0
Likely intra-abdominal or pelvic injury	Yes	1
	No	0

Additional information

- A COAST score or ≥ 3 is a good predictor of patients requiring tranexamic acid.

Figure 5 COAST (*COA*gulopathy in *S*evere *T*rauma) prehospital score used in PATCH clinical trial. From https://ambulance.qld.gov.au/%5Cdocs%5Cclinical%5Ccpp%5CCPP_COAST%20score.pdf.

In Conclusion….

At present, the focus of prehospital care of the bleeding trauma victim should **be hemorrhage control**, **hemostatic resuscitation** and **rapid transport to definitive hemorrhage control and definitive trauma care.**

Physical exam- generally unreliable

- Tenderness, peritoneal signs, wounds (path of injury), contusions
  - Cullen's sign – umbilical ecchymosis
  - Gray-Turner sign- Flank ecchymosis
- DRE

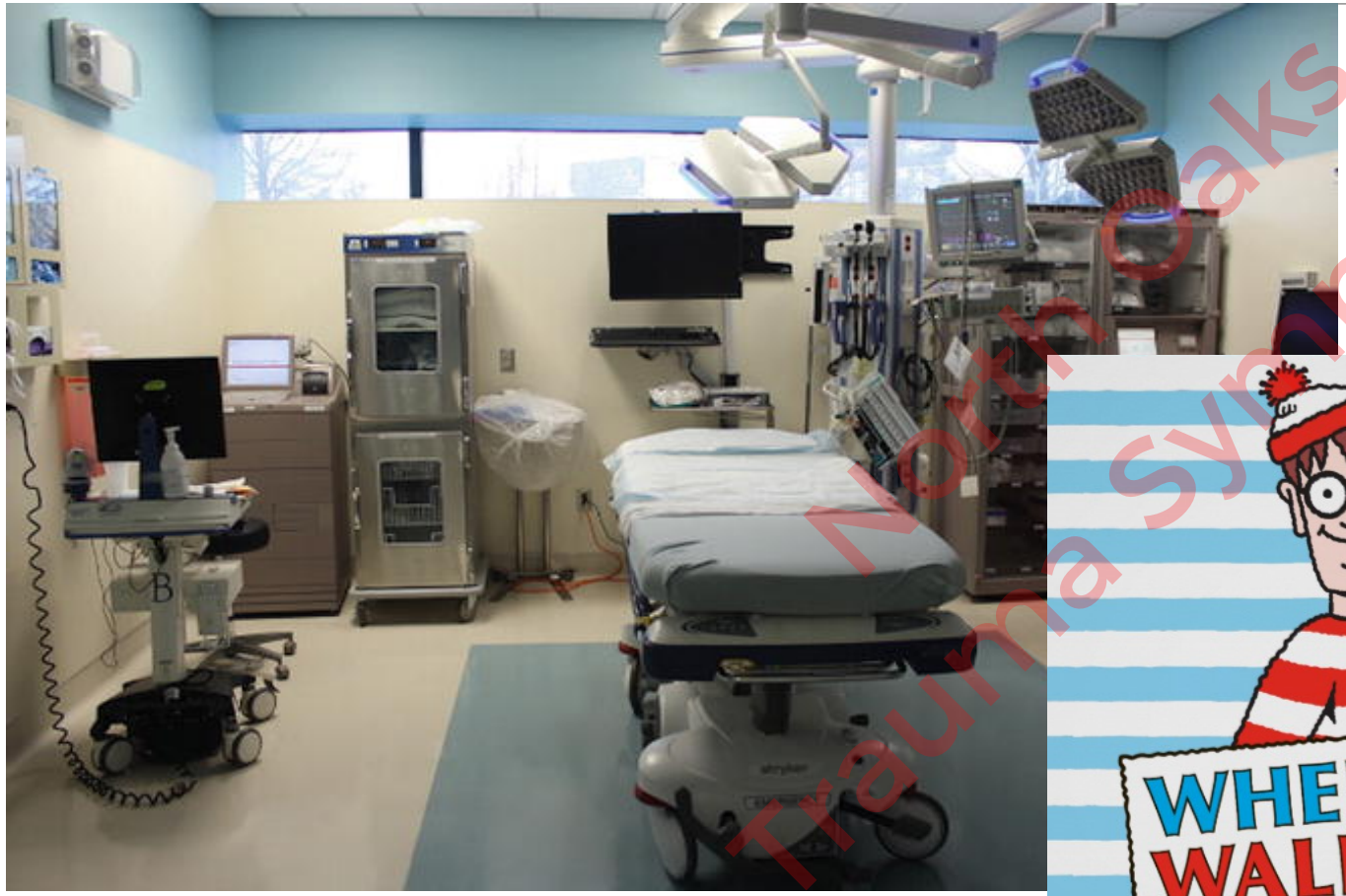
Labs- usually not resulted before you make your next decision

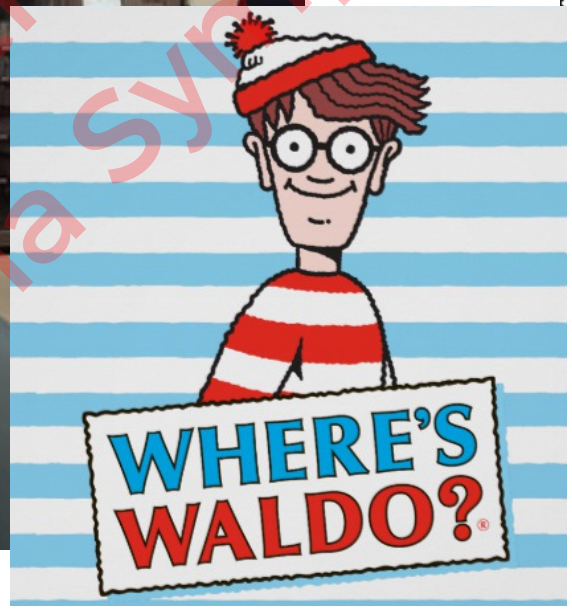
- CBC, Lactate, LFTs, Tox screen

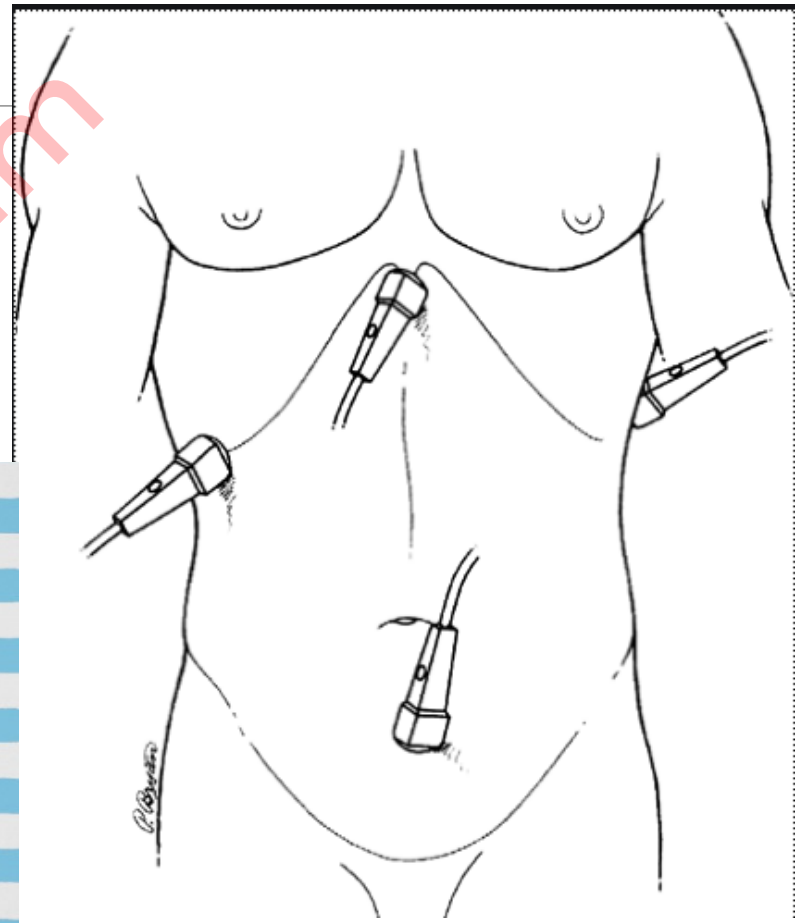
Plain films? Not much of a role

- Foreign body (Bullet, knife)
- Open book pelvis fracture

FAST Exam: When and How



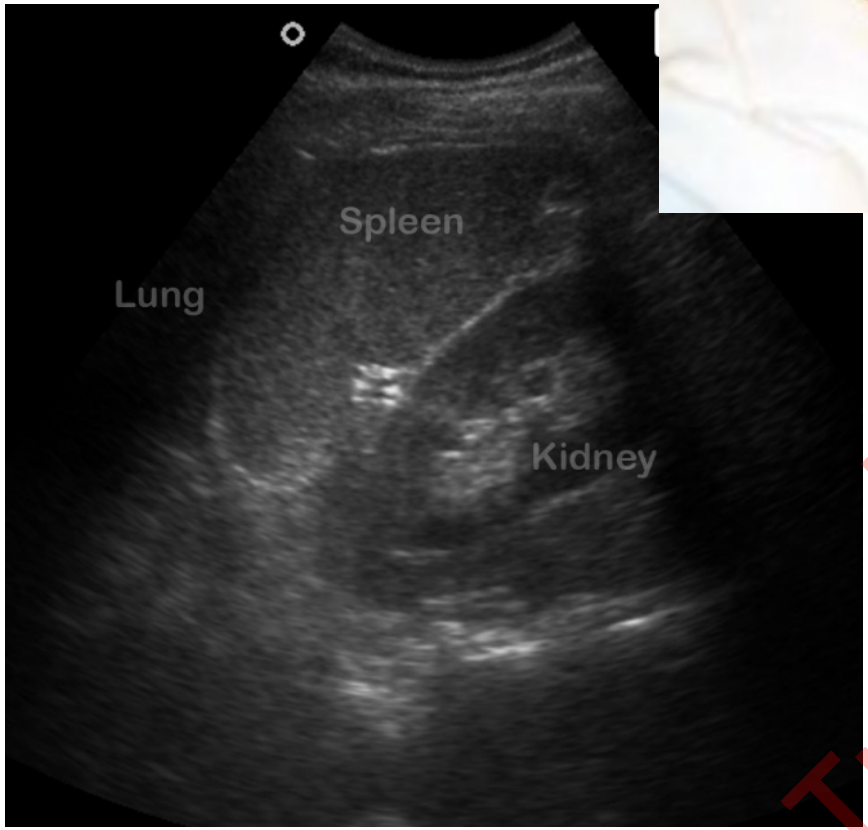


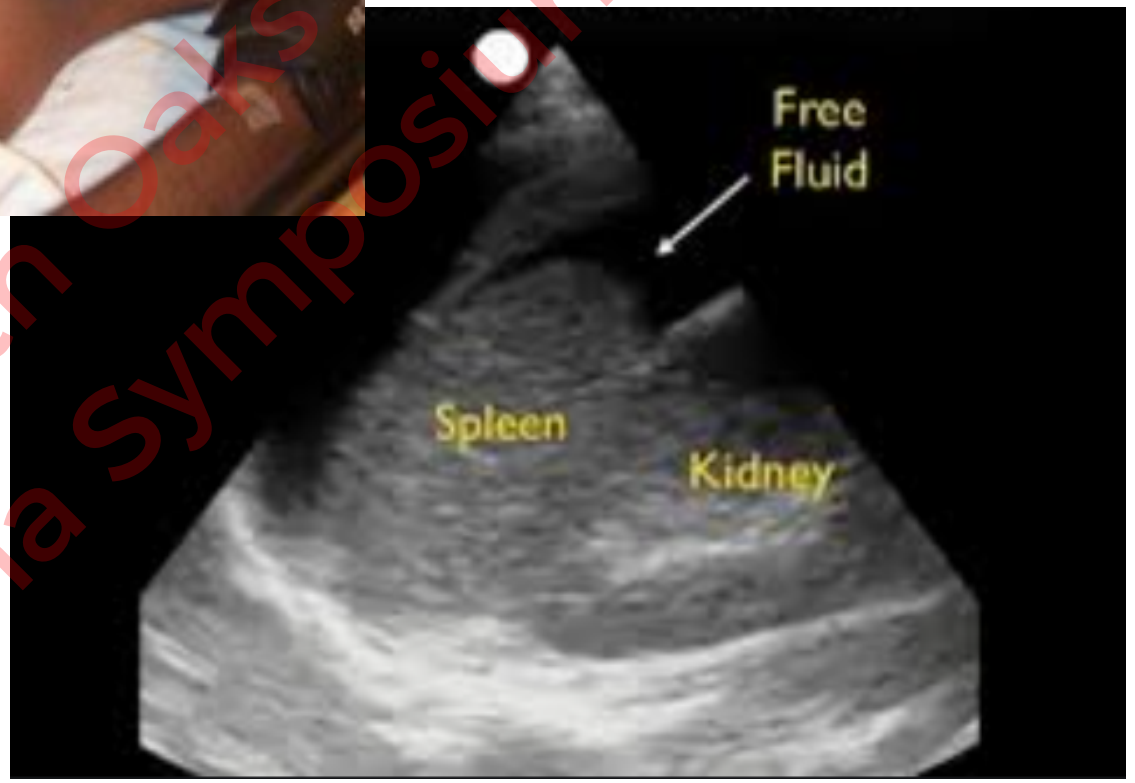


sensitivity 60 to 95% for detecting 100 mL- 500 mL of fluid

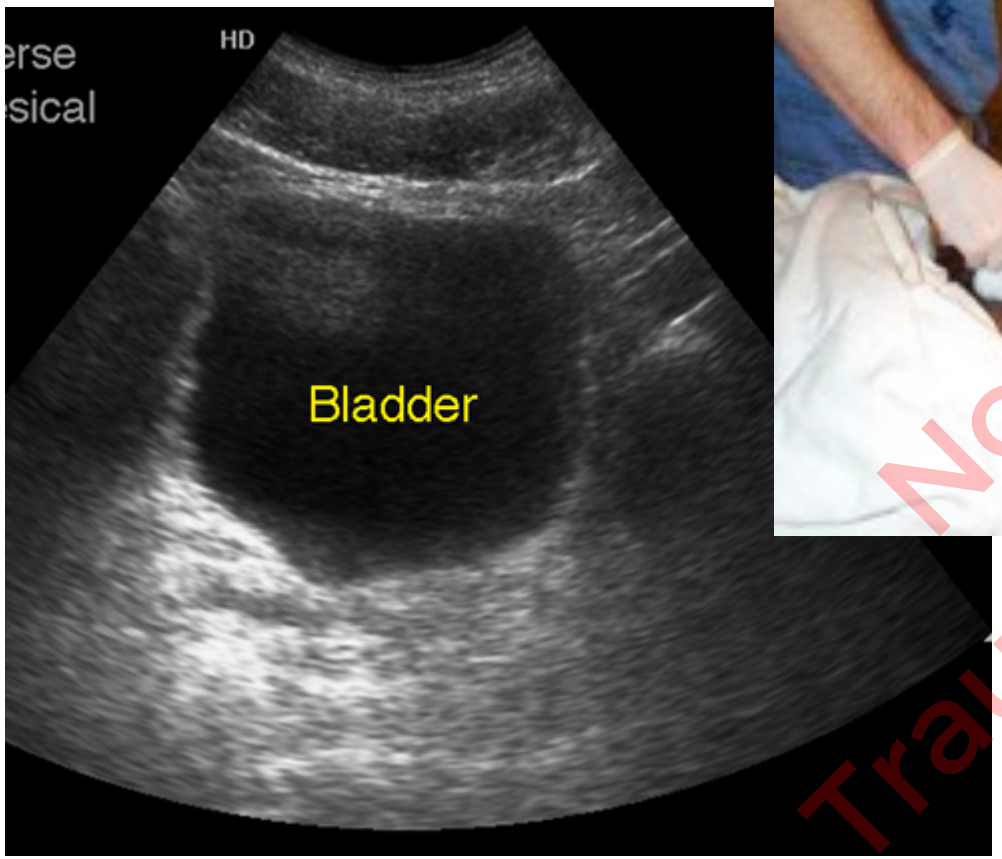
Morriosn's pouch (perihepatic, hepatorenal)

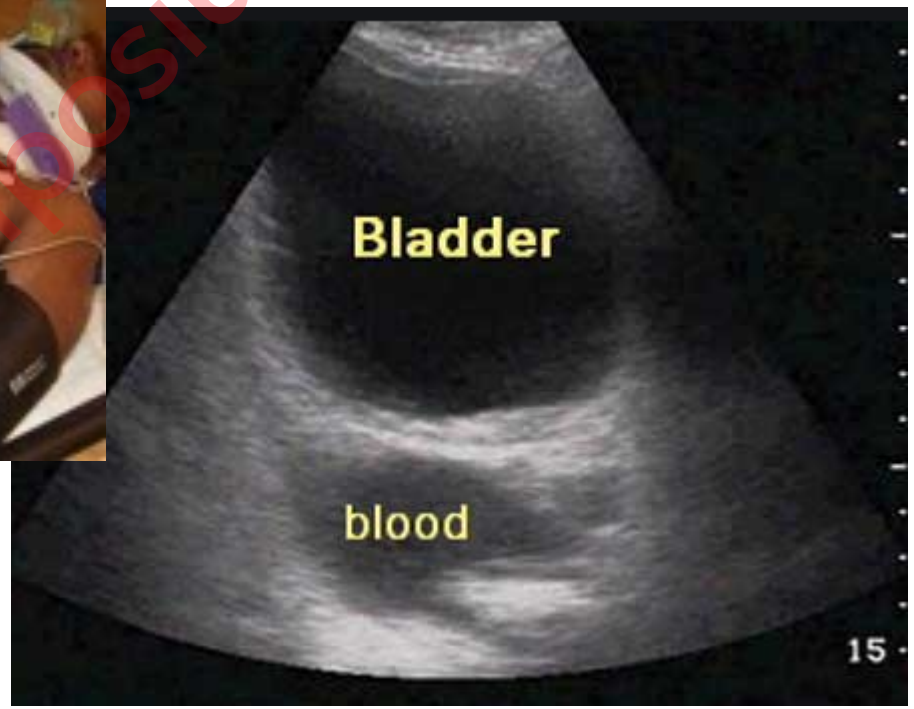
Perisplenic



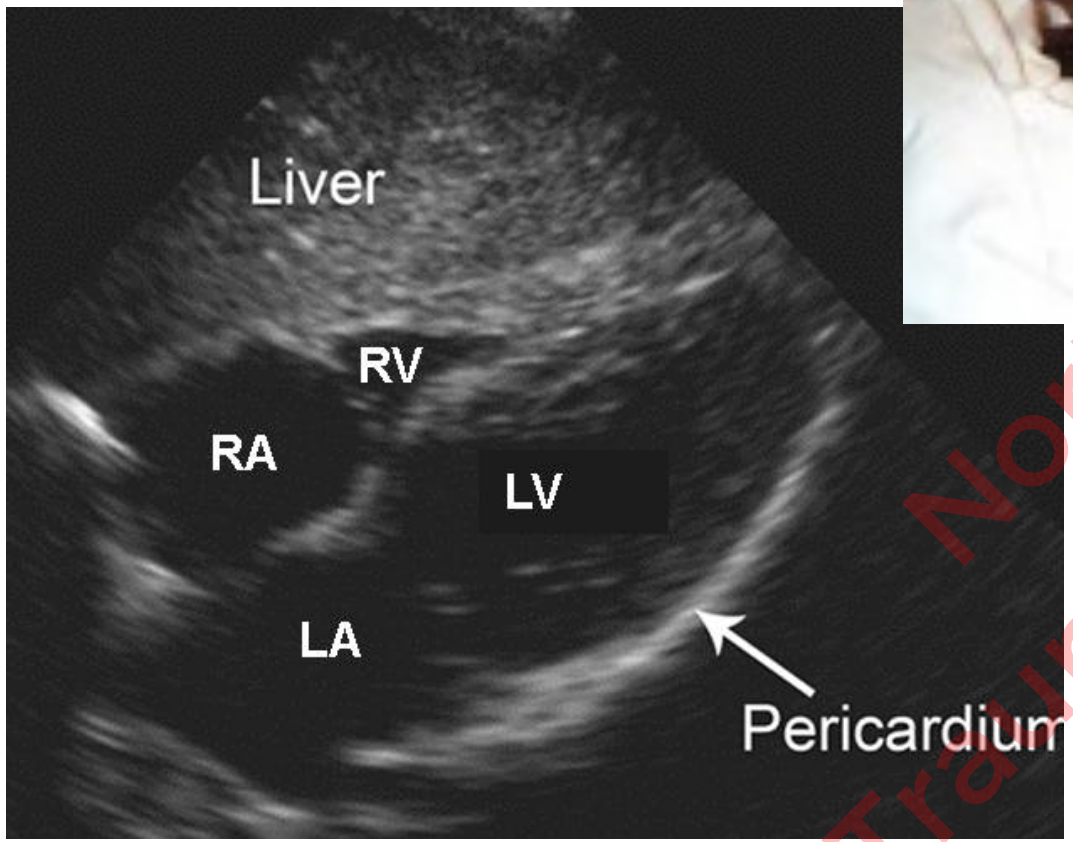


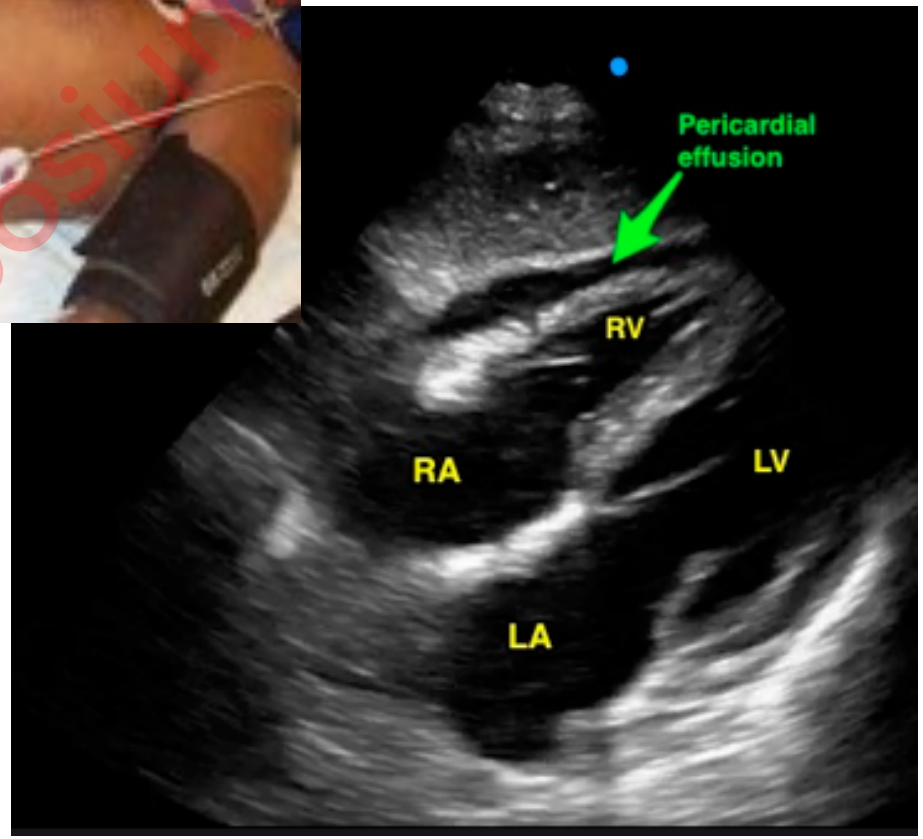
Pouch of Douglas/rectovesical pouch





Pericardium



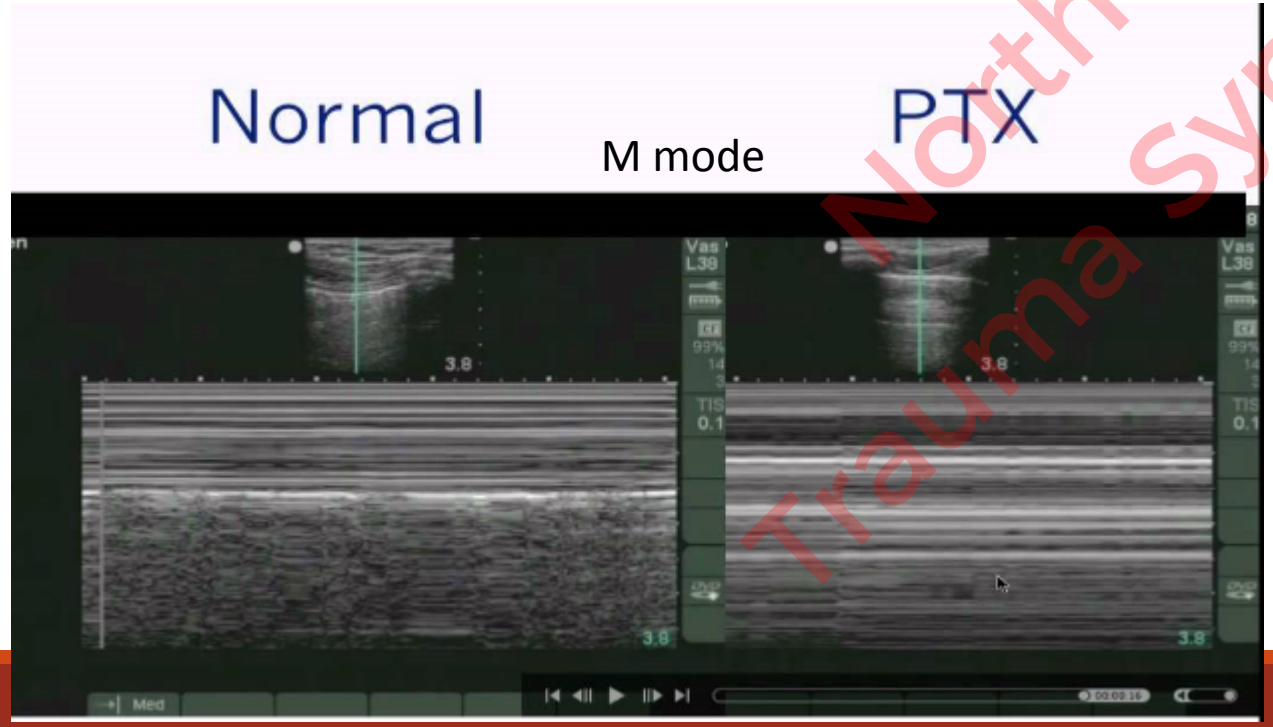


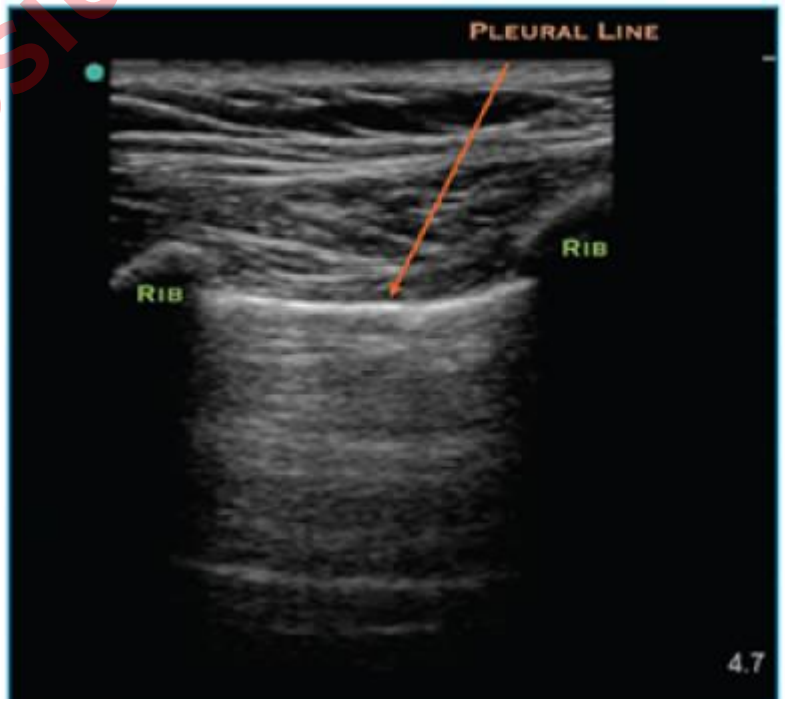
Extended FAST (5th window) Anterior thoracic view:

3rd intercostal space, mid clavicular line.

Detect missing pleural sliding or vertical lines

Sensitivity 59%, specificity up to 99% for PTX (c/w CXR 20%)





Classification and management recommendations for CT scan findings following penetrating flank/back injuries

Risk	CT findings	Intervention
Low	No penetration	Discharge from ED
	Penetration into subcutaneous tissue	
Moderate	Penetration into Muscle	Serial clinical assessments
	Retroperitoneal hematoma, not near critical structure	
High	Contrast extravasation from colon	Laparotomy
	Major extravasation from kidney	
	Hematoma adjacent to major retroperitoneal vessel	
	Free air in retroperitoneum, not attributed to wounding object	
	Evidence of injury above and below diaphragm	
	Free fluid in peritoneal cavity	

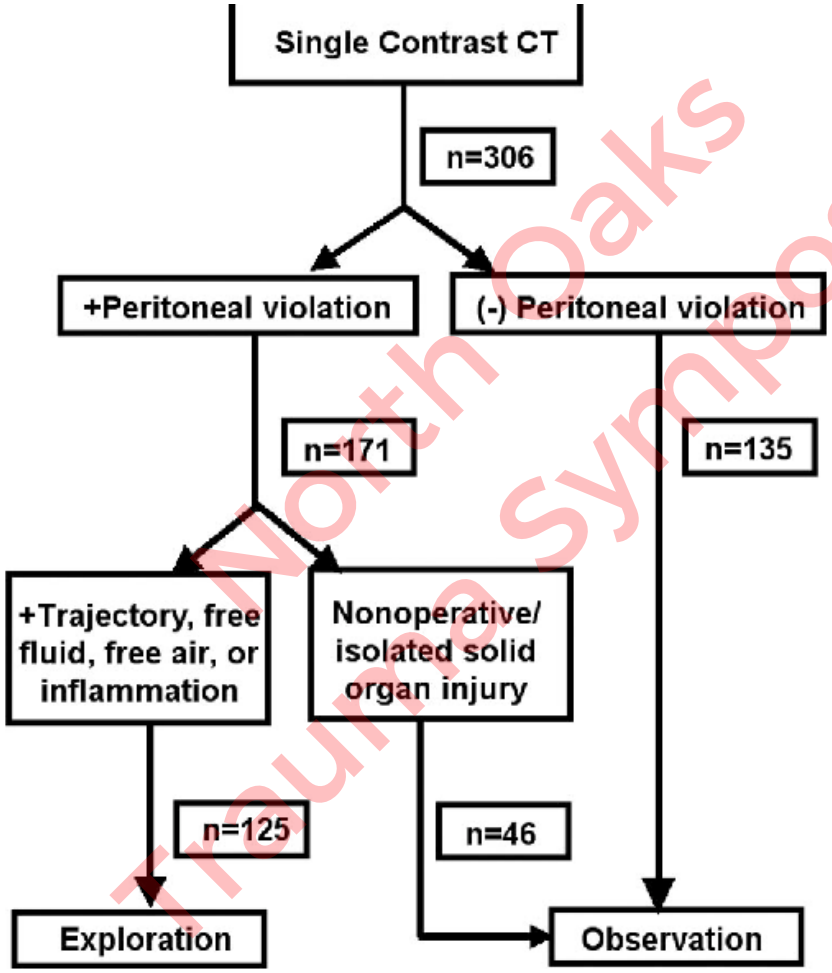
Adapted from Himmelman et al. [28]

DPL, DPA, or local wound exploration rarely utilized

J Trauma. 2009 Sep;67(3):583-8. doi: 10.1097/TA.0b013e3181a39330.

Single-contrast computed tomography for the triage of patients with penetrating torso trauma.

Ramirez RM[1], Cureton EL, Ereso AQ, Kwan RO, Dozier KC, Sadjadi J, Bullard MK, Liu TH, Victorino GP.



Diagnostic laparoscopy

- diaphragm injury: Sensitivity 87.5%, 100% specific
- miss hollow viscus injury (retroperitoneal)

Objectives

1. Approach to the patient with abdominal trauma

2. Dx / Management of Splenic, Hepatic, pancreatic Injuries.

3. Dx / Management of Intraabdominal Vascular Injuries

4. Dx / Management of hollow viscus organ injuries

5. Dx/ Management of genitourinary injuries

Splenic injury

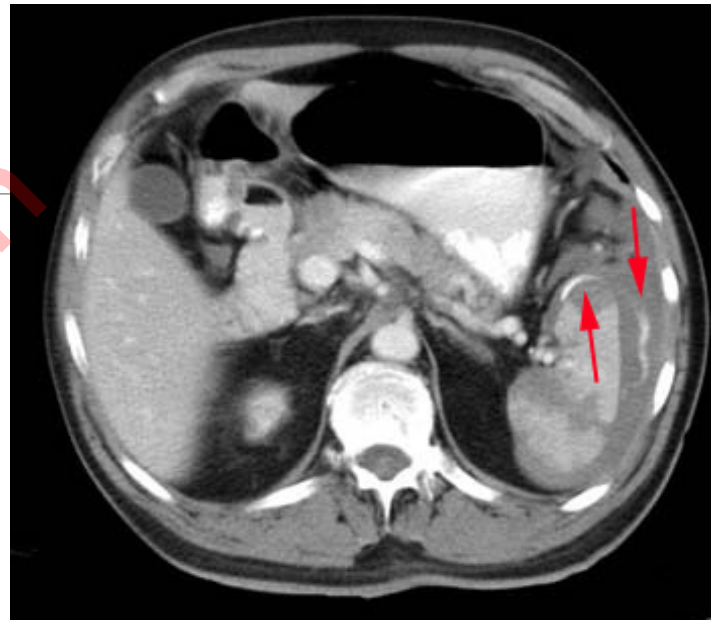
philosopher Claudius Galen (129-216 AD) described the spleen as

"**Plenum mysterii organum**" or

"the organ full of mystery"

as he struggled to elucidate its function.

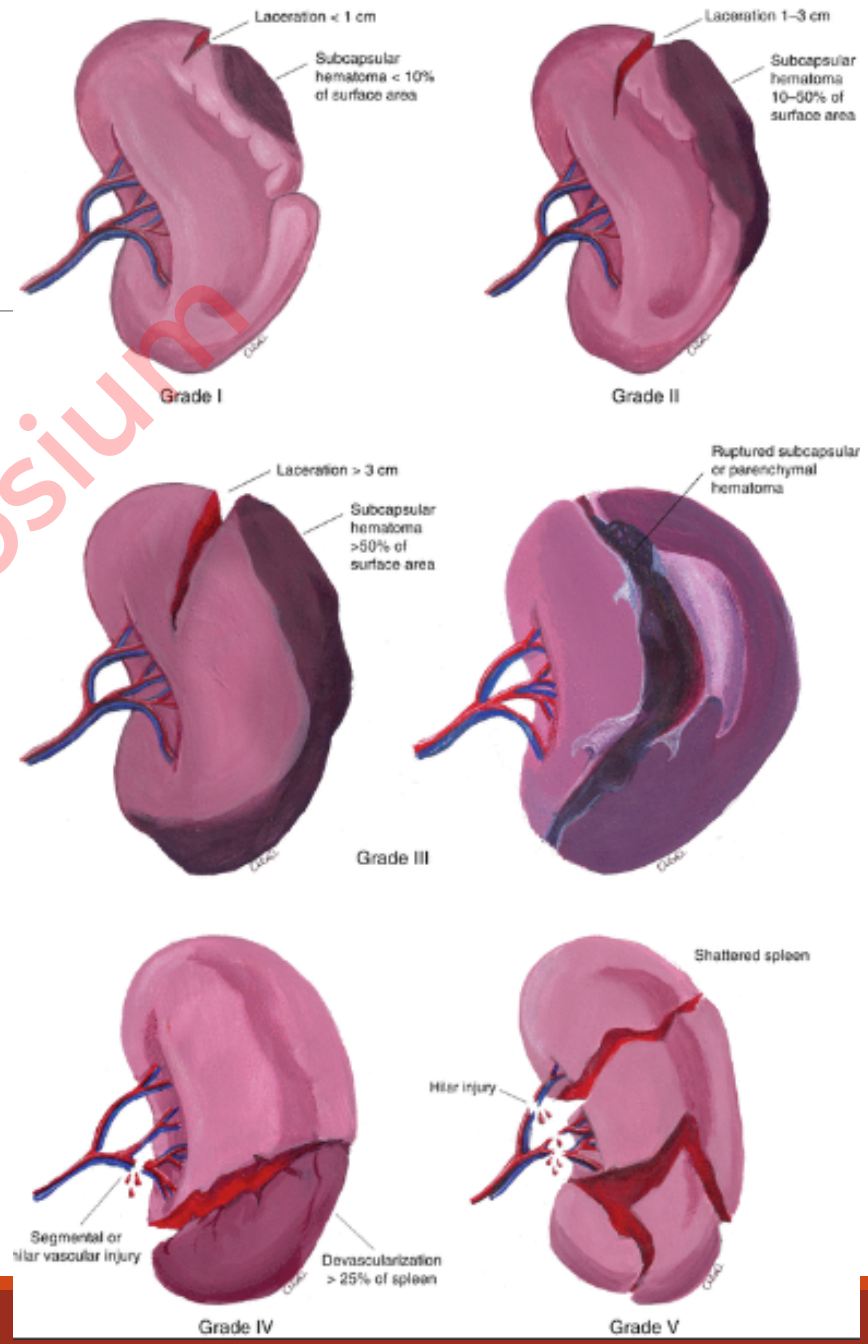
The mystery continued for over a millennium, as no one challenged his theory that the spleen functioned to remove the evil humor "black bile" produced by the liver



Grade	Type of injury	Description of injury
I	Hematoma	Subcapsular, <10%
	Laceration	Capsular tear, <1 cm in depth
II	Hematoma	Subcapsular, 10% - 50%; intraparenchymal, <5 cm in diameter
	Laceration	Capsular tear, 1 - 3 cm in parenchymal depth, not involving trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding, ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma, ≥5 cm or expanding
	Laceration	>3 cm in parenchymal depth or involving trabecular vessel
IV	Laceration	Segmental or hilar vessels, major devascularization (>25%)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury that devascularizes the spleen

*Advance one grade for multiple injuries, up to Grade III.

AAST spleen injury scale.



Unstable patient

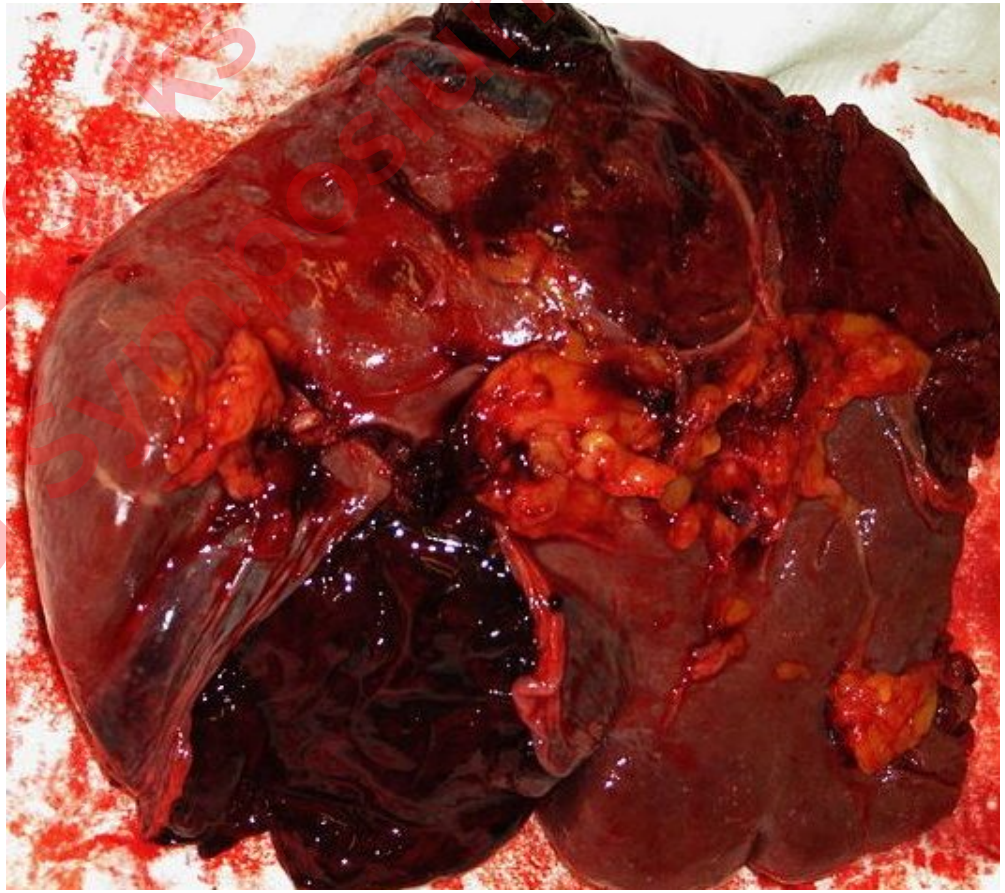
A

B

C’s

FAST

Operating room-- splenectomy



Stable patient

Non- operative/conservative– Standard of care

Attempted in 85%

Failure rate 8-38%, 75% fail within 48 hours

ICU admit/ Bed rest

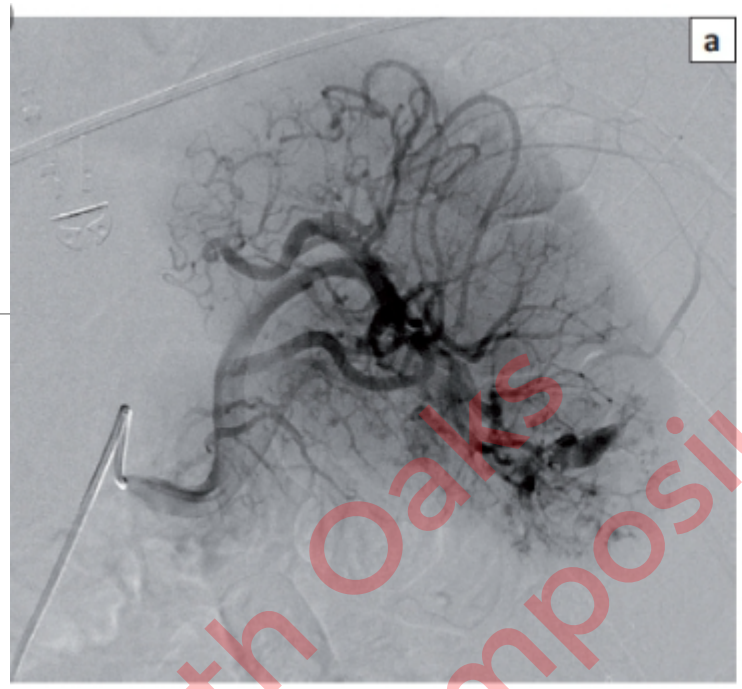
Serial abdominal exams:

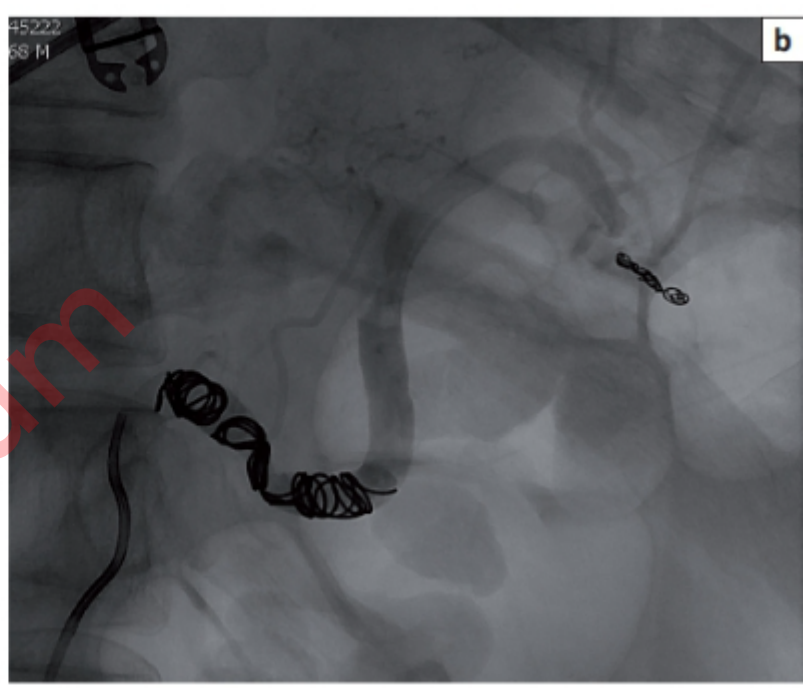
- 9.6% of patients with a solid-organ injury and an Abbreviated Injury Scale score of 2 or greater also had a hollow viscous injury.

Serial H/H

- Transfusion threshold? 2-4Units RBC

IR embolization





reduces NOM failure rate by 10%

AAST Grade greater than III injuries

Blush, moderate hemoperitoneum

Clinical evidence of ongoing splenic bleeding

Considered in patients with Oral anticoagulation use/TBI

Vaccines?

Post splenectomy- encapsulated organisms.

Ideally 6 weeks post op or prior to discharge.

Controversial for non-op management

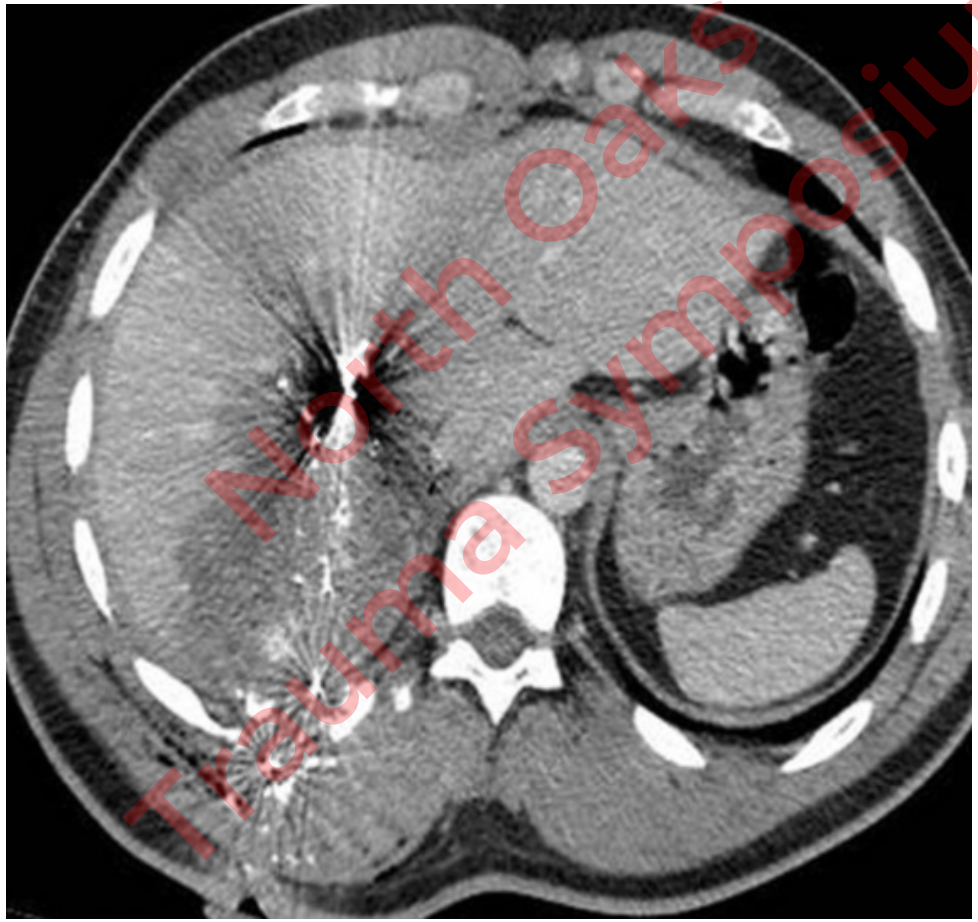
- Humoral immunosuppression is transient

Reserved function and no need for vaccines when assessed once week post injury.

Activity limitations? Longer for higher grade. 2-6months (no contact sports/heavy lifting)

Hepatic injury

Penetrating managed non-op?



J TRAUMA 2010; 68: 721-733

Stable

Management similar to splenic injury

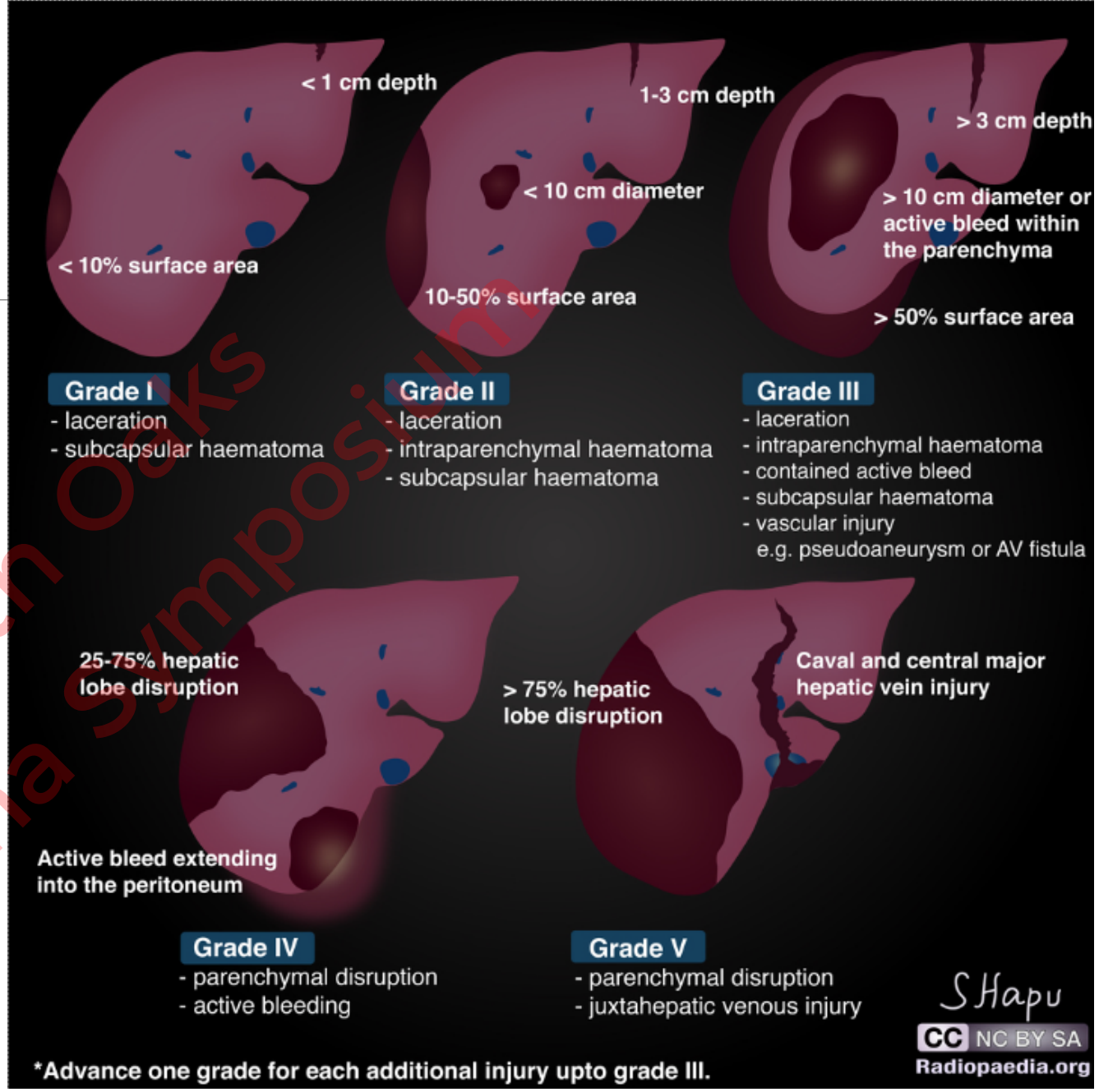
89% success rate

ICU admit/serial exam/H&H, IR embolization

Monitor LFT's

IR embolization

Biloma 8%, hepatic necrosis, hemobilia (abd pain, Hematemesis)



Unstable

Exploratory laparotomy

Manual compression

Packing

Topical hemostatics

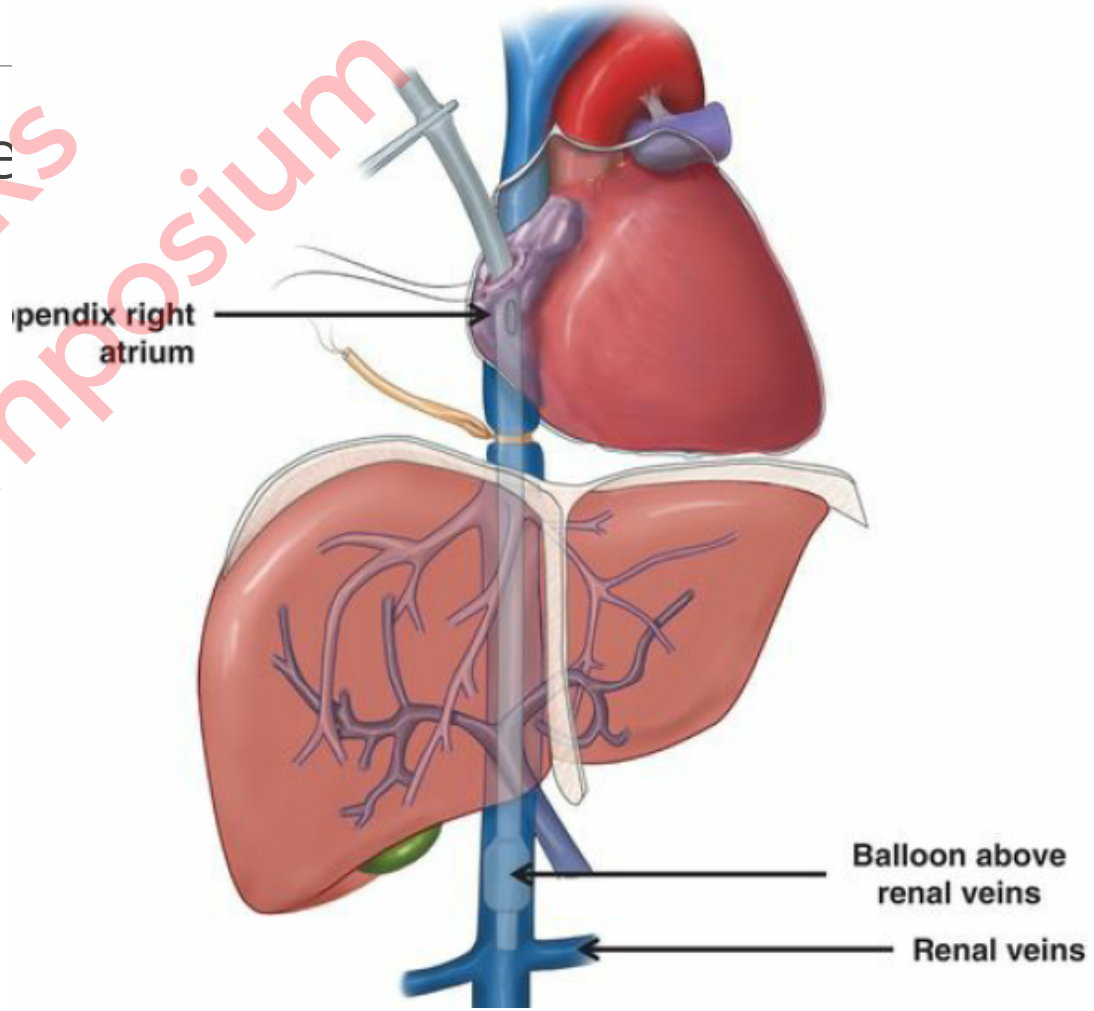
Pringle maneuver –Up to 60 minutes

Liver suture 0- chromic blunt tip.

Finger fracture/partial hepatectomy/tractotomy

Atriocaval shunt Shrock shunt

36F CT, or size 6-8 ETT, needs additional fene



Pancreatic Injury

The term "pancreas" is derived from the Greek *pan*, "all", and *kreas*, "flesh"

Kocher, in 1903 described the surgical approach to the mobilization of the duodenum and head of the pancreas

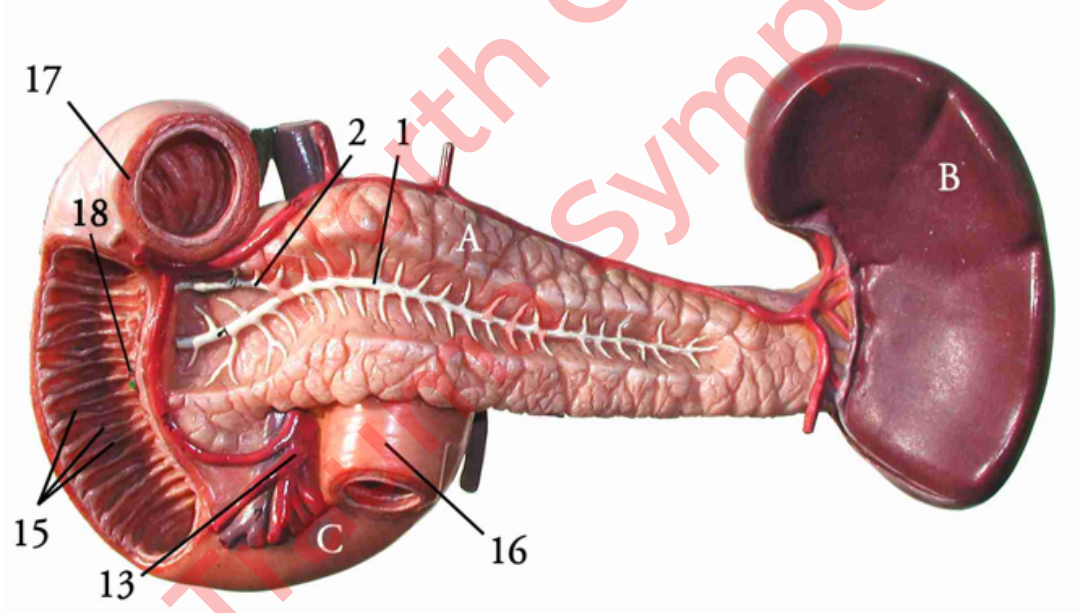
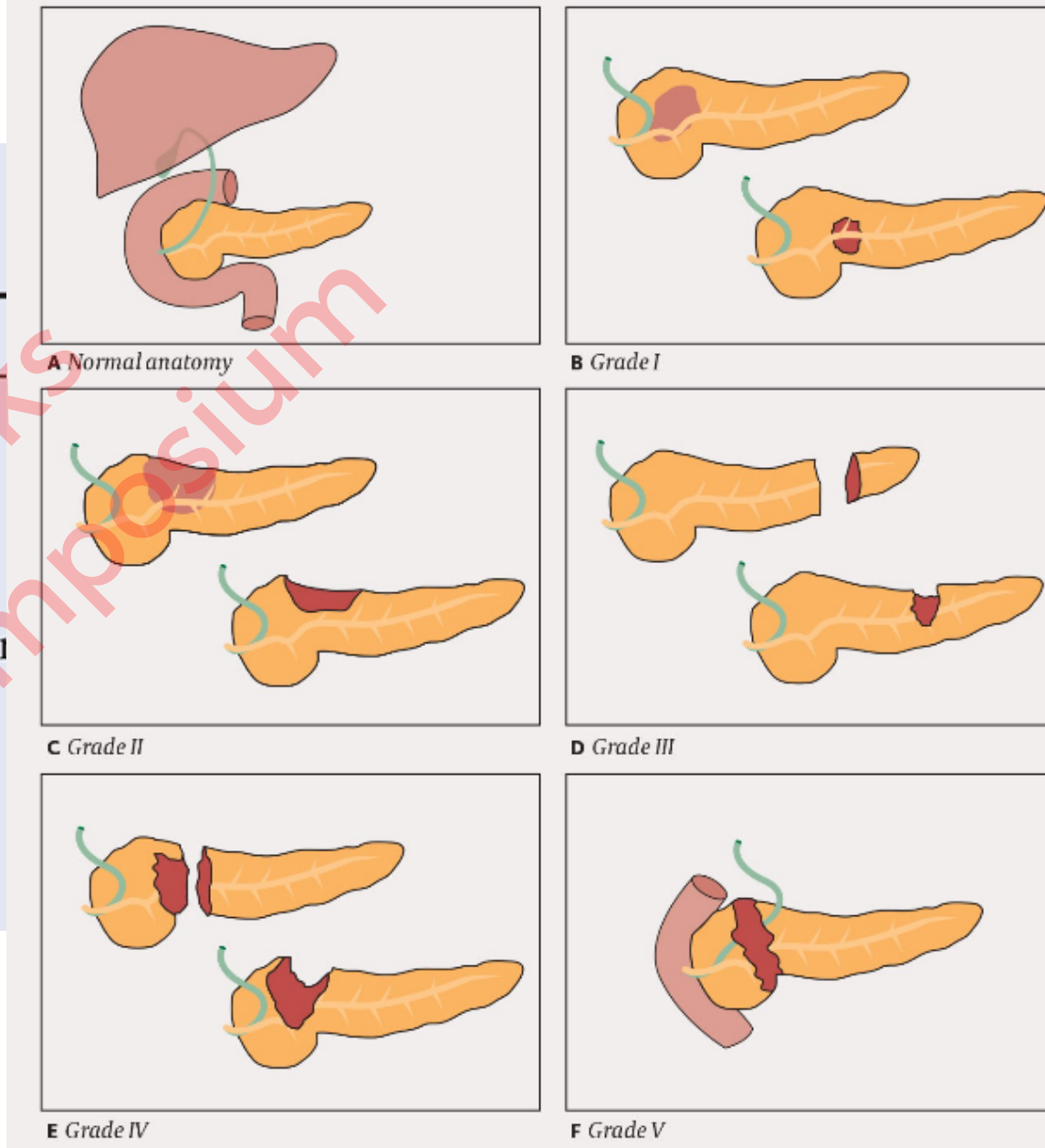


Table 6. American Association for Surgery in Trauma pancreatic trauma grading system

Grade	Pancreatic injury
Grade I	Haematoma with minor contusion/laceration but without duct injury
Grade II	Major contusion/laceration but without duct injury
Grade III	Distal laceration or parenchymal injury with duct injur
Grade IV	Proximal laceration or parenchymal injury with injury to bile duct/ampulla
Grade V	Massive disruption to pancreatic head



Rare- <0.5%, but about 18% mortality

Double the mortality with duodenal injury

Grade I & II, require only hemostasis and external drainage

Resist temptation to repair capsular laceration

External close drainage, for 10 days

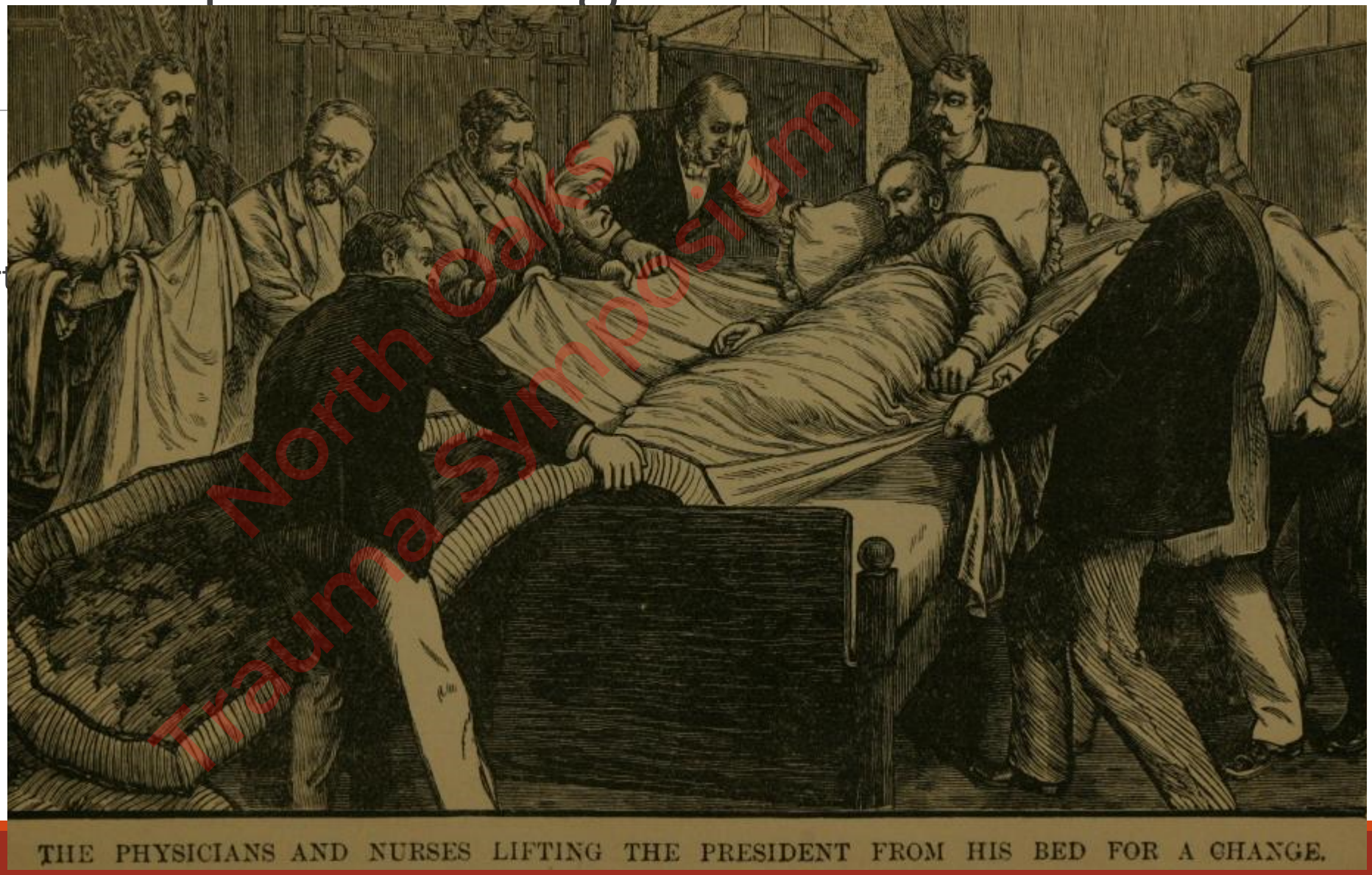
Nutritional support, elemental diets

Most injuries are penetrating

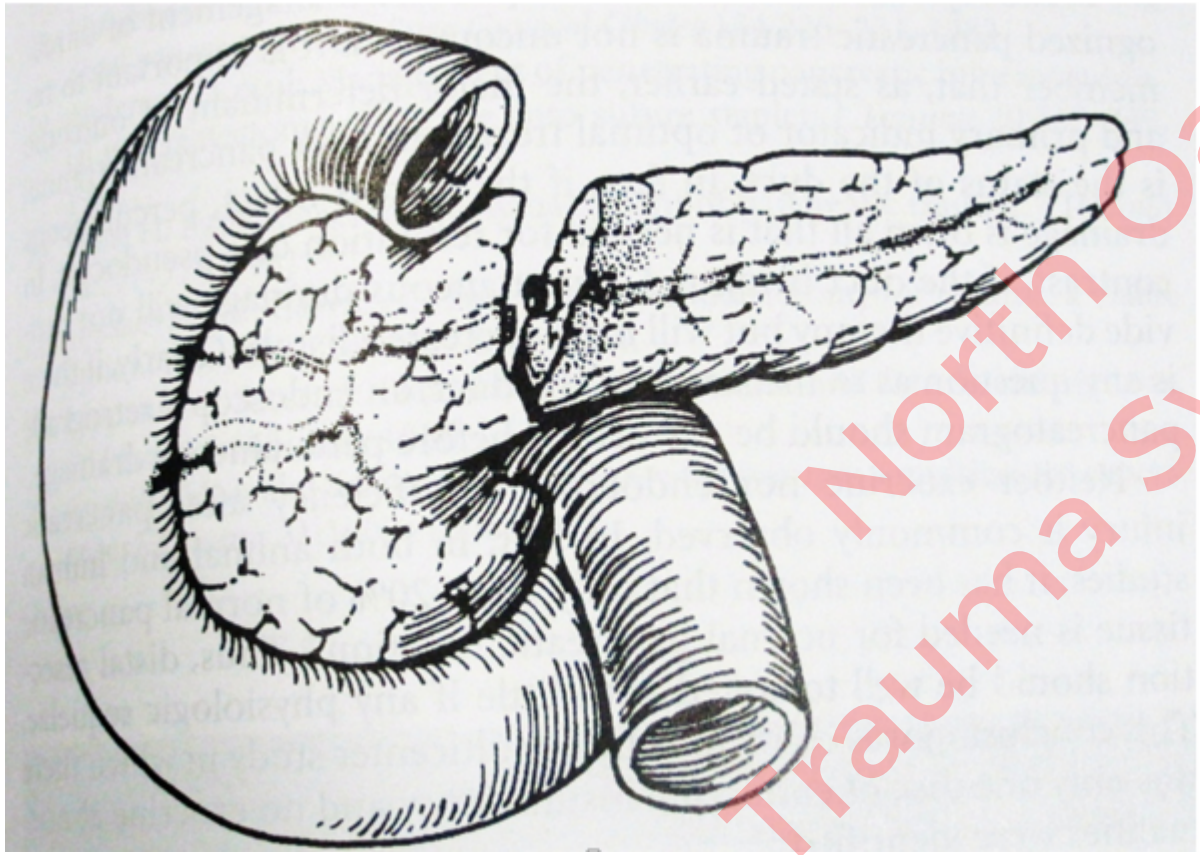
July 2nd 1881

79 days

Ruptured splenic art



Distal pancreatic transection, with ductal injury, treated with distal pancreatectomy.
TA stapler, with or without splenectomy



Pancreatic head injury

Grade IV

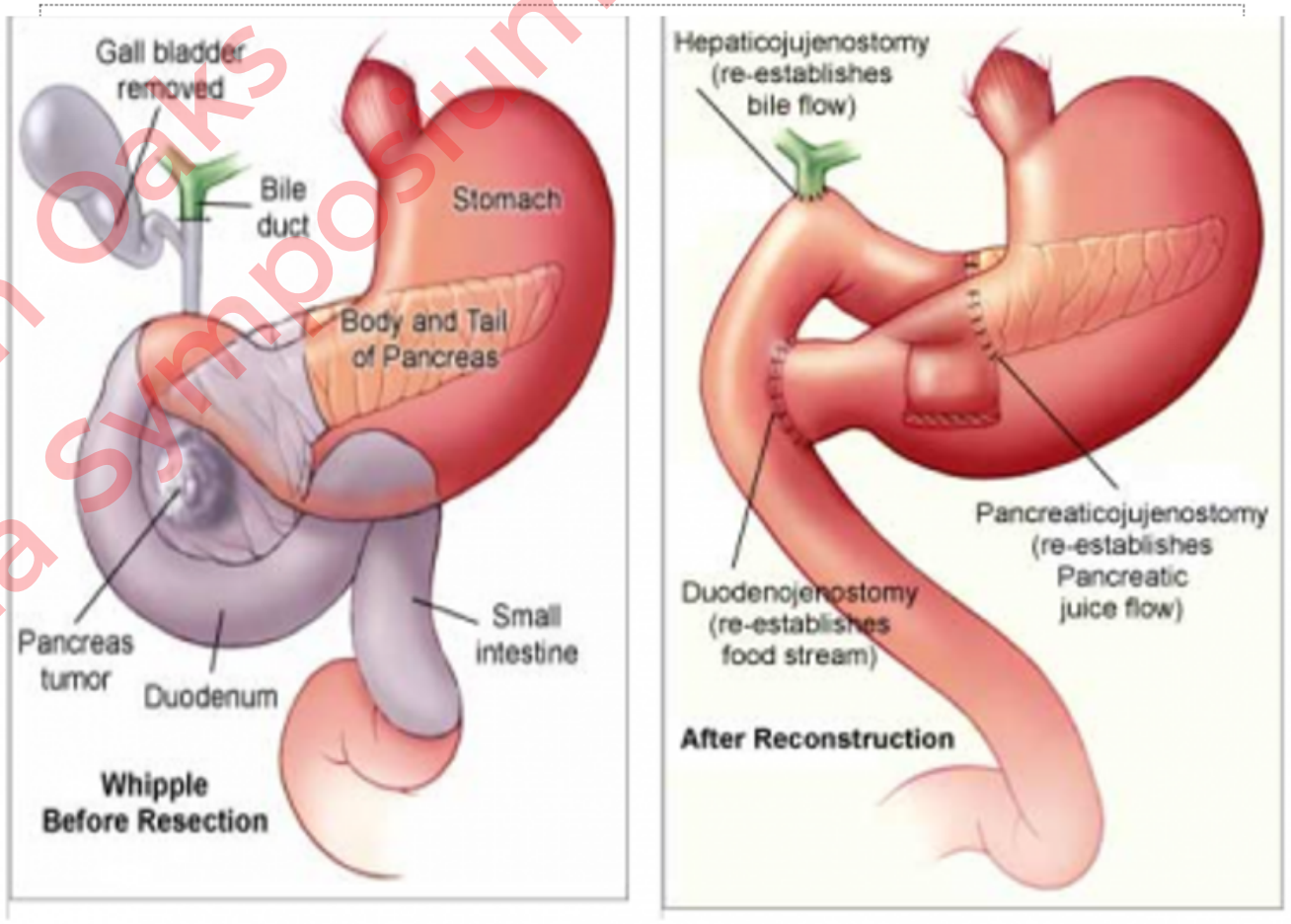
Define DUCT anatomy

Wide external drainage with post op ERCP

Grade V with duodenal injury

Determine distal CBD and ampulla integrity, IOC

Whipple resection



Objectives

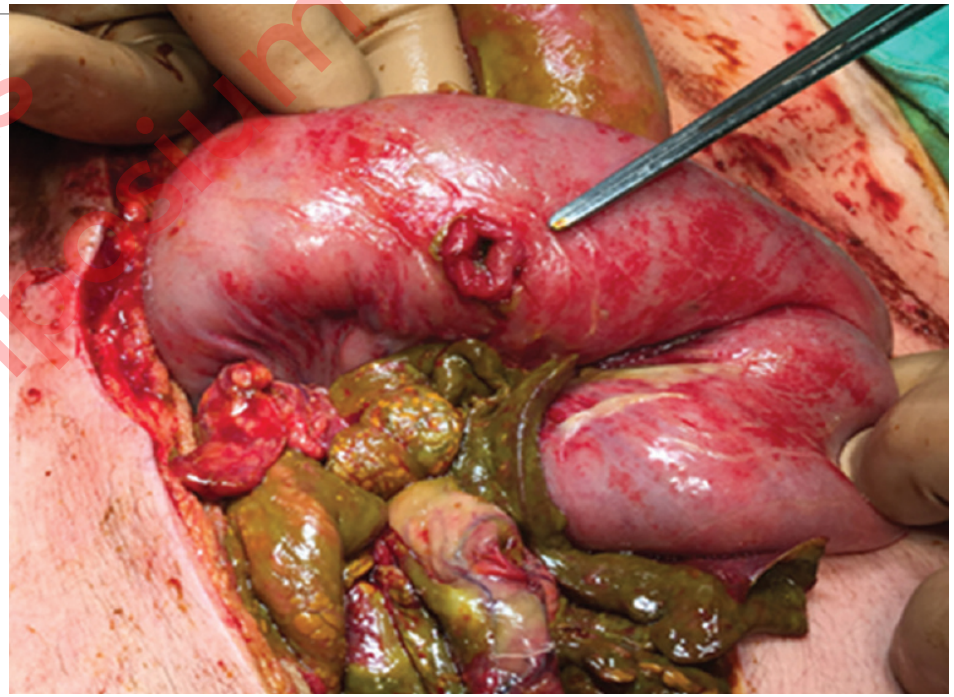
1. Approach to the trauma patient with a positive FAST exam
2. Dx / Management of Splenic, Pancreas, Hepatic Injuries.
3. Dx / Management of hollow viscus organ injuries
4. Dx / Management of Intraabdominal Vascular Injuries
5. Dx/ Management of genitourinary injuries

Bowel injury (stomach, small intestines and Colon)

General Rule- <50% of circumference can be repaired, otherwise resection with anastomosis.

Gastric injury can be repaired primarily- posterior wall injuries

Small bowel injury



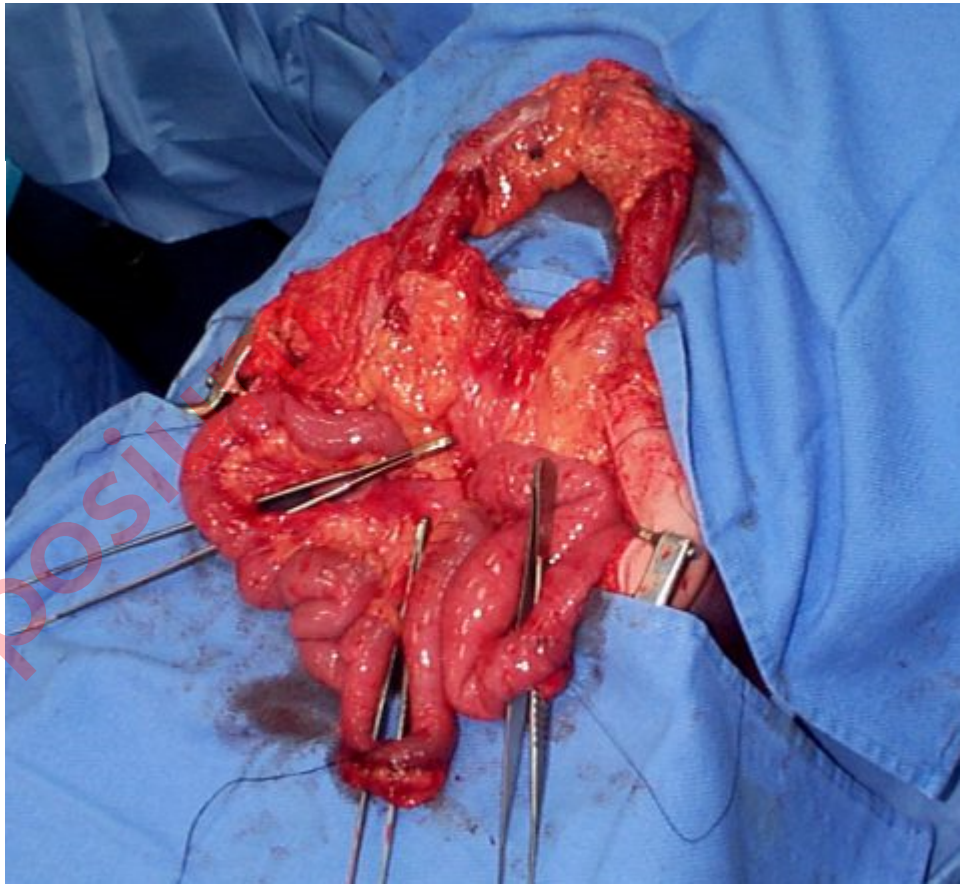
Sigmoid colon injury

Mesenteric hematoma

HEALTH

It's Official: A Brand-New Human Organ Has Been Classified

FIONA MACDONALD 3 JAN 2017



Objectives

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Intraabdominal vascular injury

IVC – Most commonly injured

Aorta

Celiac/SMA/IMA

Portal vein/SMV

Common /Internal/External iliacs

Renal Artery/Vein

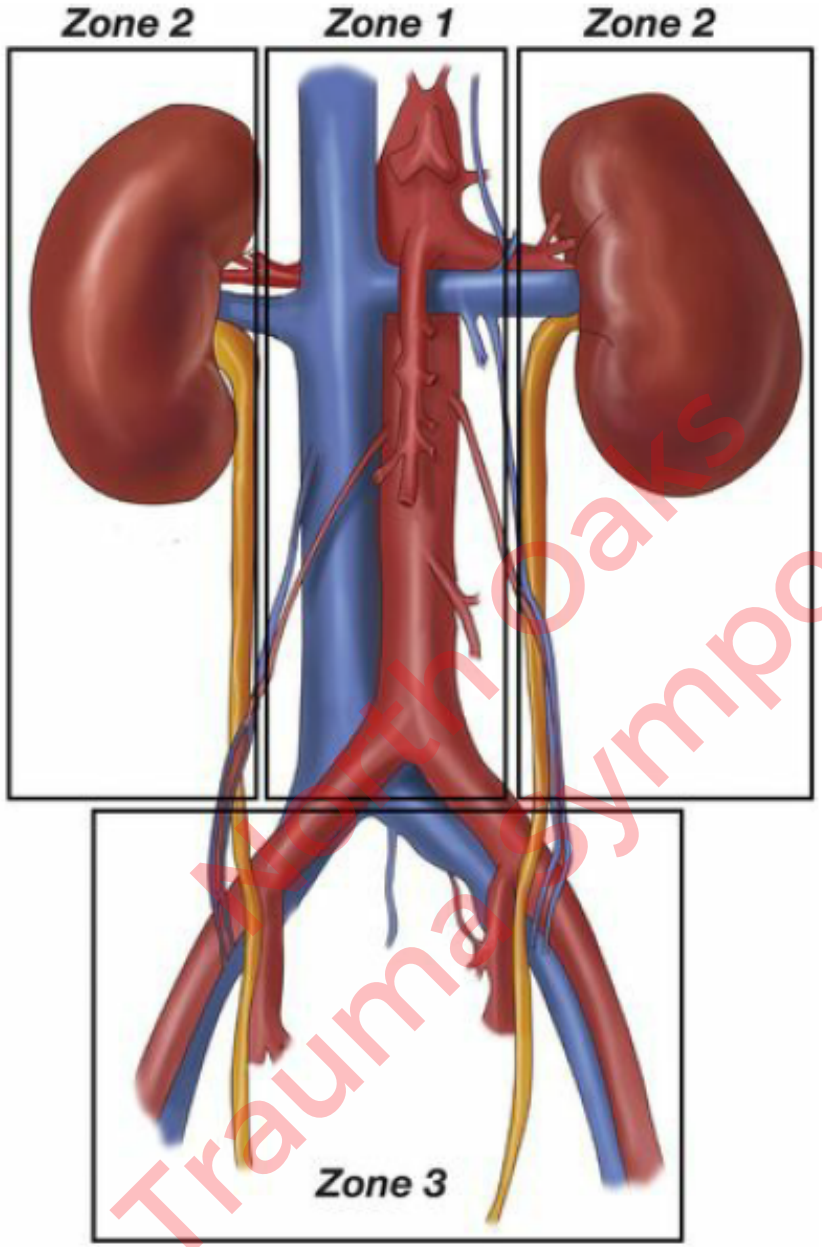


Fig. 20.1. Retroperitoneal vascular zones: *Zone I* includes the midline vessels from the aortic hiatus to the sacral promontory; *Zone II* includes the kidneys with the renal vessels; and *Zone III* includes the pelvic retroperitoneum, with the iliac vessels.

Zone I injury

Always Explore

Expose

Proximal Control

Explore and assess injury

Restore flow

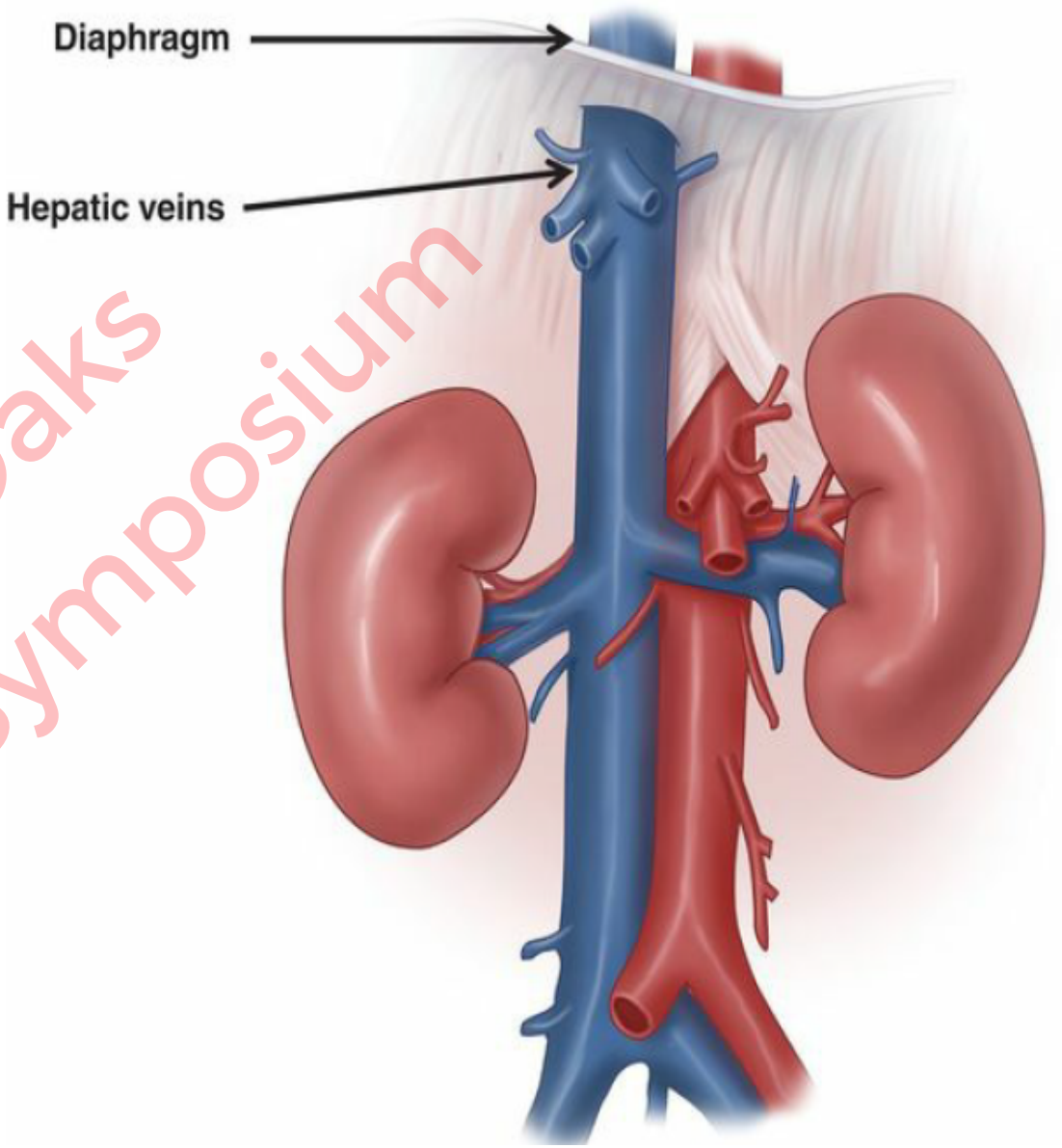
IVC

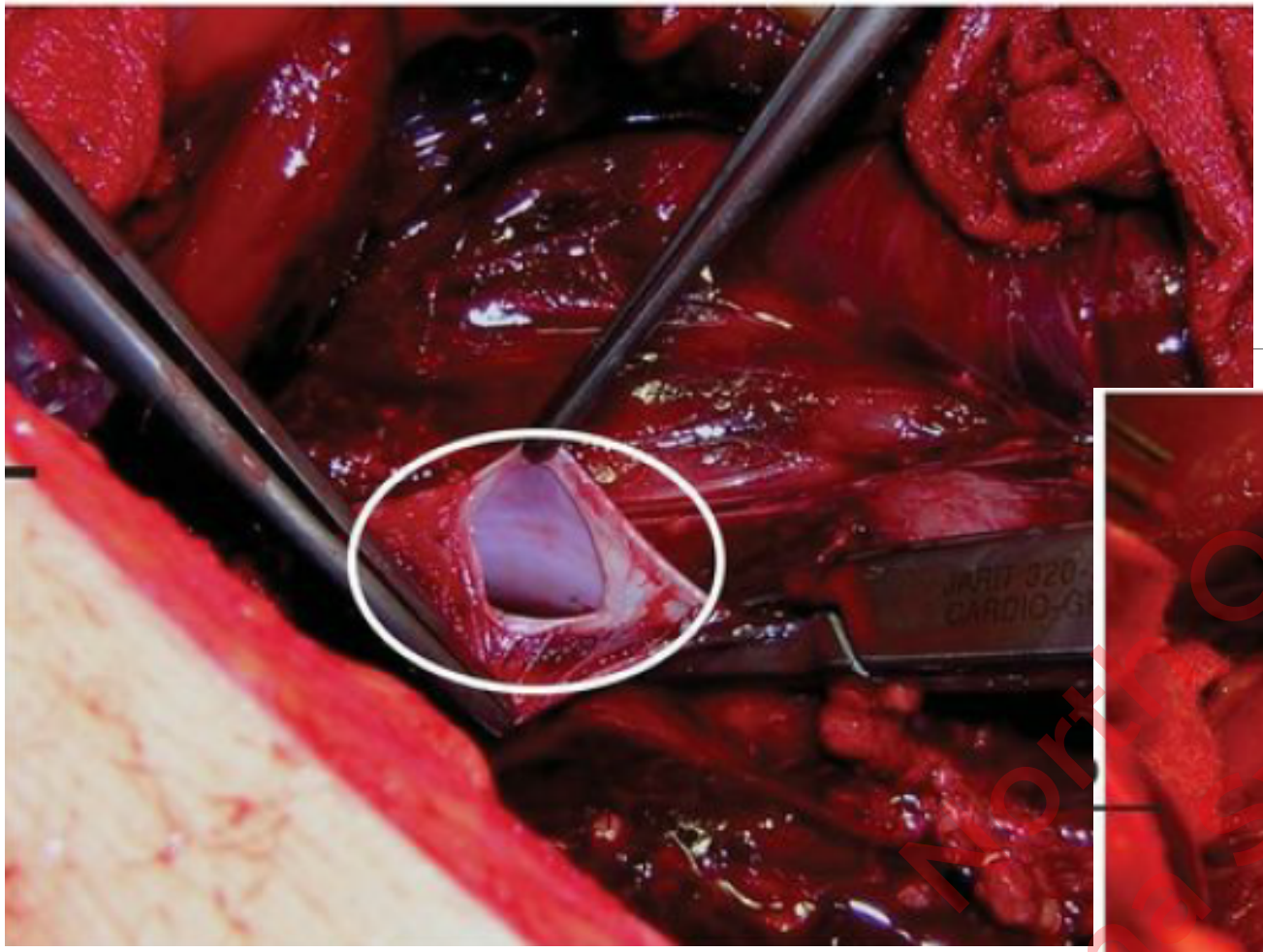
Most commonly injured with penetrating injury

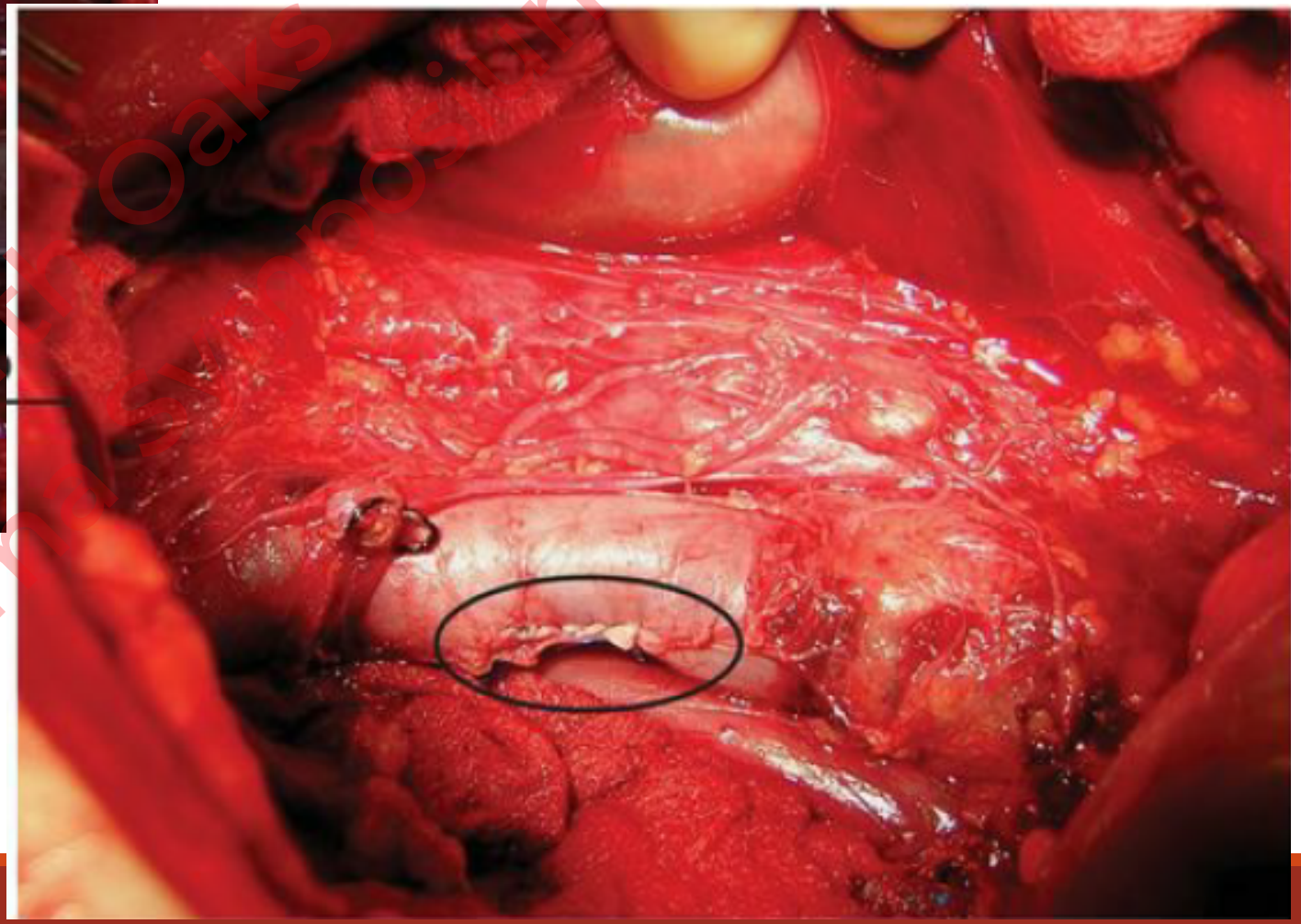
Lumbar branches below renal, only branch above renal veins is the R adrenal vein.

Infrarenal IVC can be safely ligated for hemorrhage control. With consequences.

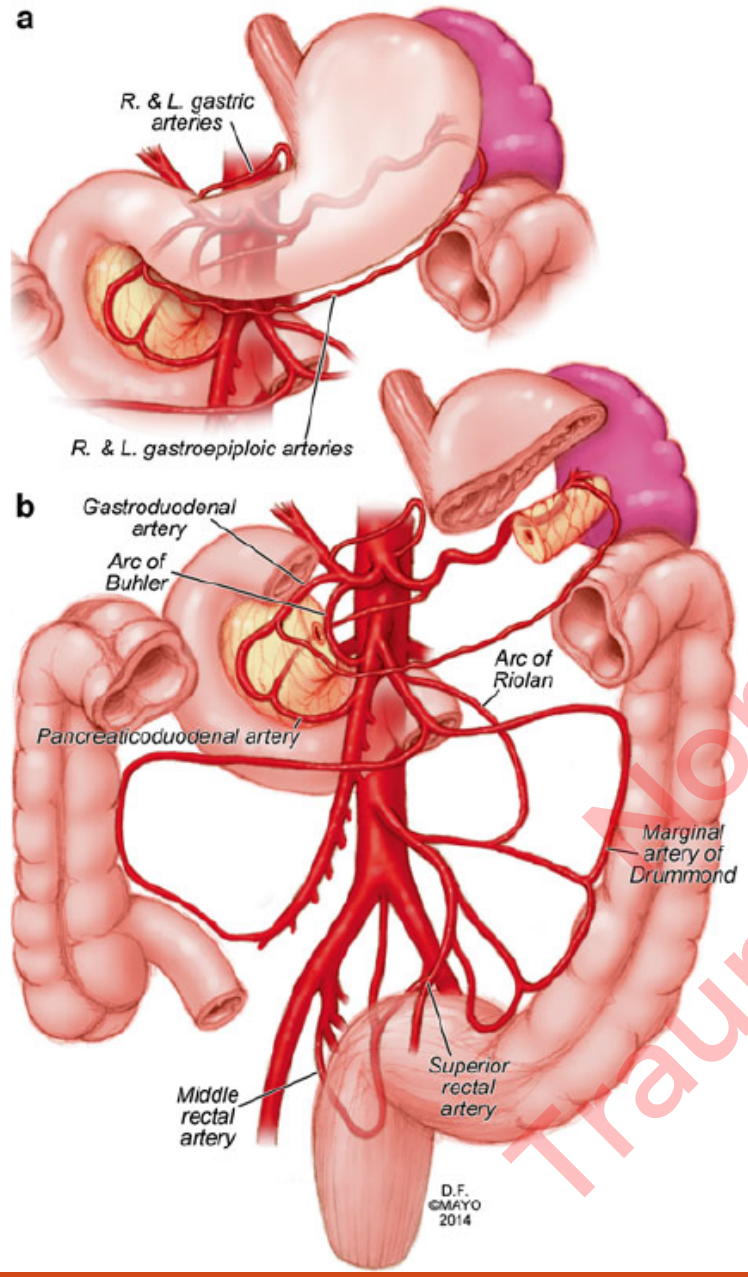
Air embolism

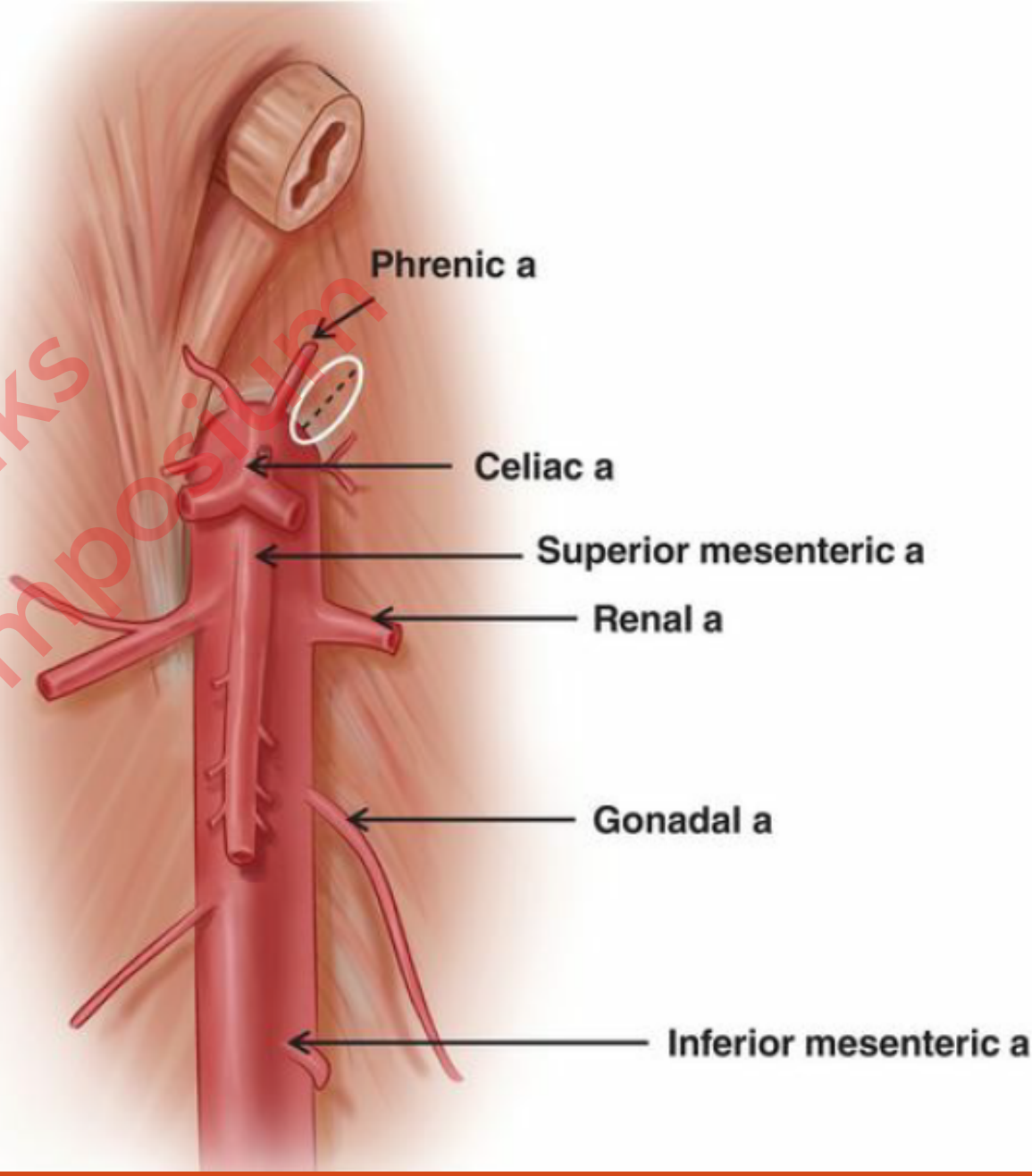




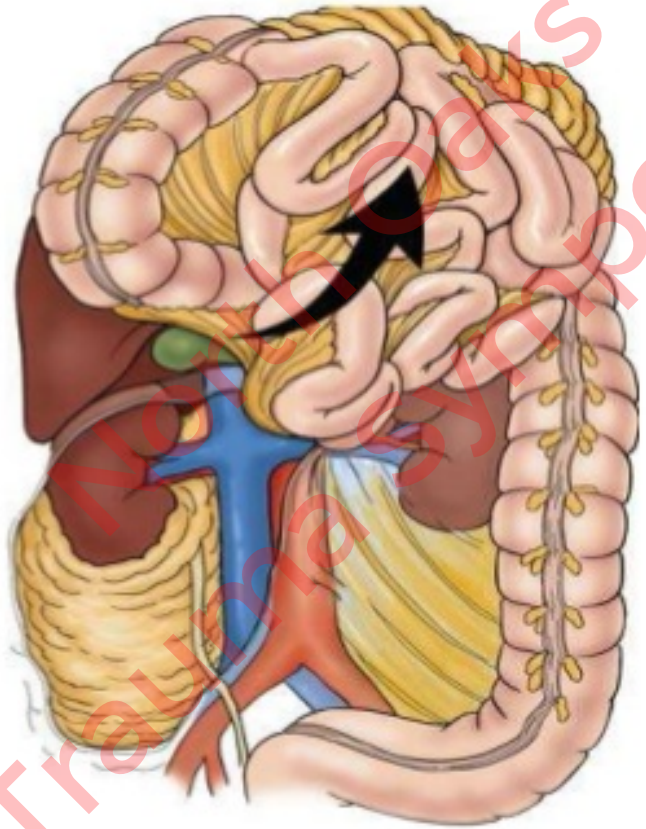


Aorta

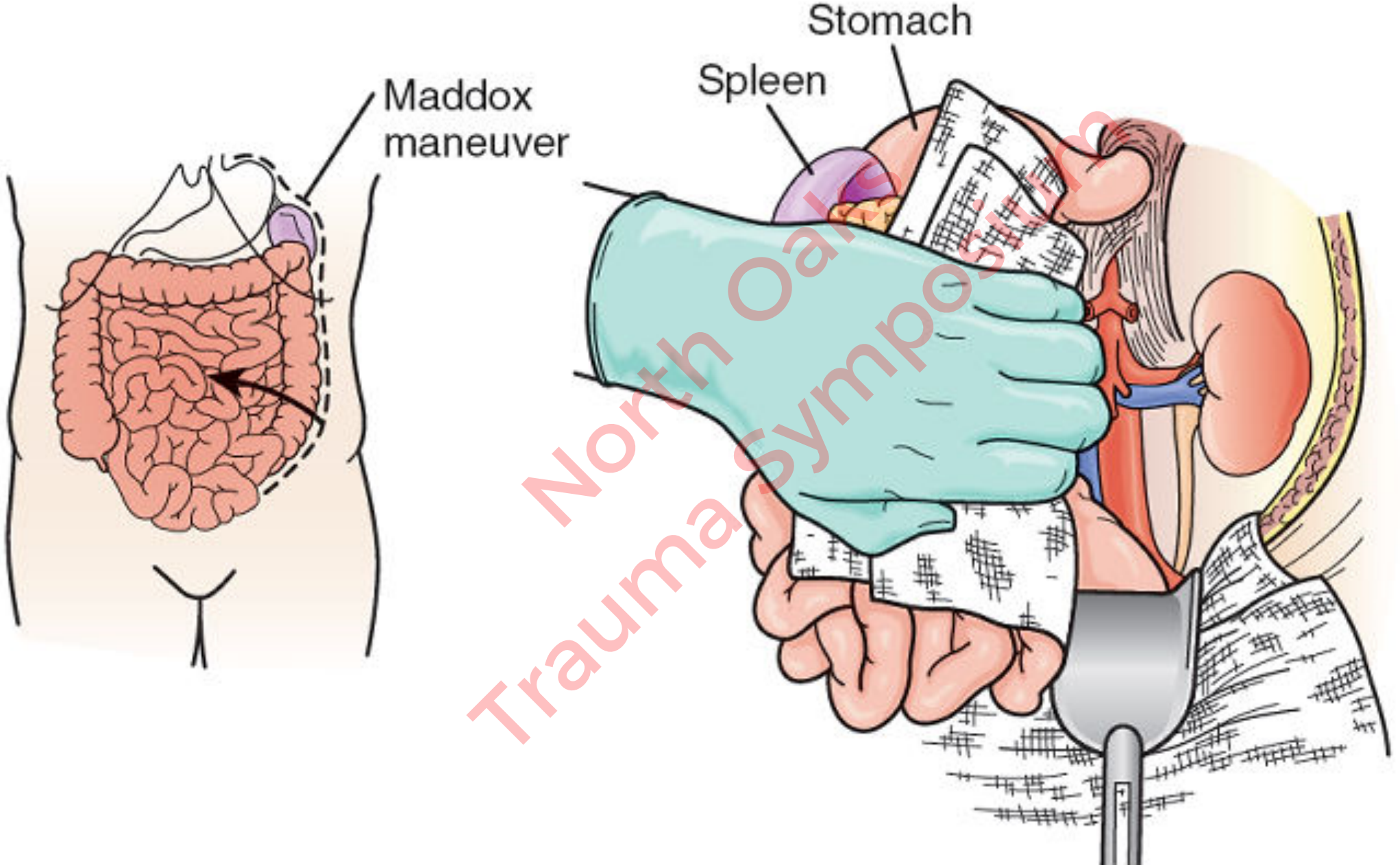


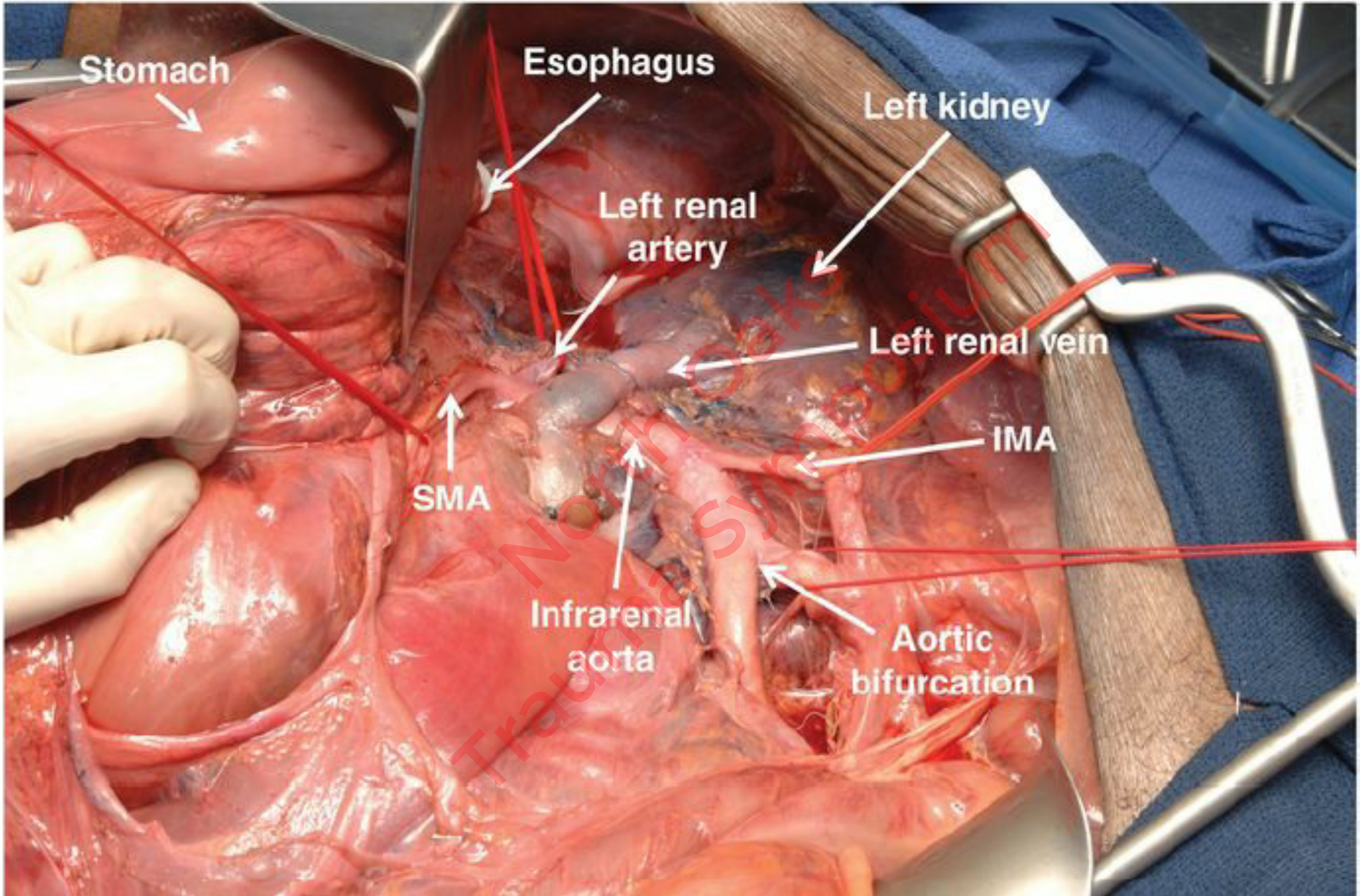


Cattell-Braasch Maneuver. Right medial visceral rotation



Left Medial visceral rotation- Maddox



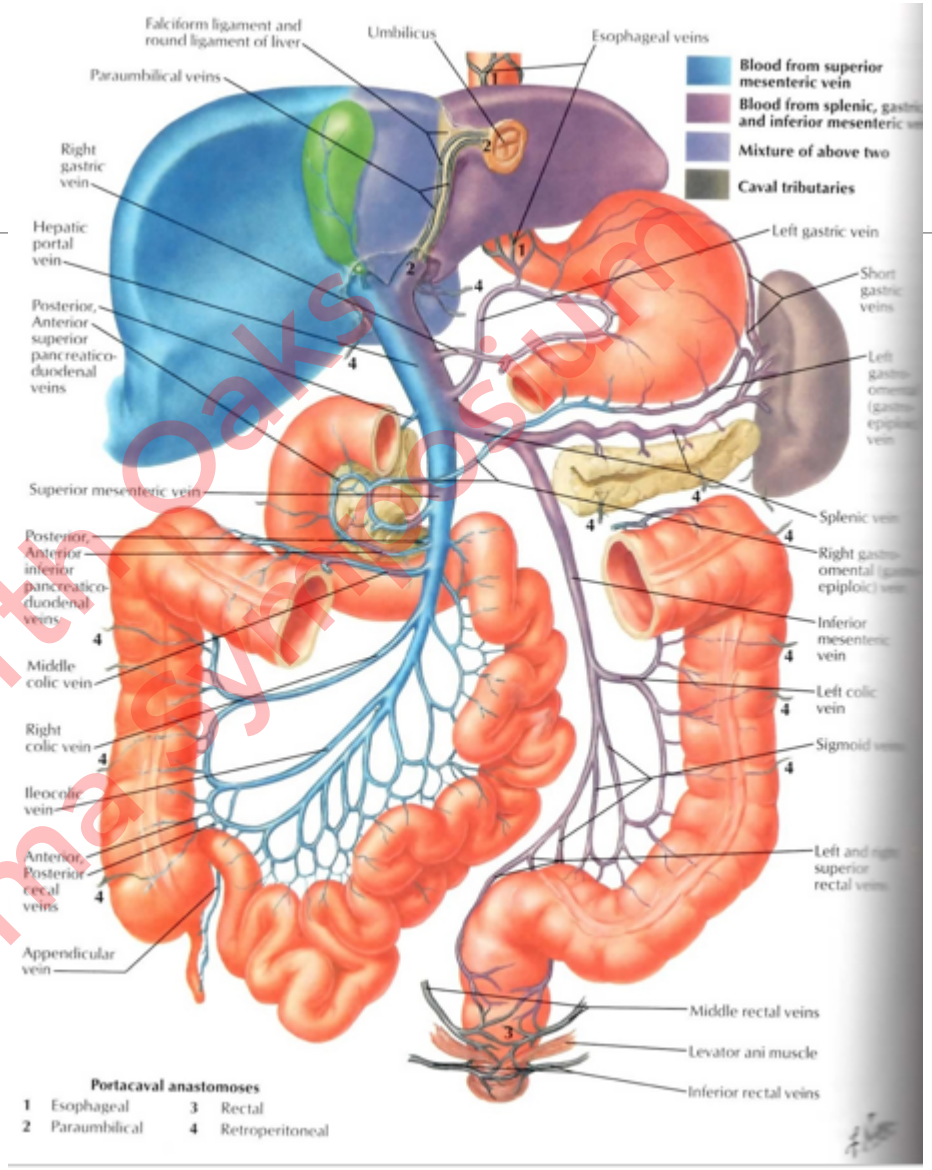

Stomach
Esophagus
Left kidney
Left renal artery
Left renal vein
IMA
SMA
Infrarenal aorta
Aortic bifurcation

Portal vein/SMV

0.1% incidence

90% penetrating

39-71% mortality. Highly lethal



Zone II: renal artery

Exposure via Cattel Brash Or Maddox maneuver. Digital pressure on hilum or vascular clamp placement.

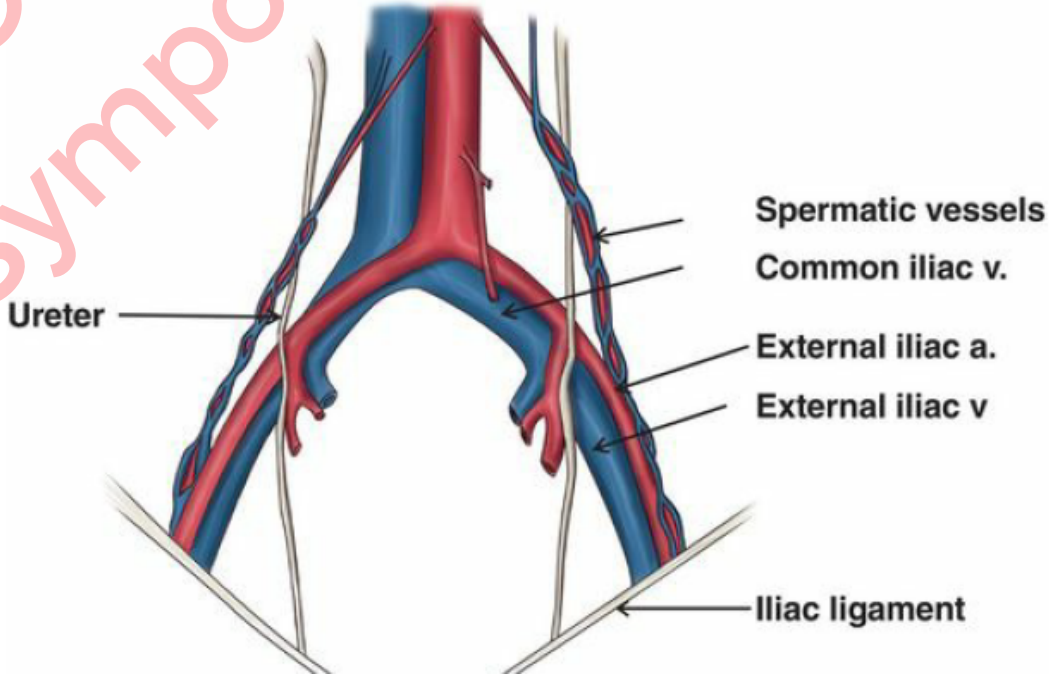
Left renal vein can be ligated without nephrectomy due to collaterals.

Zone III: Iliac injuries

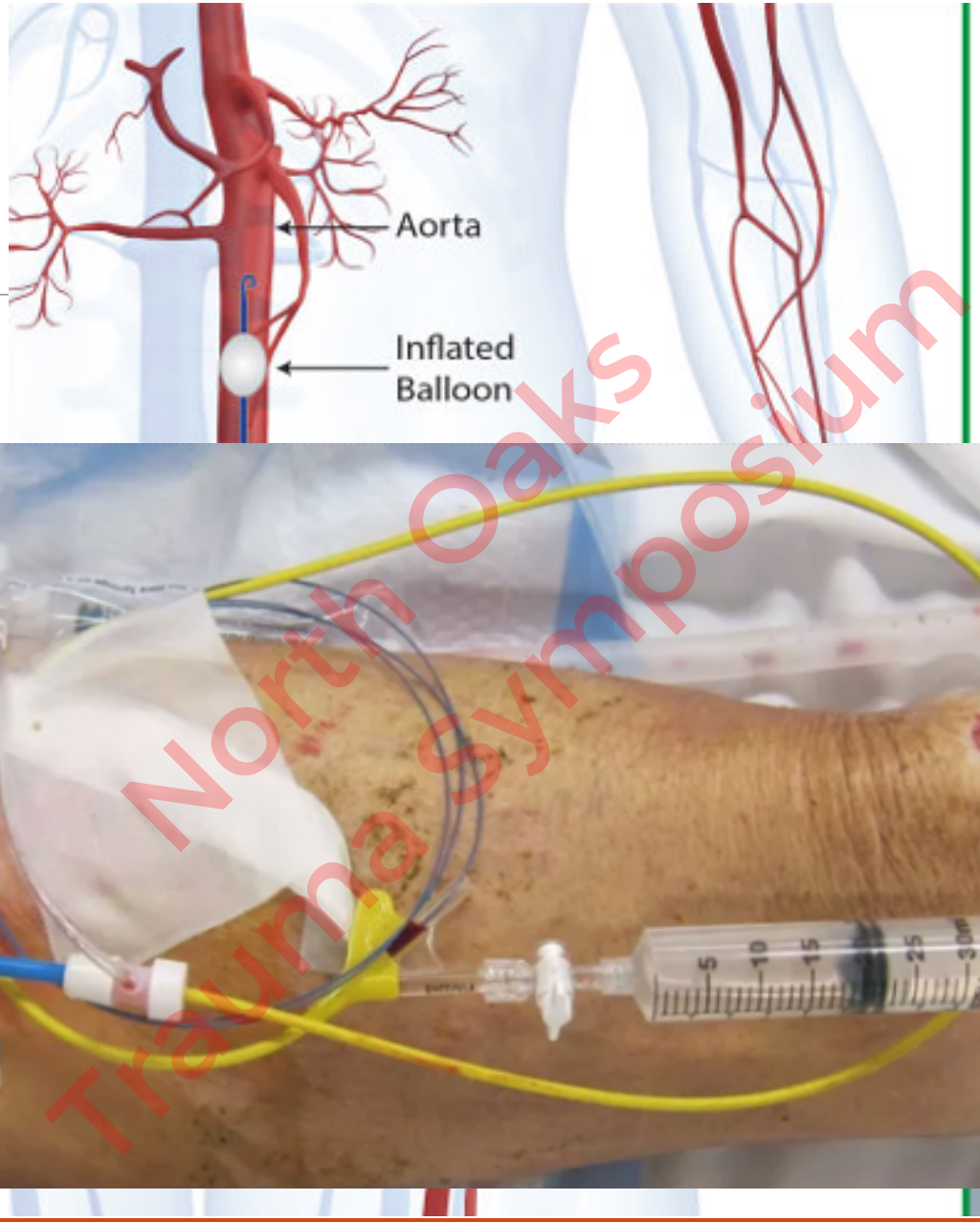
Common iliacs from aorta at L4-5. vein is posterior and medial to artery

Common Iliacs artery shouldn't be ligated, must be repaired, can use synthetic graft even with enteric contamination

Internal iliac a. can be ligated with impunity



REBOA



Resuscitative Endovascular Balloon Occlusion of the Aorta

Non-compressible torso hemorrhage

Uncontrolled hemorrhage is the cause of death in 1/3 of trauma deaths.

Above the diaphragm Zone I– 60 mins

Above the aorto-iliac bifurcation Zone III– 90 min

9 small clinical studies, no overall increase in survival

Complications: rapid access to surgical/IR control. Rapid and accurate placement. Cardiovascular collapse after deflation. Prolonged ischemia. Vascular complications (pseudoaneurysm, distal limb ischemia/losS)

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doi: 10.1590/1677-5449.030317
PMCID: PMC5829684
PMID: 29930615

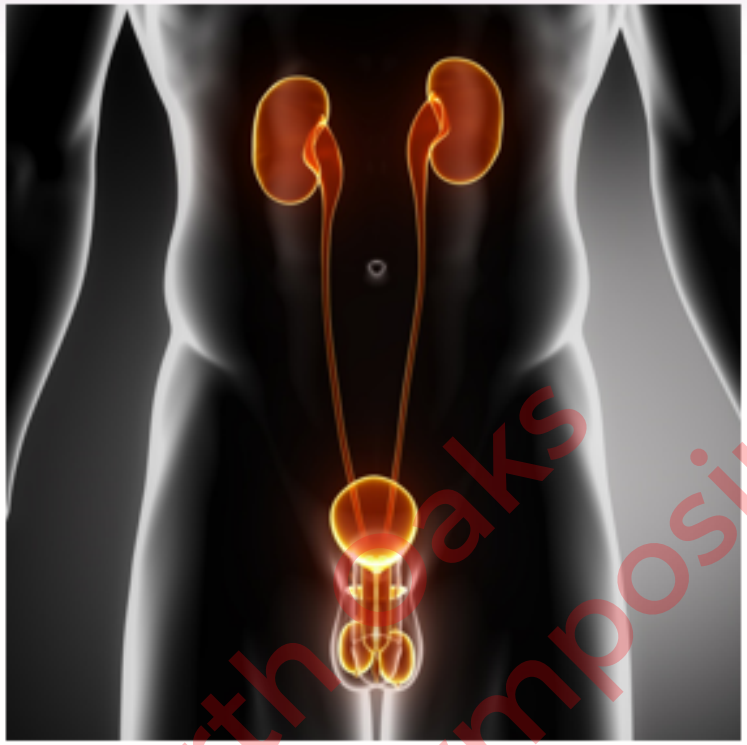
REBOA: is it ready for prime time?

Jay Doucet [1] and Raul Coimbra [1]

Objectives

1. Approach to the trauma patient with a positive FAST exam
2. Dx / Management of Splenic, Pancreas, Hepatic Injuries.
3. Dx / Management of Intraabdominal Vascular Injuries
4. Dx / Management of hollow viscus organ injuries
5. Dx/ Management of genitourinary injuries

GU injuries



Cystogram/urethrogram
- Hematuria
- Bladder injury
  - Intraperitoneal
  - Extraperitoneal

Retrograde urethrogram (RUG)
- Urethral injuries- 80% penetrating
- Blood at urinary meatus
- High riding prostate in males
- Perineal ecchymosis

Remember that the absence of either gross or microscopic hematuria does not rule out an injury

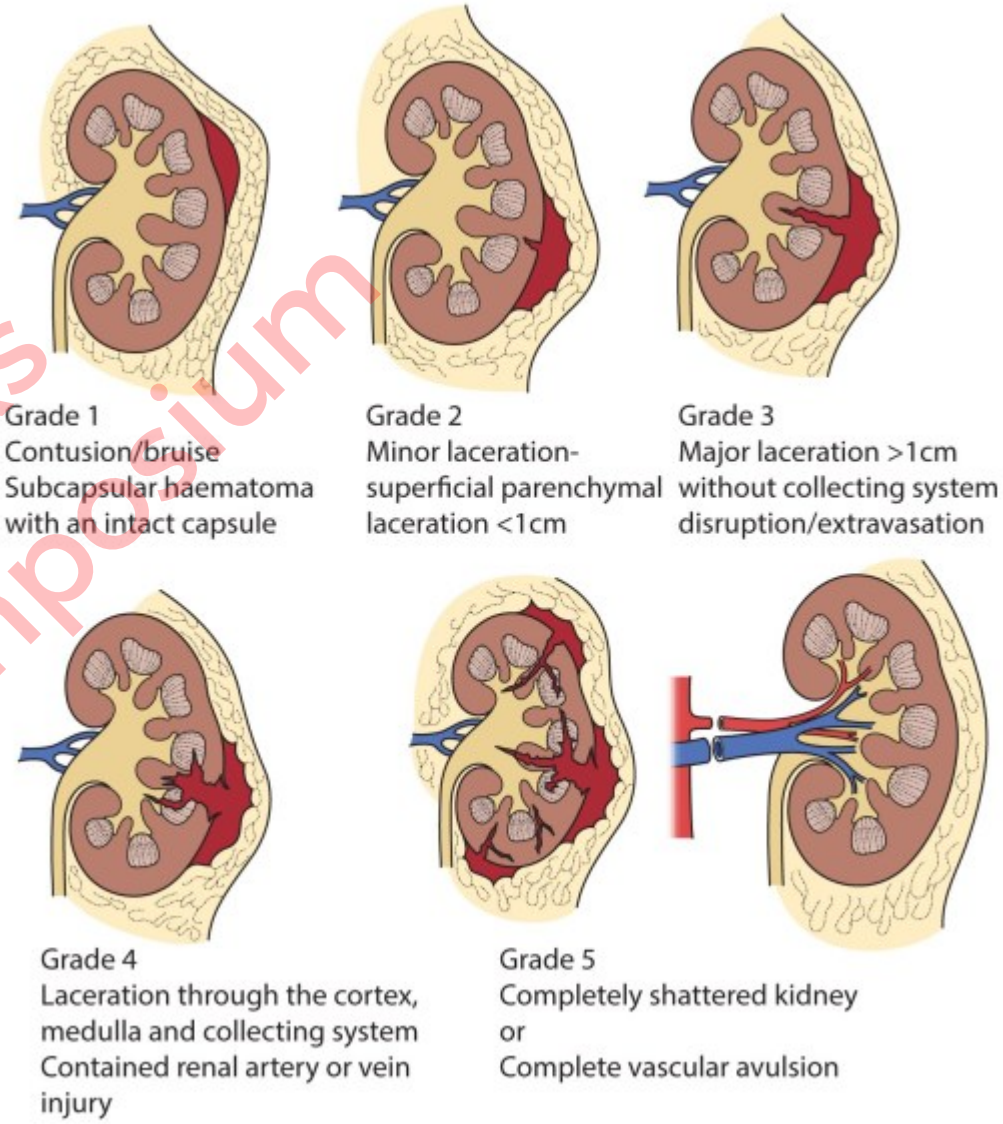
Renal Injury

Suture collecting system

Oversaw bleeding vessels

Proximal pedicle control

nephrectomy



Bladder

Blunt injuries account for 80-95% of GU injuries.

Compression injuries to rupture a full intraperitoneal bladder

GSW most common cause of ureteral injury (5-15% of GSW have GU injury); 95% of ureteral injuries have an associated abdominal injury.

95% extraperitoneal from pelvic bone fractures. Foley/non-op

Intraperitoneal – Dome, sudden increase in bladder pressure- operative

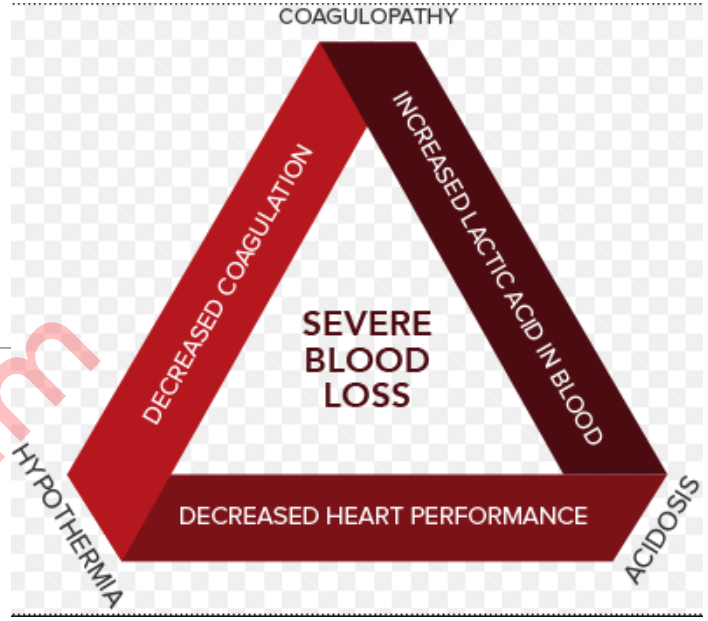
Grade[a]	Injury	Description
1	Hematoma	Contusion, intramural hematoma
	Laceration	Partial thickness
2	Laceration	Extraperitoneal (EP) <2 cm
3	Laceration	EP ≥2 cm or intraperitoneal (IP) <2 cm
4	Laceration	IP ≥2 cm
5	Laceration	EP or IP extending into bladder neck or ureteral orifice (trigone)

[a]Advance one grade for multiple injuries up to grade 3.

Damage control laparotomy

Indications:

- Unstable
- Coagulopathy
- Severe acidosis
- Hypothermia (<35◦)
- High operative time for repair
- Multiple visceral injuries with vascular trauma
- Across body cavities
- MTP >10 Units
- Injuries that are managed better non-operatively



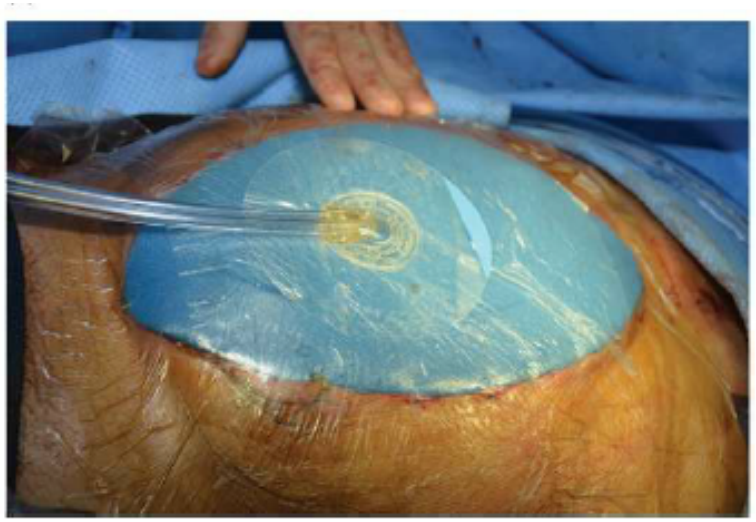
Temporary control of all bleeding (packing or compression)

Contamination control

Vascular: shunt, intraluminal balloon occlusion, ligation

Temporary abdominal closure: high risk of ACS, IAH

Return for definitive repair and reconstruction



Abdominal compartment syndrome