



دانشگاه علوم پزشکی گلستان

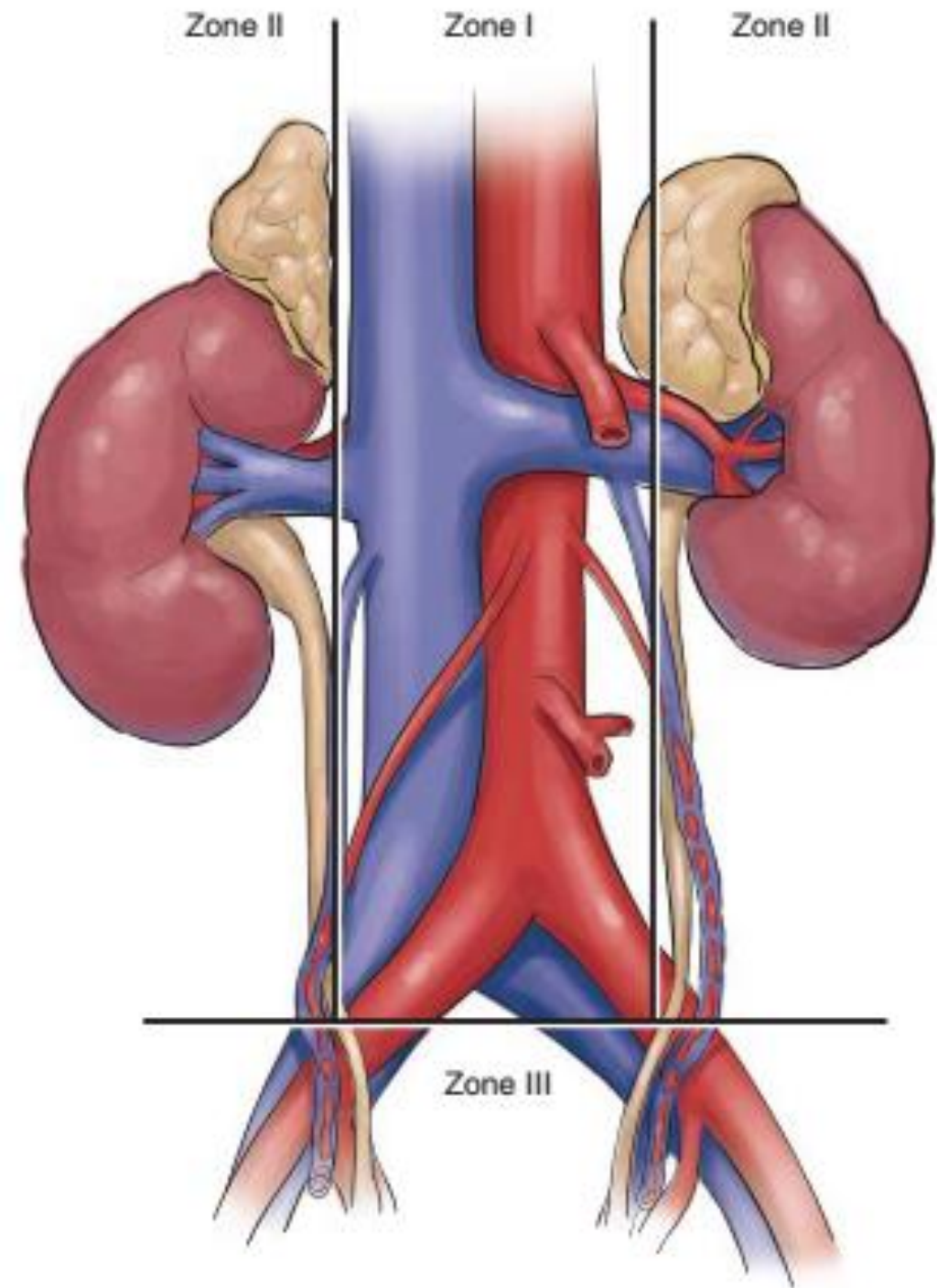
# Abdominal Vascular Injuries

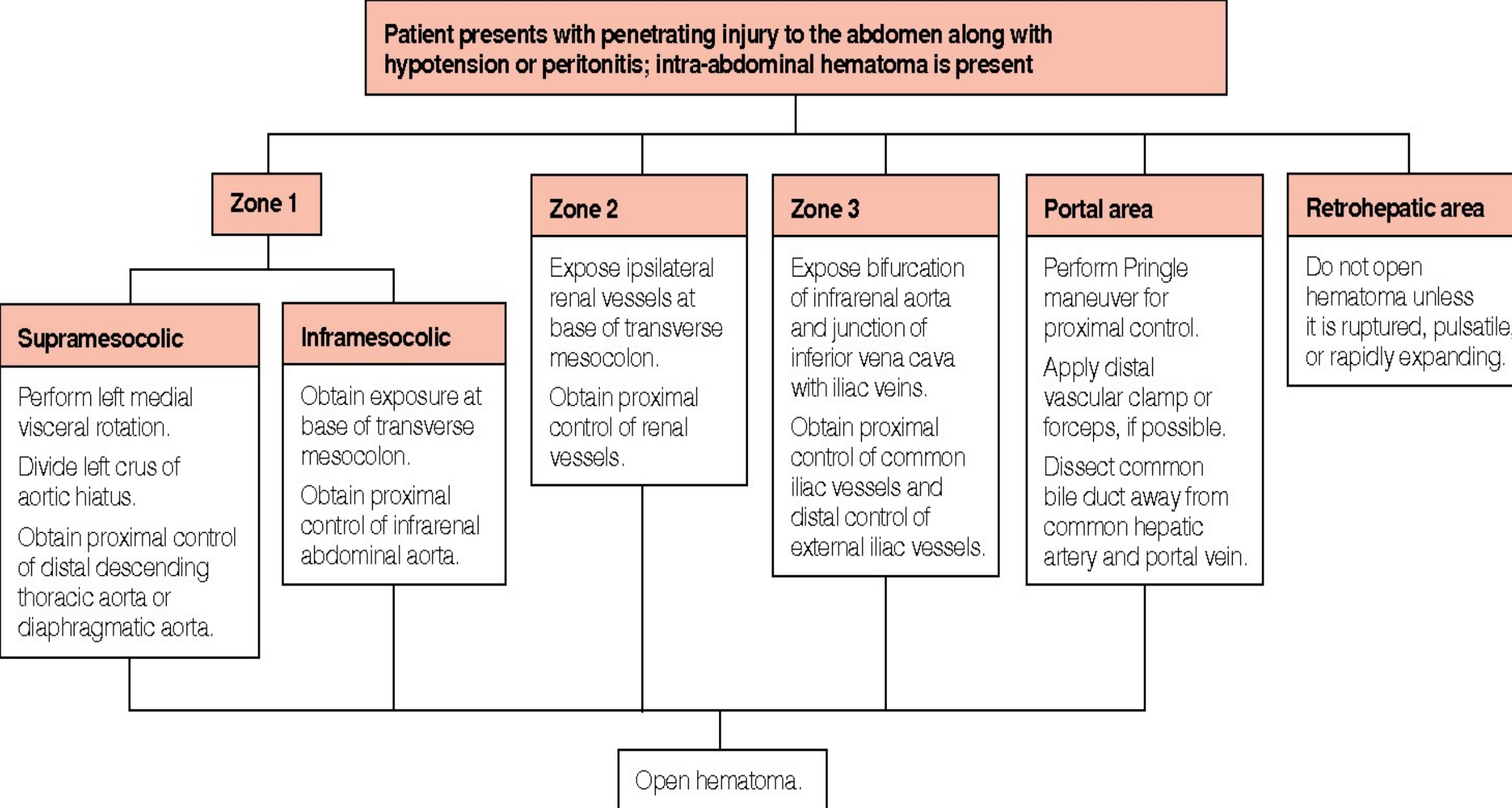
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# Abdominal zones





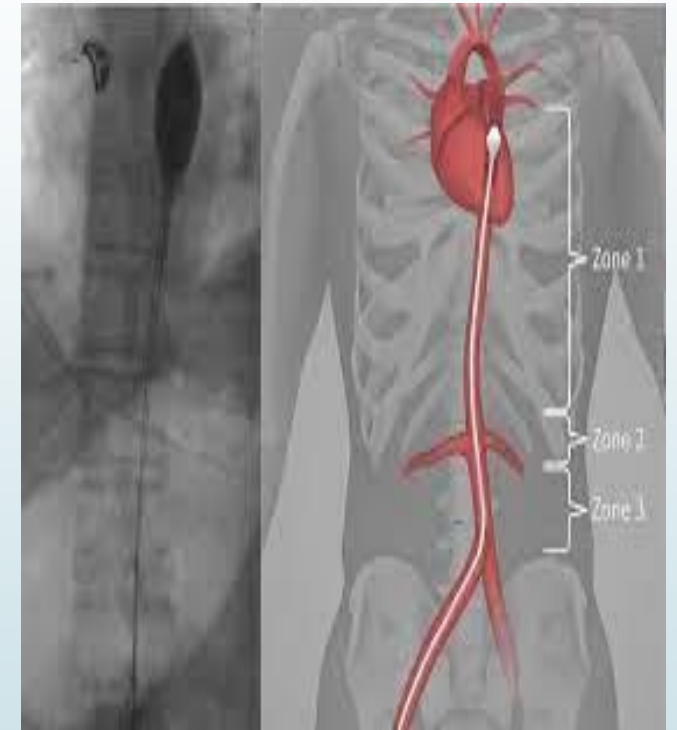
**Figure 1** Algorithm illustrates management of intra-abdominal hematoma found at operation after

# Abdominal aortic injuries

- Blunt injury is rare 0.04% of all blunt trauma admissions
  - Intimal dissections and thrombosis most common lesions
- Penetrating trauma more likely
  - 2.7% of gunshot wounds to abdomen
  - 1.5% of knife wounds to abdomen
  - 21% of all abdominal vascular injuries, second most commonly injured vascular structure

# Abdominal aortic injuries

- Supraceliac:
  - Transecting the left crus of diaphragm
  - Extending the laparotomy via a left thoracotomy
  - Placement of a trans femoral REBOA into zone I
- Supracolic: Aorta, celiac axis, proximal superior mesenteric artery [SMA], and left renal arteries) are best approached via a left medial visceral rotation
- Infracolic: Explore base of mesocolon



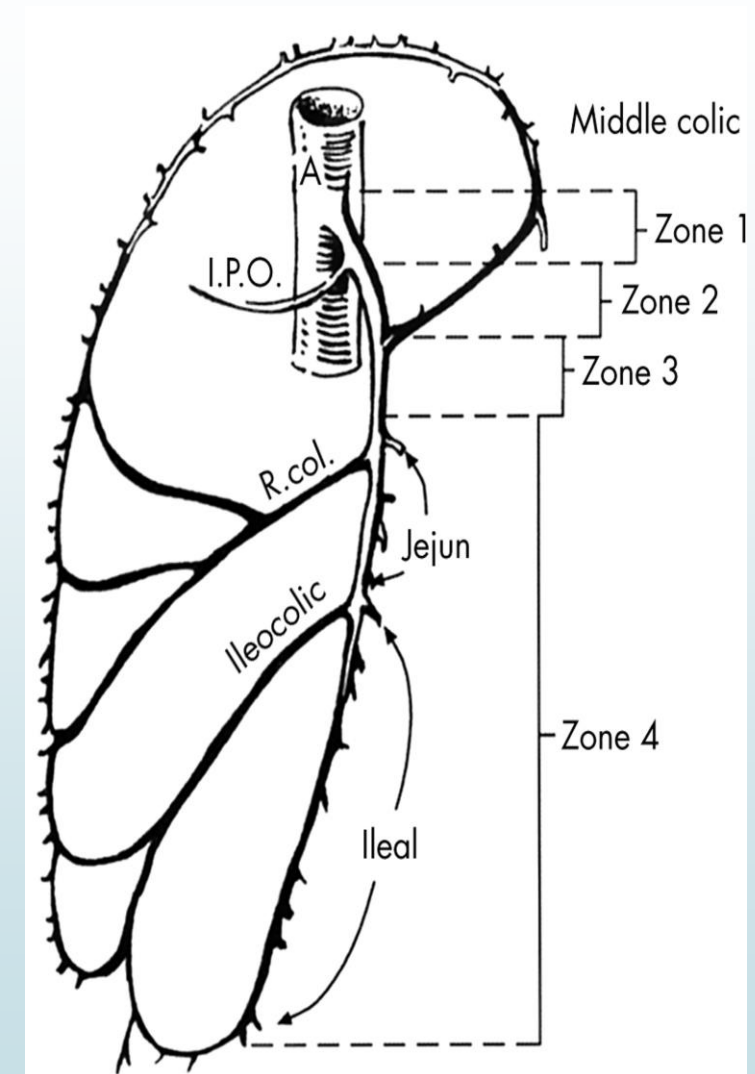


# Celiac artery injuries

- Rare, in 3.2 cases of vascular injury, the celiac artery was involved in 3.3% of cases
- Operative exposure through lesser sac or medial visceral rotation, this does not need to include the left kidney
- Ligation is tolerated well secondary to rich collateral blood supply
- Mortality ranges from 38 to 45%, probably secondary other concomitant injuries

# SMA injuries

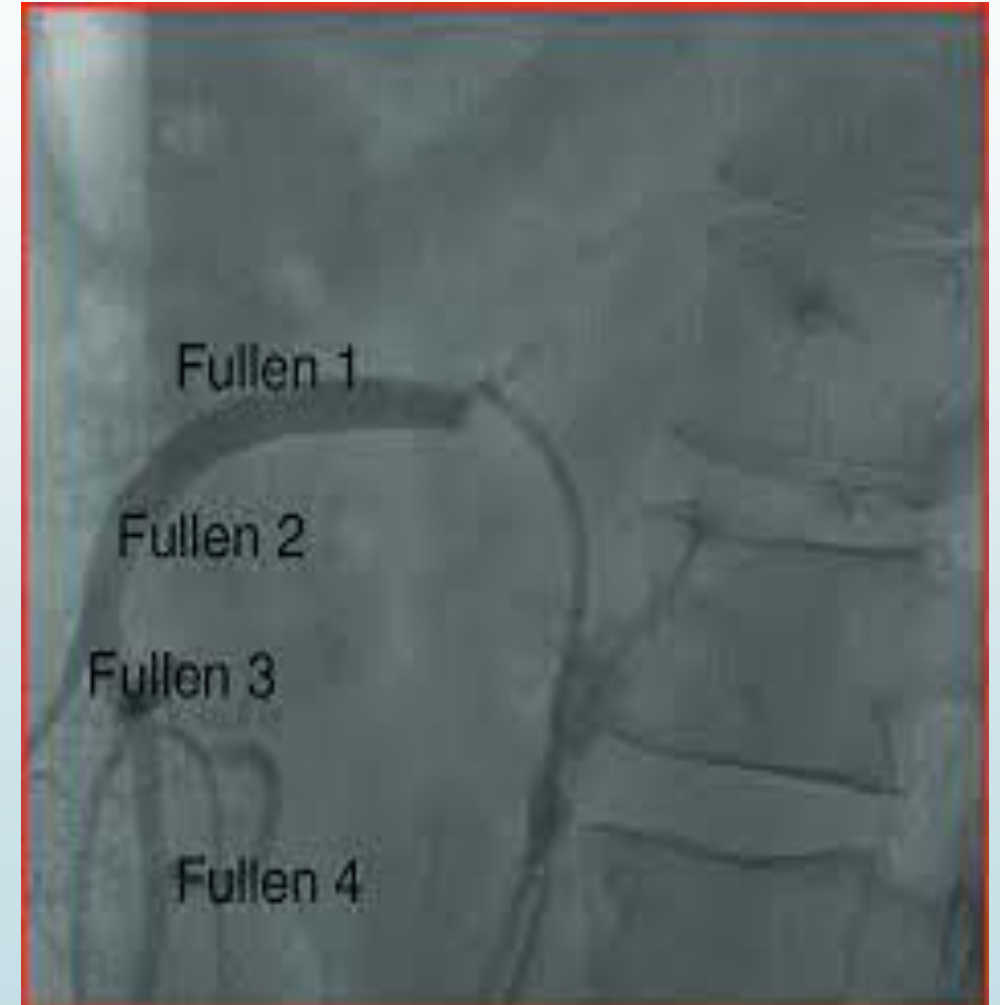
- Penetrating injuries are the most common mechanism of injury
- SMA injuries diagnosed in 0.09% of trauma admissions and account for 10% of all abdominal vascular injuries
- Blunt trauma responsible for 10 to 20% of these injuries
- With the exception of the renal artery, the SMA is the most commonly injured aortic visceral branch following blunt trauma.





# SMA injuries

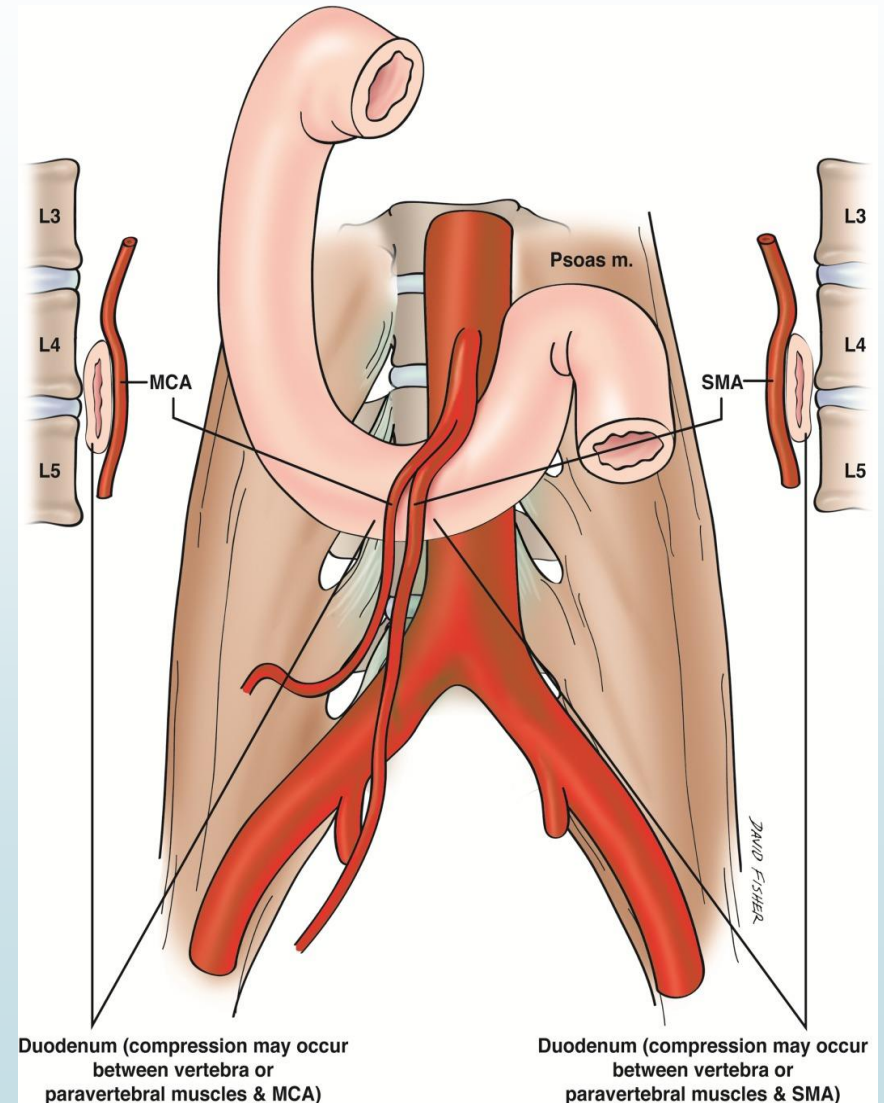
- Zone 1 aortic origin to inferior pancreaticoduodenal artery
- Zone 2 to the middle colic artery
- Zone 3 distal to middle colic artery
- Zone 4 segmental intestinal branches





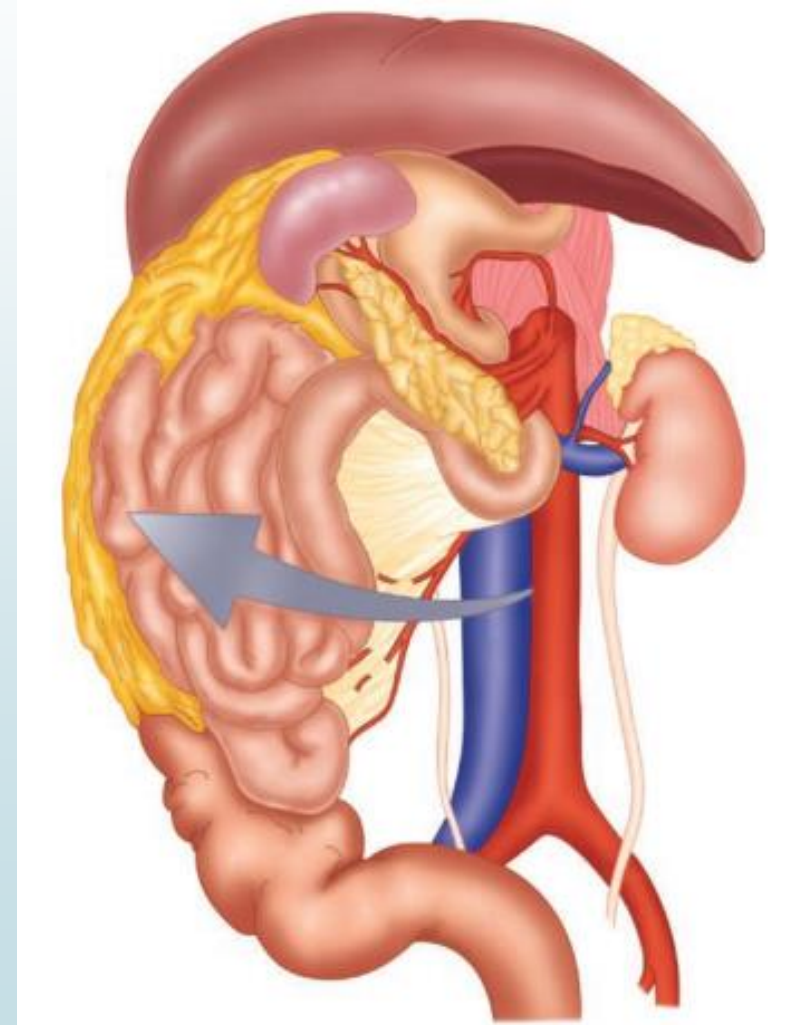
# SMA injuries

- Ligation of SMA in zones 1 and 2 results in severe ischemia of small bowel and right colon
- Ligation of SMA in zones 3 and 4 may result in localized ischemia



## SMA injuries: Exposure

- Fullen zone I SMA injuries, located posterior to the pancreas, are best exposed by a left medial visceral rotation.
- Fullen zone II SMA injuries, extending from the pancreatic edge to the middle colic branch, on the other hand, are approached via the lesser sac along the inferior edge of the pancreas at the base of the transverse mesocolon
- More distal SMA injuries, Fullen zones III and IV, are approached directly within the mesentery



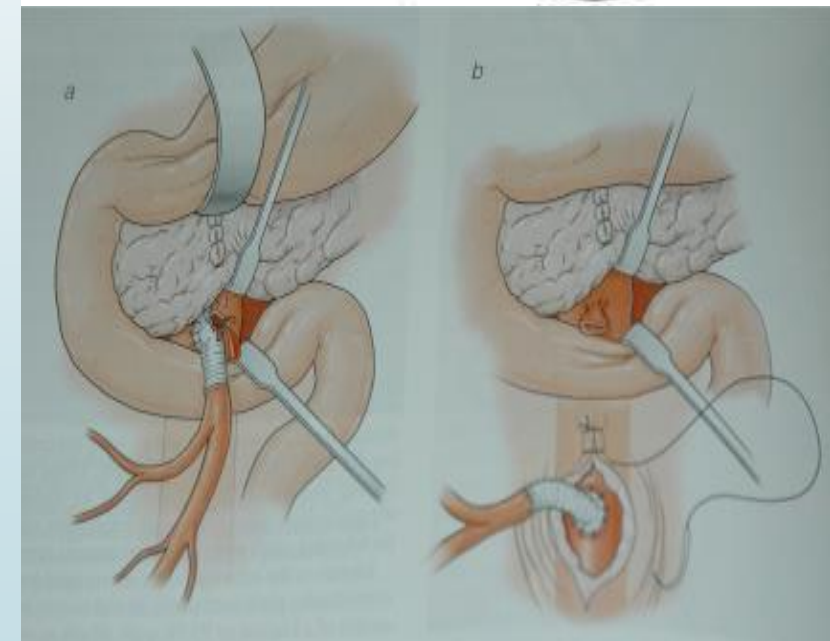
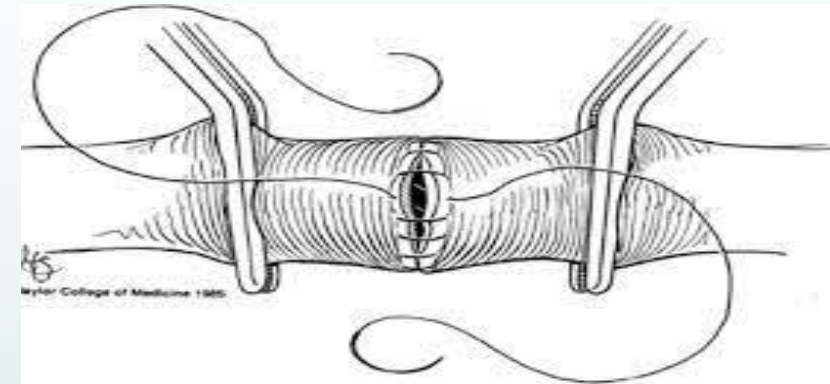


## SMA injuries

- Any hematoma injury involving bowel ischemia should be explored
- Do not explore stable hematomas if the bowel is not compromised, they are followed post-operatively by angiography or doppler ultrasound

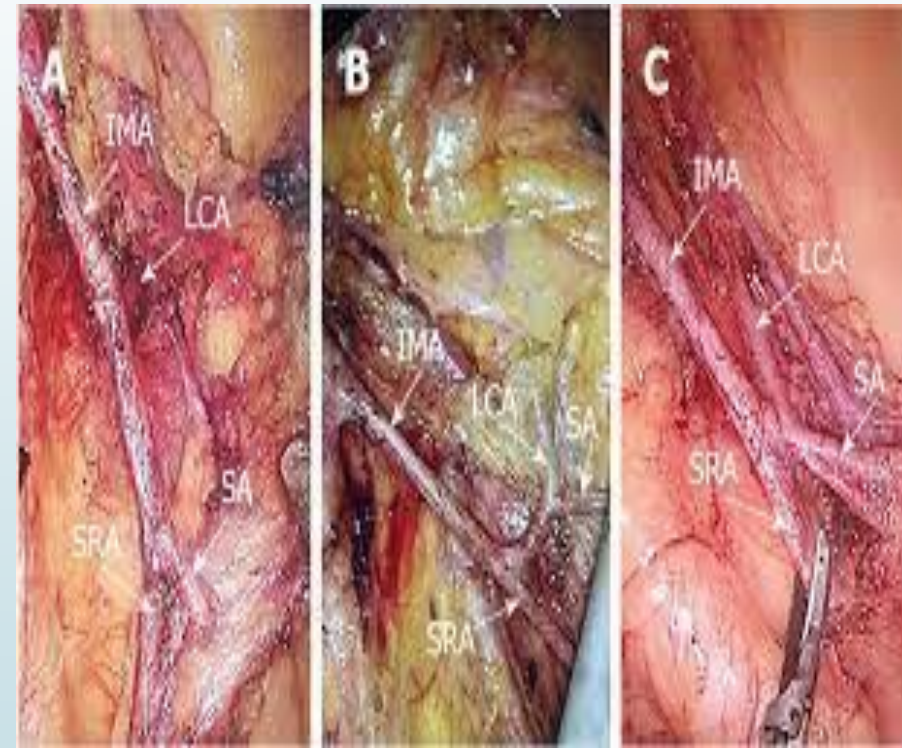
# SMA injuries: repair, interposition or ligation?

- Sharp partial transections can be managed by lateral arteriorrhaphy
- Mobilization of SMA made difficult, thus end to end anastomosis rarely possible
- Ligation of SMA below middle colic artery associated with moderate risk of bowel ischemia



# IMA injuries

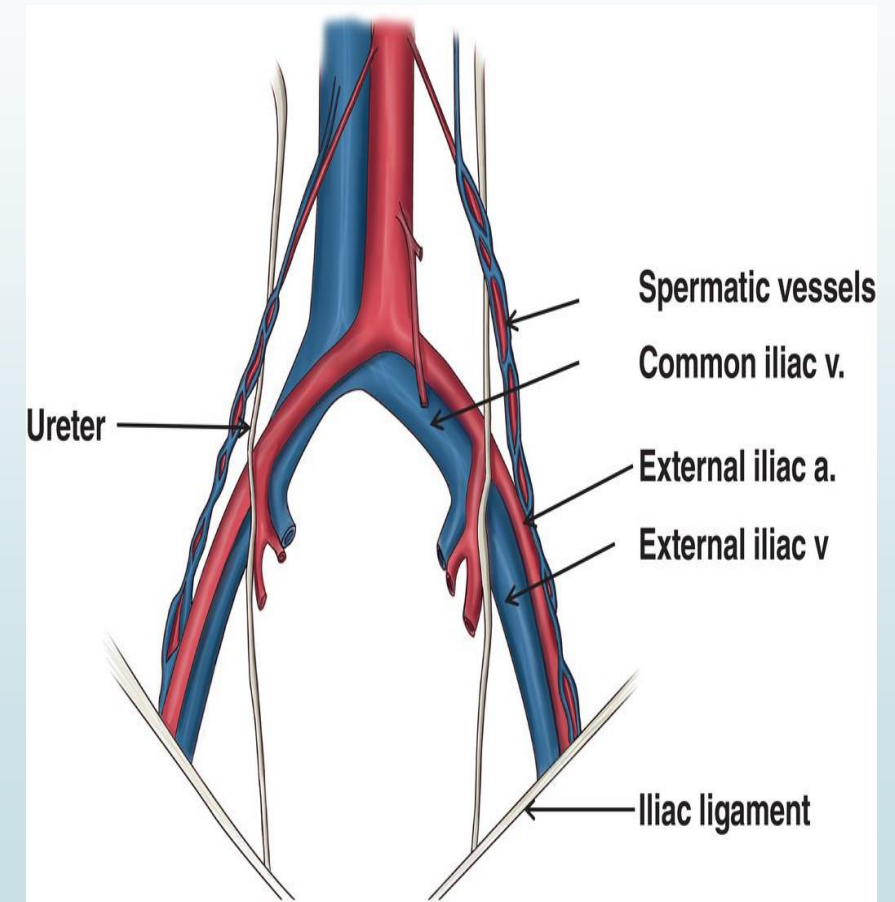
- Rare and almost always due to penetrating traumas, 1% of all abdominal vascular injuries
- Ligation is well tolerated with no cases of colorectal ischemia have been reported in trauma





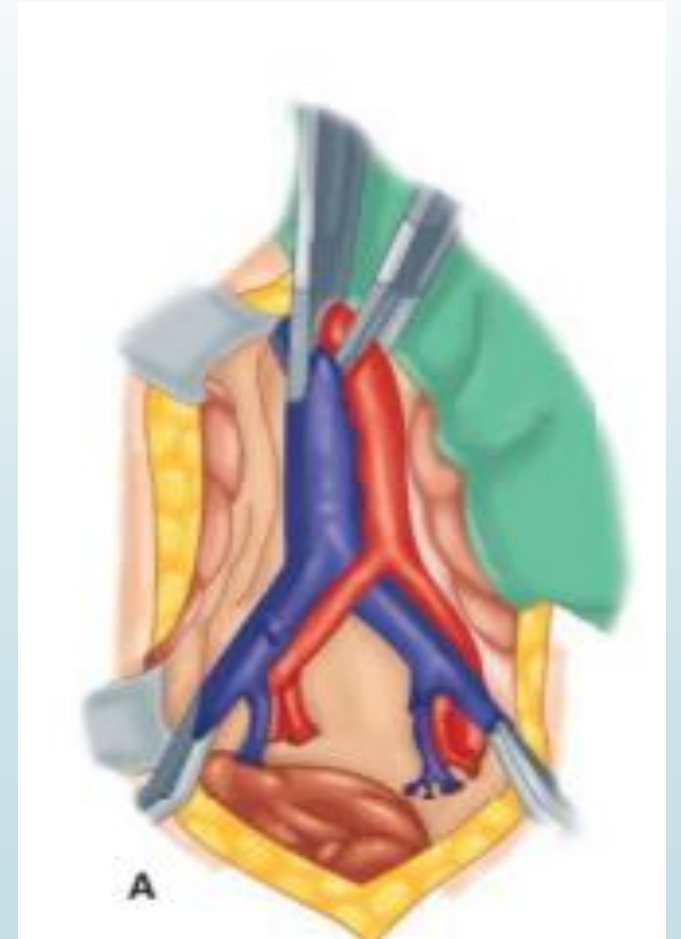
# Iliac vascular injuries

- Penetrating trauma involves common iliac vessels
- Blunt usually involves branches of internal iliac artery (pelvic fractures)
- A unique problem for emergent vascular control due to:
  - The number of vessels
  - Their close proximity
  - Cross circulation.



# Iliac vascular injuries

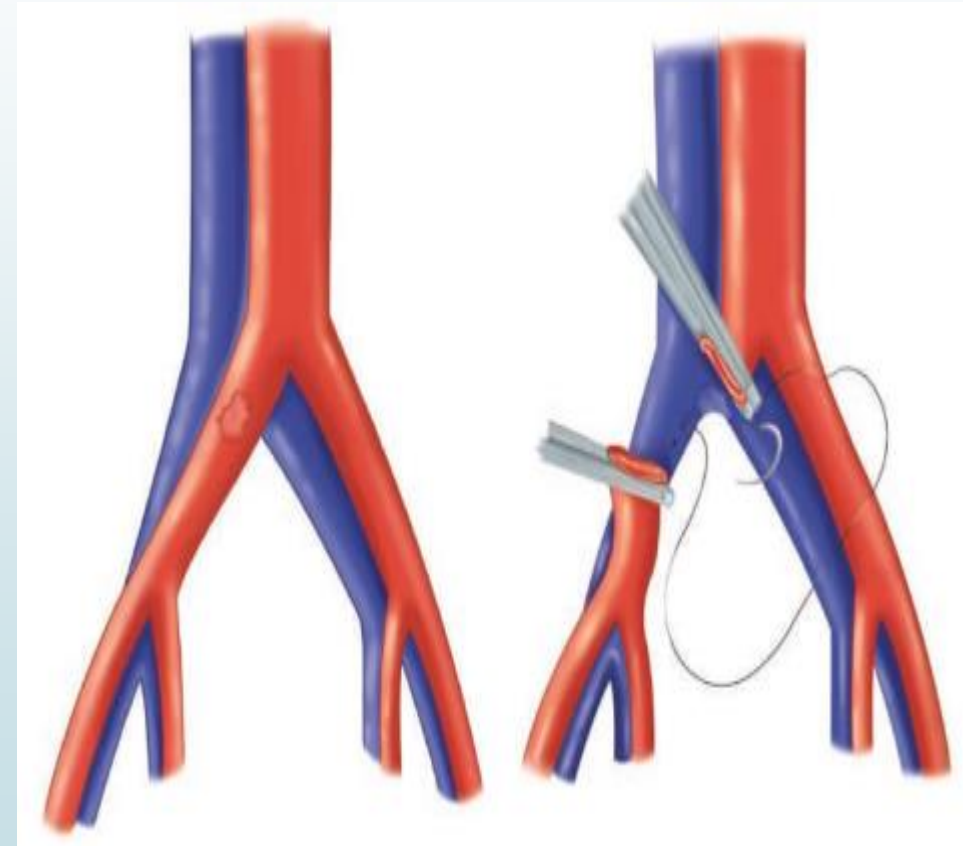
- Proximal control at the infrarenal aorta arrests the arterial bleeding
  - Venous injuries are not controlled:
    - Tamponade with digital pressure or with a folded laparotomy pad held directly over the bleeding site
    - If hemostasis is not adequate to expose the vessel proximal and distal to the injury, sponge sticks can be strategically placed on either side of the injury and carefully adjusted to improve hemostasis.
    - Alternatively, complete pelvic vascular isolation may be required



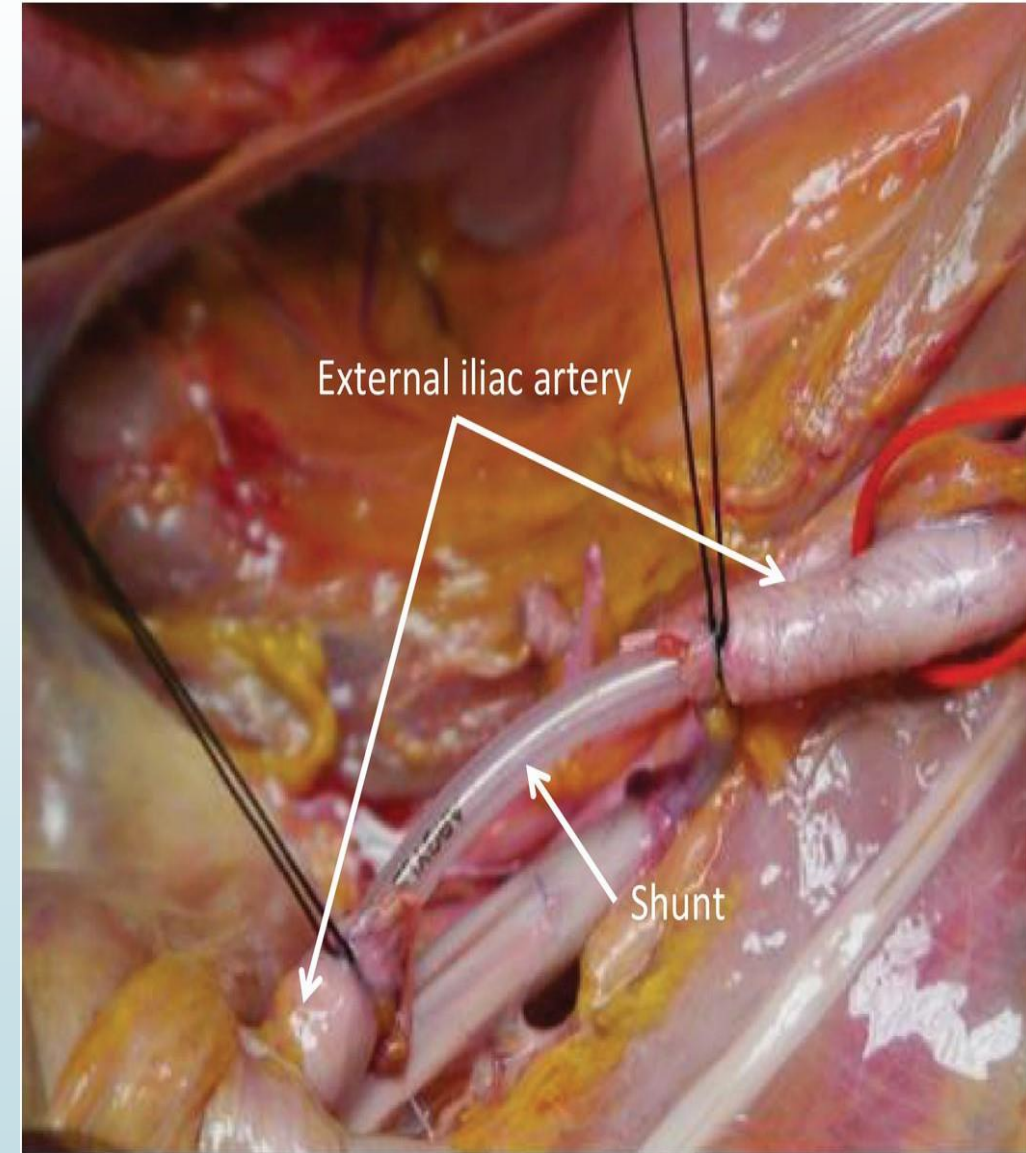


# Iliac vascular injuries

- The right common iliac artery obscures the bifurcation of the vena cava and the right iliac vein
  - The iliac artery may require division to expose venous injuries in this area
  - The artery must be repaired after the venous injury is treated because of limb threatening ischemia.

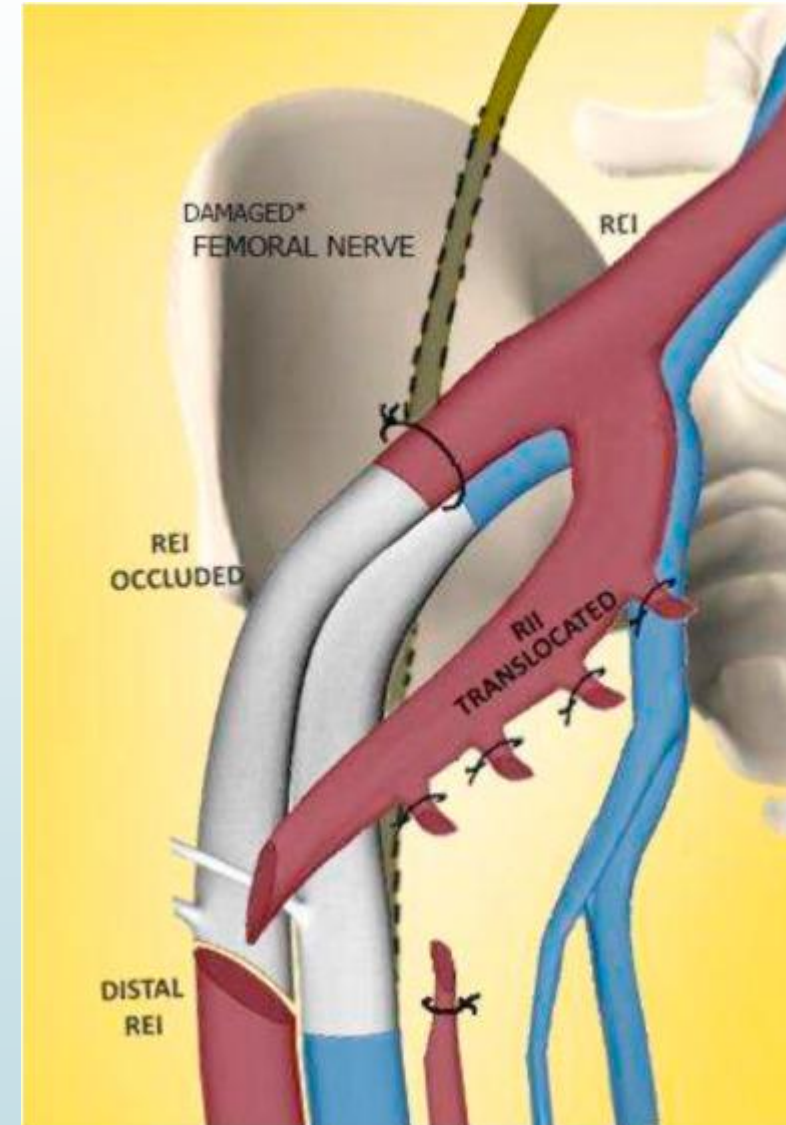


- Ligation of the common or external iliacs are not acceptable
  - Instead a temporary intraluminal shunt in moribund cases



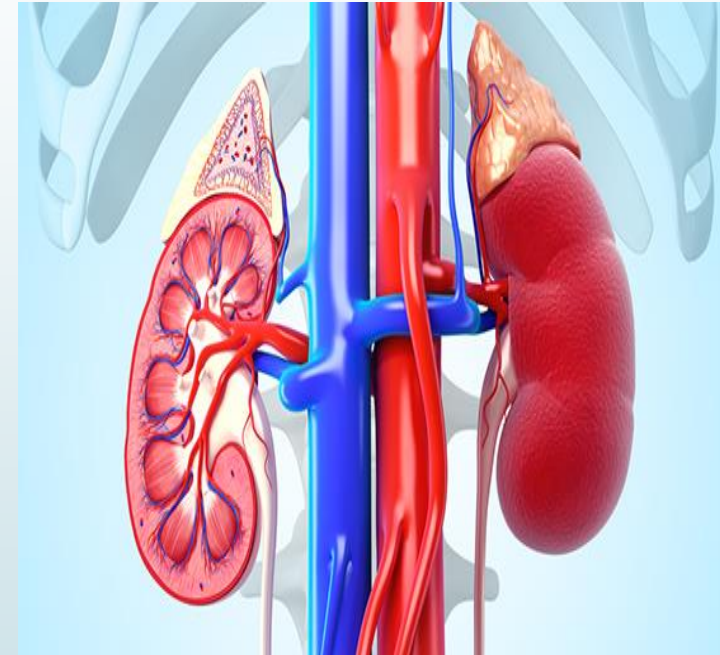
# Iliac vascular injuries

- Small arterial injuries can be repaired with 4-0 and 5-0 prolene sutures
- Venous or PTFE patch can be used to avoid stenosis
- Most gunshot wounds and blunt trauma, reconstruction by an PTFE graft interposition can be undertaken (size 6 to 12mm)
  - Fogarty catheter should be passed proximally and distally to remove clots
  - Local heparin versus systemic heparin
- Transposition of IIA



# Renovascular injuries

- There is a slightly higher incidence of injury to the left renal artery
- Half of the cases of blunt injury to the renal artery result in thrombosis and/or dissection
- Complete avulsion occurs in approximately one in ten cases
- Injuries to the distal renal artery may present with a hematoma or hemorrhage in zone II
- Most injuries to the proximal renal arteries present with a more central or supramesocolic hemorrhage.





# Renovascular injuries (intra operative diagnosis)

- There appears to be some controversy regarding exploration of perirenal hematomas
  - Most would advocate exploration following penetrating trauma
  - Stable lateral perirenal hematomas that do not encroach the midline in a patient who is hemodynamically stable can be managed by close surveillance
  - Zone II hematomas should always be explored if:
    - The hematoma is expanding
    - The patient remains hypotensive
    - The kidney has been shown to be nonfunctioning

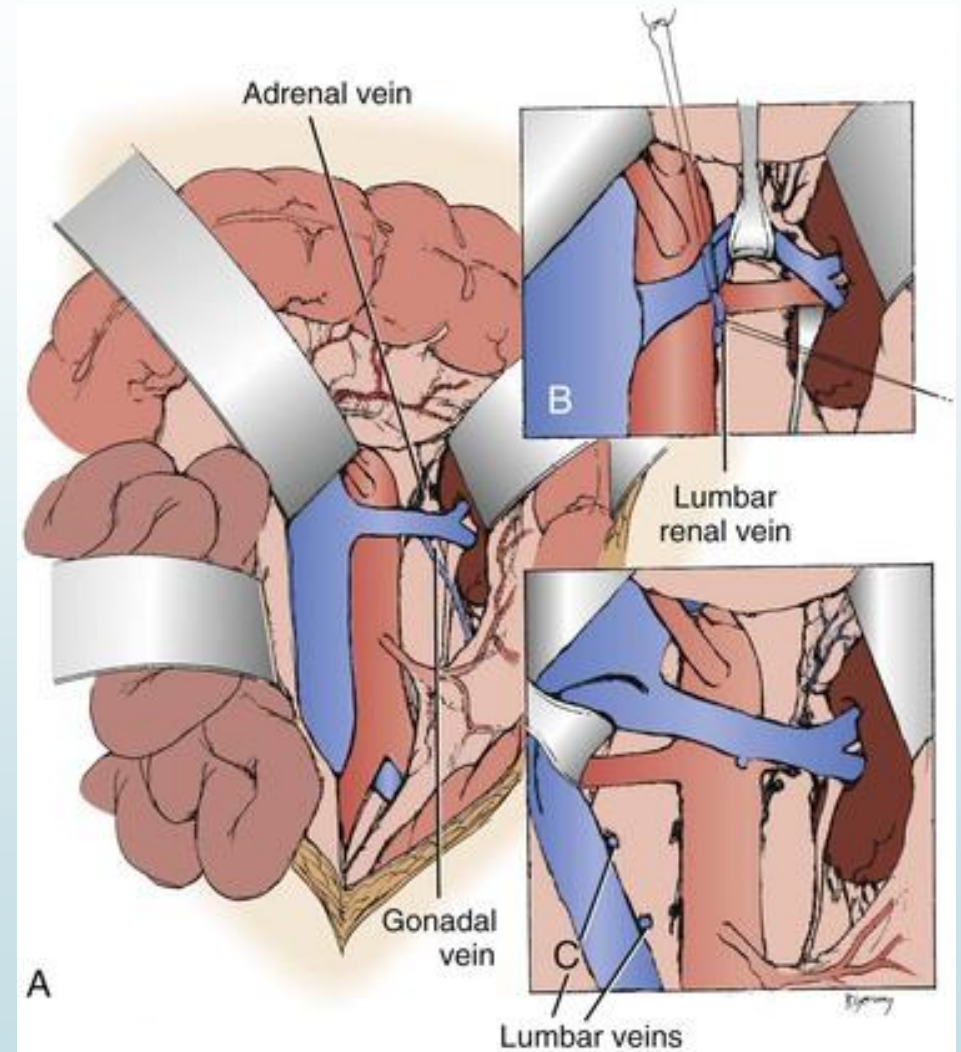


## Renovascular injuries (pre operative diagnosis)

- If they present within 6 to 6 hours, revascularization may be attempted
  - The majority of stable patients are managed nonoperatively (assuming that contralateral renal function appears sufficient)

# Renovascular injuries (Proximal control)

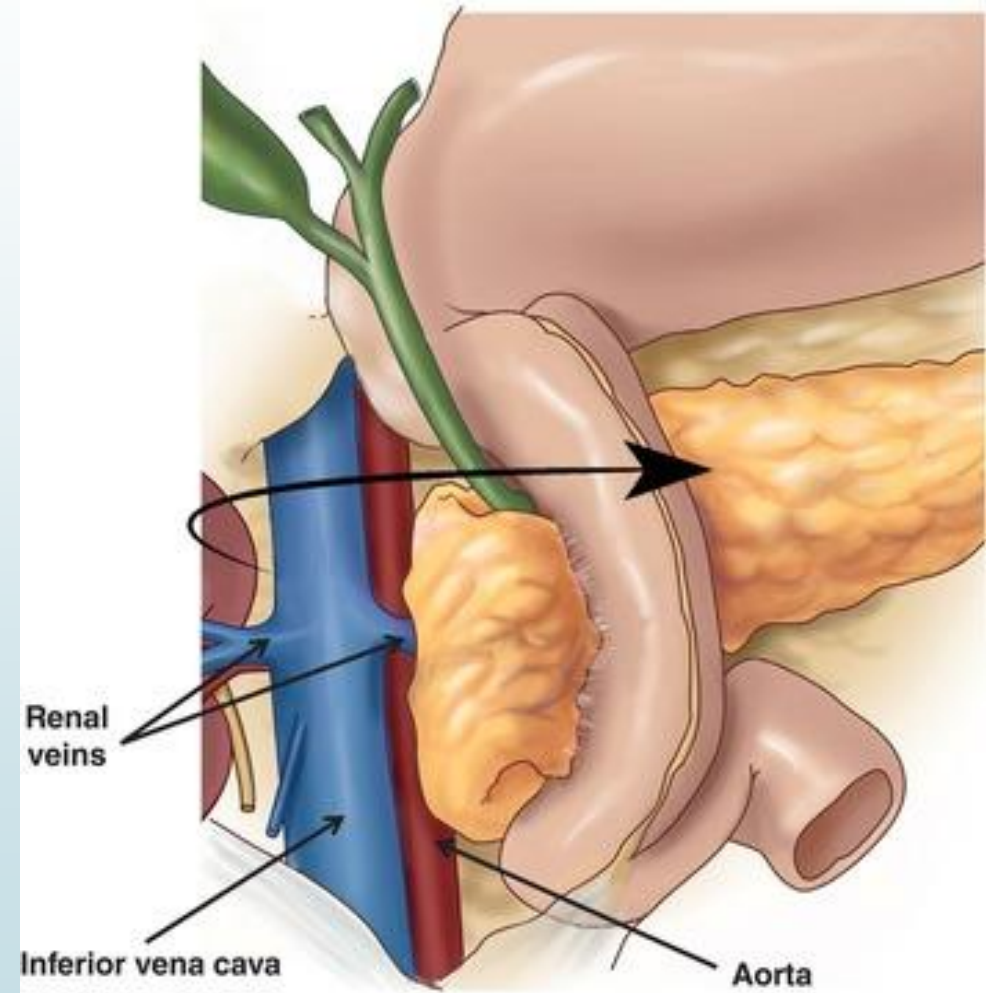
- Retracting the transverse mesocolon superiorly, eviscerating the small bowel to the right, mobilizing the duodenojejunal flexure, and retracting the left renal vein in a cephalic direction





# Renovascular injuries (Proximal control)

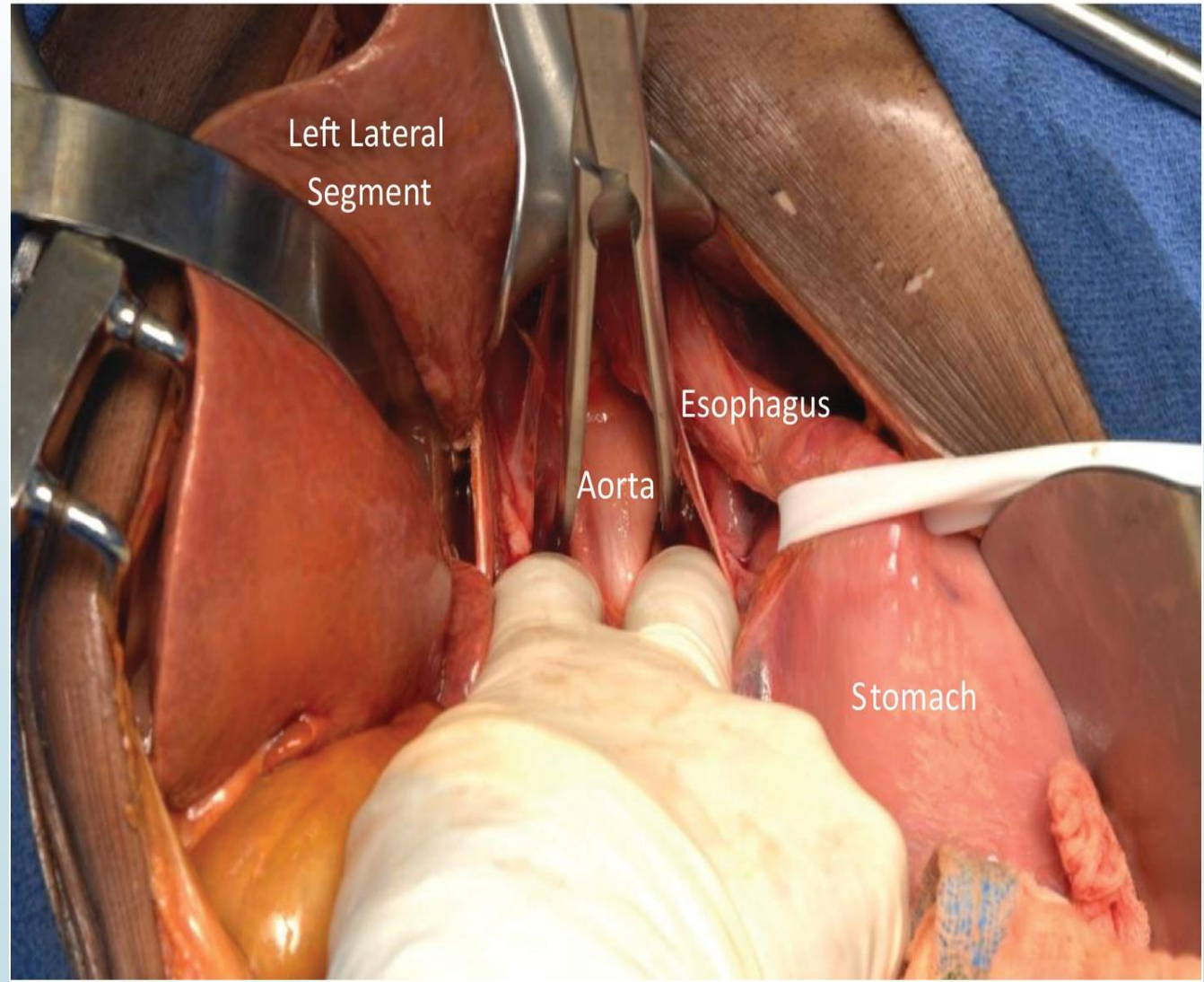
- Kocherization of the duodenum with lateral retraction of the IVC may be needed to expose the right renal artery



# Renovascular injuries (Proximal control)

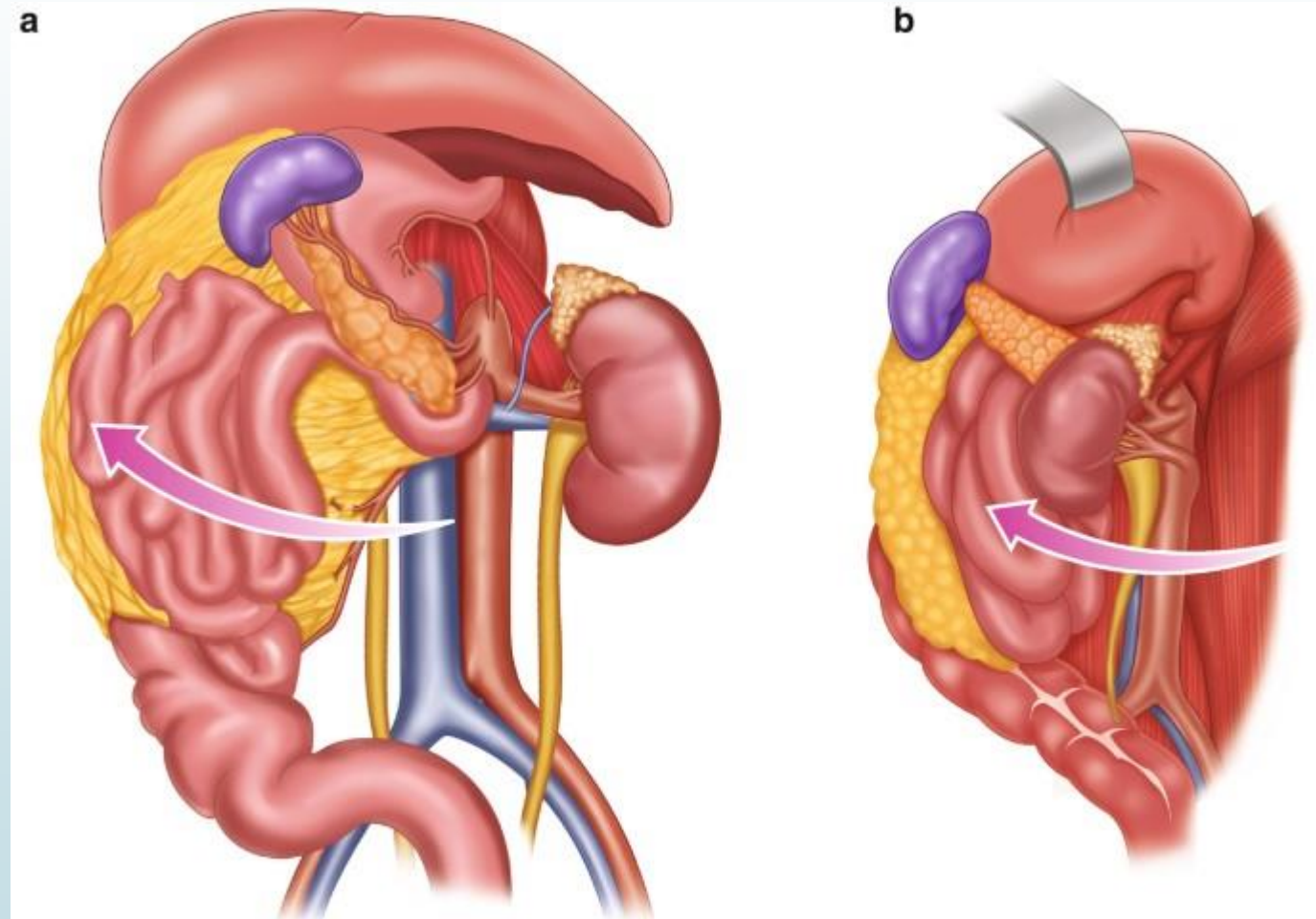
► supraceliac clamping

(b)



# Renovascular injuries (Proximal control)

► left medial visceral rotation





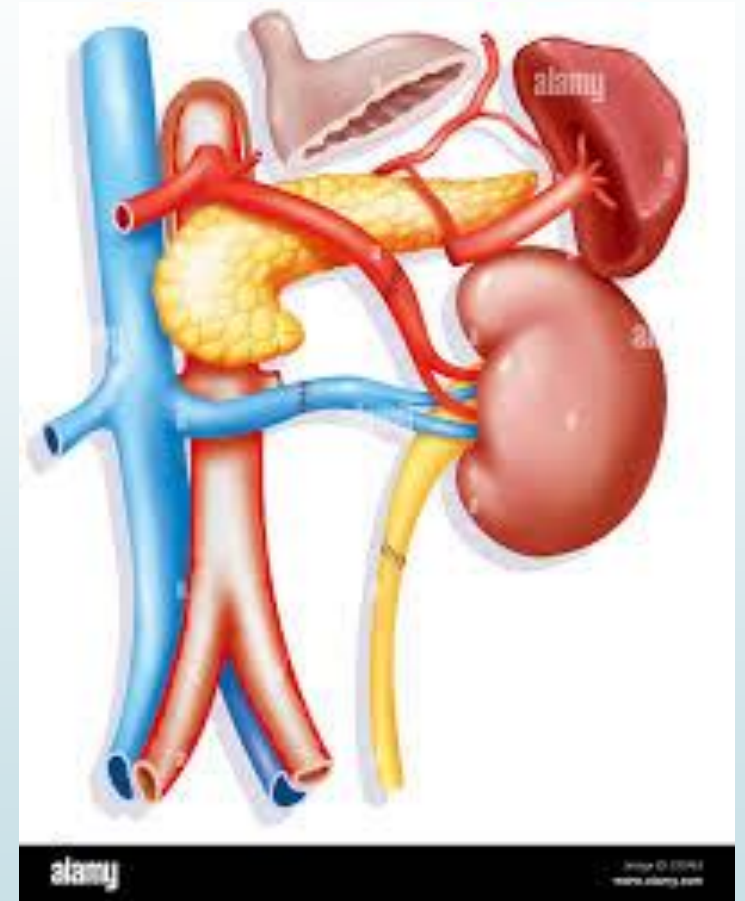
# Renovascular injuries (management)

- When a patient presents with multiple injuries and damage control surgery is indicated, ligation of the renal artery and nephrectomy are reasonable options provided the kidney is not solitary
- If the patient has a single functioning kidney, nephrectomy is contraindicated



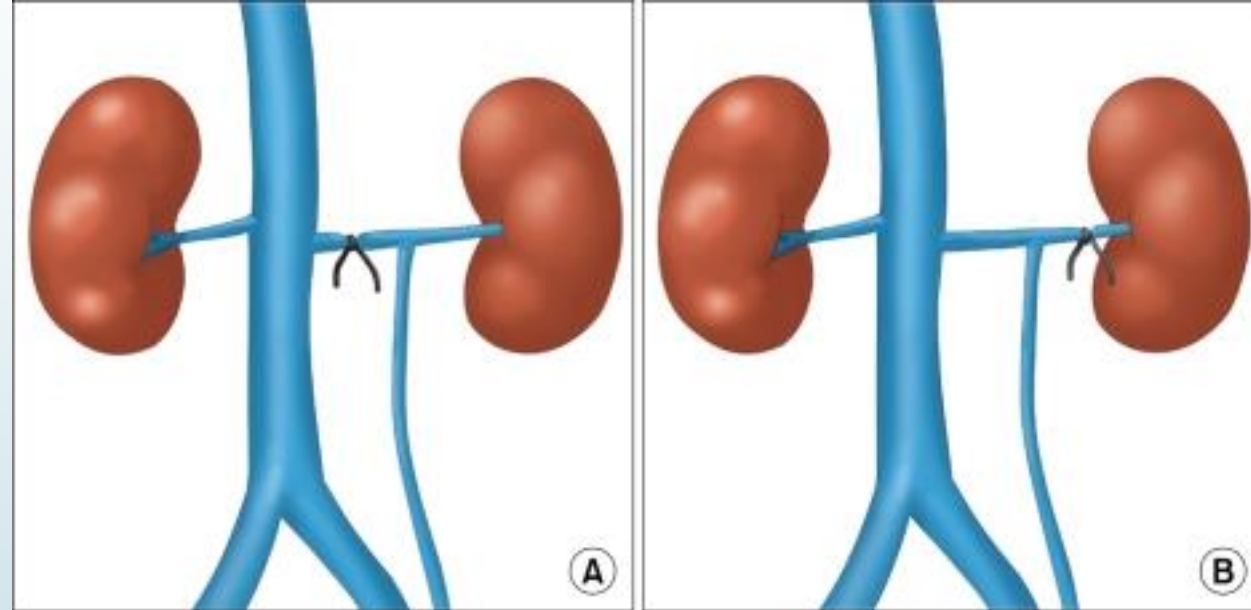
# Renovascular injuries (management)

- With small lacerations from penetrating trauma, a suture repair may be possible
- With larger lacerations, the segment may require resection
- Reconstruction with an end-to-end anastomosis or interposition grafting using long saphenous vein or prosthetic graft can be performed.
- Translocate the splenic artery onto the left renal artery or interpose a graft between the right renal artery and the hepatic artery.



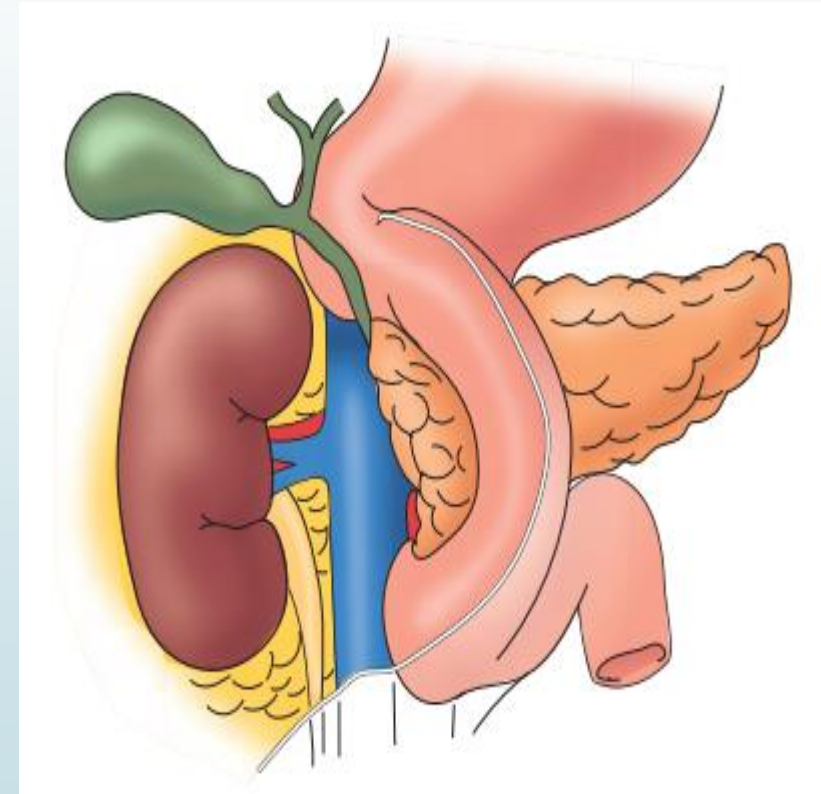
# Renovascular injuries (management)

- Right renal vein injuries should be repaired
- Left renal vein could be ligated safely just at its confluence with IVC



# Inferior Vena Cava Injuries

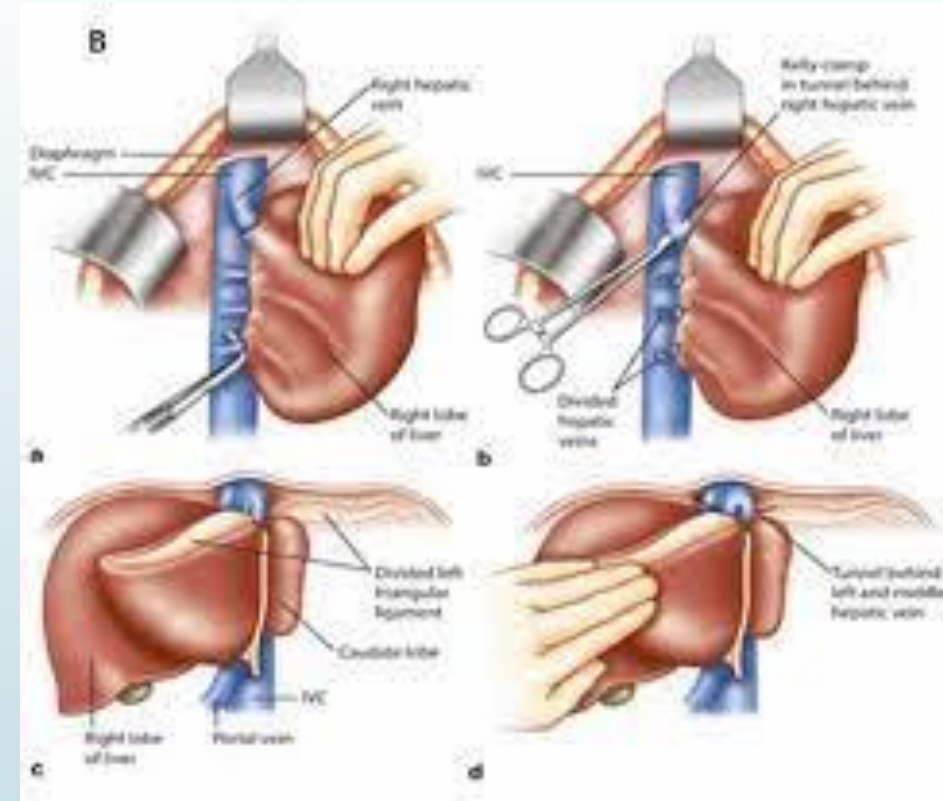
- The infrarenal and juxtarenal IVC are best exposed by mobilization and medial rotation of the right colon, the hepatic flexure of the colon, and the duodenum





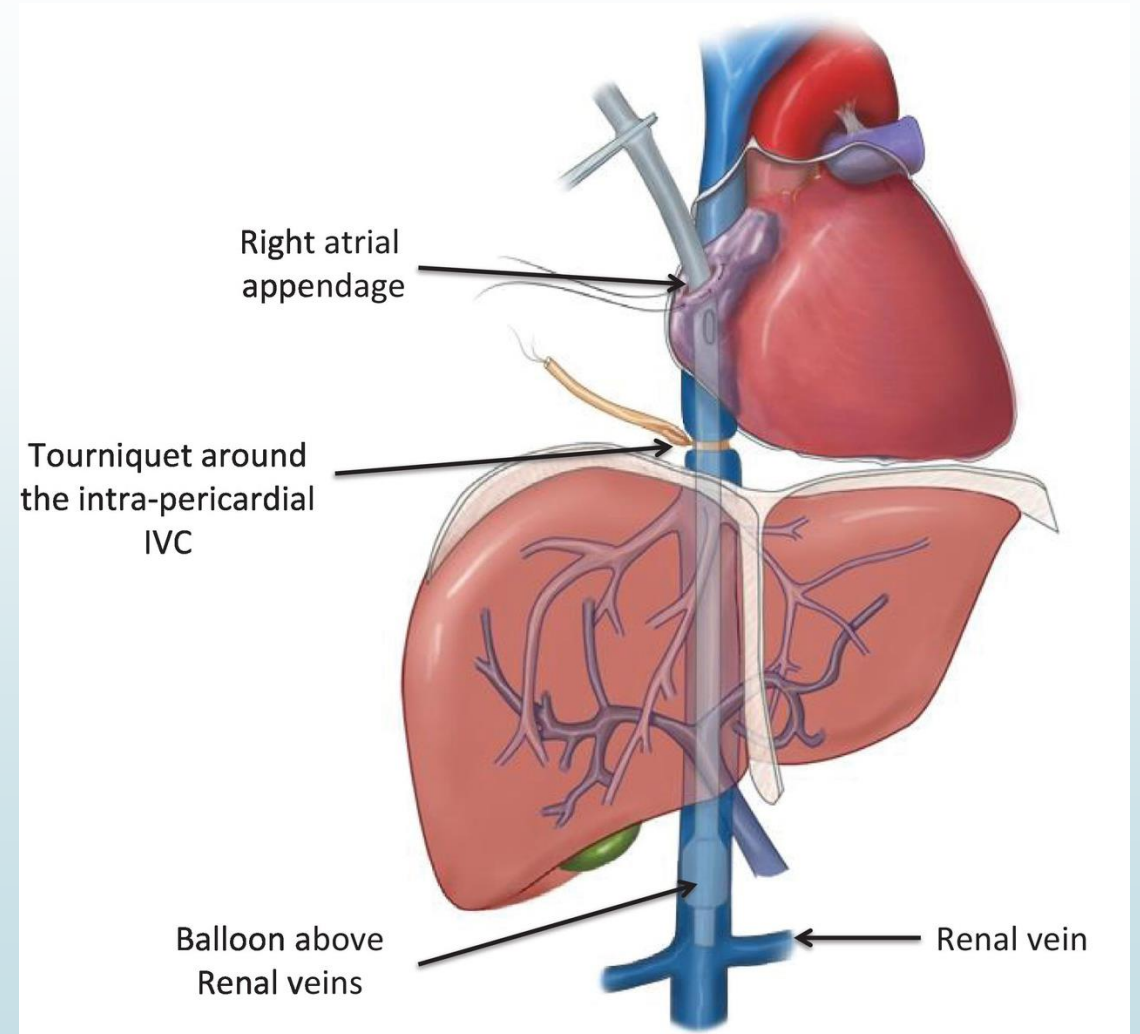
# Inferior Vena Cava Injuries

- Exposure of the retrohepatic IVC is technically challenging and usually requires extensive mobilization of the liver by dividing its ligaments and extending the incision to include a right subcostal incision, right thoracotomy, or sternotomy



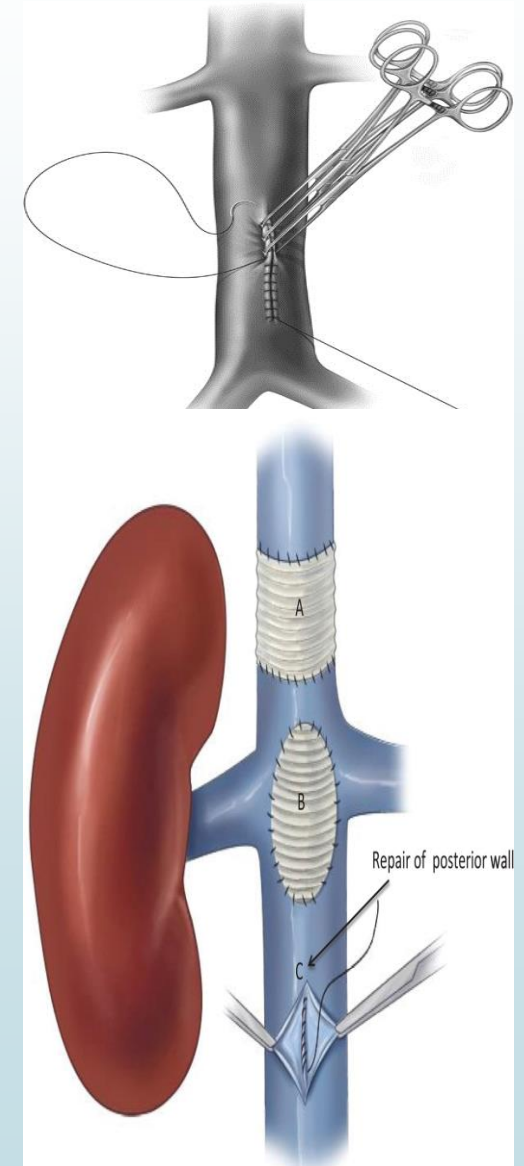
# Inferior Vena Cava Injuries

## ► Atriocaval Shunt



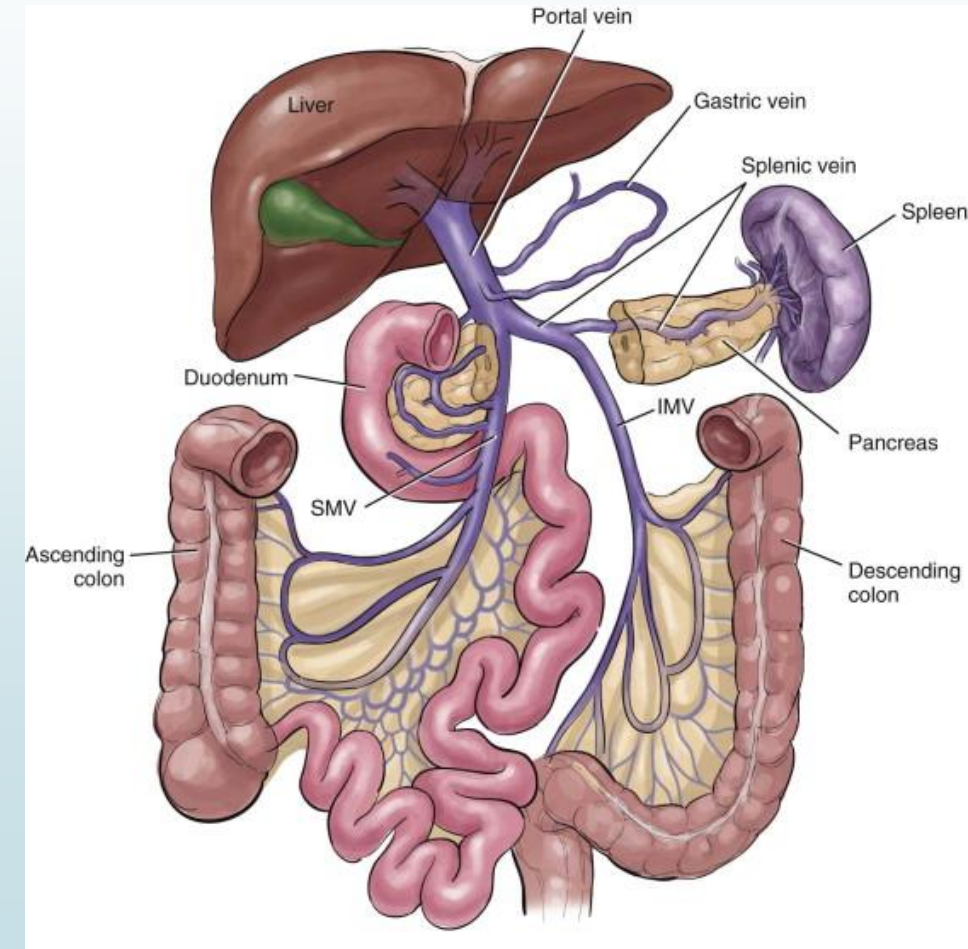
# Inferior Vena Cava Injuries: *Surgical Options*

- In most patients the IVC can be repaired by lateral venorrhaphy with 3-0 or 4-0 vascular suture material
- Ligation of the vein should be considered in hemodynamically unstable patients with severe infrarenal injuries or when repair produces major stenosis.
- Ligation of the suprarenal IVC is not an acceptable option
  - In unstable patients an intravascular shunt should be used to temporize



# Portal Venous System Injuries (exposure)

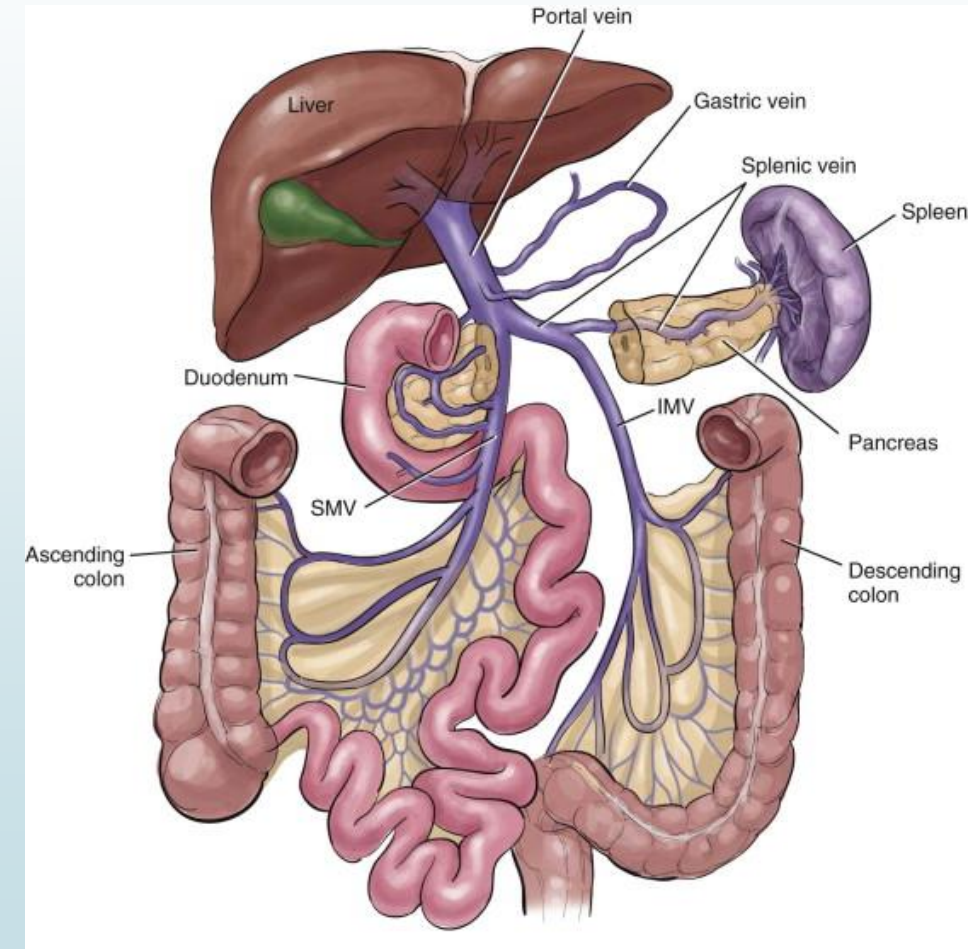
- Exposure of the retropancreatic portal vein and its major branches can be achieved by mobilization and medial rotation of the right colon and hepatic flexure of the colon and extensive Kocher mobilization of the duodenum.
- Stapled division of the neck of the pancreas provides excellent exposure and should be considered early
- The suprapancreatic portal vein can be exposed by a combination of mobilization and medial rotation of the right colon and hepatic flexure and a Kocher maneuver.





# Portal Venous System Injuries (treatment)

- The portal vein and SMV should be repaired if this can be achieved with lateral venorrhaphy
- Complex reconstructive procedures are rarely feasible or advisable
- Complex reconstruction should be undertaken only in patients with associated hepatic artery injury that cannot be repaired.
  - Ligation of both the portal vein and the hepatic artery is not compatible with life





# Damage control procedures (DCS)

- Persistent attempts to reconstruct or repair all abdominal injuries may result in increased mortality
- 'damage control' approach:
  - All complex venous injuries are ligated
  - Arterial injuries may be shunted
  - Any diffuse retroperitoneal or parenchymal bleeding is controlled by tight gauze packing



**Thank you**