

UPPER URINARY TRACT TRAUMA

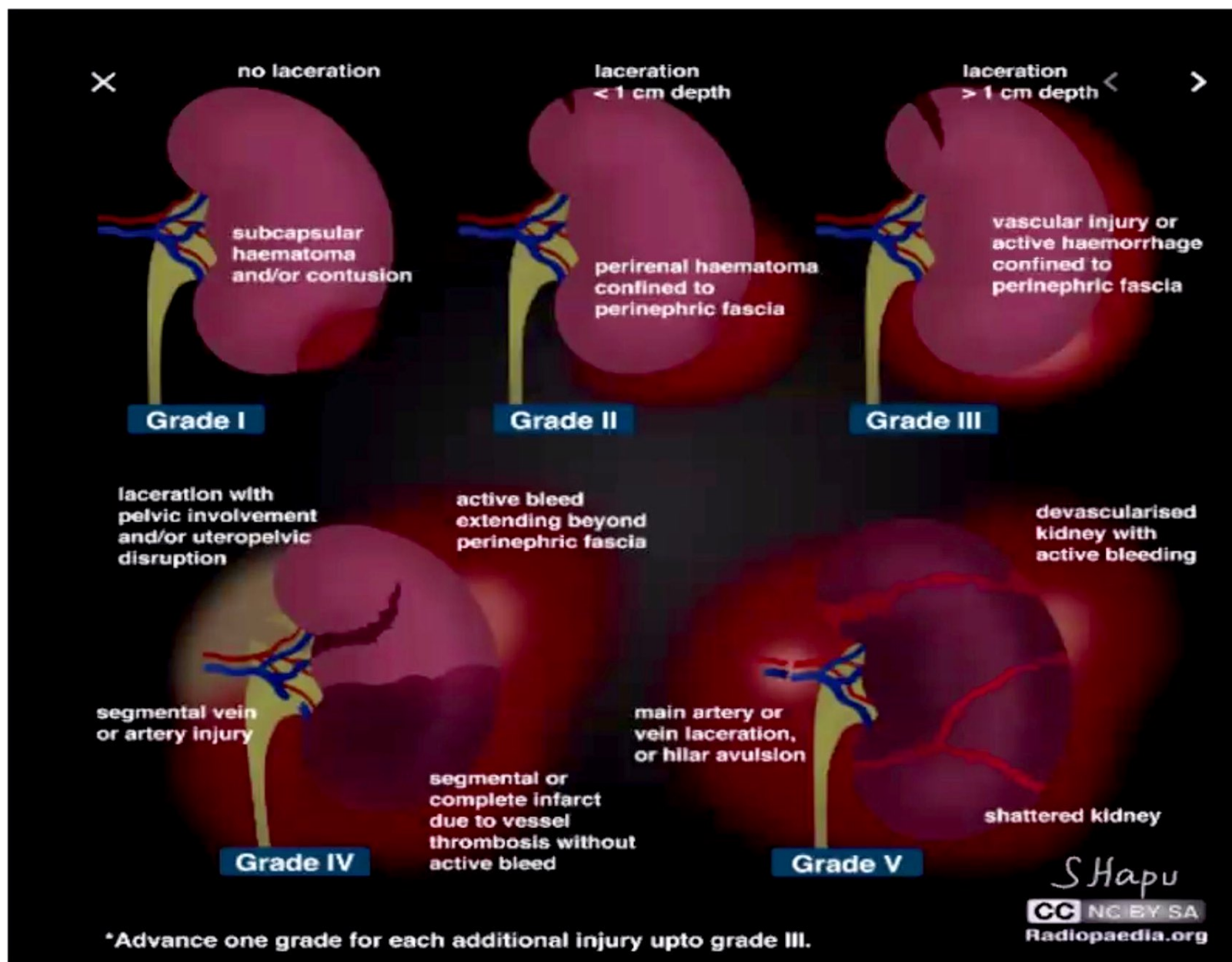
**-Department of Urology and Renal
Transplantation**

JIPMER

Pathophysiology

- **deceleration** and **acceleration** forces.
- The kidney is covered by fat and the Gerota fascia in the retroperitoneum, and the renal pedicle and uretero-pelvic junction (UPJ) are the major attachment elements - **deceleration forces** on these elements may cause renal injury like rupture or thrombosis.
- **Acceleration forces** may cause collision of the kidney in its surrounding elements, like the ribs and spine, and cause parenchymal and vascular injury

Classification



Kidney injury scale

Grade*	Type of injury	Description of injury
I	Contusion	Microscopic or gross hematuria, urologic studies normal
	Hematoma	Subcapsular, nonexpanding without parenchymal laceration
II	Hematoma	Nonexpanding perirenal hematoma confirmed to renal retroperitoneum
	Laceration	<1.0 cm parenchymal depth of renal cortex without urinary extravasation
III	Laceration	>1.0 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation
IV	Laceration	Parenchymal laceration extending through renal cortex, medulla, and collecting system
	Vascular	Main renal artery or vein injury with contained hemorrhage
V	Laceration	Completely shattered kidney
	Vascular	Avulsion of renal hilum which devascularizes kidney

*Advance one grade for bilateral injuries up to grade III

INITIAL MANAGEMENT

- Secure the airway
- Control any external bleeding('blood on the floor and 4 more')
- Resuscitation of shock
- Assess other injuries.

- Vital signs
 - pre-existing renal disease-
 1. solitary kidney
 2. hydronephrosis due to ureteropelvic junction (UPJ) abnormality,
 3. calculi,
 4. cysts
 5. Tumours
- may complicate a minor injury

Recommendations	Strength rating
Assess haemodynamic stability upon admission.	Strong
Record past renal surgery, and known pre-existing renal abnormalities (ureteropelvic junction obstruction, large cysts, lithiasis).	Strong

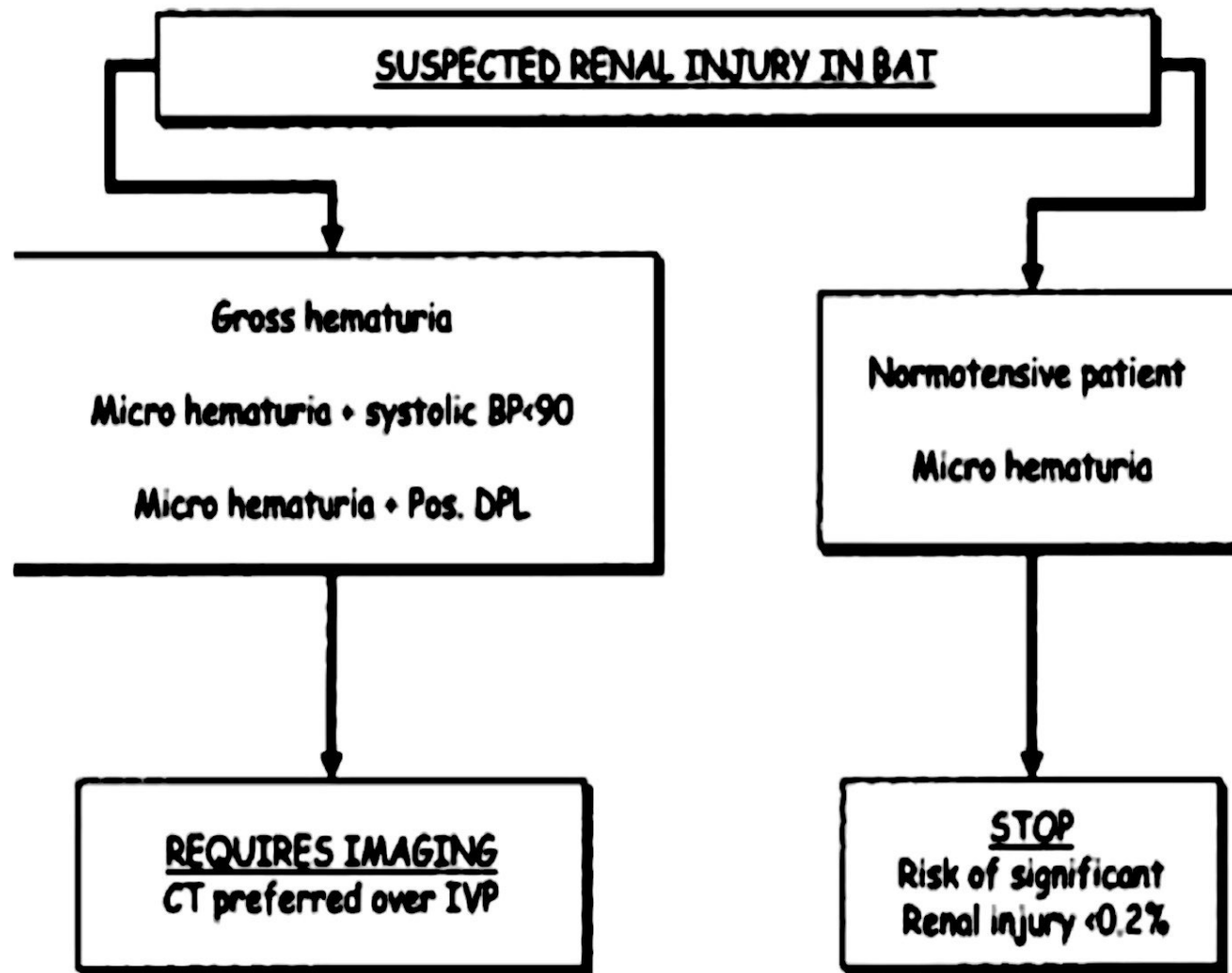
Possibility of Renal involvement

1. Hematuria
2. Flank pain
3. Flank ecchymosis
4. Flank abrasions
5. Fractured ribs
6. Abdominal distension
7. Abdominal mass
8. Abdominal tenderness

Laboratory evaluation

- Urinalysis, haematocrit and baseline creatinine
- urine dipstick is an acceptable, reliable and rapid test
- Serial haematocrit determination
- Baseline creatinine measurement reflects renal function prior to the injury

Radiology



Absolute:

- visible haematuria
- non-visible haematuria with haemodynamic instability
- a history of rapid deceleration injury and/or significant associated injuries
- penetrating abdominal or lower thoracic injury rapid deceleration injury

Relative:

- direct flank trauma
- flank contusions
- fracture of the lower ribs and fracture of the thoracolumbar spine regardless of the presence or absence of haematuria

USG

- low sensitivity for solid abdominal organ injury
 - ACR Renal Trauma guidelines considers US usually not appropriate in renal trauma
 - contrast enhanced US (CEUS) increases the sensitivity of US
- PRESENCE OF MICROBUBBLES DECREASES USEFULNESS.**

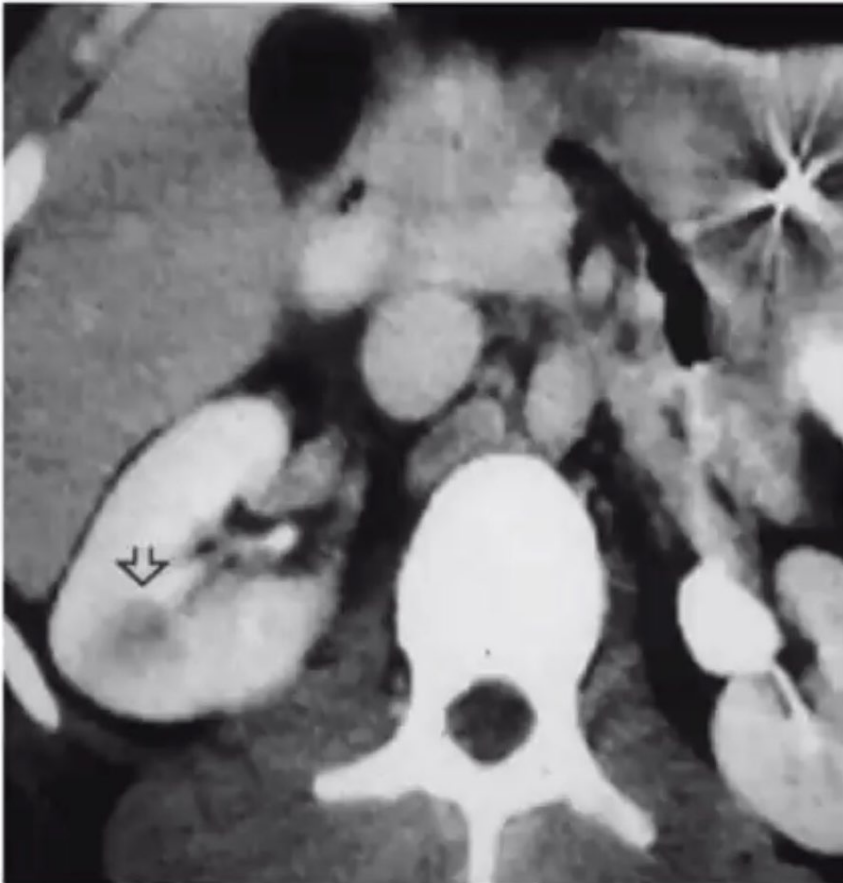
Computed Tomography

- **Pre-contrast images**- subcapsular haematomas obscured on post-contrast sequences.
- **Administration of intravenous iodinated contrast media** is essential - Low rates of contrast-induced nephropathy seen in trauma patients.
- **Arterial phase images** - assessment of vascular injury and presence of active extravasation of contrast.
- **Nephrographic phase** - parenchymal contusions and lacerations.

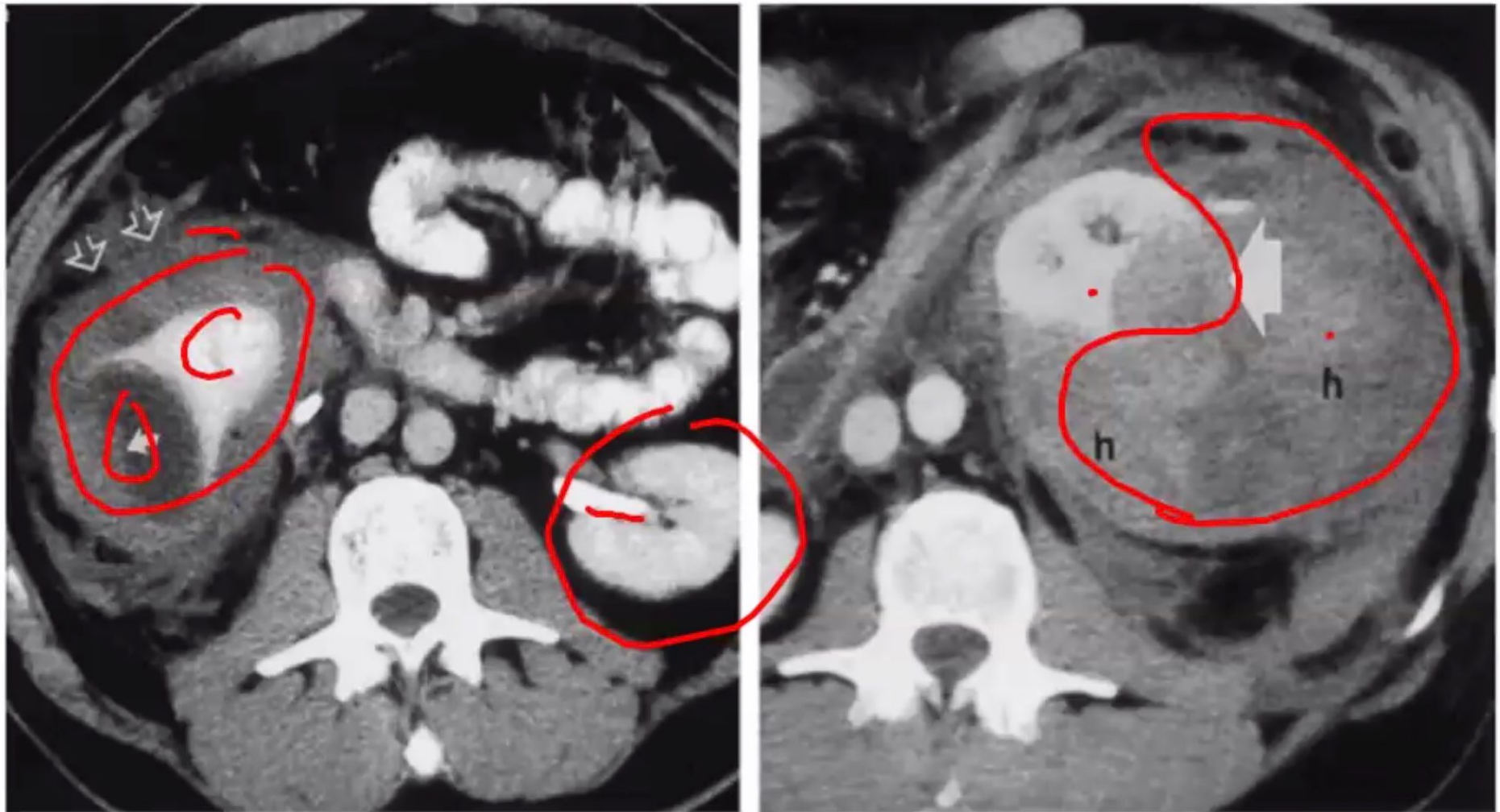
IVP

- One-shot, intraoperative IVP remains a useful technique to confirm the presence of a functioning contralateral kidney in patients too unstable to undergo pre-operative imaging
- The technique consists of a bolus intravenous injection of 2 mL/kg of radiographic contrast followed by a single plain film taken after ten minutes.
- when CT is not available

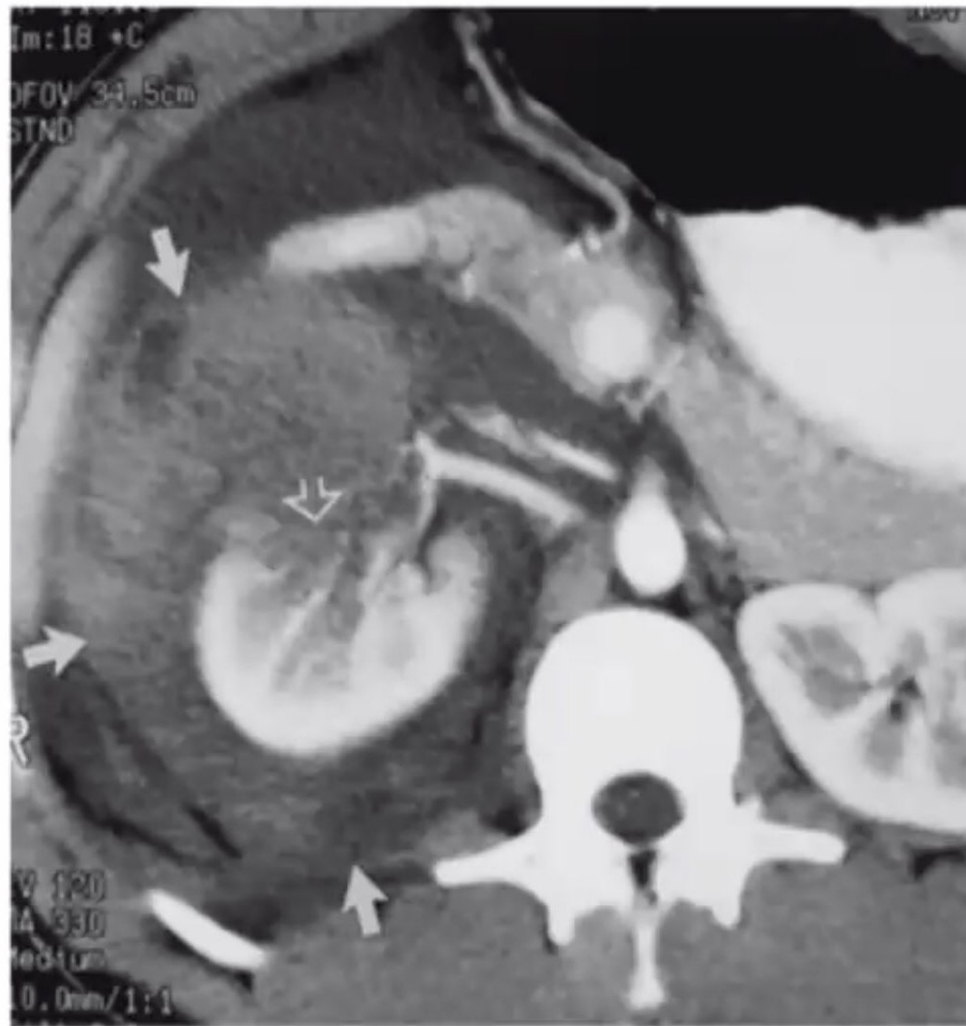
Renal Contusions



Perirenal Hemorrhage



A. Deep renal laceration
B. Parenchymal Fracture



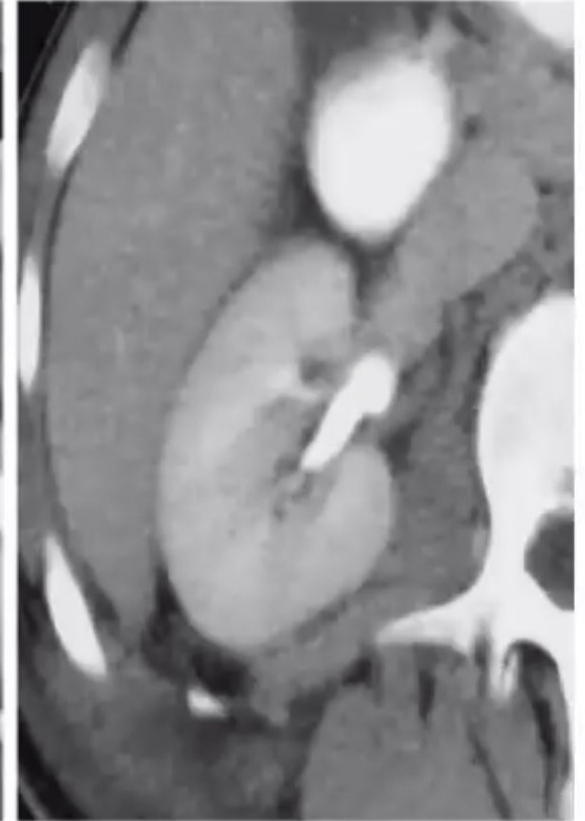
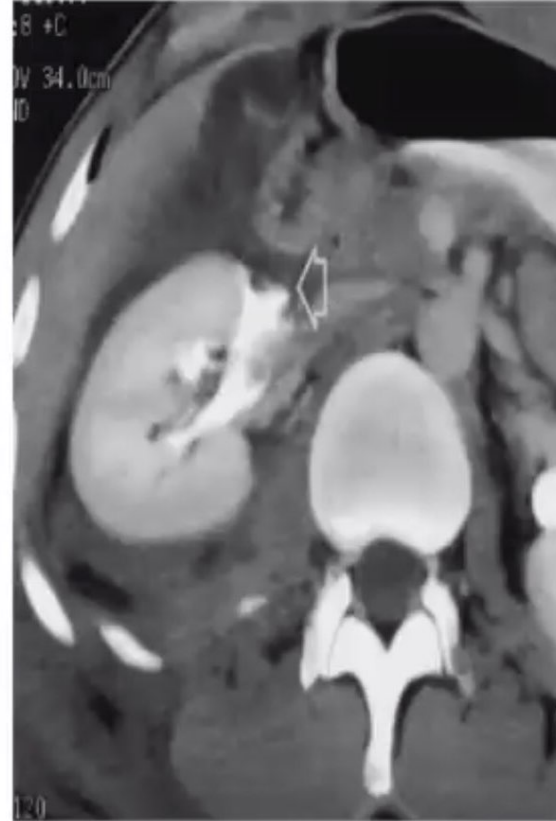
a.



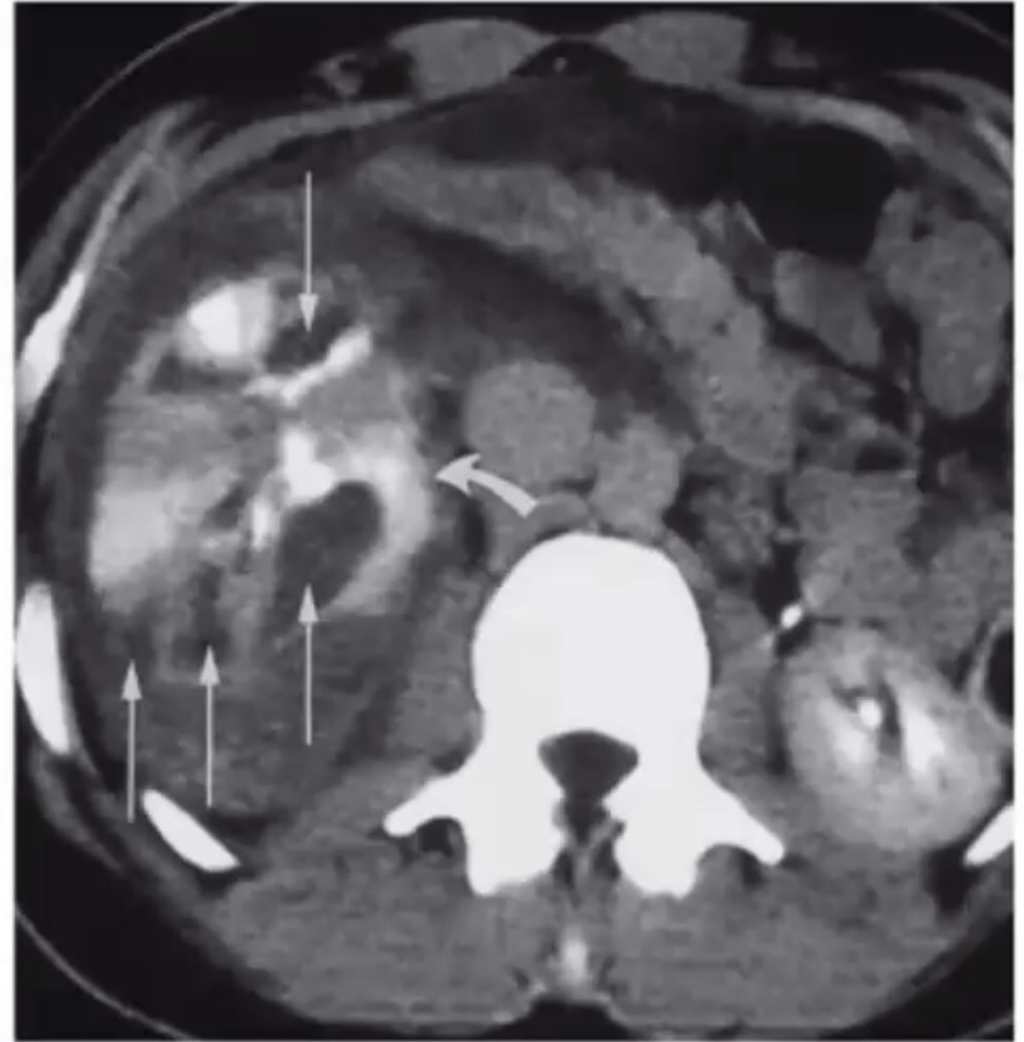
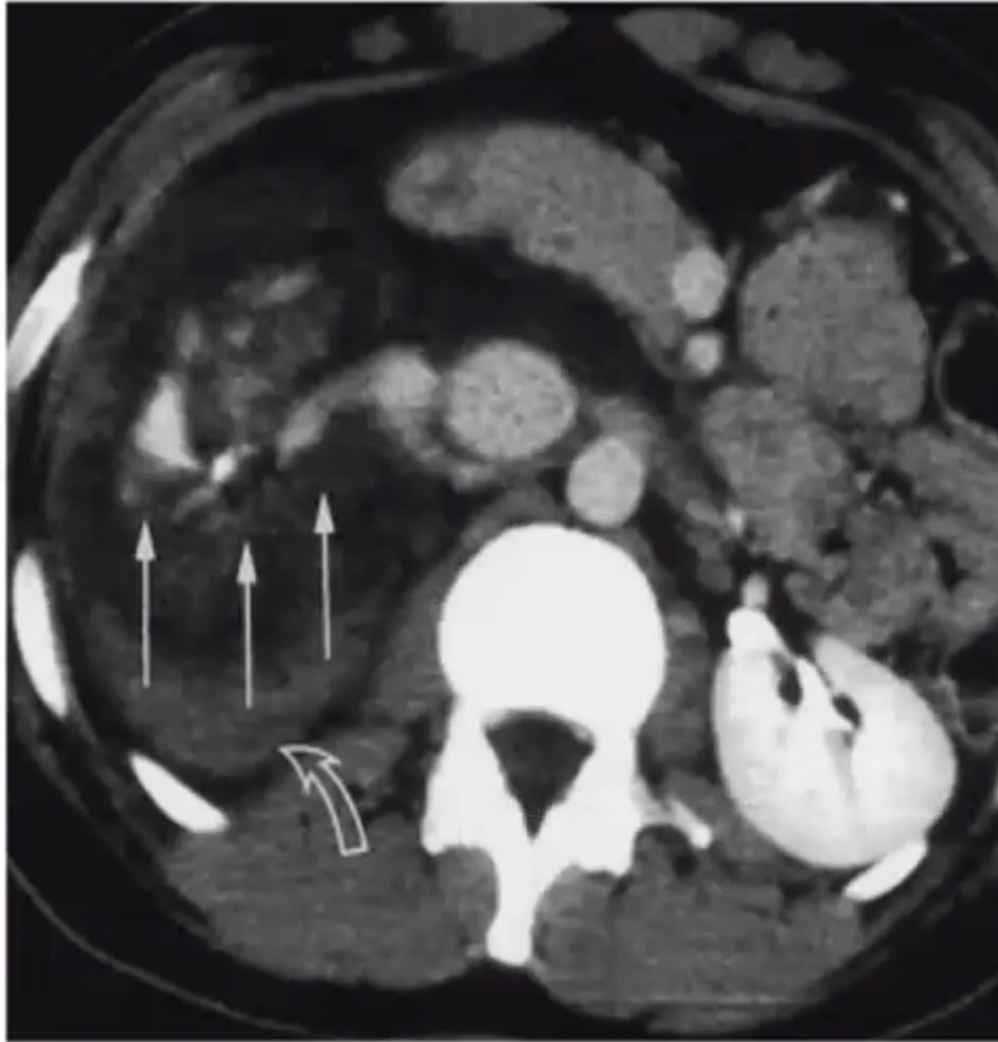
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A.Active Hemorrhage

B.Urinary Extravasation

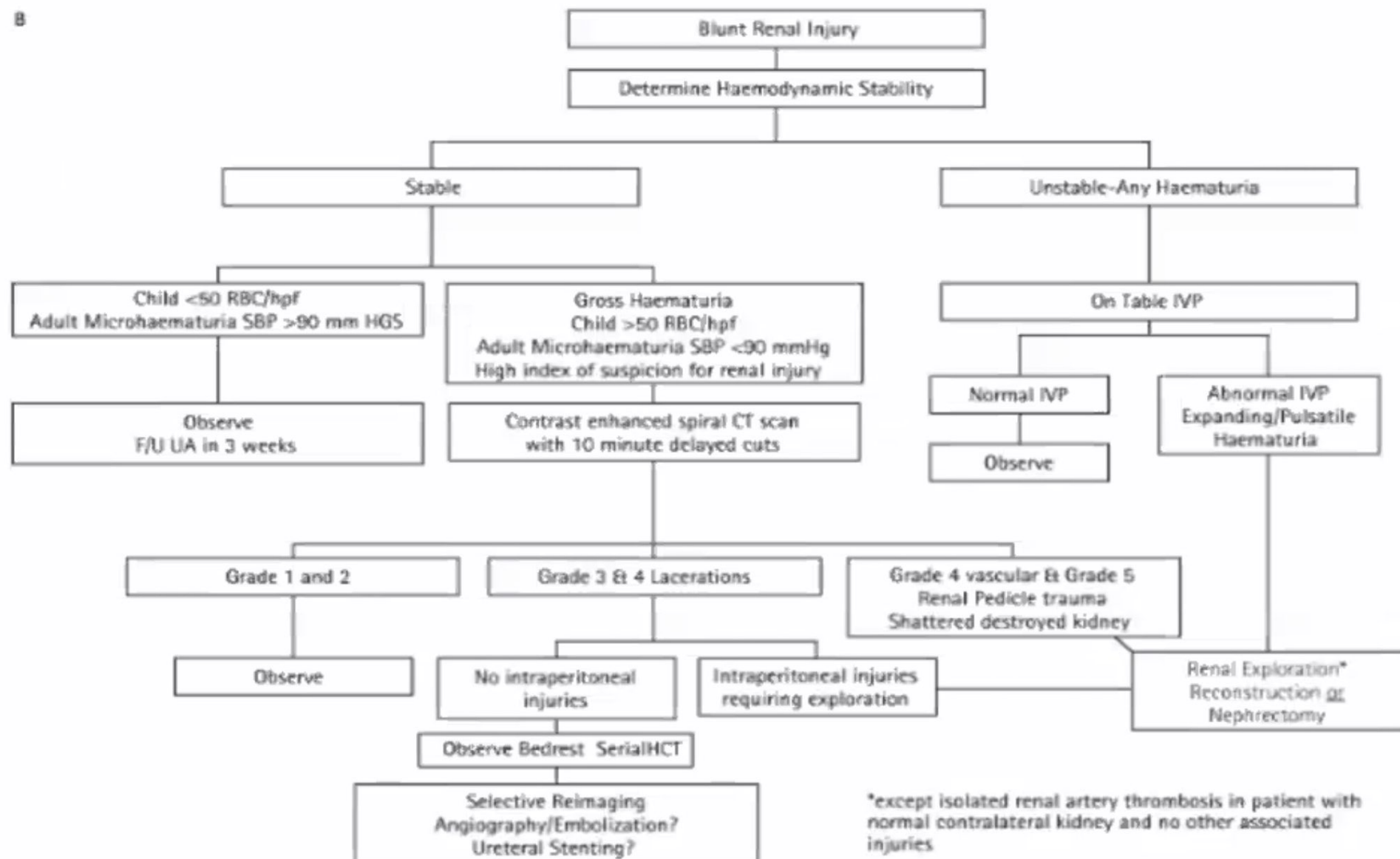


Multiple segmental renal infarcts. Late-nephrographic- (a) and excretory-phase (b)

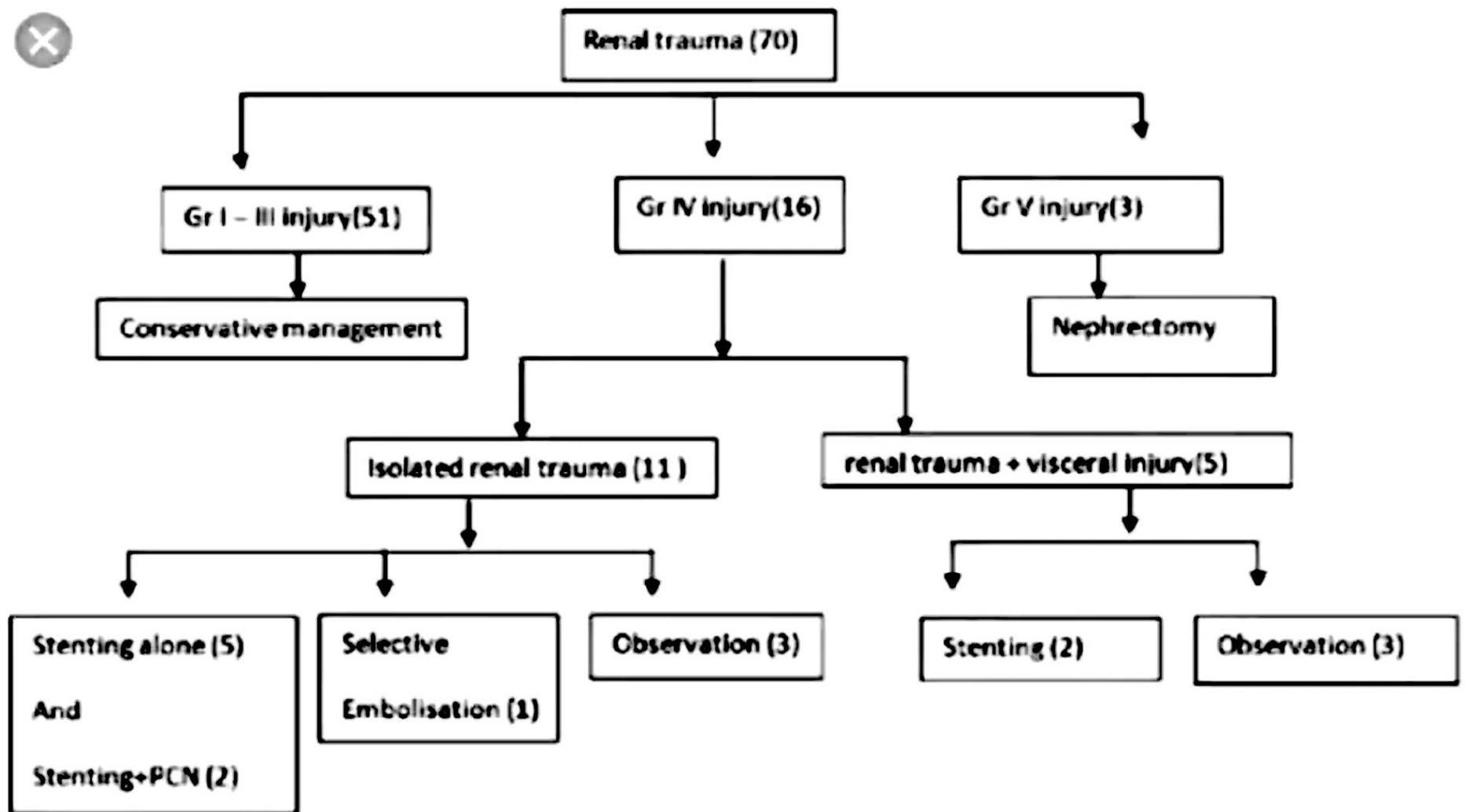


Management

8



*except isolated renal artery thrombosis in patient with normal contralateral kidney and no other associated injuries



Non Operative Management(NOM)

- The overall exploration rate for blunt trauma is less than 10%
- The overall rate of patients who have a nephrectomy during exploration is around 13%
- Stable patients following grade 1-4 blunt renal trauma , should be managed conservatively :
Bed-rest , hydration and antibiotics , and continuous monitoring of vita signs until hematuria resolves
- lower rate of nephrectomies

Surgical Management

1. A grade V injury
 2. Haemodynamic instability
 3. Exploration for associated injuries
 4. Incidental finding of pre-existing renal pathology requiring surgical therapy
 5. Expanding or pulsatile perirenal hematoma identified during laparotomy
- parenchymal grade 5 patients, intervention is predicted by
 1. need for continued fluid and blood resuscitation
 2. peri-renal haematoma size > 3.5 cm
 3. the presence of intravascular contrast extravasation

Surgical Approach

- **Transperitoneal** - Access to the pedicle is obtained
 1. the posterior parietal peritoneum, which is incised over the aorta, just medial to the inferior mesenteric vein
 2. bluntly dissecting along the plane of the psoas muscle fascia, adjacent to the great vessels, and directly placing a vascular clamp on the hilum

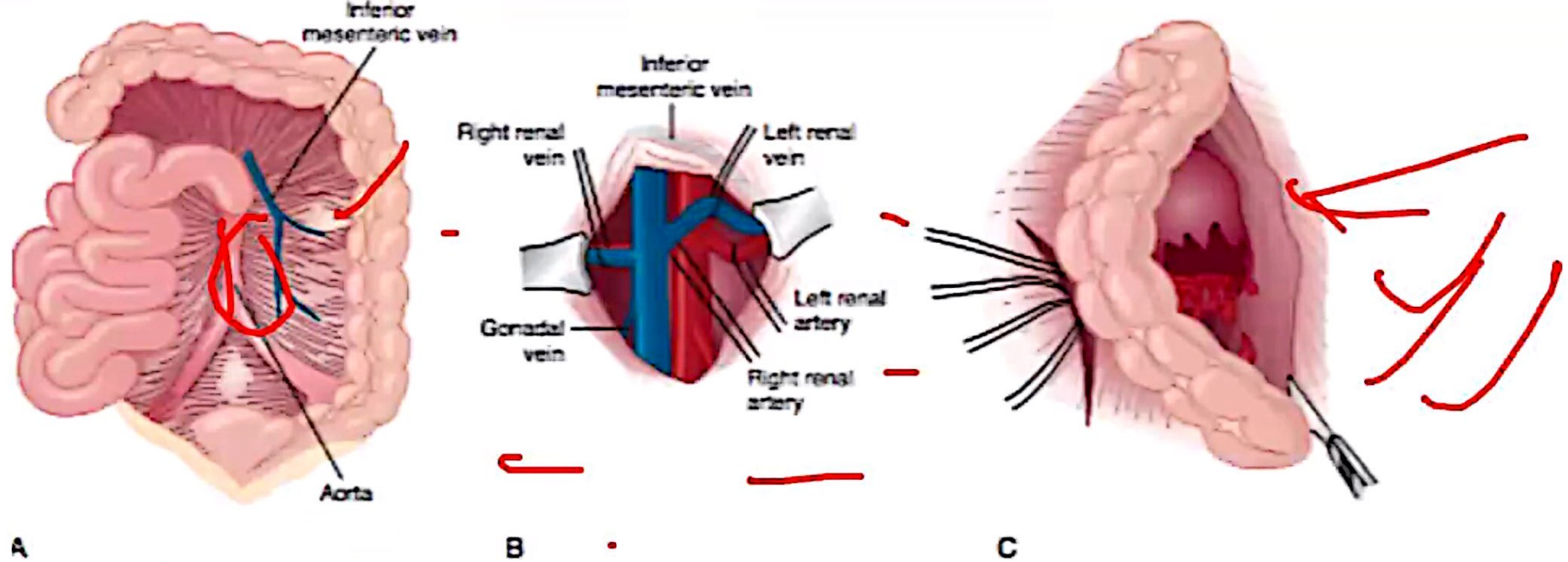


Figure 50-8. The surgical approach to the renal vessels and kidney. A, Retroperitoneal incision over the aorta medial to the inferior mesenteric vein. B, Anatomic relationships of the renal vessels. C, Retroperitoneal incision lateral to the colon, exposing the kidney.

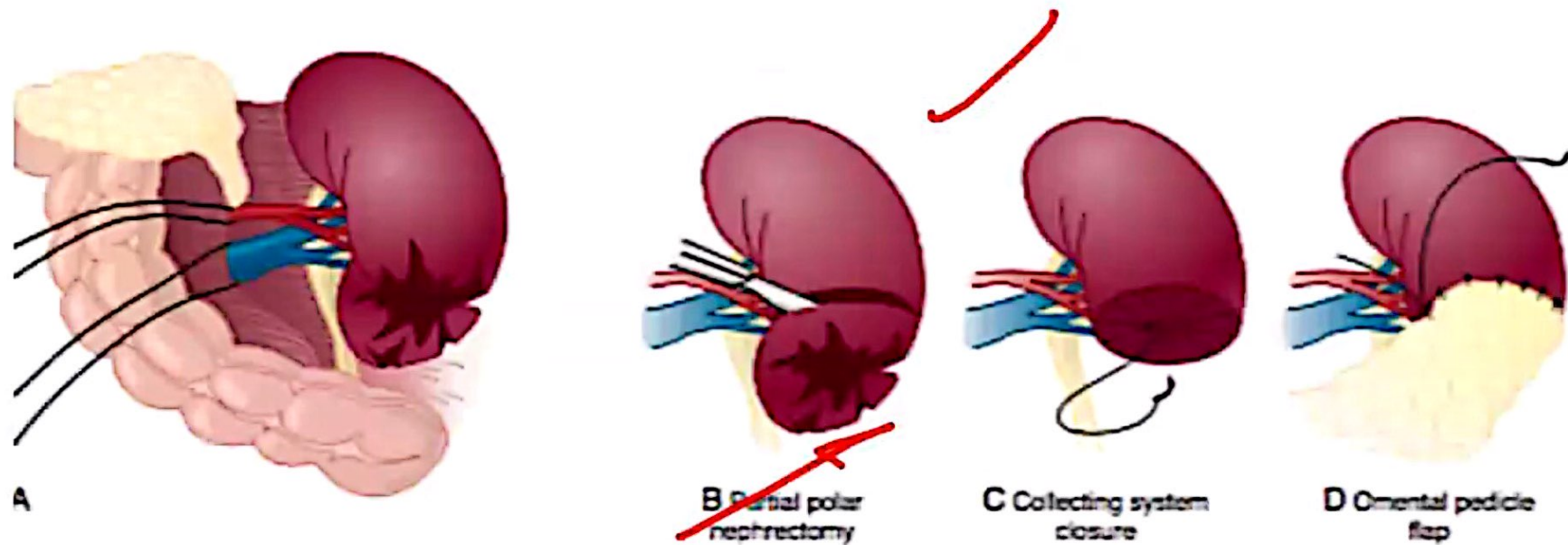
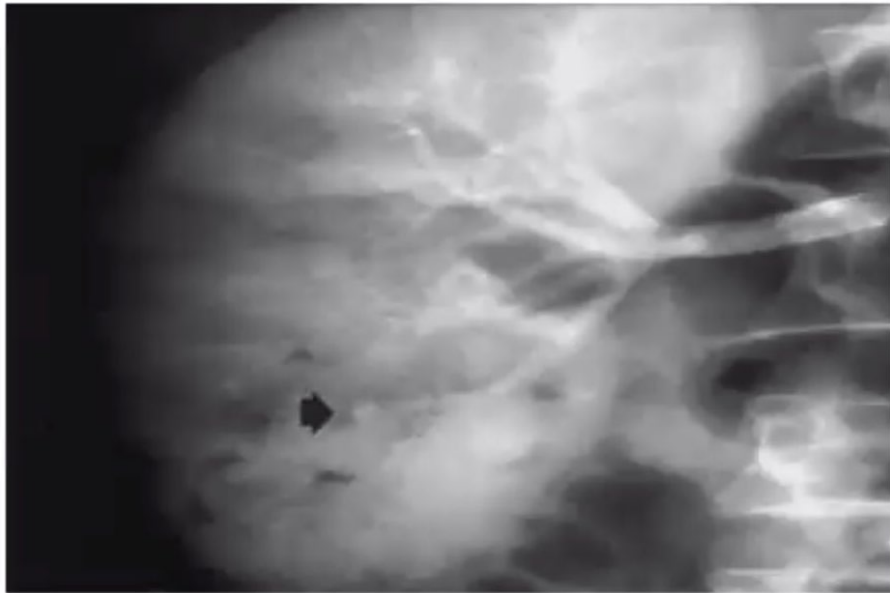


Figure 50-9. Technique for partial nephrectomy. A, Total renal exposure. B, Sharp removal of nonviable tissue. C, Hemostasis obtained and collecting system closed. D, Defect covered.

Angioembolisation

- accepted CT findings
 1. active extravasation of contrast
 2. arteriovenous fistula
 3. pseudoaneurysm.
- The presence of both active extravasation of contrast and a large haematoma (> 25 mm depth) predict the need for angioembolisation with good accuracy.
- It has been utilised in the nonoperative management of all grades of renal injury
Most beneficial in high grade renal trauma (AAST > 3)

Angioembolisation of a pseudoaneurysm with Gelatin Beads



a.



b.



Complications

- **Early:**

Bleeding , infection , perinephric abscess , sepsis , urinary fistula , hypertension , urinary extravasation and urinoma

- **Delayed:**

Bleeding , hydronephrosis , calculus formation , chronic pyelonephritis , hypertension , arteriovenous fistula , and psuedoaneurism

Management of Paediatric Trauma

- Indications for radiographic evaluation of children suspected for renal trauma include :
 1. Blunt and penetrating trauma patients with any level of hematuria
 2. Patients with associated abdominal injuries regardless of the urinalysis findings
 3. Patients with normal urinalysis who sustained a rapid deceleration events , direct flank trauma , or fall from height
- Ultrasonography is considered a reliable method of screening and following blunt renal injuries
- CTscans is the imaging study of choice for staging renal injury
- Haemodynamic instability and a diagnosed grade V injury are absolute indications for surgical exploration

Follow-Up

Recommendations	Strength rating
Repeat imaging in case of fever, worsening flank pain, or falling haematocrit.	Strong
Follow-up approximately three months after major renal injury with: • physical examination; • urinalysis; • individualised radiological investigation including nuclear scintigraphy; • serial blood pressure measurements; • renal function tests.	Weak

World Society of Emergency Surgery (WSES) Guideline

- **Minor kidney injuries:**

WSES class I includes hemodynamically stable AAST-OIS grade I–II blunt and penetrating lesions.

- **Moderate kidney injuries:**

WSES class II includes hemodynamically stable AAST-OIS grade III blunt and penetrating lesions.

- **Severe kidney injuries:**

WSES class III includes hemodynamically stable AAST-OIS grade IV–V blunt and penetrating lesions and any grade parenchymal lesion with arterial dissection/occlusion.

WSES class IV includes hemodynamically unstable AAST-OIS grade I–V blunt and penetrating lesions

AUA Guideline Summary

- In stable blunt trauma patients with gross hematuria or microscopic hematuria and systolic blood pressure < 90 mm Hg, diagnostic imaging with intravenous (IV) contrast-enhanced computed tomography (CT) should be performed. (**Standard; evidence strength: Grade B**)
- Diagnostic imaging with IV contrast-enhanced CT should be performed in stable trauma patients whose mechanism of injury or physical exam findings raise concern for renal injury (eg, rapid deceleration; significant blow to the flank; rib fracture; significant flank ecchymosis; penetrating injury of the abdomen, flank, or lower chest)). (**Recommendation; evidence strength: Grade C**)
- IV contrast-enhanced abdominal/pelvic CT with immediate and delayed images should be performed when renal injury is suspected

- Noninvasive management strategies should be used in patients with renal injury who are hemodynamically stable. **(Standard; evidence strength: Grade B)**
- Hemodynamically unstable patients with no response or only transient response to resuscitation must undergo immediate intervention (surgery, or angioembolization in selected situations). **(Standard; evidence strength: Grade B)**
- Patients with renal parenchymal injury and urinary extravasation may initially be observed. **(Clinical Principle)**

- Follow-up CT imaging should be performed for renal trauma patients having either deep lacerations (American Association for the Surgery of Trauma [AAST] grade IV-V) or clinical signs of complications (eg, fever, worsening flank pain, ongoing blood loss, abdominal distention) **(Recommendation; evidence strength: Grade C)**
- Urinary drainage should be performed in patients with complications such as enlarging urinoma, fever, increasing pain, ileus, fistula or infection (Recommendation; evidence strength: Grade C); ureteral stenting should be used for drainage and may be augmented by percutaneous urinoma drain, percutaneous nephrostomy, or both. **(Expert Opinion)**

Ureteral Injury

Etiology

- **External trauma very rare**
 - <4% of penetrating trauma
 - <1% of blunt trauma
 - Look for concomitant visceral injuries (SB, LB, K, B)

Etiology

- External trauma very rare
 - <4% of penetrating trauma
 - <1% of blunt trauma
 - Look for concomitant visceral in
- Usually surgical trauma
 - Gynecologic, vascular, urologic or general surgery
 - Open
 - Laparoscopic
 - Ureteroscopy

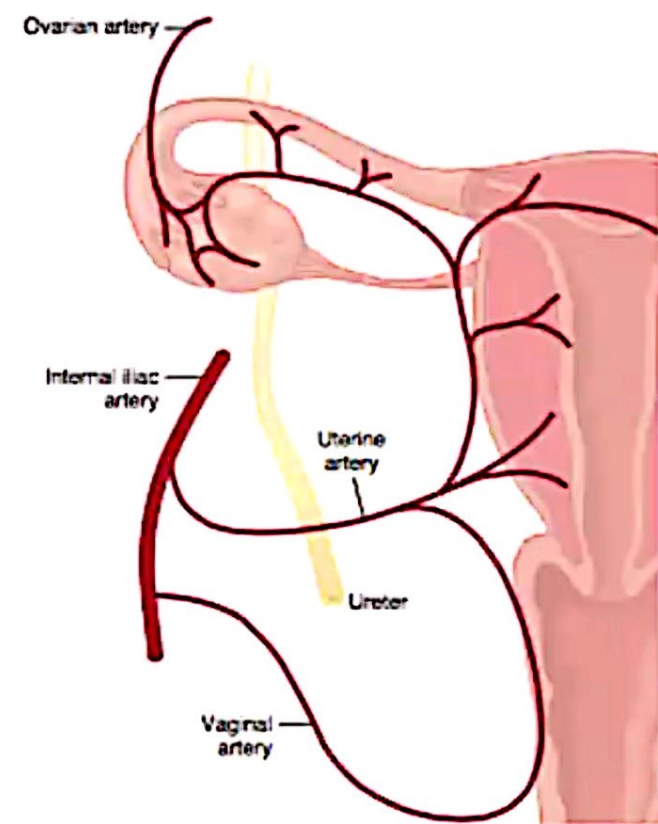


Figure 50-14. Ureteral anatomy showing relationship to fallopian tube and uterine artery.

Traumatic ureteral injury

- Extremely rare, gunshot is most common
- No reliable Phx findings! Usually a retrograde diagnosis
- **Urinalysis is normal 25% of the time, do not rely on it**
- Being suspicious for it is the only way you will catch it
- Imaging: Delayed CT with IV contrast
- Management: Requires OR

The diagram illustrates the human urinary tract from a posterior perspective, showing the kidneys, ureters, and bladder. The ureters are highlighted in brown, and the bladder is shown in orange. The diagram is divided into three horizontal sections: UPPER, MIDDLE, and LOWER, each with associated surgical approaches. The spine is shown in the center, and the pelvic bones are visible at the bottom. The kidneys are shown in a reddish-brown color. The ureters descend from the kidneys towards the bladder. The diagram is used to illustrate various surgical techniques for ureteral reconstruction, such as direct ureteroureterostomy, transureteroureterostomy, reimplantation, and the psoas hitch.

UPPER

Direct ureteroureterostomy
Transureteroureterostomy

MIDDLE

Direct ureteroureterostomy
Transureteroureterostomy

LOWER

Reimplantation
Psoas hitch

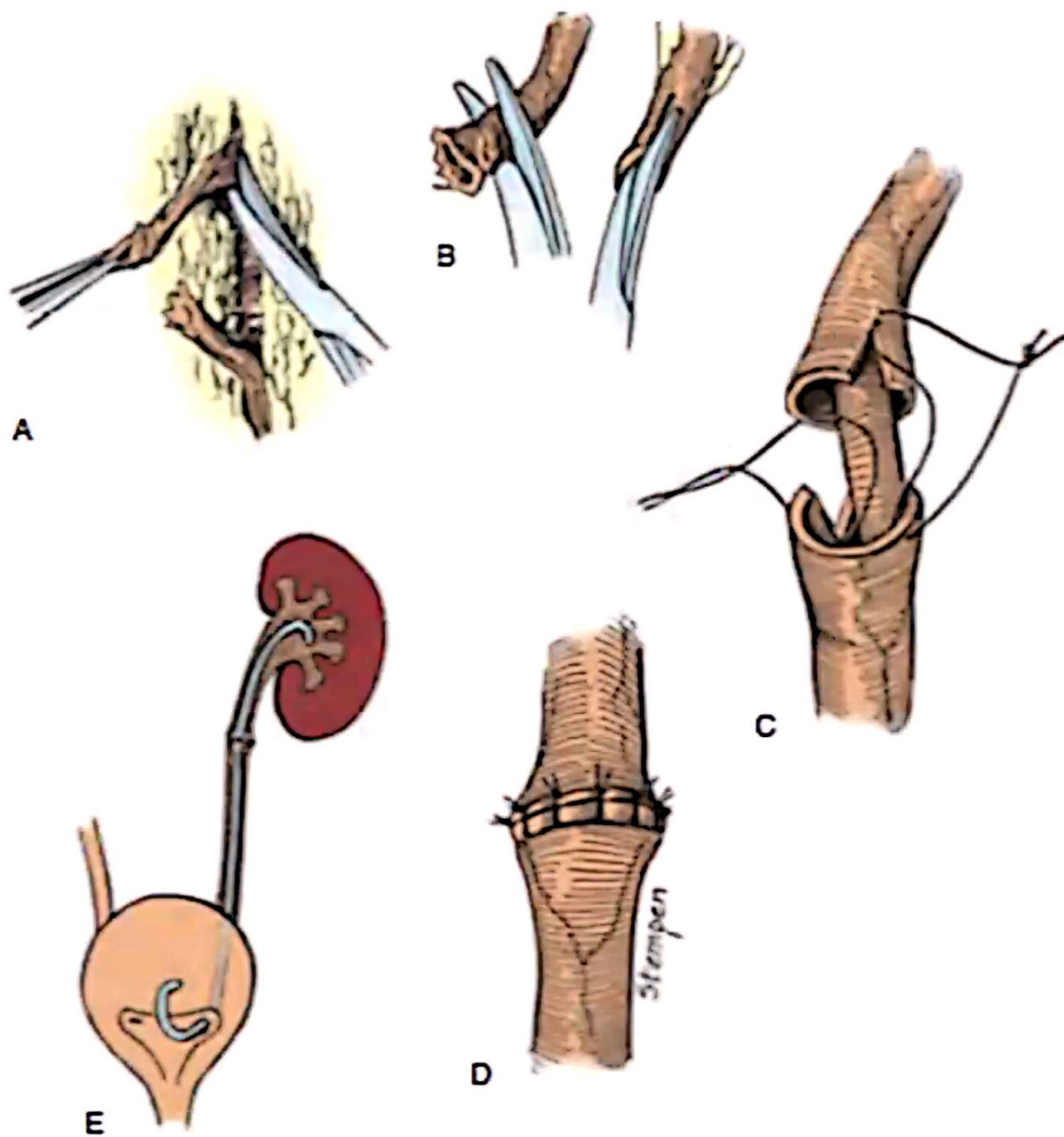
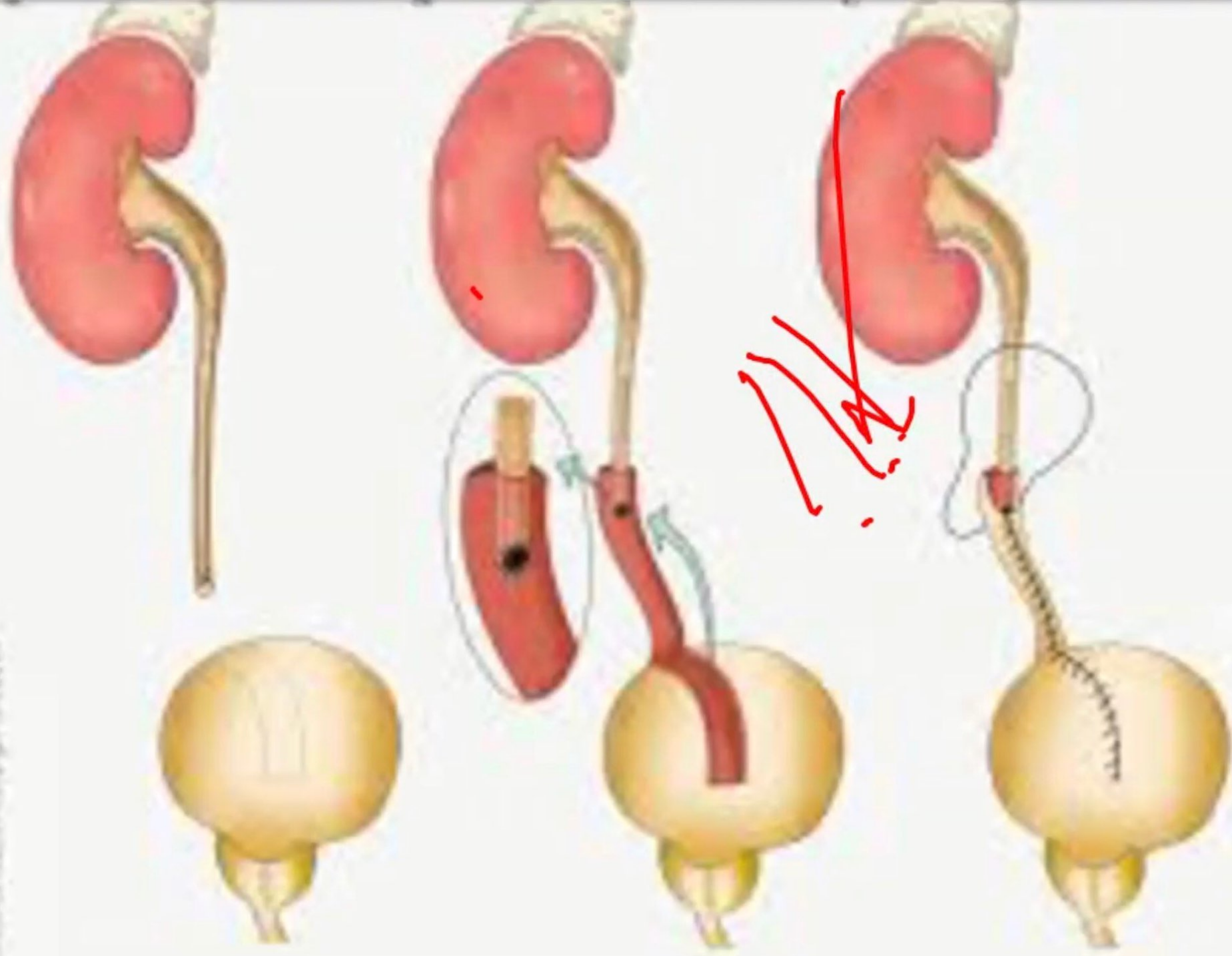


Figure 50-18. Technique of ureteroureterostomy after traumatic disruption. A, Injury site definition by ureteral mobilization. B, Debridement of margins and spatulation. C, Stent placement. D, Approximation with 5-0 absorbable suture. E, Final result.



Figure 50-21. Psoas hitch. Bladder is opened and secured to the psoas muscle to facilitate ureteral anastomosis. (From Hohenfellner M, Santucci RA. *Emergencies in urology*. Heidelberg (Germany): Springer; 2007. © Copyright, 2007 Dr. Markus Hohenfellner, with permission.)



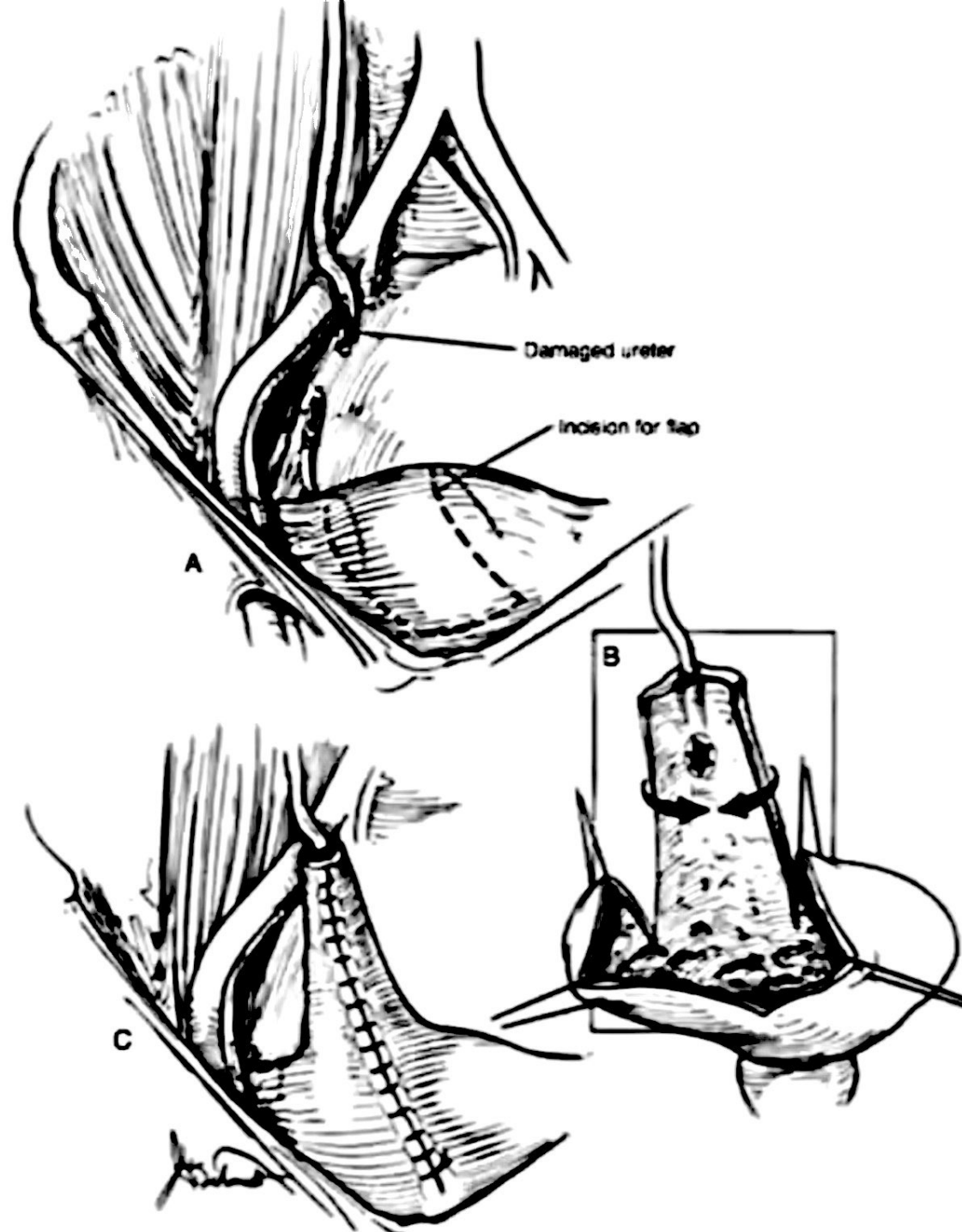


Figure 50-22. Boeri flap. Bladder flap is marked (A), mobilized free (B), tubularized (C). (From Hohenfellner M, Santucci RA. Emergencies in urology. Heidelberg (Germany): Springer; 2007. © Copyright, 2007 Dr. Markus Hohenfellner, with permission.)