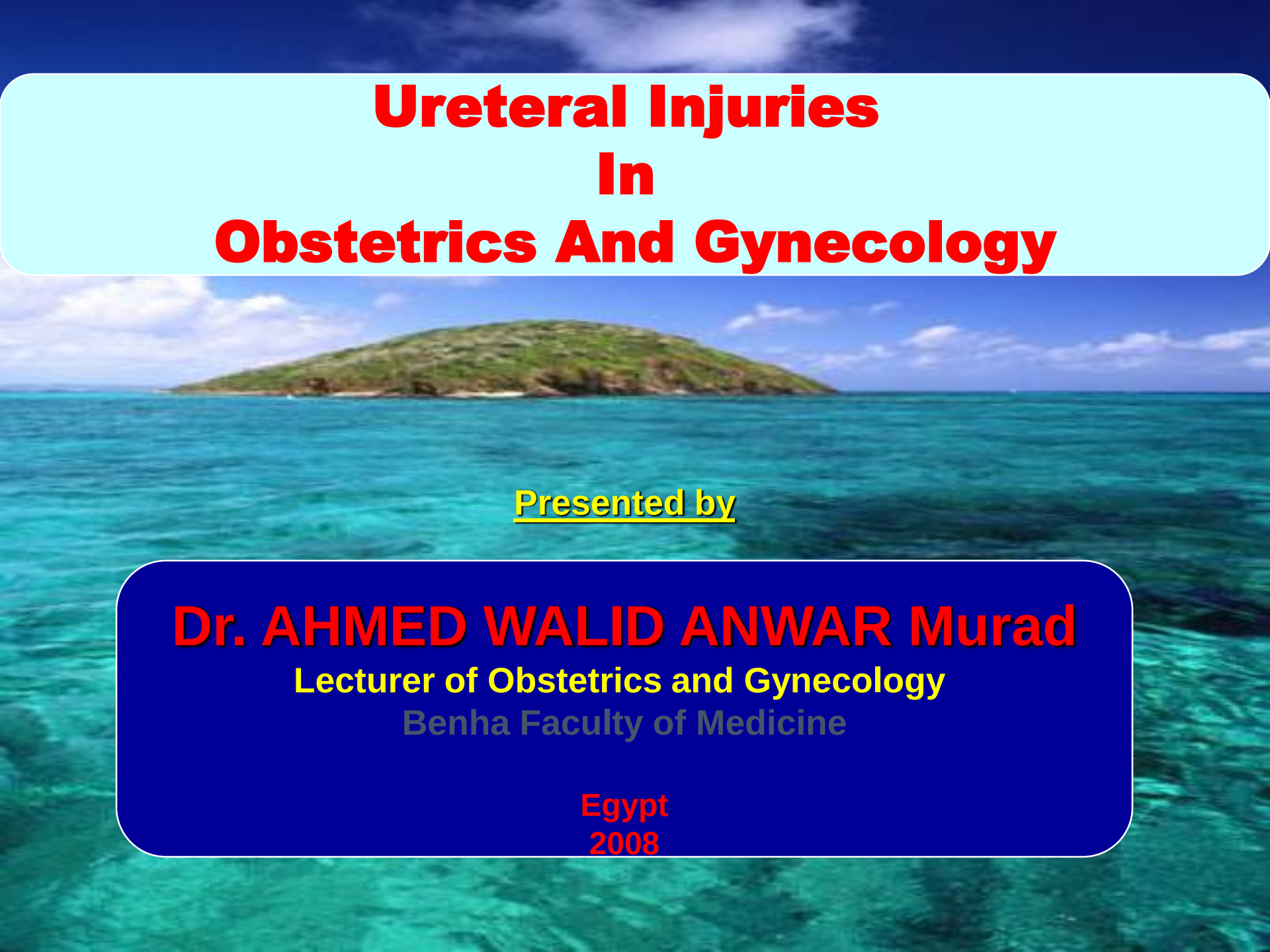
Ureteral Injuries
In
Obstetrics And Gynecology



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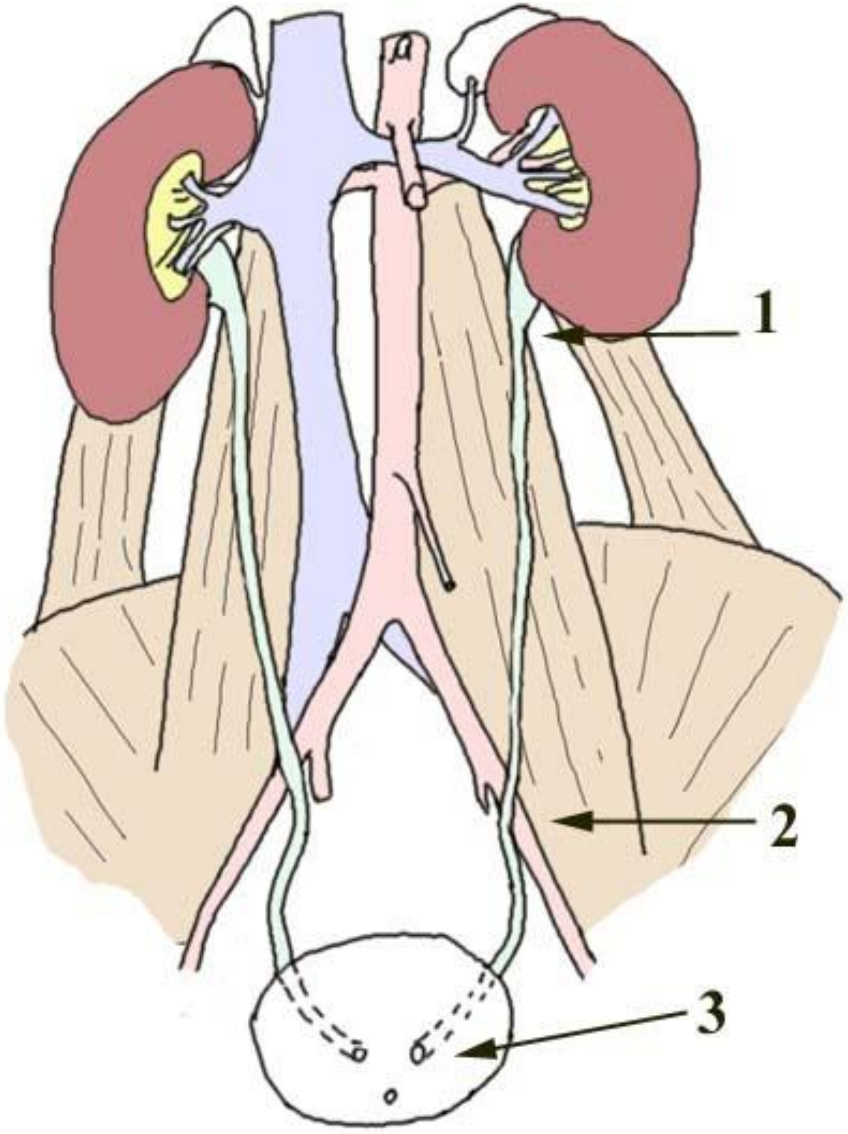
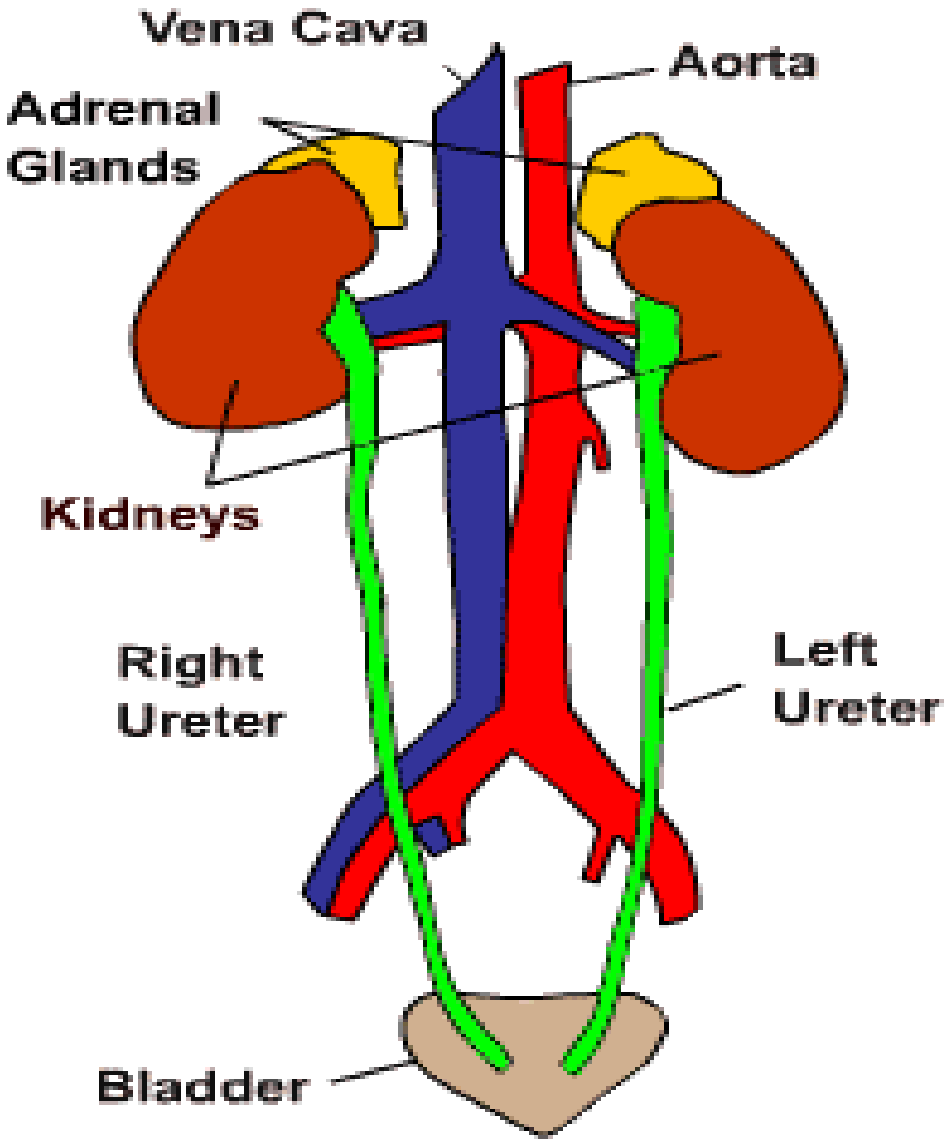
Ureteral Anatomy





Ureters

- **2 in number,**
- **Each arise at renal pelvis and passes downward and medially.**

- Lies Anterior to psoas muscle.
- Crosses over the iliacus
  - **Rt.→ over external IA.**
  - **Lt. →Over common IA.**
- Crossed anteriorly by the gonadal vessels

Course and relation of pelvic ureter

- Length: 15 cm.
- At pelvic brim:
  - It enters the pelvis retroperitoneally by crossing the bifurcation of common IAA near sacro-iliac joint.
  - It is related anteriorly to ovarian vessels as they cross the infundibulopelvic ligament.
  - Ureter is adherent to medial flap of infundibulopelvic ligament.

Course and relation of pelvic ureter

- The ureter descends downward and medially along and anterior lower part of IAA.
- The ureter forms the posterior boundary of ovarian fossa.
- The ureter cross over:
  - **EIA &EIV.**
  - **Obturator Artery, Vein, &Nerve.**
  - **Obliterated hypogastric artery.**

Course and relation of pelvic ureter

- At the level of ischial spine:
  - **It curves forwards & medially below base of broad ligament.**
- Then passes through upper part of cardinal ligament:
  - **Below and at right angle to uterine artery.**
  - **1.5cm above &lateral to lateral vaginal fornix.**
- It enters the postero-superior angle of the bladder and run in the bladder wall for 2 cm before opening in the trigon.

Blood supply of the ureter

- Ureter has **poor** blood supply **why**?
- As it has Segmental blood supply from the following vessels:

A A
V V
R R
I I
C C
O O

Nerve supply of the ureter

- **Extrinsic {Autonomic} nerve supply:**
  T10→S4 via (Renal ,Aortic ,pelvic Plexuses}
  - **-Sympathetic → Contraction.**
  - **-Parasympathetic → Relaxation.**

- **Intrinsic nerve supply:** → Peristalsis.

*Incidence of Ureteric Injuries:

- -The incidence of ureteric injury varies between 0.1% and 30%, depending on the type of surgery.
- 1-Obstetric and gynecological surgeries account for approximately 50% of ureteric injuries.
- 2-Ureteric injuries are less common during vaginal{0.1%} than abdominal hysterectomies1%.

*Incidence of Ureteric Injuries:

- 3-Alought prevalence of ureteric injury being higher following gynaecological cancer surgery, it is the benign gynaecological surgery that accounts for most cases.
- **4**-The incidence of all major complications associated with laparoscopy have declined but ureteric injuries have stayed constant at approximately 1 %.
- **38% occur during the treatment of endometriosis**.

*Risk factors for ureteric injuries:

- I} Anatomical risk factors?
- II} Pathological risk factors?
- III} Technical risk factors?

I} Anatomical risk factors:

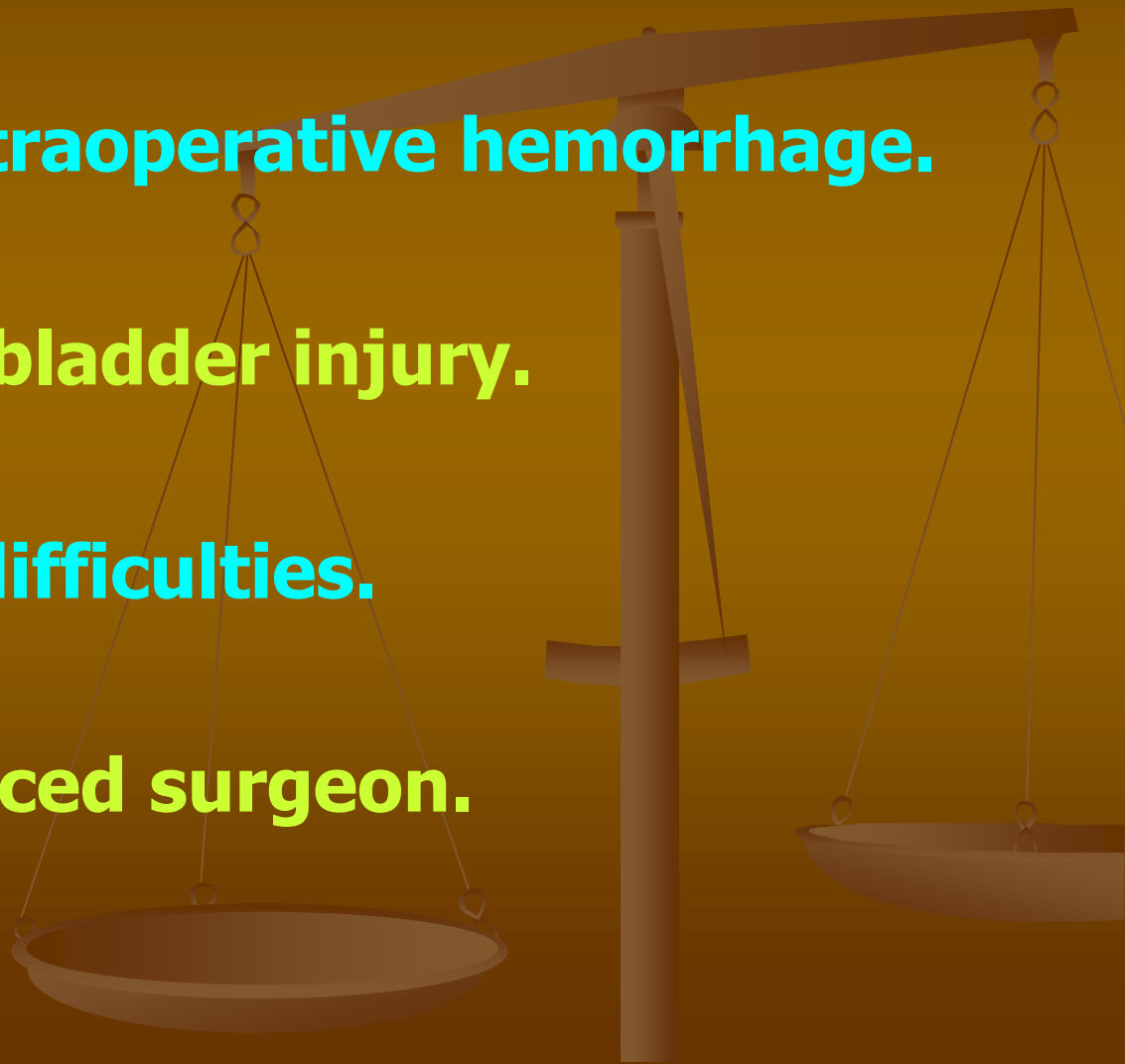
- **The ureter:**

- 1. **Has close attachment to the peritoneum.**
- 2.
- 2. **Closely related to FGT.**
- 3.
- 3. **Has variable course.**
- 4.
- 4. **Not easily seen or palpated.**

II} Pathological risk factors:

- 1-Congenital anomalies of ureter or kidney.
- 2-Ureteric displacement by:
  - -Uterine size ≥12 weeks
  - -Prolapse.
  - -Tumor{ ovarian neoplasms}.
  - -Cervical or broad ligament swellings.
- 3-Adhesions:
  - -Previous pelvic surgery.
  - -Endometriosis.
  - -PID
- 4-Distorted pelvic anatomy.

III} Technical risk factors:



- 1- Massive intraoperative hemorrhage.
- 2-Coexistent bladder injury.
- 3- Technical difficulties.
- 4- Inexperienced surgeon.

*Types {Causes} of injury:

Intraoperative	Postoperative
▪ 1}Crushing from misapplication of a clamp. ▪ 2}Ligation with a suture. ▪ 3}Transsection (partial or complete). ▪ 4}Angulation of the ureter with secondary obstruction. ▪ 5}Ischemia from ureteral stripping, LASER, or electrocoagulation. ▪ 6}Resection of a segment of ureter. N.B: Any combination of these injuries may occur.	1-Avascular necrosis. 2- kinking . 3-Subsequent obstruction over: -Haematoma ,or -Lymphocele

*Procedures associated with increased risk of ureteric injury:

- I) Obstetrical Procedures
- II) Gynaecological Procedures
- III) Urogynaecology Procedures
- IV) Laparoscopic Procedures

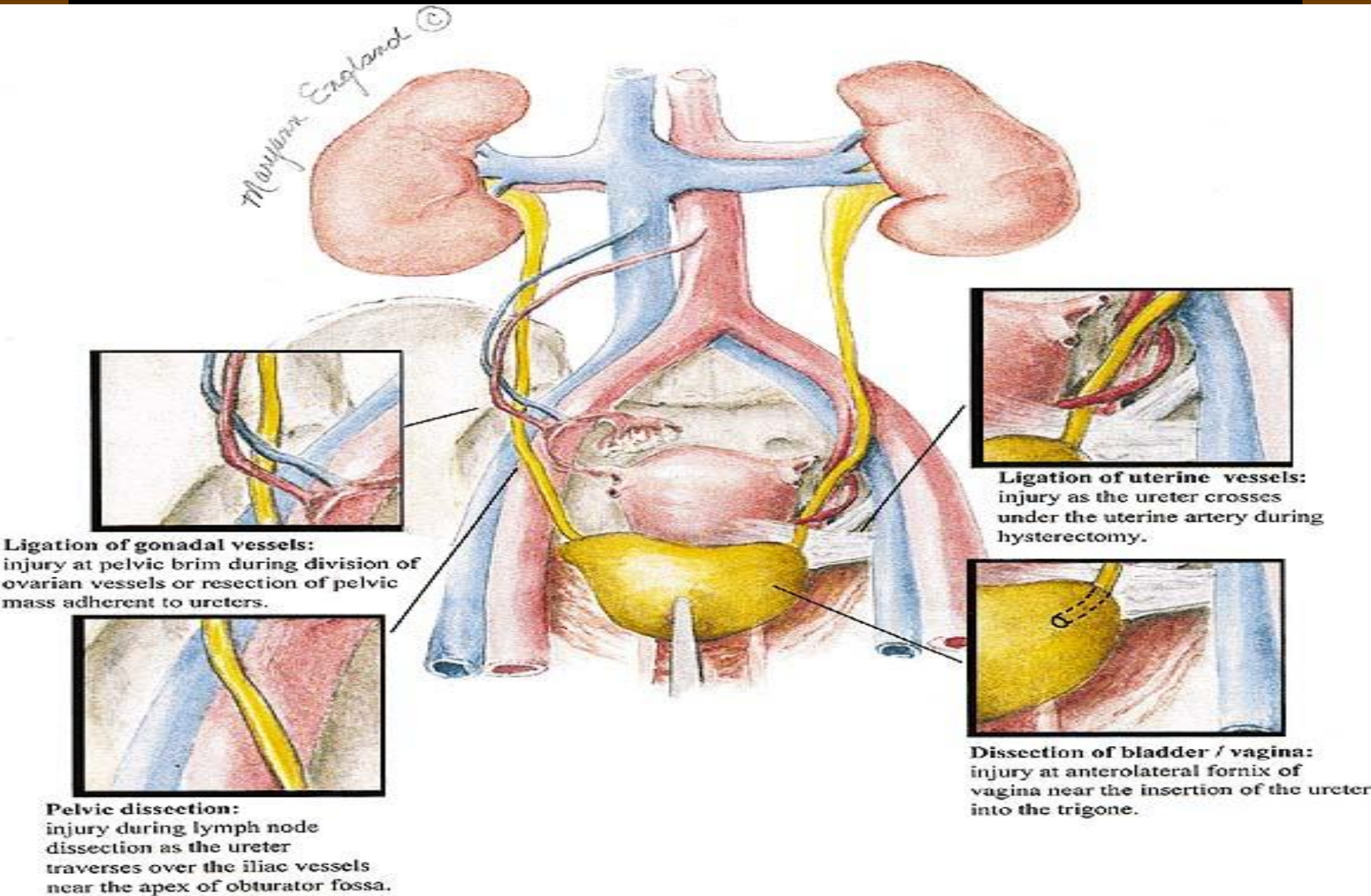
Sites of Ureteric Injuries:

Ureteric site	Lower third	Upper third	Middle third
Incidence of injury.	51%	30%	19%

Sites of Ureteric Injuries:

- ***The most common sites of ureteral injury are:**
  - **Lateral to the uterine vessels (Most common site).**
  - **The area of the ureterovesical junction close to the cardinal ligaments**
  - **The base of the infundibulopelvic ligament as the ureters cross the pelvic brim at the ovarian fossa**
  - **At the level of the uterosacral ligament.**
  - **Bladder junction with ureter: during vaginal cuff closure, or anterior utero-vesical pouch entry from the vagina.**

Common Sites of Ureteral Injury



Sites of Ureteric Injuries:

- ***N.B:**
  During laparoscopy the ureter is injured most frequently adjacent to the uterosacral ligaments

◙ Classification:

{No clear prognostic implications}

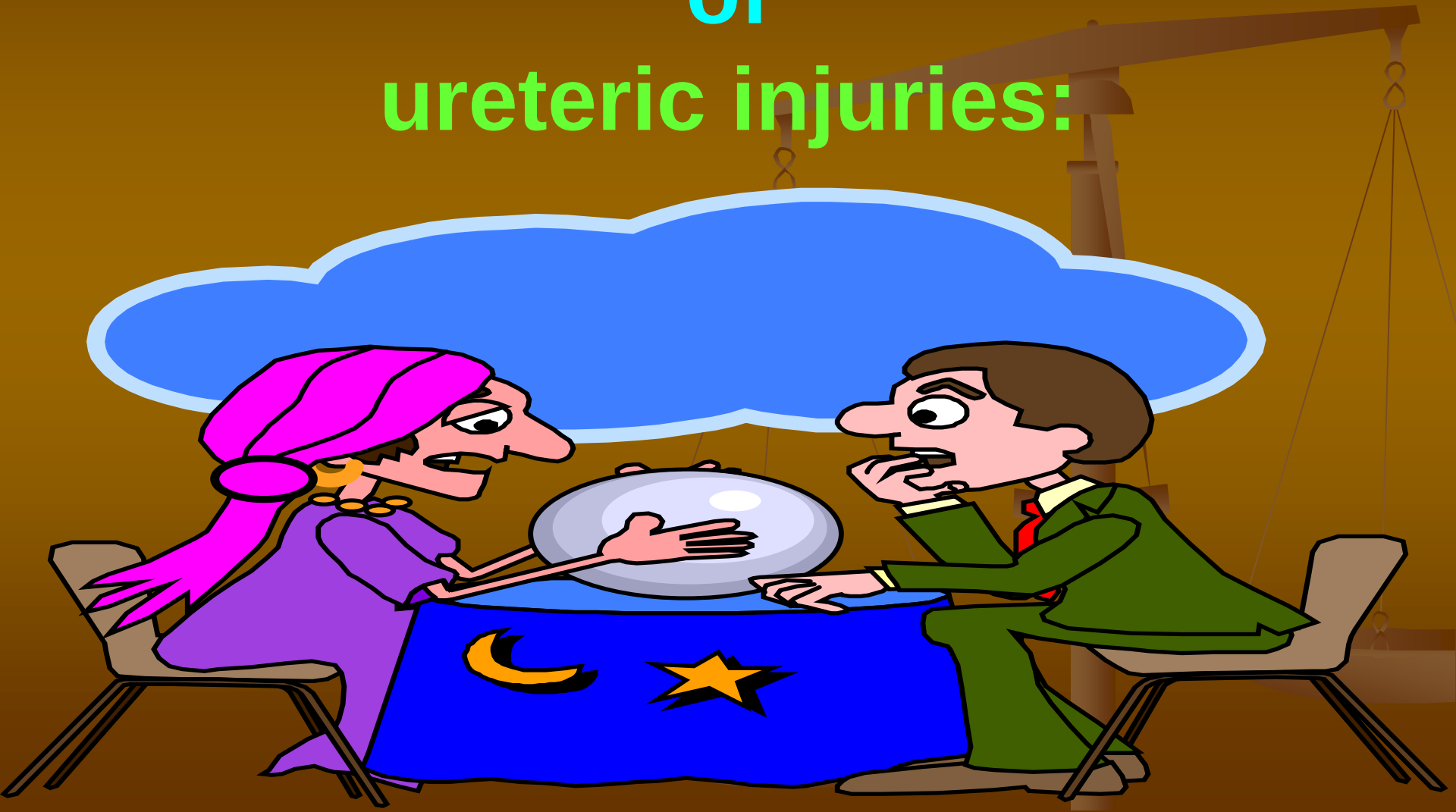
According to the Organ Injury Scaling System developed by the Committee of the American Association for the Surgery of Trauma,

- **ureteric injuries are classified as follows**:
  - - Grade **I** laceration; contusion or haematoma without devascularisation
  - - Grade **II** laceration; < 50% transection
  - - Grade **III** laceration; ≥ 50% transection
  - - Grade **IV** laceration; complete transection with < 2 cm of devascularisation
  - - Grade **V** laceration; avulsion with > 2 cm of devascularisation.

Management strategies of ureteric injuries

- 1.1}**Anticipate** the potential for specific injuries, based on the patient's known risk factors.
- 2.2}**Prevent:** the likelihood of injury.
- 3.3}**Recognize:** Take measures to identify any injuries as soon as they occur or soon thereafter.
- 4.4}**Evaluate** each injury to ascertain its full extent and plan its repair.
- 5.5}**Repair the injury.**
- 6.6}**Test** the integrity of the repair.
- 7.7}**Follow up** postoperatively to verify that the repair remains intact.

Preventive strategies to reduce the risk of ureteric injuries:



Preventive strategies to reduce the risk of ureteric injuries:

- **I} General Preventive strategies:**
- **II} Specific Preventive strategies:**

I} General Preventive strategies:

A} Preoperative measures:

1) Intravenous urogram (IVU).
2) Ultrasound scan .

1,2 can identify ureteric dilatation and disclose anatomical variations.

B} Intraoperative measures:

1. Appropriate operative approach.
2. Adequate exposure.
3. Avoid blind clamping of blood vessels.
4. Ureteric dissection and direct visualisation.
5. Mobilise bladder away from operative site.
6. Short diathermy applications.

II} Specific Preventive strategies:

A} During abdominal hysterectomy:

- Clamp {Cardinal ,Uterosacral } ligaments close to the uterus.
- Clamp , divide and ligate uterine vessels close to the uterus.
- Clamp infundibulopelvic ligament near to the ovary after dissection and palpation.
- Never to open vagina unless urinary bladder is dissected downward and laterally.
- Use of intrafacial technique.

II} Specific Preventive strategies:

B} During vaginal surgery:

1- Prevention of ureteric injuries can be achieved by adequate development of vesico-uterine space, by:

-Downward traction on the cervix.

-Counter traction upward by Sim's speculum below the bladder.

2- All clamps: - Small bites.

- Close to the uterus.

3- Avoid double clamping of uterosacral ligaments.

4- Vaginal oophorectomy should be avoided or done cautiously.

5-During anterior colporrhphy:

-Avoid too lateral dissection.

-Avoid deep sutures: as the distance between needle and ureter in upper vagina ≤0.9cm.

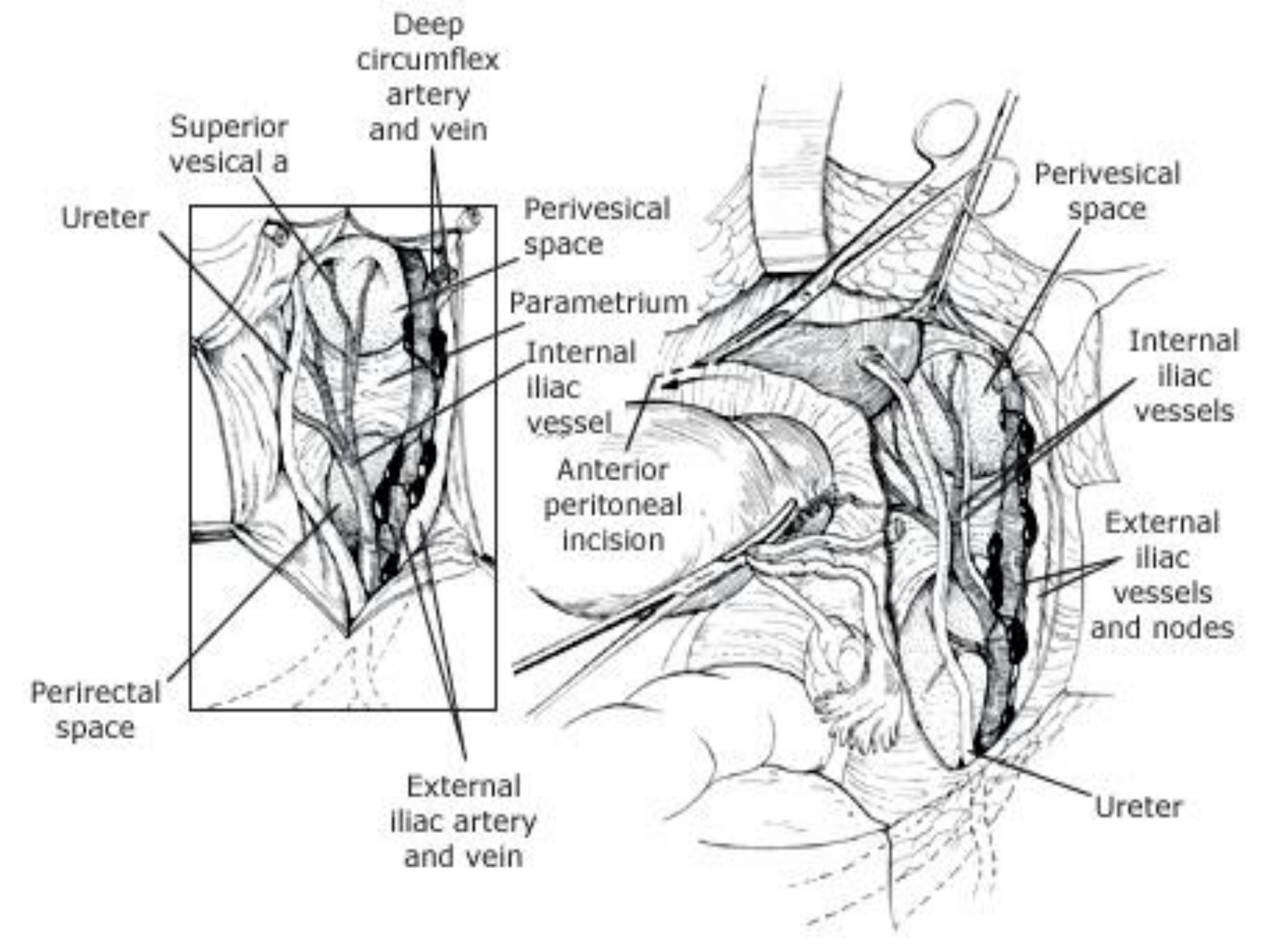
II} Specific Preventive strategies:

C} During laparoscopy: can be achieved by:

- 1.-Moving the fallopian tubes away from pelvic side walls before coagulation.
- 2.-The bleeding points at uterosacral ligaments should be secured with sutures or clips instead of electrocoagulation.
- 3.-In LAVH place stapler or suture across uterine vessels and cardinal ligaments instead of electrocoagulation.

Identification of the ureter.

- The peritoneal reflection anterior to the uterus is incised and the bladder is reflected inferiorly with sharp dissection.
- The ureter is identified on the medial aspect of the broad ligament during the development of the perivesical and perirectal spaces, as is the superior vesical artery


Deep circumflex artery and vein
Superior vesical a
Ureter
Perivesical space
Parametrium
Internal iliac vessel
Anterior peritoneal incision
Perirectal space
External iliac artery and vein
Perivesical space
Internal iliac vessels
External iliac vessels and nodes
Ureter

Management of ureteric injuries

I} Intraoperative management:

*Aim: Quick repair → ↓ morbidity + ↓ legal risks.

*Diagnosis:

♠Clinically:

1-See cut ends of the ureter.

2-Urine flow in the operative field.

♠Investigation:

1- Intravenous administration of methylthioninium chloride or indigo carmine →Ureteric injury is suspected by extravasation of the dye.

2- Intraoperative transurethral cystoscopy or telescopy (through cystotomy) using an abdominal approach may be required to visualize ejaculation of dye stained urine from both ureteric orifices.

3-Ureteric catheter inserted :

- From above: Ureterotomy.
- From below: Through bladder.

I} Intraoperative management:

Injury	Management
1}Needle injury	No action unless bleeding or leakage.
2}Crushed ureter	Ureteric catheter for 10-14 days.
3}Ligated ureter	Remove ligature + Ureteric catheter for 10-14 days.
4}Small hole	Suture or Ureteric catheter for 10-14 days.

I} Intraoperative management:

Injury	Management
5}Partial transection	Stent placement
6}Complete transection (no loss of length)	
a} ≤5 cm from vesicoureteric junction	1}Ureteroneocystostomy {ureterovesical anastomosis} without tension→ submucosal tunnel to avoid urine reflux when urinary bladder distended with urine}

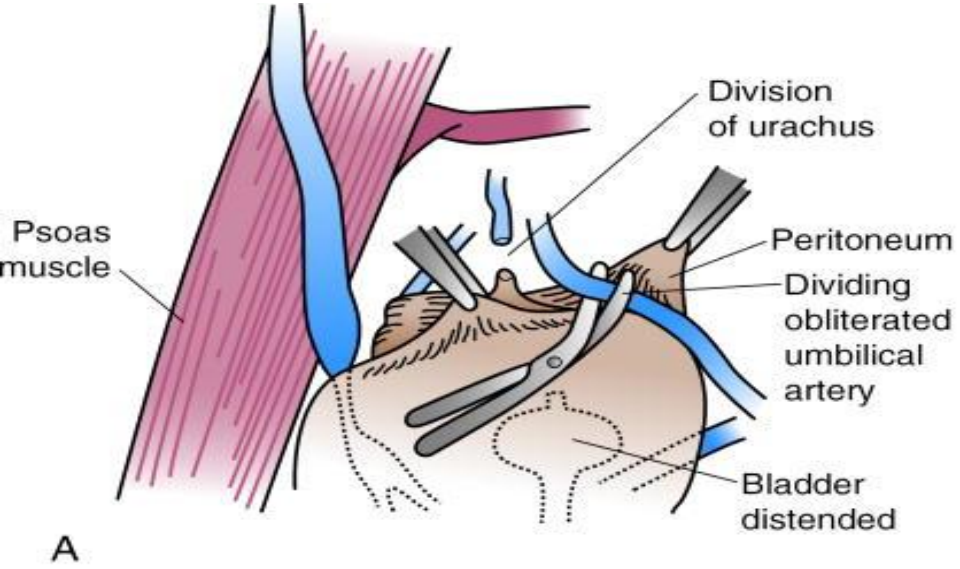
I} Intraoperative management:

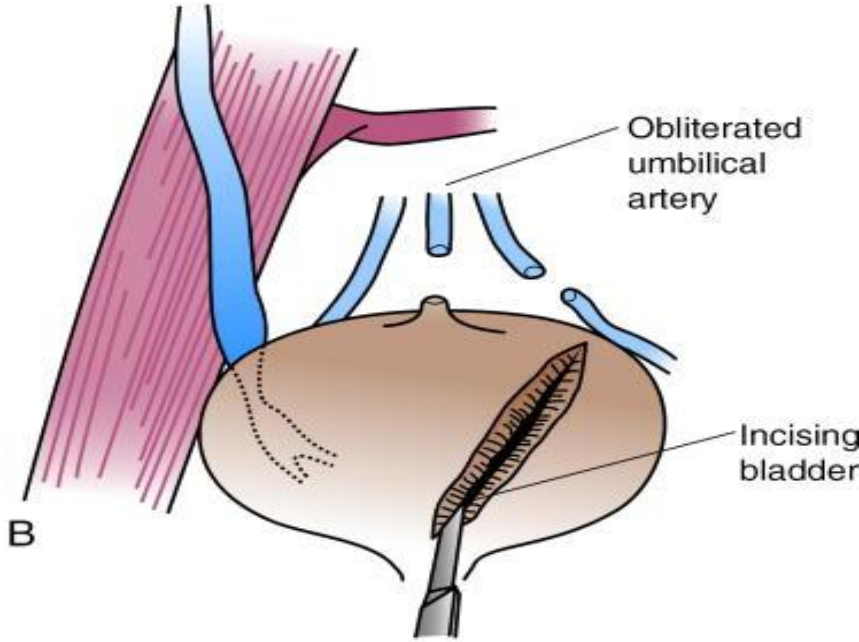
Injury	Management
6}Complete transection (no loss of length)	
b} >5 cm from vesicoureteric junction	2}Ureteroureterostomy{ uretero-ureteric anastomosis} -End to end→ Stricture. -End to side→ Best. -Invaginate upper end into lower end.

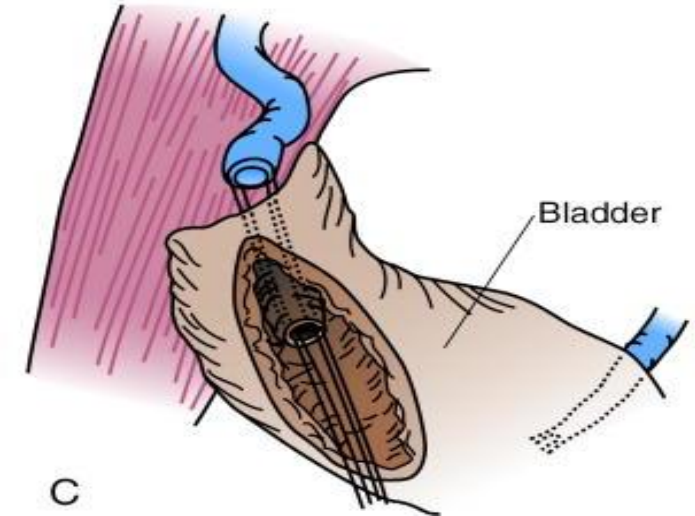
I} Intraoperative management:

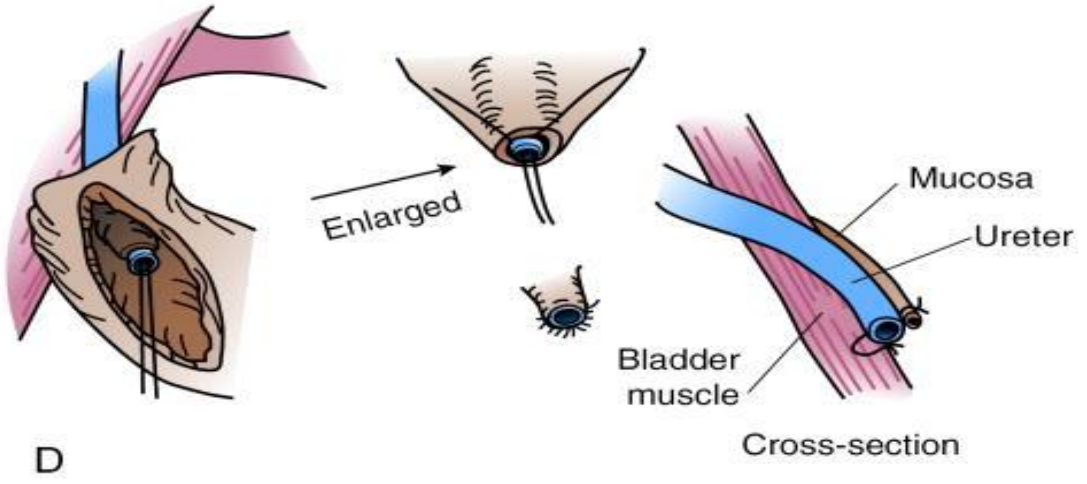
Injury	Management
7}Complete transection (loss of length)	**1}Ureteroneocystostomy:** **a) Psoas hitch: mobilize bladder towards ureter.** **b) Straight pelvic ureter: mobilize ureter towards bladder.** **c) Boari flap with a psoas hitch: bladder flap like tube.** **2}Transureteroureterostomy** **3}Ureteroileocystostomy** **4}Ureterocalycostomy** **5}Renal autotransplantation**

Psoas hitch Procedure





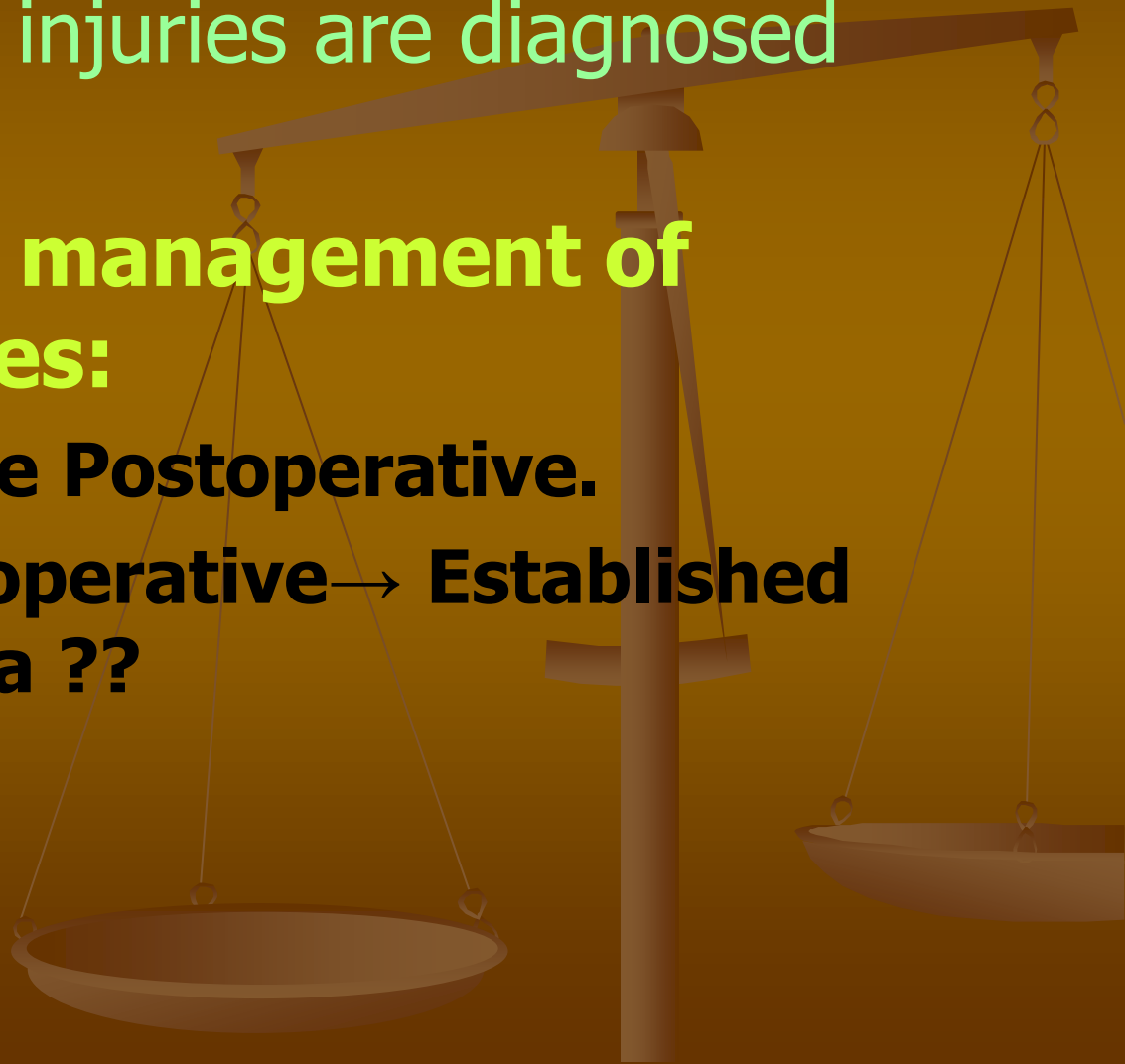




BOARI FLAP WITH PSOAS HITCH

II} Postoperative management of ureteric injuries:

- 70% of ureteric injuries are diagnosed postoperatively.
- **Postoperative management of ureteric injuries:**
  - **A} Immediate Postoperative.**
  - **B} Late Postoperative→ Established ureteric fistula ??**



A} Immediate Postoperative Diagnosis.

♠**Clinically:**

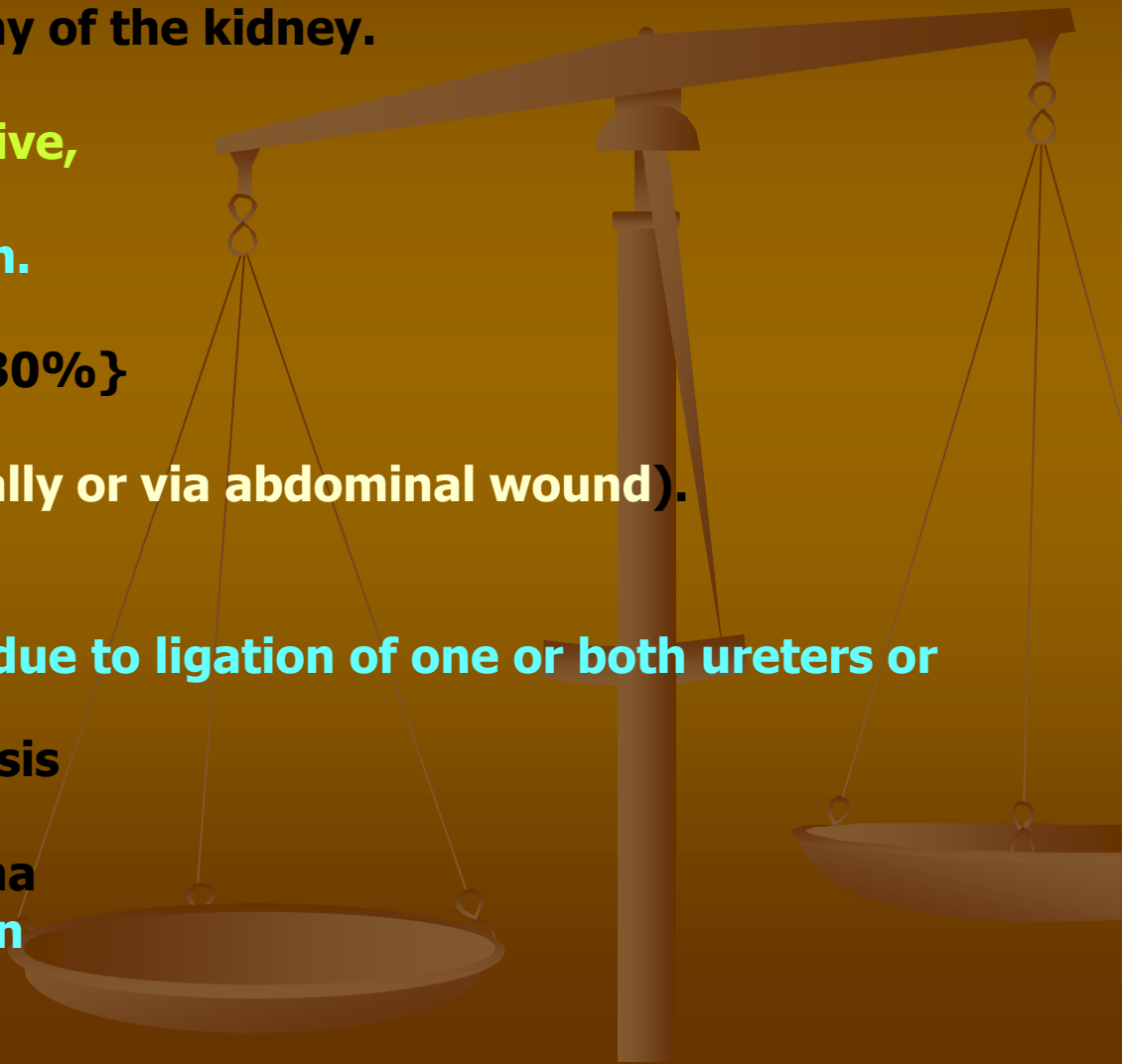
1-Asymptomatic + Atrophy of the kidney.

2-Unexplained postoperative,
- -Stormy Fever.
- -Abdominal distension.
- -Flank pain.

3-Haematuria{absent in 30%}

4- Urinary leakage (vaginally or via abdominal wound).

5-Complications:
- Postoperative anuria {due to ligation of one or both ureters or reflex spasm}
- Abscess formation/sepsis
- Peritonitis/ileus
- Retroperitoneal urinoma
- Secondary hypertension



A} Immediate Postoperative Diagnosis.

♠Investigations

I} Investigations are needed to establish renal function:

- Renal function tests.
- A full blood count and an electrolyte profile.

II} Investigations to rule out hydronephrosis and to evaluate continuity of the ureter:

1. Intravenous urogram
2. Abdominal and pelvic computerized tomography scan with intravenous contrast
3. Retrograde ureterogram
4. Renal ultrasound
5. Cystoscopy
6. Contrast-dye tests.
7. Analysis of fluid aspirated from the abdomen.


Renal outline (black arrows)
Ureter
Bladder

A} Immediate Postoperative Treatment.

- **When recognition of ureteric injury has been delayed, repair should not be delayed.**
- Exceptions include:

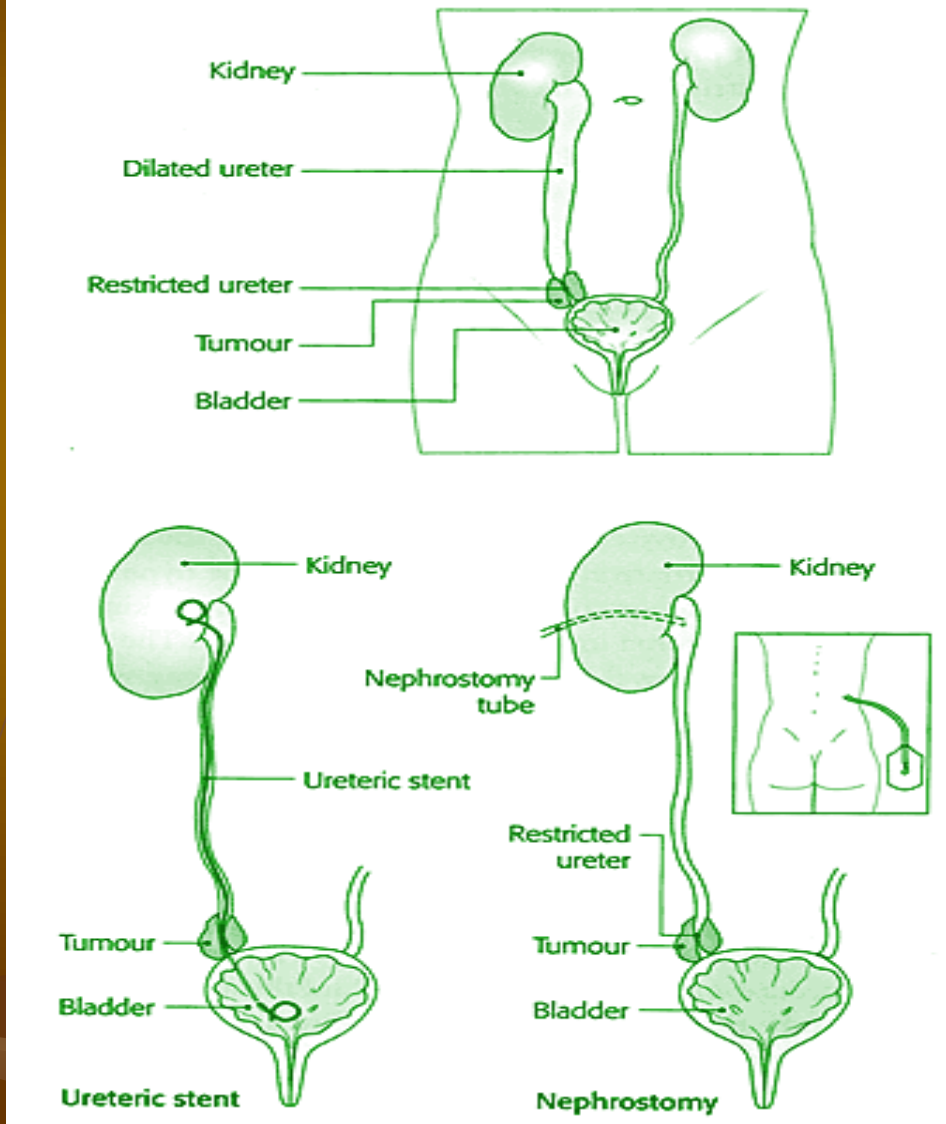
I} Complications: Sepsis, extensive haematoma or abscess formation at the site of injury.

II} woman is haemodynamically unstable.

A} Immediate Postoperative Treatment.

- In these situations it is preferable to perform:

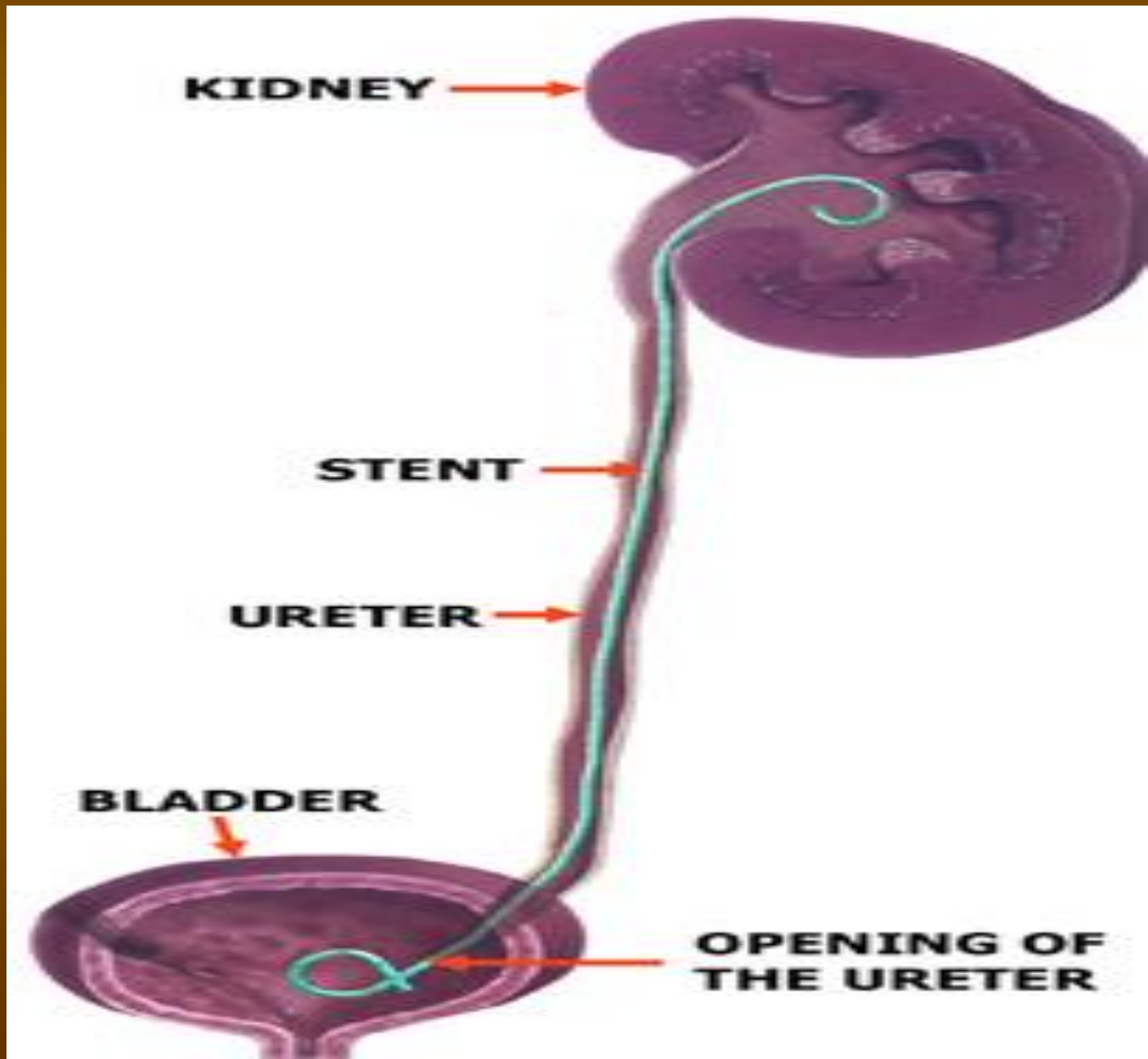
  1} Percutaneous nephrostomy drainage of the renal pelvis or



A} Immediate Postoperative Treatment.

2}A retrograde ureteric stent placement.

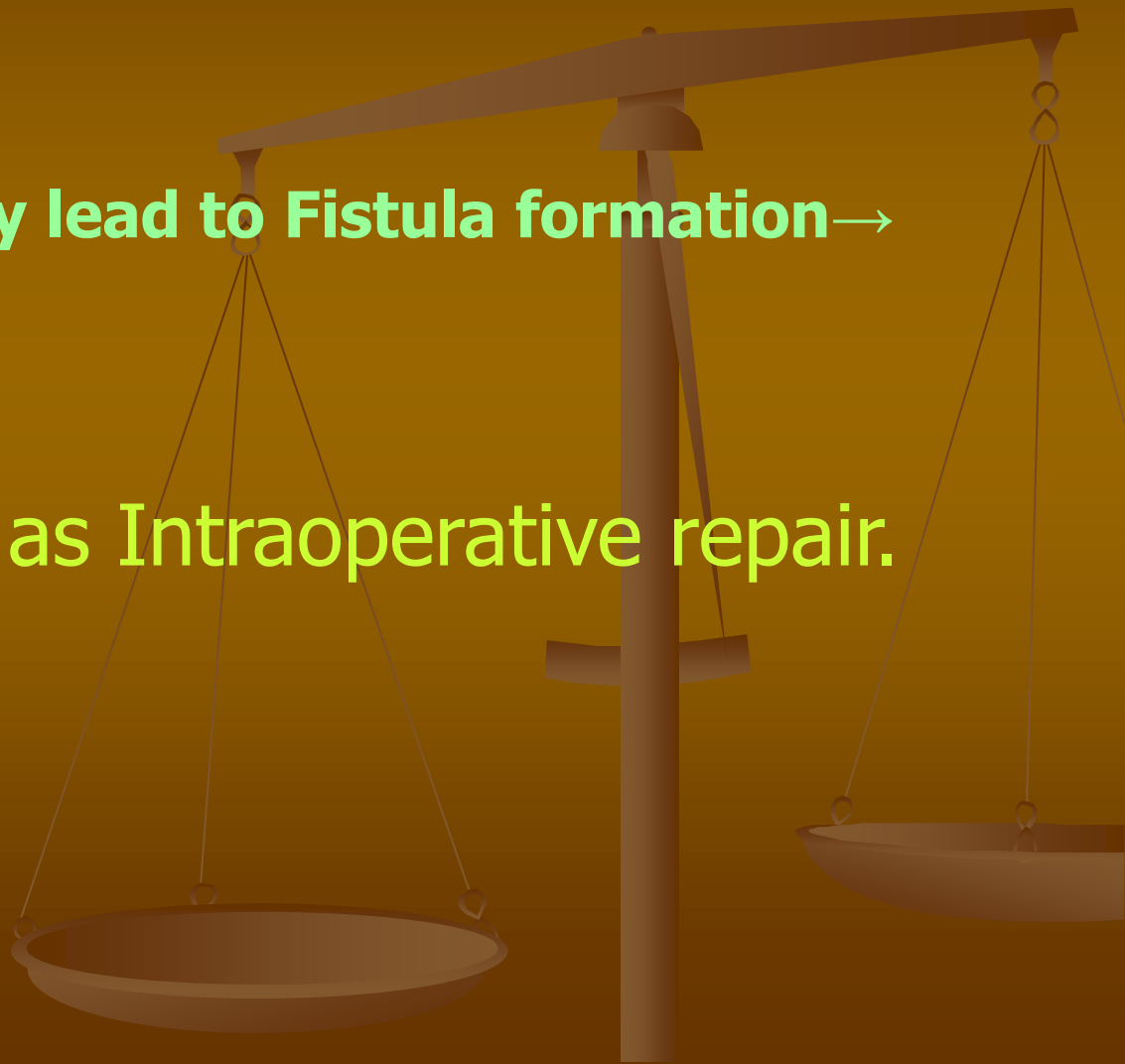
and delay surgery until the complication is resolved.



N.B:

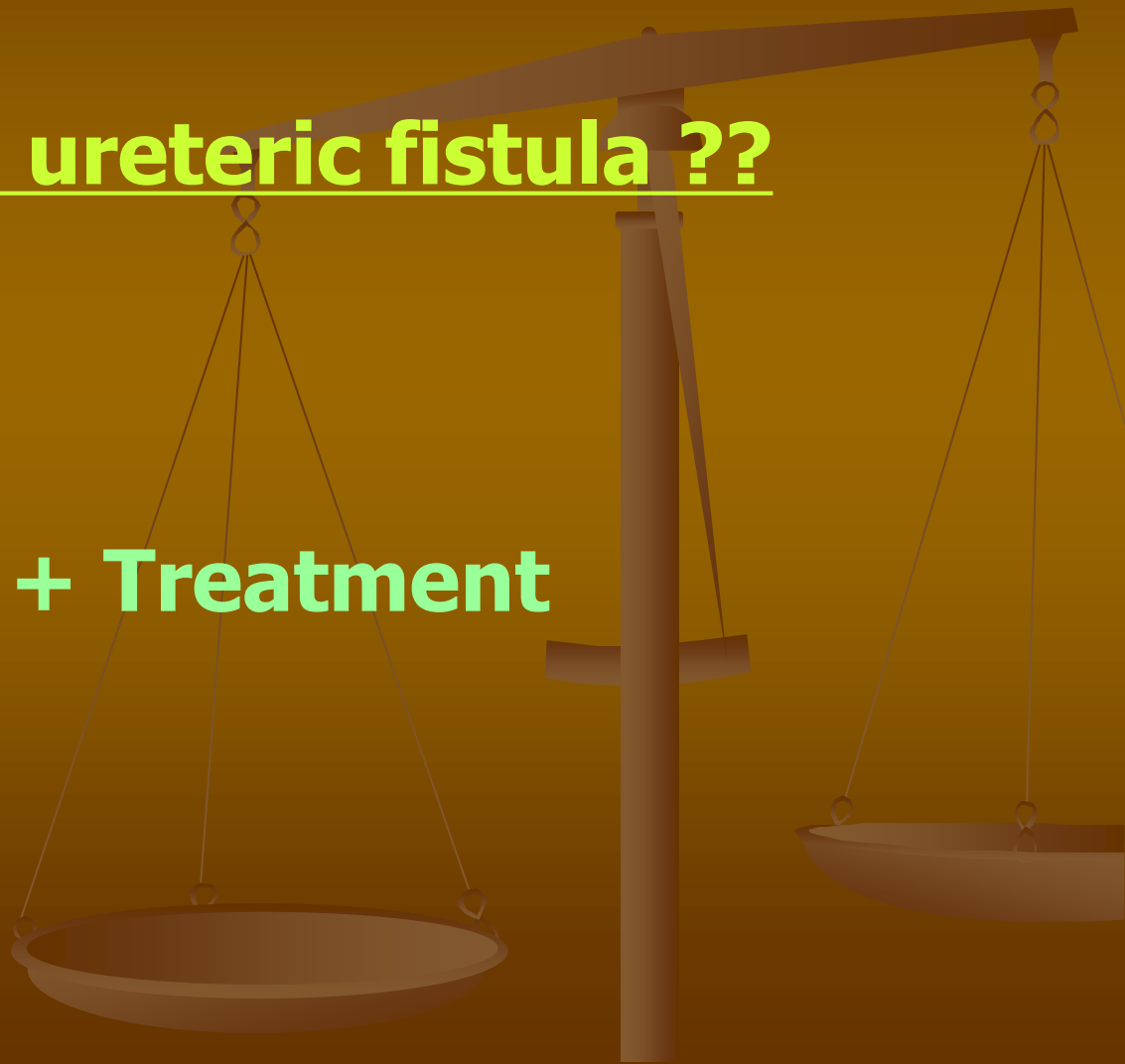
Delayed repair may lead to Fistula formation→ Repair.

Treatment: SAME as Intraoperative repair.



B} Late Postoperative

- → **Established ureteric fistula ??**
  - **Diagnosis + Treatment**

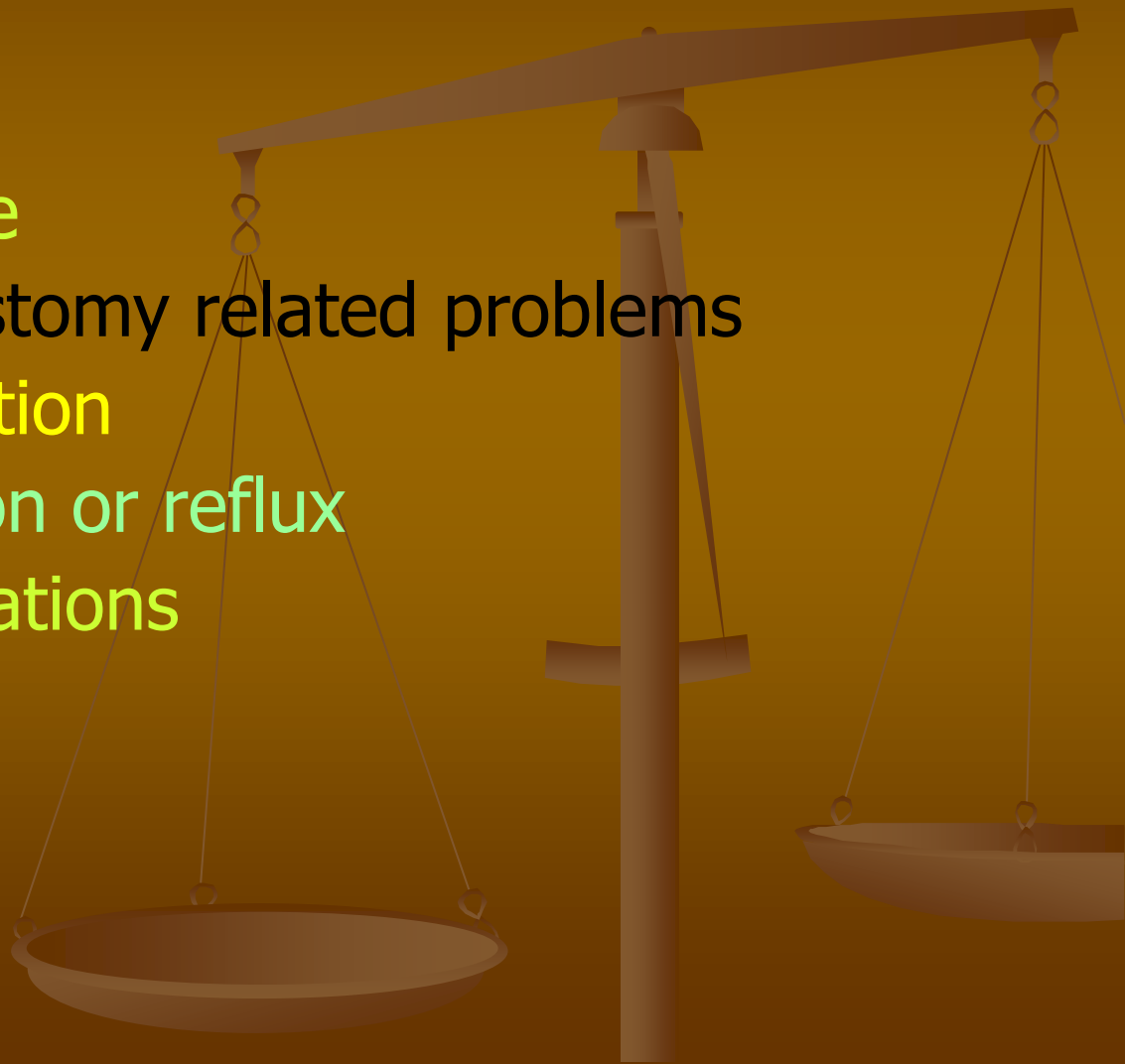


*General principles of ureteric repair

1. **Meticulous ureteric dissection preserving adventitial sheath and its blood supply.**
2. **Tension-free anastomosis by ureteric mobilization**
3. **Repair over stent with a ureteric catheter**
4. **Minimal use of fine absorbable suture to attain watertight closure**
5. **Use of peritoneum or omentum to surround the anastomosis**
6. **Drain the anastomotic site with a passive {Closed} drain to limit urinoma formation.**
7. **Consider a proximal diversion.**

*Complications following surgery for ureteric injury:

- Stricture
- Excessive drainage
- Stent and nephrostomy related problems
- Urinary tract infection
- Ureteric obstruction or reflux
- Boari flap complications
- Haematoma
- Wound infection



Summary

Clinical Management of Ureteral Injury

Intra-operative period

Findings:
- obvious injury
- leakage of indigo carmine

Minor injury

- Ureteral stent placement via cystotomy / cystoscopy
- follow-up intravenous pyelogram at 6 weeks, remove stent if normal

Major injury

Location?

Upper

- Ureteroilio-neocystotomy

Middle

- End to end anastomosis ± psoas hitch

Distal

- Ureteral reimplantation

Postoperative period

Findings:
- transient elevation of creatinine
- Symptoms of costovertebral angle tenderness, fever, ileus

Diagnostic Workup

- Intravenous pyelogram
- Cystoscopy with fluoroscopy
- Ureteral stent if minor injury
- If major injury - may require additional surgical treatment (see flowchart on left)

Thank you

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