Complications of Laparoscopic colorectal surgery

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Laparoscopic Colorectal Surgery

Advanced laparoscopic surgery, especially colorectal surgery is technically challenging

– Require ability to identify and dissect tissue planes without tactile sensation

– Require capability to control major blood vessels

– Need to operate in multiple abdominal quadrants

– Longer learning curve

Intra operative Complications

- Complications of Access
- Complications of General Anesthesia & CO2 Pneumoperitoneum
- Complications related to Procedure

Complications of Access

- Injury to
  - Small bowel (25.4%)
  - Iliac artery (18.5%)
  - Colon (12.2%)
  - Iliac vein (8.9%)
  - Mesenteric vessels (7.3%)
  - Aorta (6.4%)
  - Other organs < 5 %

Effects of General Anesthesia & CO2 Pneumoperitoneum

Tachycardia	**Sympathetic response to impaired venous return and hypercarbia**
Hypertension	Sympathetic response to impaired venous return and hypercarbia
Increased vascular resistance	Sympathetic response to impaired venous return and hypercarbia
Increased myocardial oxygen demand	Sympathetic response to impaired venous return and hypercarbia, tachycardia, increased afterload
Decreased cardiac output	Reduced venous return, increased afterload, impaired contractility from hypercarbia
Bradycardia	Vasovagal response to peritoneal stretching and irritation

Effects of General Anesthesia & CO2 Pneumoperitoneum

Cardiac arrhythmias	**Hypercarbia, hypoxia, catecholamine response**
Hypotension	Vena caval compression, decreased venous return
Pneumomediastinum	Diaphragmatic perforation
Reduced lung compliance	Reduced lung volumes, elevated diaphragm
Increased airway resistance	Increased intrathoracic pressure from transmitted increased intraabdominal pressure
Ventilation-perfusion mismatch	Reduced lung volumes from elevated intrathoracic pressures
Hypercarbia/acidosis	Carbon dioxide retention
[illegible]ctasis	Collapse of lung bases secondary to high diaphragmatic pressures

Complications of CO2 Pneumoperitoneum & General Anesthesia

Cardiopulmonary	
Tension pneumothorax	Barotrauma, diaphragmatic perforation, or hiatal dissection
Myocardial infarction	Reduced myocardial blood flow in the presence of increased oxygen demand
Metabolic acidosis	Inadequate metabolic perfusion due to reduced cardiac output, increased peripheral resistance, and hypercarbia
Hypoxia	Atelectasis and reduced lung volumes
Hypercarbia	Increased carbon dioxide retention
Respiratory acidosis	Increased carbon dioxide retention
Aspiration	Increased risk of regurgitation of gastric contents
Air embolus	Entry of carbon dioxide through injured blood vessels
Subcutaneous emphysema	Insufflation of carbon dioxide into the subcutaneous tissues
Shoulder pain	Irritation of diaphragm

Complications of CO2 Pneumoperitoneum & General Anesthesia

Neurological	
Increased intracranial pressure	Increased intracranial blood flow from hypercarbia
Potential cerebral edema	Increased intracranial blood flow from hypercarbia
Brain stem herniations	Increased intracranial pressure
Renal	
Oliguria	Decreased renal blood flow from elevated intraabdominal pressure and low cardiac output
Renal failure	Decreased renal blood flow from elevated intraabdominal pressure and low cardiac output

Factors that may increase the general risk of anesthesia in intraabdominal surgery

- Active coronary artery disease
- Congestive heart failure
- Dysrhythmias
- Chronic obstructive pulmonary disease
- Cirrhosis
- Asthma
- Diabetes
- Hemodynamically significant aortic stenosis
- Age >70 yrs
- Emergency operation
- Renal failure

Complications related to Procedure

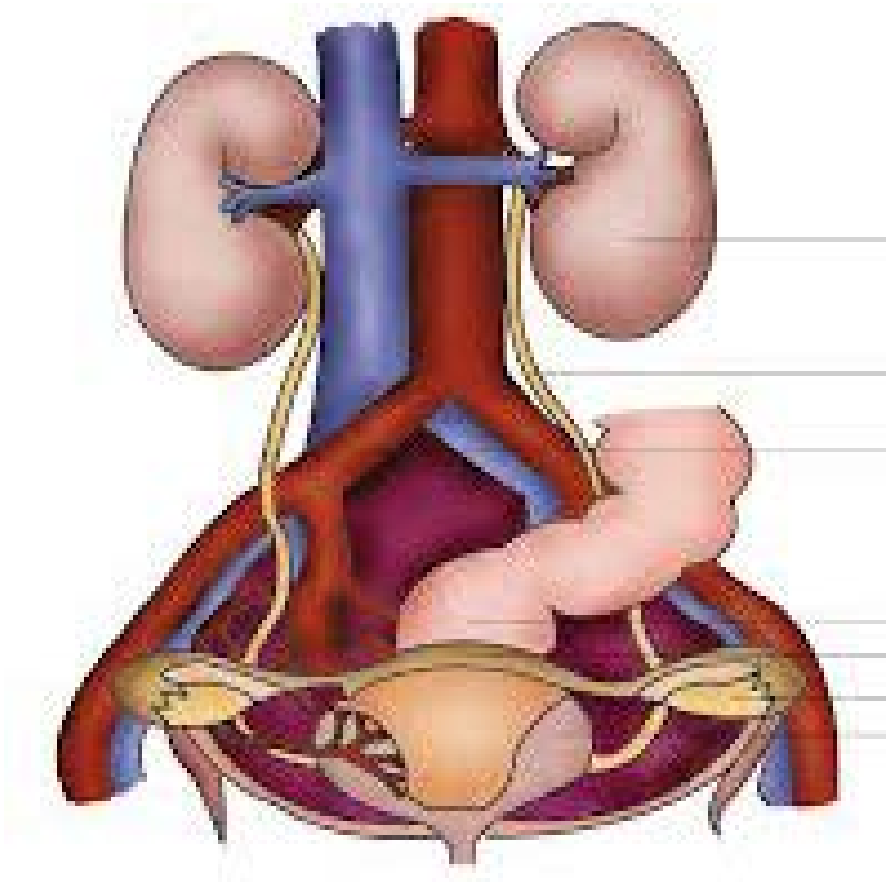
- Injury to
  - Ureters
  - Duodenal and small bowel
  - Autonomic Nerves

How to prevent?

- For any kind of injury
  - "Prevention is always better than cure"
  - Know the normal Anatomy
  - Know the variants of anatomy
  - Identify landmarks
  - Without confirmation never go ahead
  - When in doubt convert to open

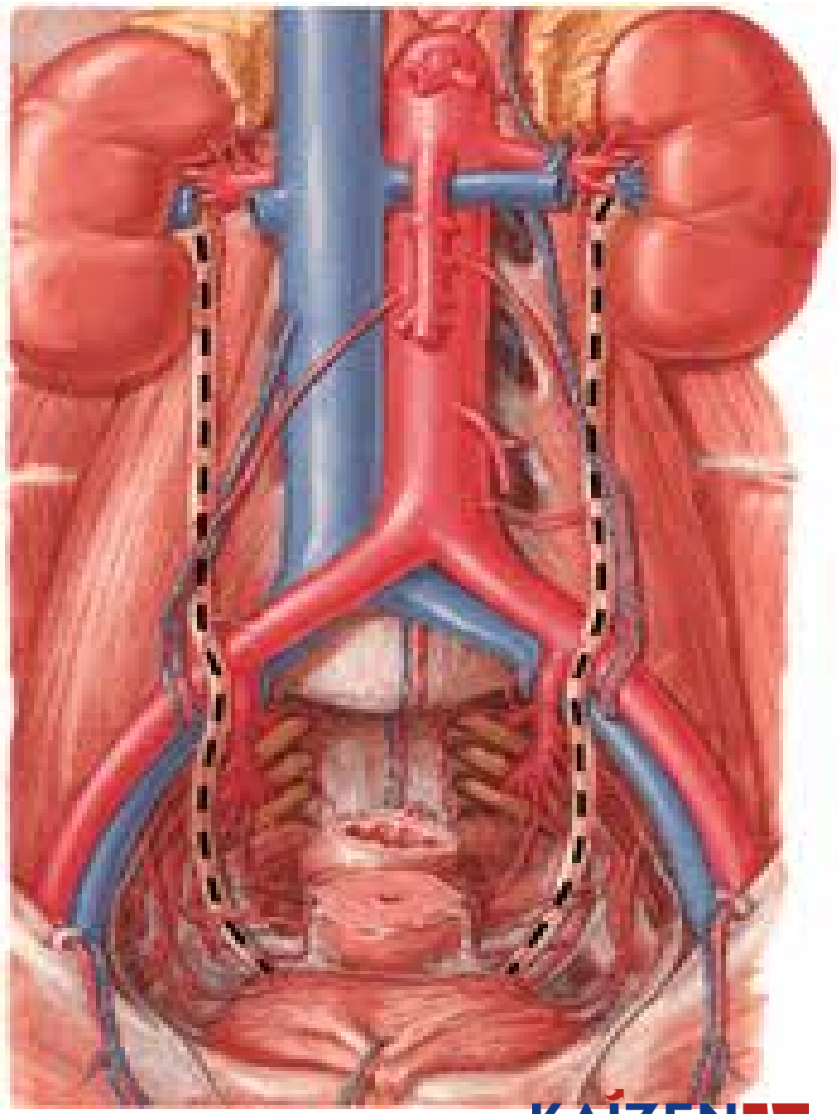
Ureters

- Anatomy-
- 25 to 30 cm in length, tubular structure
- Conveys urine from the kidneys to the urinary bladder



Abdominal part

- Lies behind the peritoneum
- On the medial part of the psoas major
- Crossed obliquely by the internal spermatic vessels.
- Enters the pelvis by crossing the bifurcation of the common, or the commencement of the external iliac vessels.



Right ureter

- Covered at its origin the by the descending part of the duodenum
- Lies to the right of the inferior vena cava, and is crossed by the right colic and ileocolic vessels
- Near the superior rim of the pelvis it passes behind the lower part of the mesentery and the terminal part of the ileum.

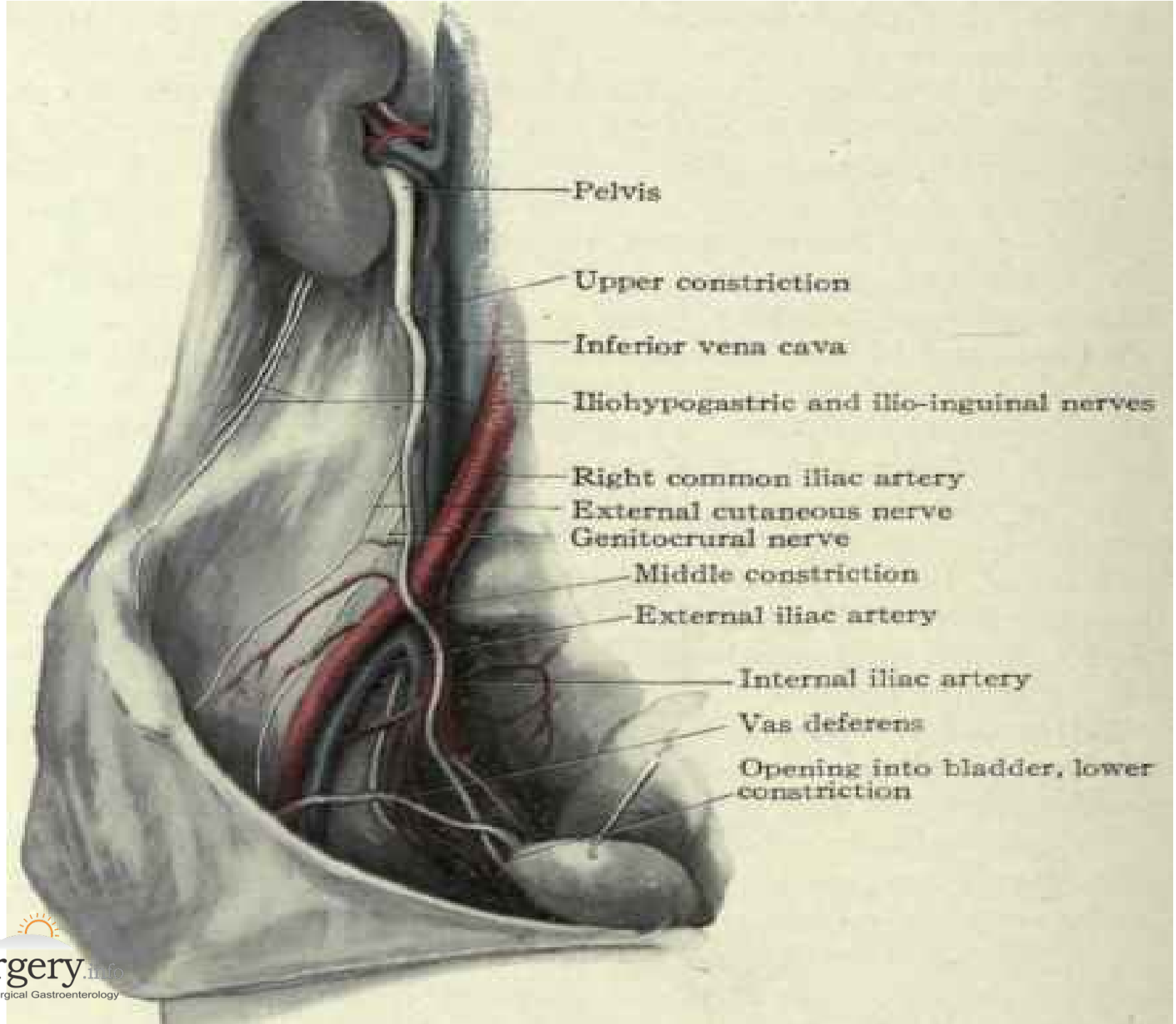
Left ureter

- Crossed by the left colic vessels

- Near the superior brim of the pelvis passes behind the sigmoid colon and its mesentery

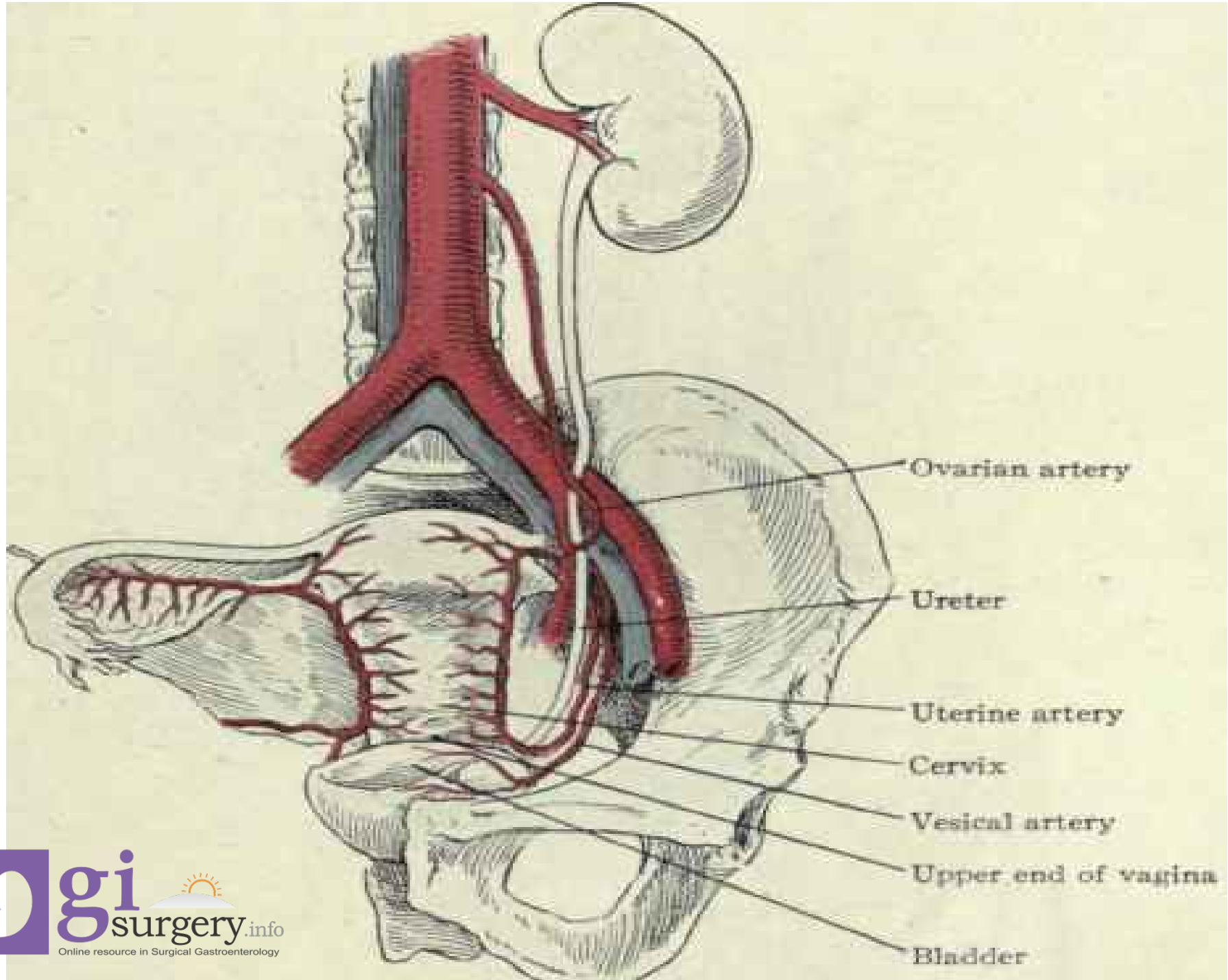
Pelvic part

- Runs at first downward on the lateral wall of the pelvic cavity
- In front of the hypogastric artery medial to the obturator nerve and the obturator and middle hemorrhoidal arteries.
- At lateral angle of the bladder situated in front of the upper end of the seminal vesicle
  - 5 cm from the opposite ureter,
  - At this site the ductus deferens crosses to its medial side, and the vesical veins surround it.



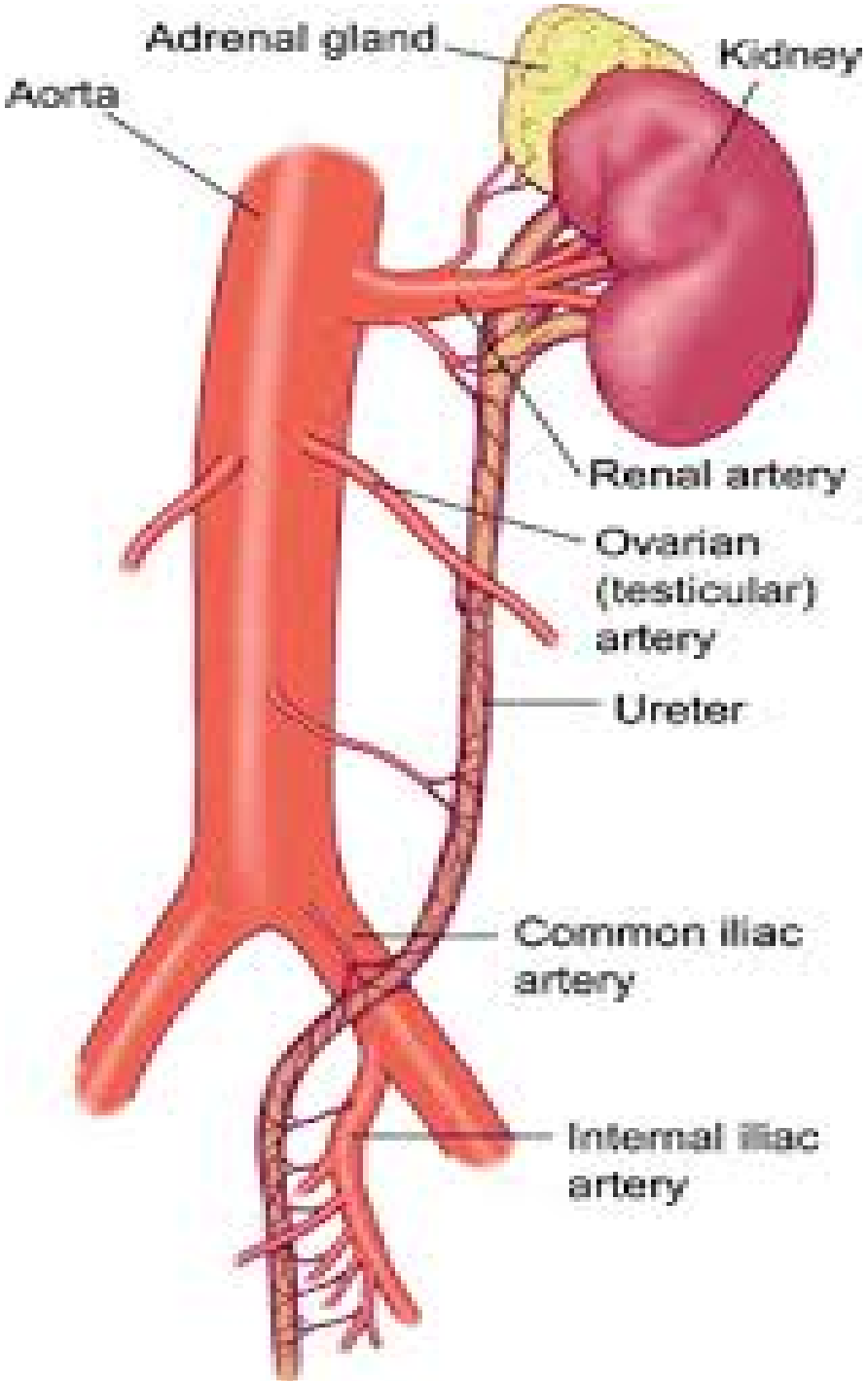
In the female

- Forms the posterior boundary of the ovarian fossa
- Runs medially and forward on the lateral aspect of the cervix uteri and upper part of the vagina
- Accompanied for 2.5 cm by the uterine artery- crosses in front of the ureter
- 2 cm from the side of the cervix



The arteries supplying the ureter are branches from

- The renal
- Aorta
- Gonadal
- Hypogastric
- Inferior vesical



Intra operative confirmation

- Pinching with forceps- Peristalsis
- Needle aspiration of urine
- Landmarks- Psoas major, Crossing at bifurcation of iliac vessels
- Prevention- Preoperative ureteric stenting in expected difficult cases-
  - Re-explorations
  - Locally advanced malignancy

- Mechanism of iatrogenic ureteric injury
  - Crushing from misapplication of a clamp.
  - Ligation with a suture.
  - Transection (partial or complete)
  - Angulation of the ureter with secondary obstruction
  - Ischemia from ureteral stripping or electrocoagulation
  - Resection of a segment of ureter

Repair of injured ureter

- Sepsis or hemodynamic instability-
  - urinary diversion
  - percutaneous nephrostomy

- Depends on –
  - level of the injury
  - length of the injured segment

- Principals of repair
  - tension-free anastomosis
  - water-tight mucosal approximation
  - Stenting
  - coverage of the repair with vascularized tissue
  - appropriate drainage

Upper ureter (upper ureter or the UPJ):

- primary anastomosis of the renal pelvis and the ureter.

Middle ureter. (abdominal ureter):

- Ureteroureterostomy.
- Large defects in the abdominal ureter may necessitate transureteroureterostomy.

Distal ureter (pelvic ureter):

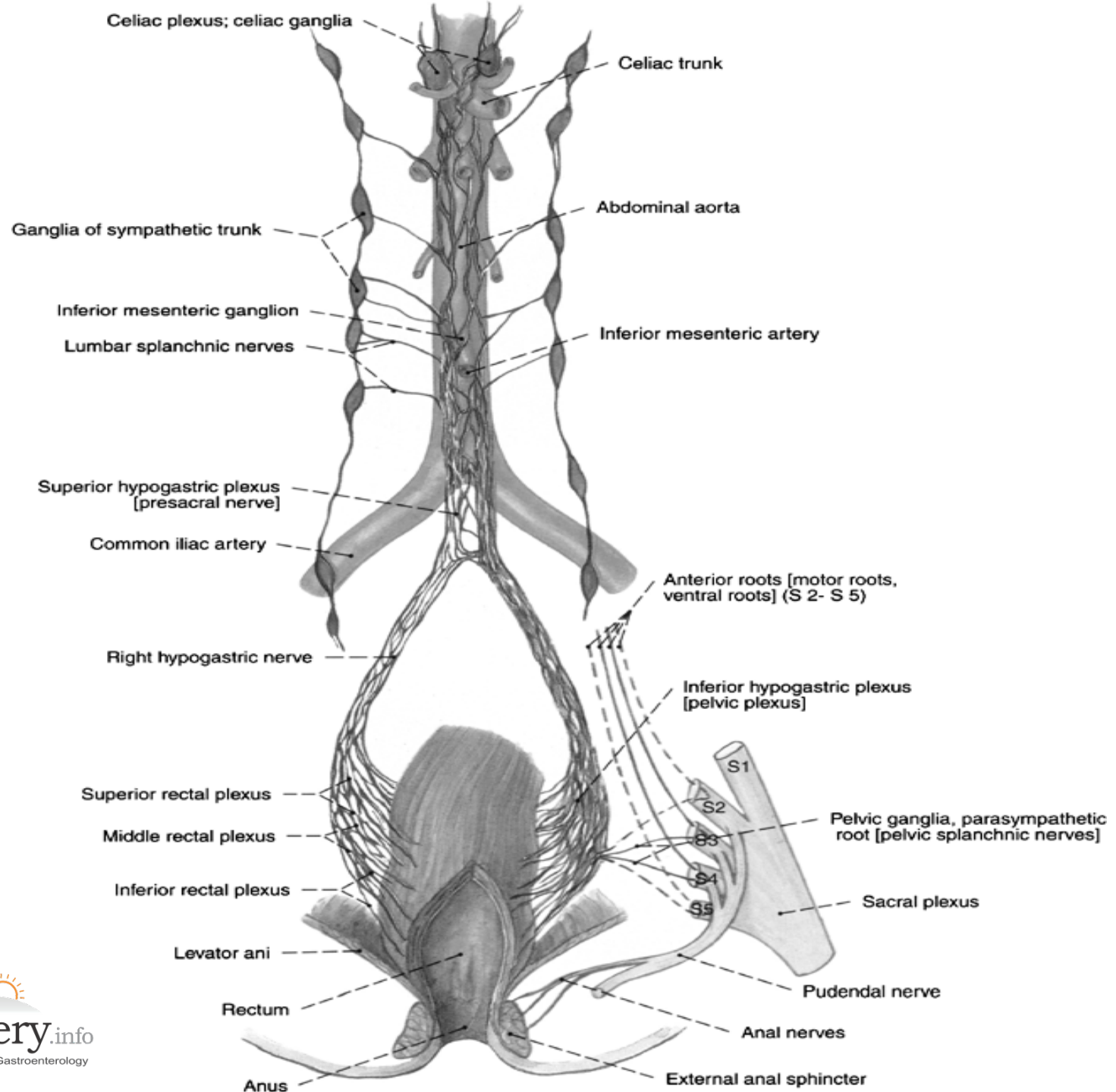
- Reimplantation
- Larger defects--vesicopsoas hitch
- Complex bladder or vascular injuries- transureteroureterostomy
- Boari Flap

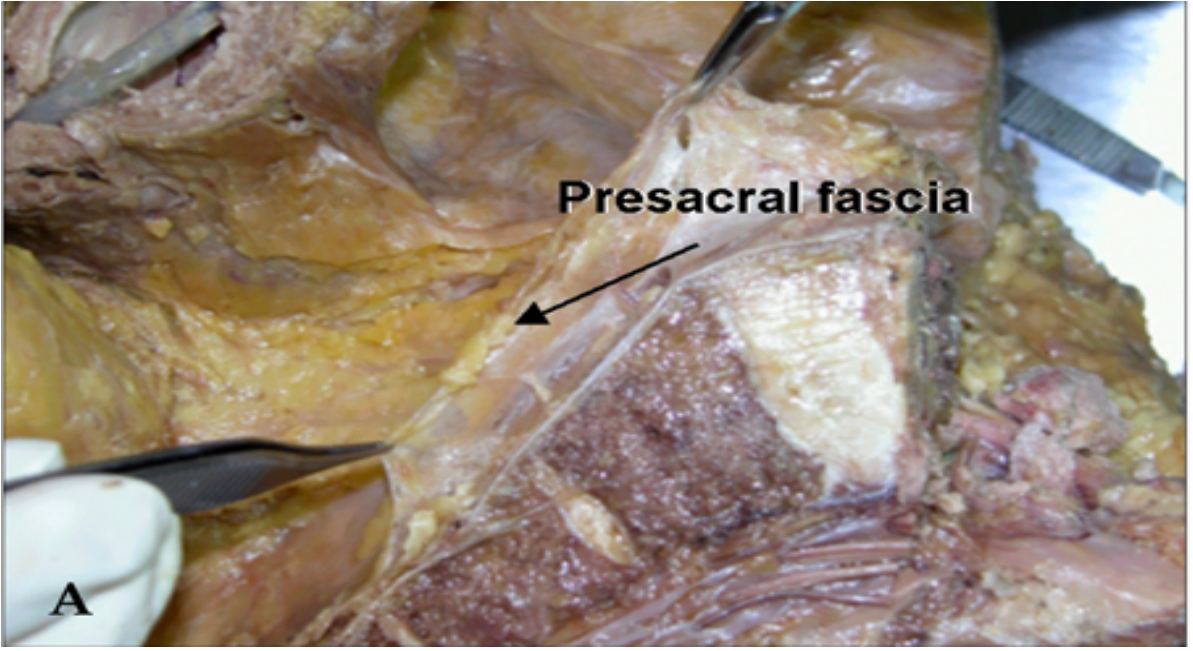
Autonomic Nerves

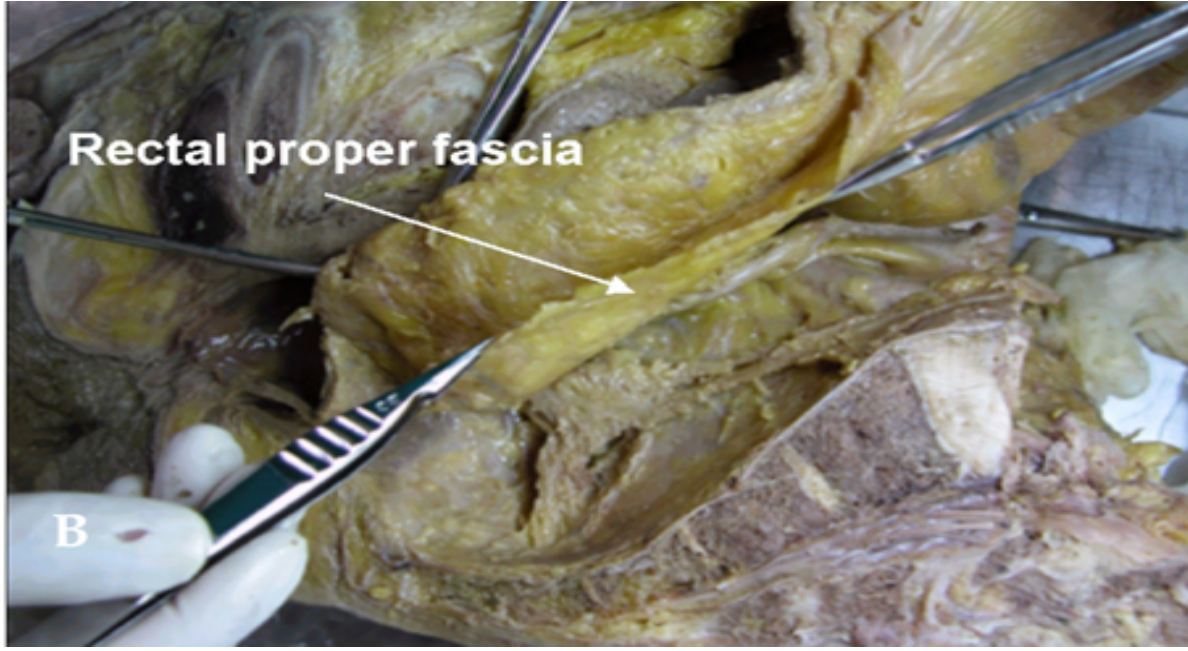
- Superior hypogastric plexus- at the lower extent of the abdominal aorta

- Lies on the aorta anterior to its bifurcation and extends inferiorly on the anterior surface of L5 vertebra.

- Contiguous bilaterally with inferior hypogastric plexuses-extending into the pelvis - Pelvic Plexus



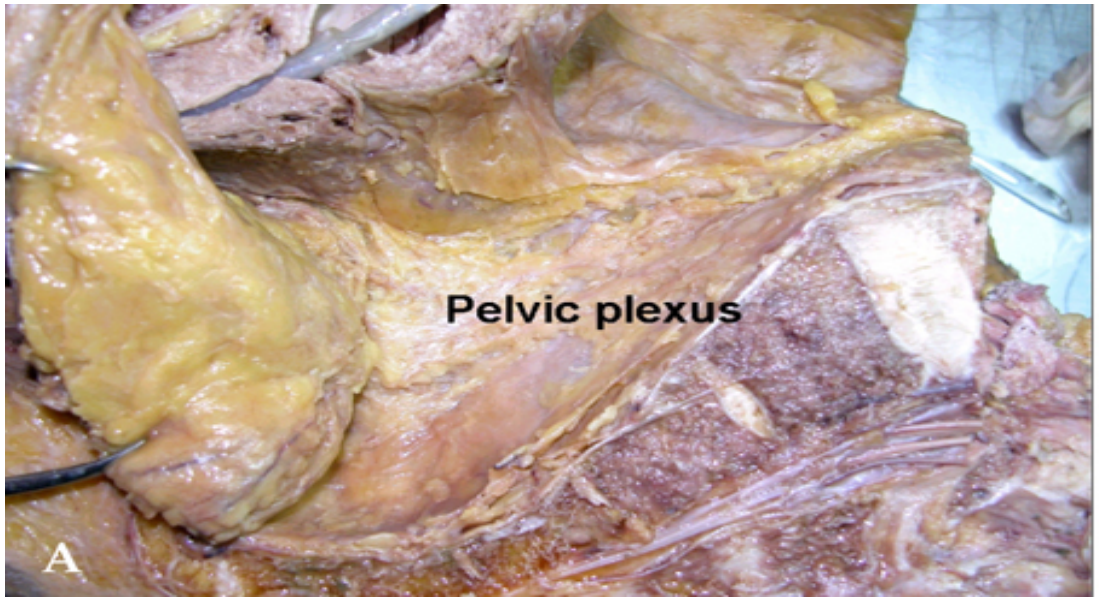


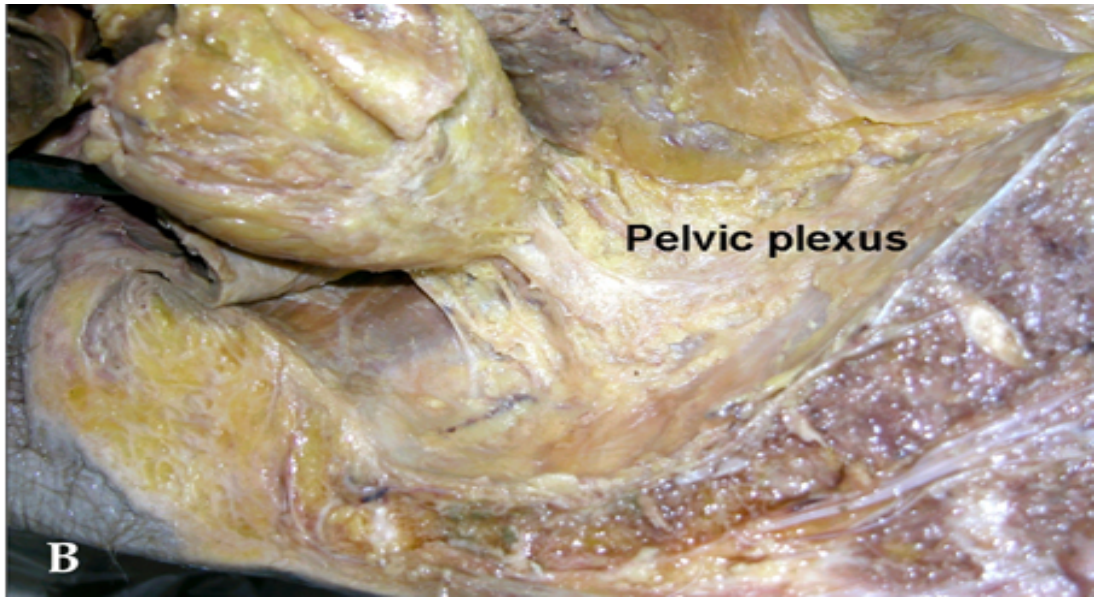


Cadaveric dissection of hemisectioned pelvis.

(A)Presacral fascia covers the presacral vein over the sacrum

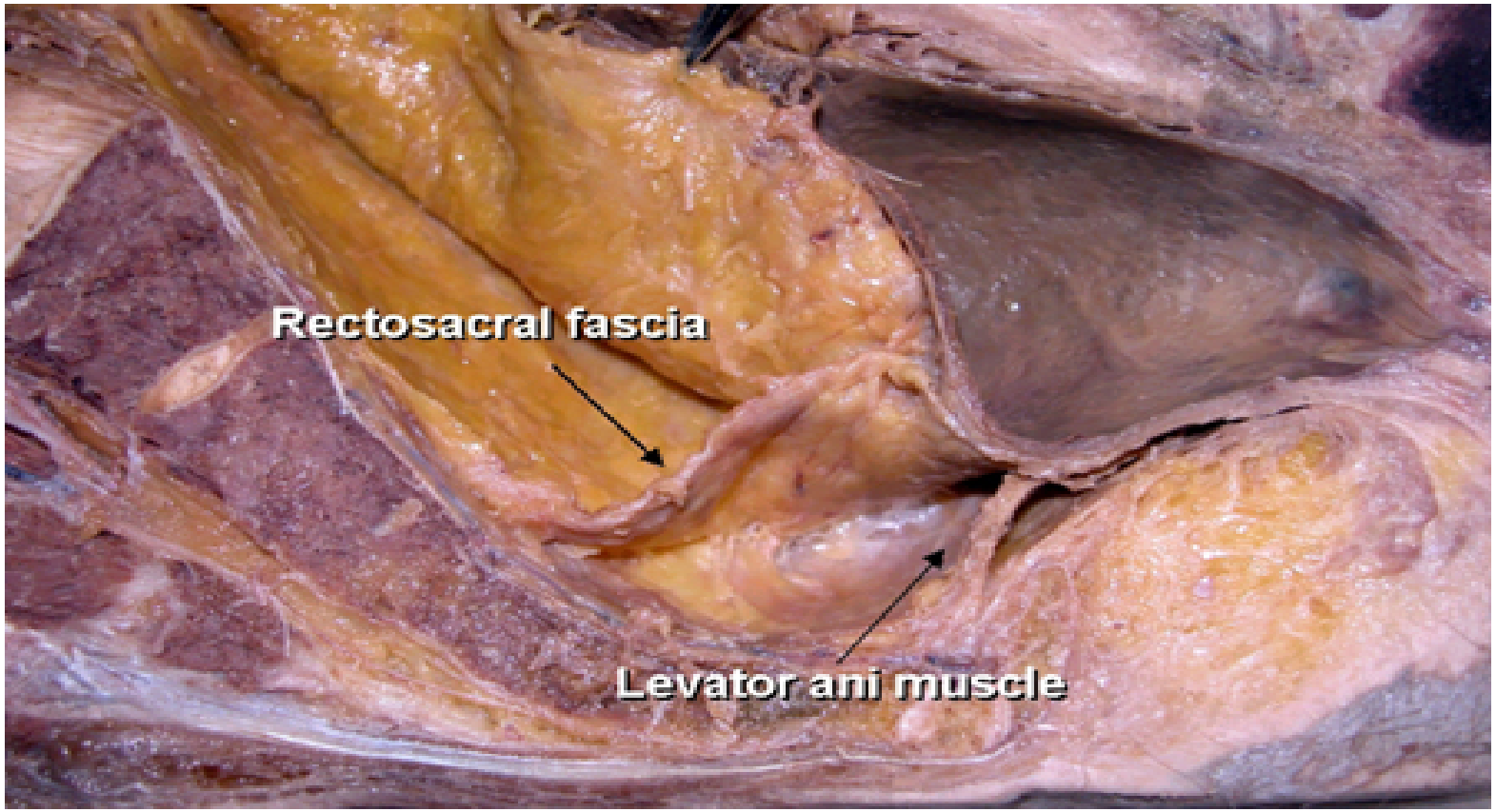
(B) The fascia picked up by the forceps is the rectal proper fascia enveloping the mesorectum and the rectum.





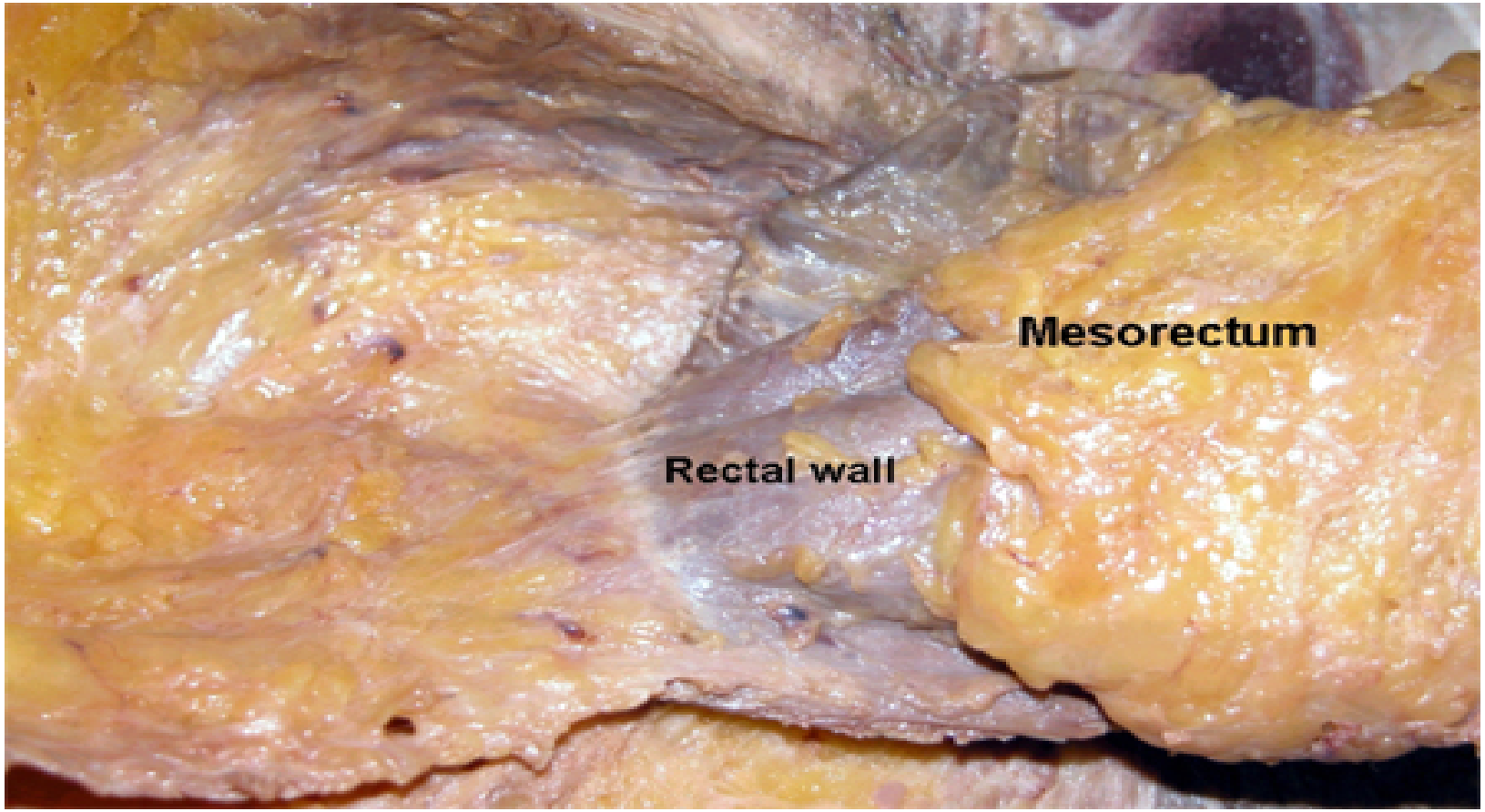
(A)The rectal proper fascia is adhered to the mesh like pelvic plexus at the lateral pelvic wall.

(B) The fine branches from pelvic plexus enter the rectal wall



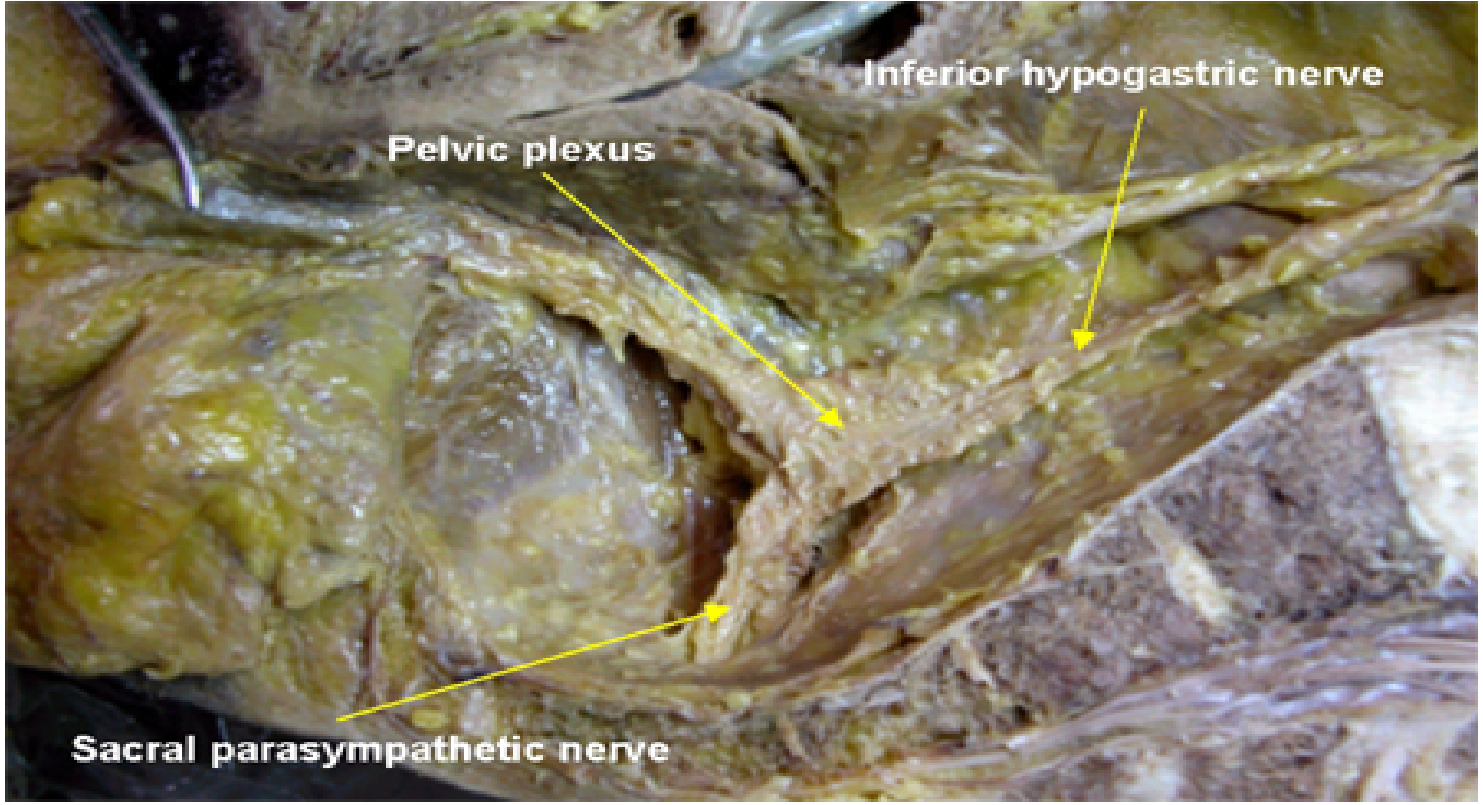
Cadaveric dissection-The retrorectal space.

The rectosacral fascia is noted in the retrorectal space at the level of 4th sacrum when dissection proceeds along the rectal proper fascial plane.



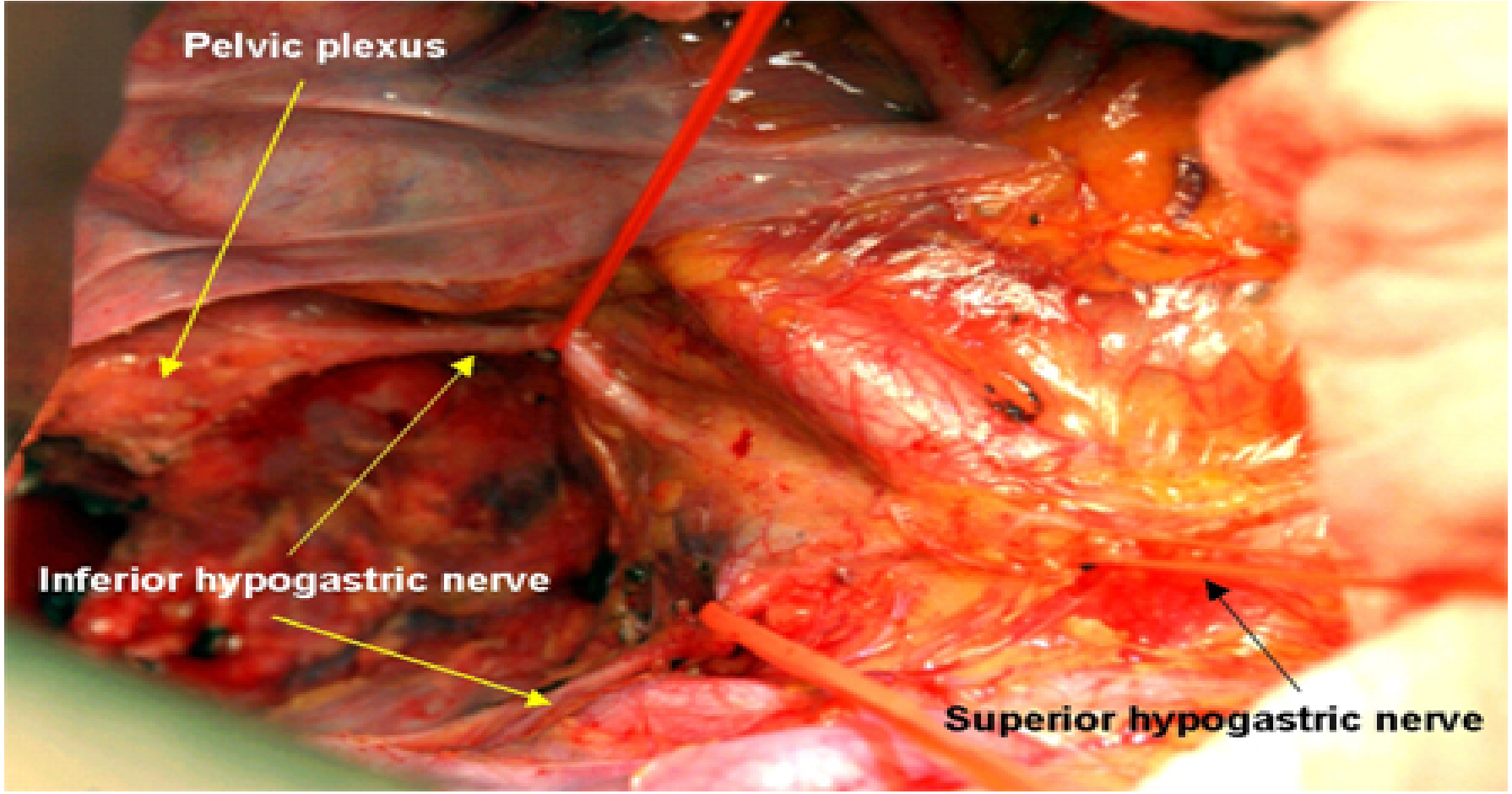
The mesorectum is well developed at the posterolateral side of the rectum.

The mesorectum is tapered down and it ended 2-3 cm above the level of the levator ani muscle.



Cadaveric dissection –The Inferior Hypogastric Nerve

- Meets sacral parasympathetic nerve arising from S2th, 3th, 4th foramen nearby the piriformis muscle.
- Forms the pelvic plexus at the lateral pelvic wall
- Nerve bundles from pelvic plexus go to the genitourinary organ along the seminal vesicle in male



- Bifurcation of the superior hypogastric nerve at the aortic bifurcation
- Inferior hypogastric nerve descends along the pelvic side wall
- Pelvic plexus forms after merging with the sacral parasympathetic nerve

White arrows showing fibres of inferior hypogastric nerves as seen during laparoscopy

General Considerations

- Sharp division of the rectosacral(Waldeyer's) fascia
- The hypogastric nerve must be visualized over the whole length
- Initially median and then lateral

- Avoid excessive traction on the rectum
- Dissection is continued laterally in contact with and medial to the pelvic plexus
- At the level of the seminal vesicle, the neurovascular bundle can be seen from the pelvic plexus running to the prostate at the lateral part of pelvic wall
- At 10 an 2 o’clock
- Strong anterior traction on the rectum

- Vulnerable sites of injury

1) The superior hypogastric nerve –at the origin of the inferior mesenteric artery.

- Leaving 1 to 2 cm stump of IMA- avoid injury to superior hypogastric nerve

2) During the separation of the mesosigmoid colon from the gonadal vessels and ureter

- The superior hypogastric nerve descends to the pelvis by crossing the left common iliac artery at the level of the 1st sacrum and descends into the pelvic cavity along the pelvic side wall

3) Pelvic dissection must be kept along the plane between the inferior hypogastric nerve fibers and the rectal proper fascia in the pelvic cavity.

- The inferior hypogastric nerve forms the pelvic nerve plexus at the lateral pelvic wall by encountering the parasympathetic sacral nerve originating from the 2nd, 3rd and 4th sacral cavities- Nervi Erigenties

4) Small numerous neurovascular bundles running from the pelvic nerve plexus to the genitalia cross the seminal vesicle in the 10 o'clock and 2 o'clock

5) Lateral wall of the rectum and the area where the pelvic plexus is attached

- The pelvic plexus is sometimes revealed as a matted rhomboid structure with dimensions of 4 cm by 2.5 cm, lying almost in the sagittal plane lateral to the rectum.

- Nerve-oriented mesorectal excision (NOME)
- Preparation of the splanchnic nerves at the mid-posterior sidewall
- The hypogastric nerves at the upper sidewall, and the urogenital nerve branches (Walsh) at the caudal-anterior sidewall
- The dissection of the lateral ligament is strictly performed as the last step.

- Runkel N, Reiser H. Nerve-oriented mesorectal excision (NOME): autonomic nerves as landmarks for laparoscopic rectal resection. *Int J Colorectal Dis*. May 11 2013

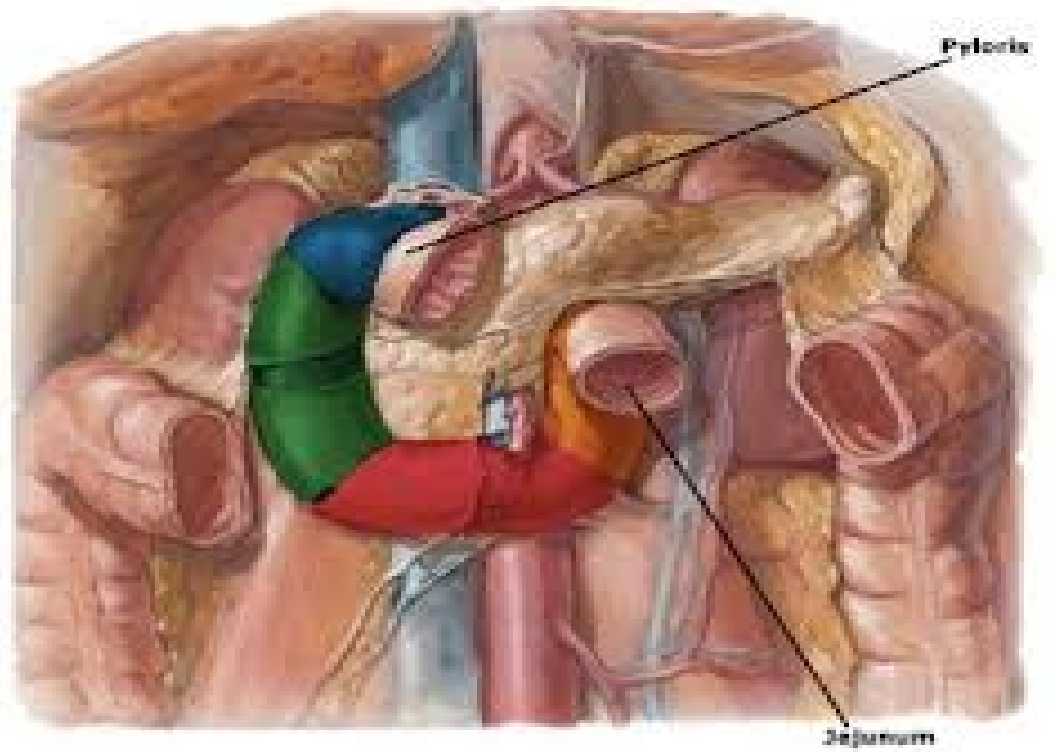
- Intraoperative neuromonitoring is an emerging technique.

- Early reports suggest the use of neuromonitoring during total mesorectal excision is associated with significantly lower rates of urinary and anorectal dysfunction.

- Practically not feasible-
  - Lengthening of duration of surgery
  - Cost of Device

Duodenum

- Divided in four parts
- Except 1st part and distal fourth part- retroperitoneal
- Retroperitoneal part relatively fixed
- Liable to injury in right colonic mobilization in laparoscopic surgery
- Lacks serosa- tendency to leak after suture repair



Organ Injury Scaling Committee of the American Association for Surgery of Trauma

I Serosal tears or hematoma of a single portion

II Injuries > 1 portion or laceration < 50% or circumference

III Lacerations of 50-75% of the 2nd portion or 50-100% or any other part

IV Laceration > 75% of 2nd portion or distal CBD

V Massive disruption of both duodenum

pancreas

- 4 basic principles in managing duodenal trauma:
  - Restore intestinal continuity
  - Decompress the duodenal lumen
  - Provide wide, external drainage
  - Provide nutritional support

Treatment – Duodenal Injuries

- **Duodenal hematoma**
  - Usually 2nd or 3rd portion
  - Partial or even complete obstruction
  - Symptoms of pain and bilious emesis not impressive initially
  - Treatment with NGT suction and TPN allows resolution within 1-3 weeks

- **Duodenal laceration**
  - Debridement – particularly with GSW
  - Repair primarily and buttress with omentum

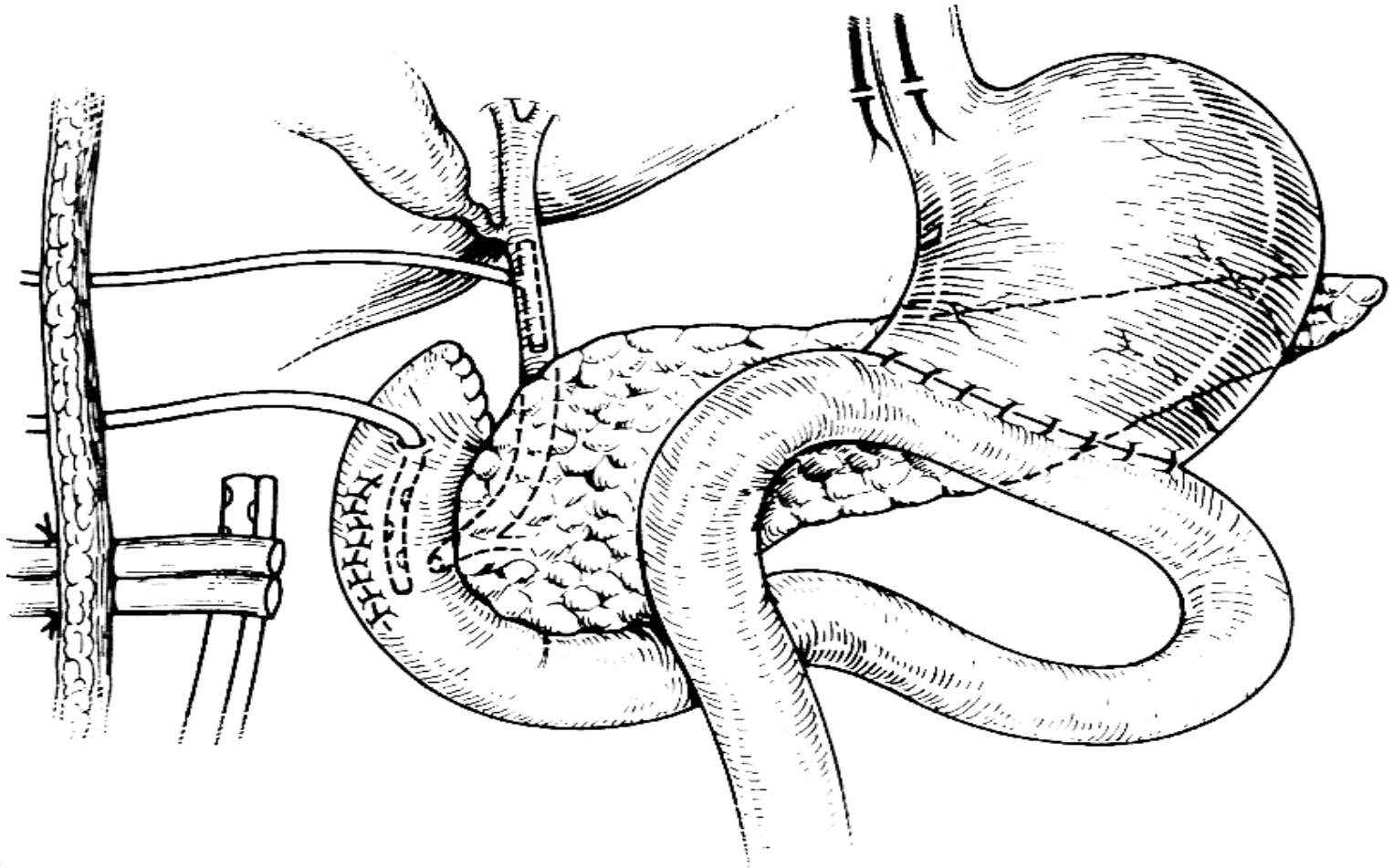
Primary closure possible but significant concern about wound closure consider duodenal catheter drainage, pyloric exclusion, or duodenal diverticulization

Treatment – Duodenal Injuries

- **Duodenal wall loss**
  - Attempt transverse primary repair
  - Too much tension
    - Duodenojejunostomy
    - End-end duodeno-Roux-en-Y-jejunostomy

- **Duodenal transection**
  - Primary end to end anastomosis
  - Extensive loss of tissue
    - Distal to ampulla of vater – Roux-en-Y jejunostomy
    - Proximal to ampulla – Billroth II gastrojejunostomy or Whipple

Duodenal Diverticulization



Take home message

- Laparoscopic Colorectal surgery demands patience and longer learning curve

- Complications also demand expert management

Thank You