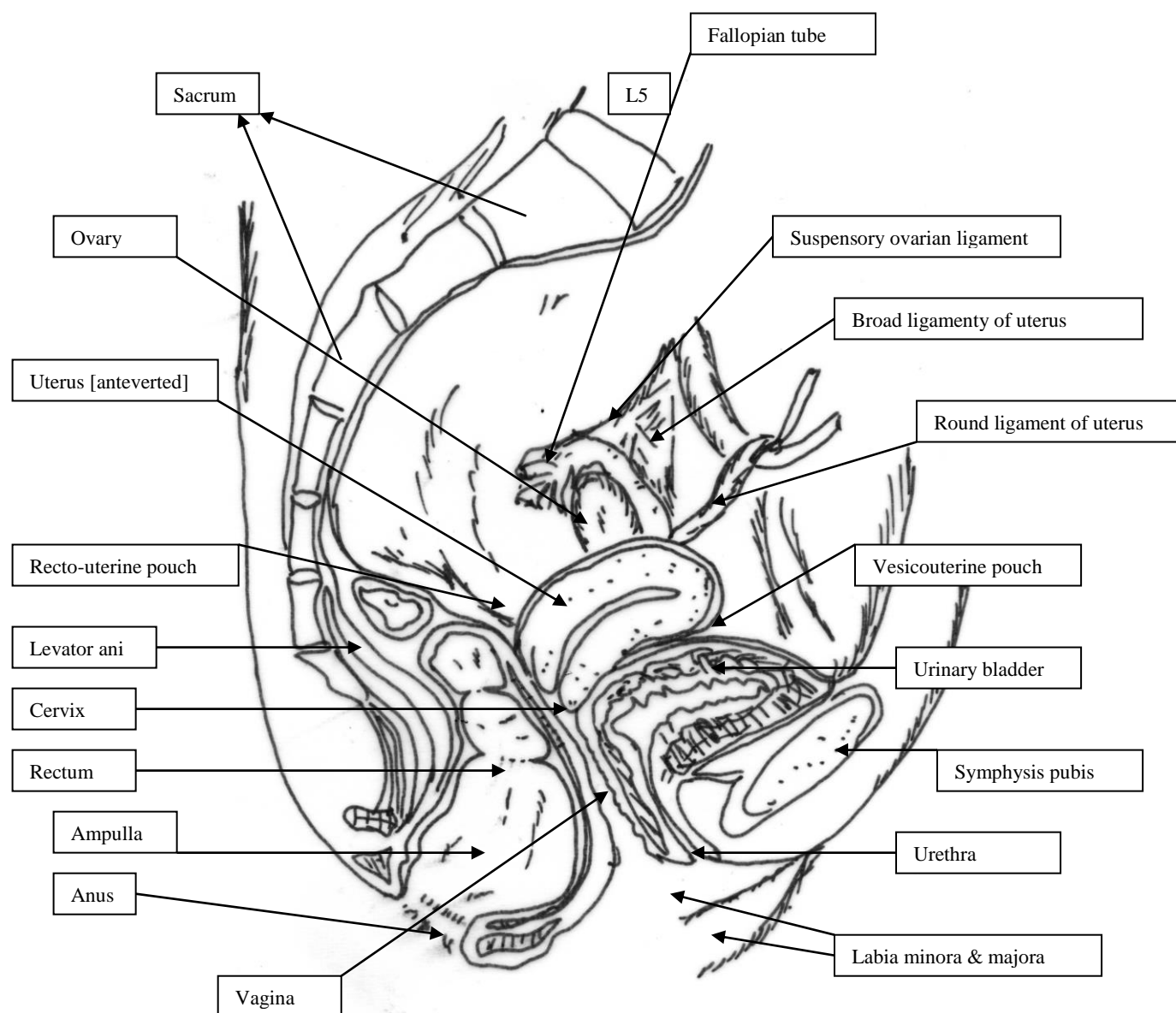


# FEMALE GENITALIA & PELVIS

**Yiannis P Panayiotopoulos, MD, PhD**



• *Median section of female pelvis*

- **LYMPHATICS**
- **Upper 3<sup>rd</sup>** : extrenal and internal iliac nodes
- **Middle 3<sup>rd</sup>** : internal iliac nodes
- **Lower 3<sup>rd</sup>** : superficial inguinal nodes

- **STRUCTURE**

The vagina is lined by **stratified squamous epithelium** which is **rugose in nulliparous** women and contains no glands. It is lubricated by cervical mucous and desquamated cells. Beneath the epithelium is a thin layer of submucosa and then the **muscular wall with a criss-cross arrangement** of its fibres. The muscular layer is ensheathed in a **fibrous capsule** which blends with the pelvic connective tissue in order to hold the vagina in place.

## THE UTERUS

A pear shaped organ, 7.5cm in length, usually bending anteriorly and forwards [**anteflexed and anteverted**]

- **CHARACTERISTICS**

It is morphologically divided to **fundus, body** and **cervix**. The **fallopian tubes** open between body and fundus, at the superolateral angle of the uterine cavity, called the **cornu**. The body has a waist, **the isthmus**, which is continuous to the cervix. The latter is encircled by the vagina at its lower half. The isthmus is the landmark of the **internal os**, which is also the junction point of **cervical epithelium** and **endometrium**.

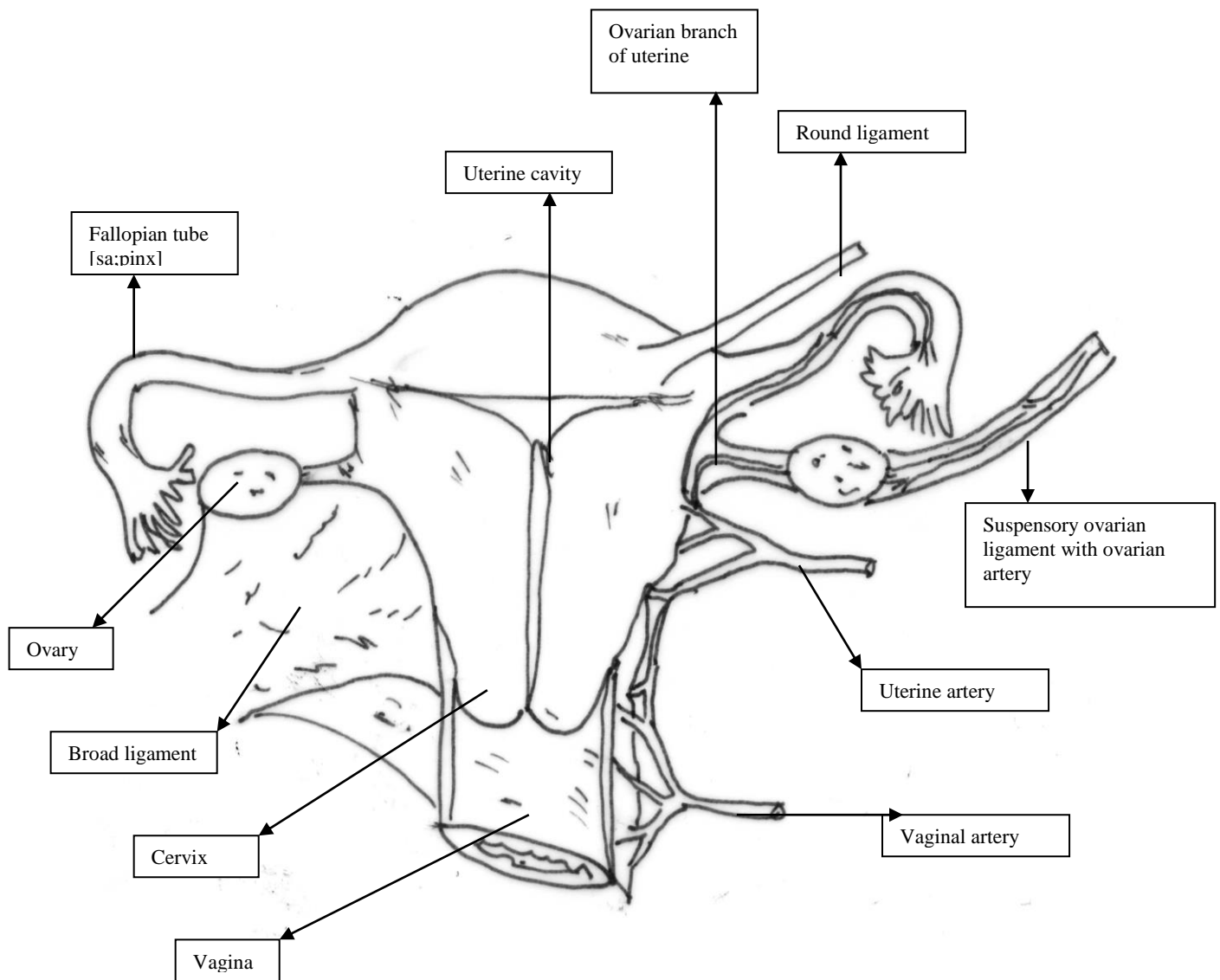
The **cavity** of the uterine body is **triangular in coronal section** but just a **slit on the sagittal plane**. The internal os communicates with **cervical canal** which opens in the vagina [external os]. The **external os** is circular in nulliparous women but becomes a transverse slit with an anterior and posterior lip in parous women.

- **POSITION OF UTERUS**

In infantile and childhood uterus the cervix is twice the size of the body; the latter enlarges during puberty. The uterus flexes at the level of internal os, forming an angle of 170° which may be either **anteflexed** or **retroflexed**. Normally, the axis of the cervix forms a 90° angle with the longitudinal vaginal axis, with the cervix directed forwards [**anteversion**]; if it is directed upwards and backwards then **retroversion** exists. Version and flexion coexist in various different forms.

- **RELATIONS**

- **Anteriorly:** vesicouterine pouch and supero-posterior surface of the of the bladder [for uterine body  
connective tissue and bladder [for supravaginal cervix]  
anterior fornix [for infravaginal cervix]
- **Posteriorly:** recto-uterine pouch of Douglass

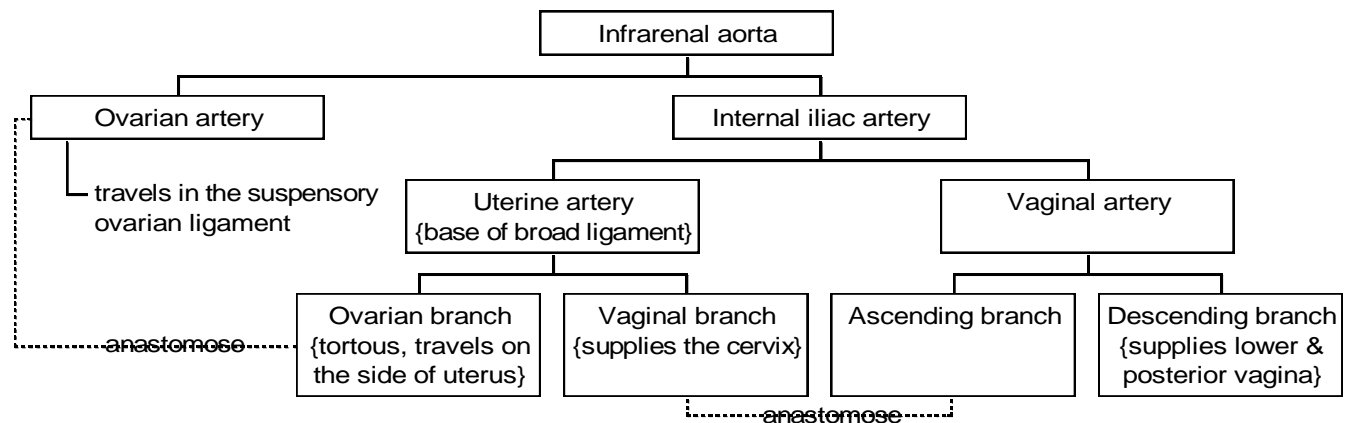


- ***The Female genital organs and blood supply***

- **Laterally:** broad ligament

The **ureter** lies **12mm laterally to the supravaginal cervix**, passing just above the level of the **lateral fornix**, below the uterine vessels as they cross it to split to uterine and vaginal branches. This is the only place of the body where a stone in the ureter can be felt during palpation.

## • BLOOD SUPPLY



The **veins** accompany the arteries and drain to the **internal iliac veins**. They also communicate with the **vaginal veins** via the pelvic venous plexus.

## • LYMPHATICS

1. **Fundus:** → ovary, fallopian tubes, → **aortic nodes**  
→ **round ligament** → superficial **inguinal nodes**
2. **Body:** → broad ligament nodes → **external iliac nodes**
3. **Cervix:** [lateral part] → broad ligament nodes → **external iliac nodes**  
[inferolateral part, across uterine vessels] → **internal iliac nodes**  
[posterior part, along rectouterine fold] → **sacral nodes**

## • STRUCTURE

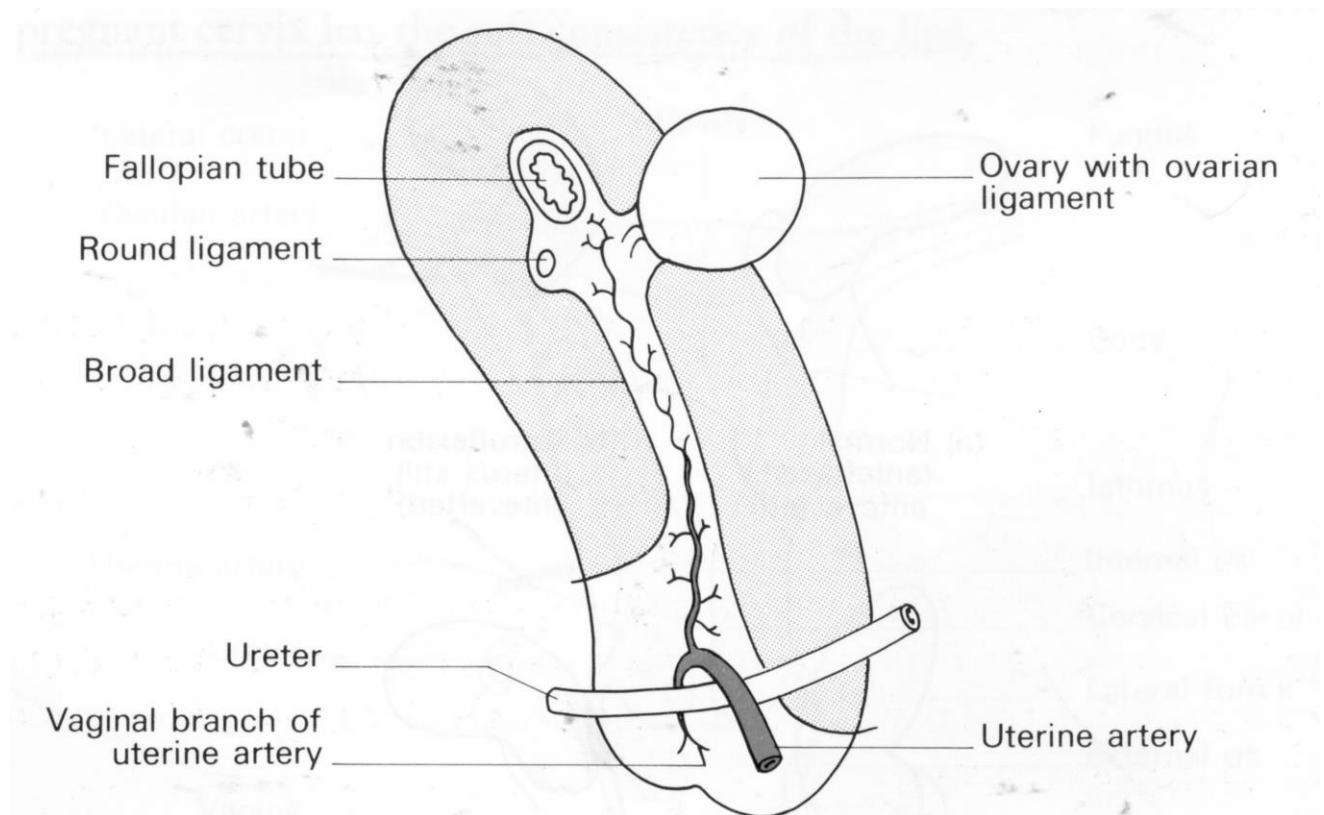
1. **Peritoneum** [except at the sites where it is reflected, laterally to the broad ligament and anteriorly, at the isthmus level, to the bladder]

The peritoneum passes downwards and posteriorly from the internal surface of the anterior abdominal wall, superiorly to the pubic bone, onto the **superior surface of the urinary bladder**. It then forms the **vesicouterine pouch**, covers the **fundus and body of the uterus**, the **posterior fornix** and the **upper quarter of the vaginal wall**, it then forms the **rectouterine pouch** and covers the anterior and lateral aspects of the rectum.

### 2. Muscle wall

Is thick and its involuntary fibres have a criss-cross arrangement, mixed with...

### 3. Fibroelastic connective tissue



- *Lateral view of uterus to show the composition of the broad ligament and the ureter crossed by the uterine artery*

#### 4. Endometrium

There is no submucosa. The epithelium is made up by a single layer of **cuboidal ciliated cells** which form **single tubular glands**, dipping down to the underlying muscle.

The **epithelium of the cervical canal** is made of **tall columnar cells** forming complicated branching glands secreting an **alkaline mucous** [→ **protective cervical plug**]. The **vaginal aspect of the cervix** is covered by **stratified squamous epithelium**.

### • MENSTRUAL CYCLE

**0-4 days:** desquamation of superficial two thirds of endometrium → bleeding

#### **Proliferative phase**

**5-7 days:** Rapid reconstitution of mucosal surface

**7-14 days:** Reformation of endometrium

#### **Secretory phase**

**14-24 days:** The endometrium thickens, the glands lengthen and distend, the stroma becomes more oedematous and three zones are evident: superficial, middle spongy and basal zone

#### **Ischaemic phase**

**24-28 days:** Coincides with degeneration of corpus luteum. There is shrinkage of endometrium,

retraction of the arteries, ischaemia of the superficial and middle zones, followed by desquamation.

## **THE FALLOPIAN [UTERINE] TUBES**

They are 10cm long, lie on the free edge of the broad ligaments and open into the uterine cornu. They are subdivided in;

1. **Infundibulum**, which is bugle shaped and has an **ostium** opening into the peritoneal cavity. Its mouth is fibriated [**fallopian fimbriae**], one of which [**fimbria ovarica**] is attached to the ovary.
2. **Ampulla**, which is wide but with thin wall.
3. **Isthmus**, narrow with thick wall
4. **Interstitial part**, piercing the uterine wall to open in the cornu

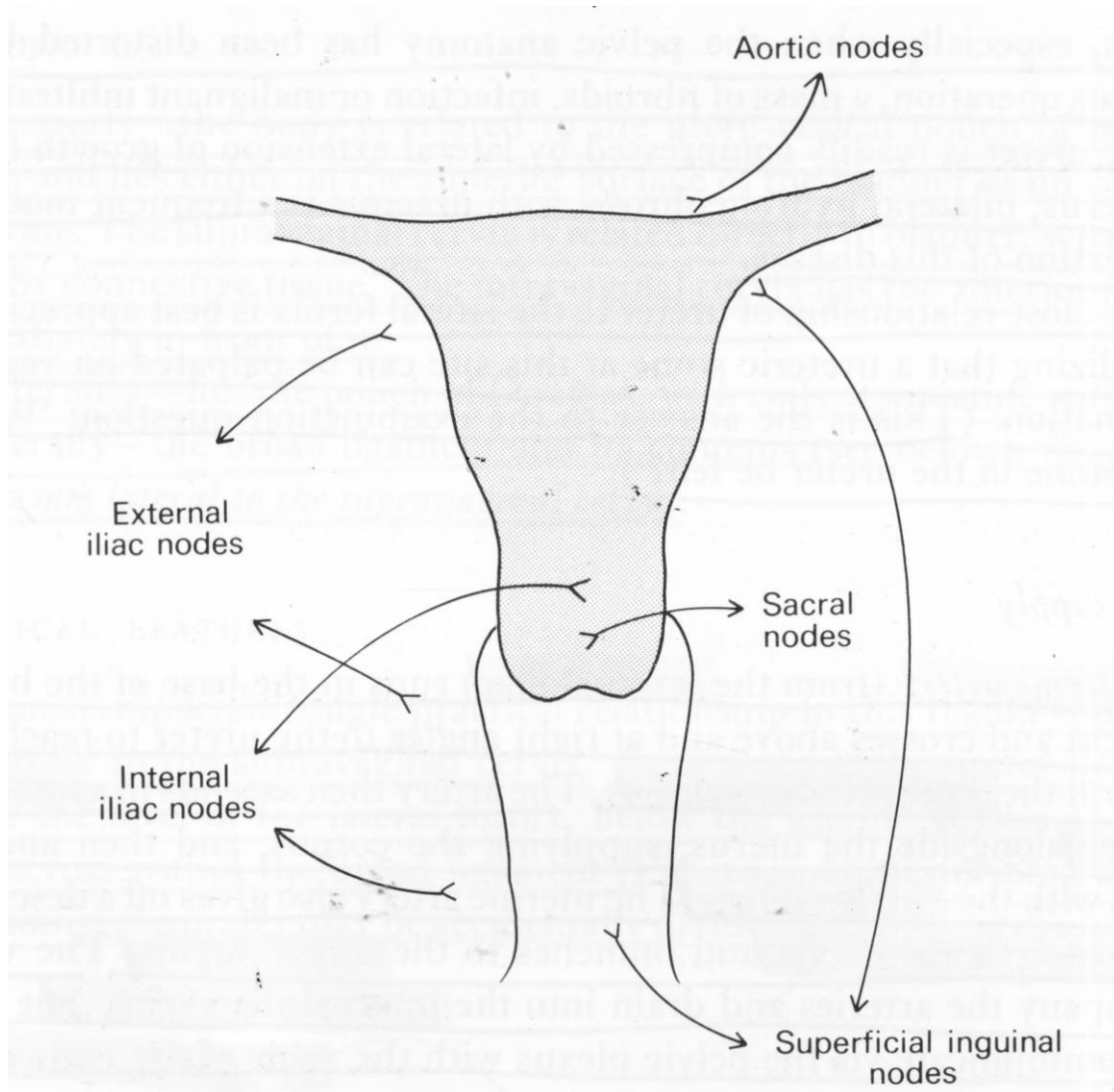
### **STRUCTURE**

#### a. **Peritoneum**

b. **Muscle layer**, consisting in **outer longitudinal** and **inner circular** muscle coats.

c. **Columnar ciliated mucosa**, forming numerous folds.

The muscle peristalsis and the action of the cilia propel the ovum to the uterine cavity.



- *The lymphatic drainage of uterus & vagina*



## THE OVARY

Is an almond shaped organ attached through the **mesovarium** to the **broad uterine ligament**. It lies on the side wall of the pelvis, occupying the ovarian fossa, an area between the external iliac vessels [anteriorly] and the ureter and internal iliac vessels [posteriorly].

- **LIGAMENTS**
- **Suspensory ovarian ligament [infundibulo-pelvic]**. Is a peritoneal reflexion which conveys the ovarian vessels and nerves.
- **Ovarian ligament**. Connects it to the uterine cornu.
- **Fimbria ovarica** which attaches it to the fallopian tube

- **BLOOD SUPPLY**

As the ovary develops from the genital ridge and descends into the pelvis, it drags its blood and lymphatic supply downwards. The **ovarian artery** [spermatic] arises from the **aorta** at the level of the renals and passes on the posterolateral abdominal wall to enter the ovary through its **suspensory ligament**. The **ovarian vein** follows the artery.

The ovarian **lymphatics** drain directly to the aortic nodes.

**Nerve supply** is from the aortic plexus at T10 level.

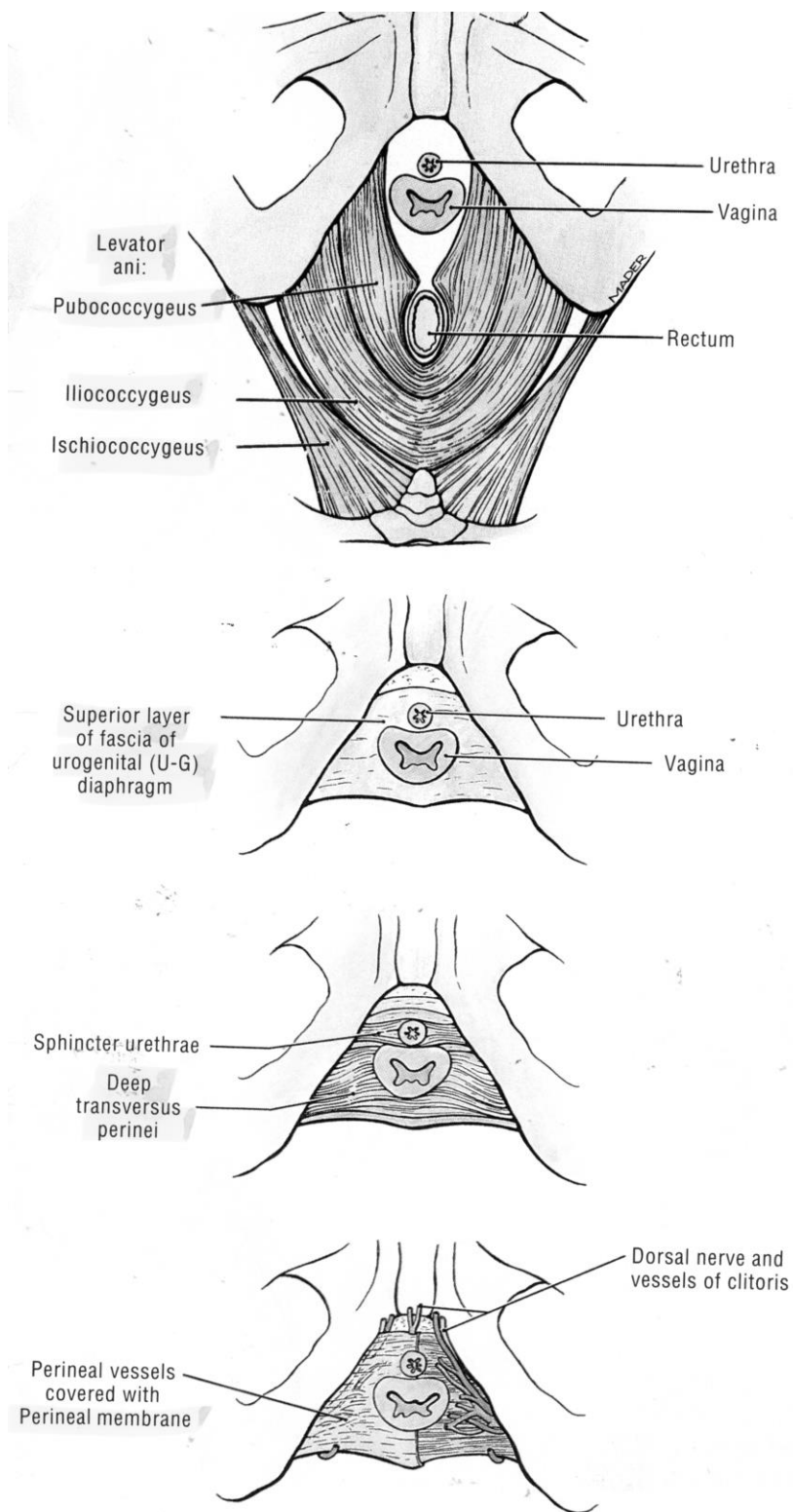
- **STRUCTURE**

The ovary **lacks peritoneum**.

It is composed of a connective tissue **stroma** which contains the **Graffian follicles** [corpora lutea and albicantia]. In early life is covered by a membrane called **germinal epithelium**, consisting of cuboidal cells. It disappears in adult life, leaving a fibrous capsule in its place, the **tunica albuginea**.

## THE ENDOPELVIC FASCIA AND LIGAMENTS

- **PELVIC FASCIA**: the connective tissue of the pelvic floor, covering the levator ani and obturator internus muscles
- **ENDOPELVIC FASCIA**: the extraperitoneal tissue covering the uterus, vagina, bladder and rectum. Within it are some important condensations forming ligaments:
  1. **Cardinal ligament [transverse, McKenrodt's ligament]**: passes laterally from the cervix and upper vagina to the lateral wall of the pelvis, along the lines of attachment of levator ani.
  2. **Utero-sacral ligament**: from the posterior aspect of cervix [at the level of isthmus] it passes to the lateral boundaries of rectouterine pouch and then to the periosteum in front of the sacroiliac joints.
  3. **Pubo-cervical fascia**: it originates from the pubis and passing on the sides of the bladder blends with the cardinal ligament.
  4. **Broad ligament**: is a peritoneal condensation connecting the lateral margins of the uterus to the sides of the pelvic wall. It contains or conveys:
    - **fallopian tube** and **mesosalpinx** on its free edge



- *The pelvic fasciae, muscles and diaphragms in females*

- **ovary** and **mesovarium** on its posterior aspect
- **round ligament**
- **ovarian ligament**
- **uterine vessels**
- lymphatics
- nerve fibres

5. **Round ligament:** is a fibromuscular cord which passes [located on the anterior part of the broad ligament] from the uterus to the internal inguinal ring, inguinal canal and inserts to the labia majora.

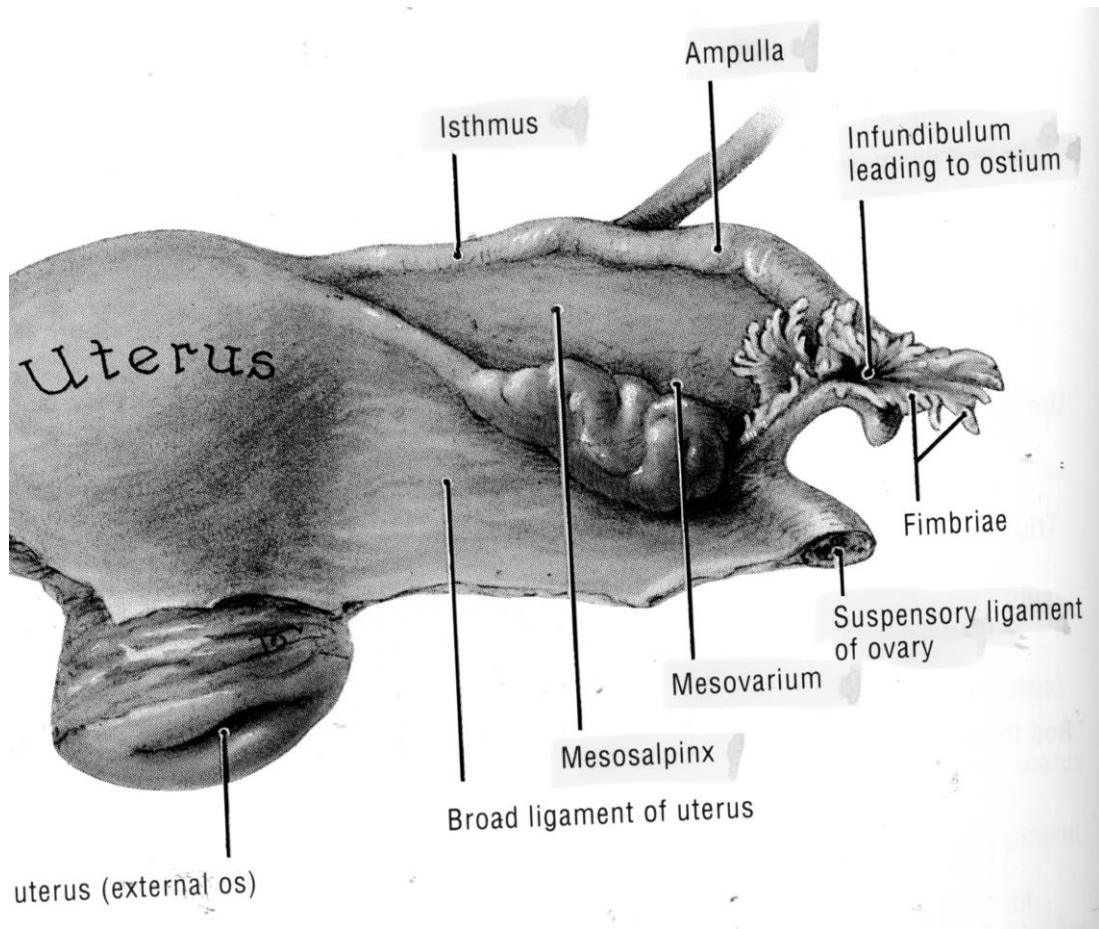
## EMBRYOLOGY

On the posterior abdominal wall, adjacent to the **mesonephric [Wolffian] ducts**, develop the mesodermal **Mullerian ducts [paramesonephric]**, which project caudally to the **urogenital sinus**, cephalad to the cloaca.

**In males**, the Mullerian ducts disappear [apart from the part forming the **appendix testis** and the **prostatic utricle**].

**In females**, only remnants of the Wolffian system remain in the broad ligament [**epo-oophoron, para-oophoron, ducts of Gardner**]. The **Mullerian ducts** form the **fallopian** tubes cranially while caudally they fuse in the midline [dragging with them a peritoneal fold which will become the **broad ligaments**]. The median structure differentiates into **endometrium, cervical canal and upper third of the vagina**. The rest of the vagina develops by canalisation of the sino-vaginal node at the back of the urogenital sinus. Failure of canalization will lead to **haematocolpos, haematometra and haematosalpinx** during menstruation.

Failure or incomplete fusion of the Mullerian ducts may lead to **uterine atresia, bicornuate uterus, reduplication or hypoplastic uterus**.



- *The ovary with its ligaments and the salpinx*

# THE PELVIS

## THE BONY & LIGAMENTOUS PELVIS

Is formed by the **innominate bones**, the **sacrum** and the **coccyx**, bound to each other by **dense ligaments**. The **false [major] pelvis** is formed by the **iliac fossae** and the **ala of sacrum**. The **pelvic inlet** is made by **3 bones** [the two **innominate bones and sacrum**] and **3 joints** [two **sacroiliac joints** and **symphysis pubis**] In the anatomical position the pelvis is **tilted forwards** [anteriorly] so that the plane of the **superior pelvic aperture [inlet]** forms an angle of 50-60° with the horizontal plane. The **inferior pelvic aperture [outlet]** forms a 15° angle. On the erect position the anterior superior iliac spines and the pubic tubercles lie on the same vertical plane.

## FUNCTIONS OF THE PELVIS

1. Protection of pelvic viscera
2. Support of body weight [extremely well reinforced sacroiliac joint]
3. Rotatory movement during walking from side to side, due to lumbosacral articulation
4. Provides attachments for muscles
5. Bony support to the birth canal in women

## INNOMINATE BONES [OS INNOMINATUM or OS COXAE]

Is formed by the junction of the **ilium**, **ischium** and **pubic** bone.

The **superior iliac spines** [anterior & posterior] form the **iliac crest**. Further posteriorly [and inferiorly] are the **inferior iliac spines** [anterior & posterior].

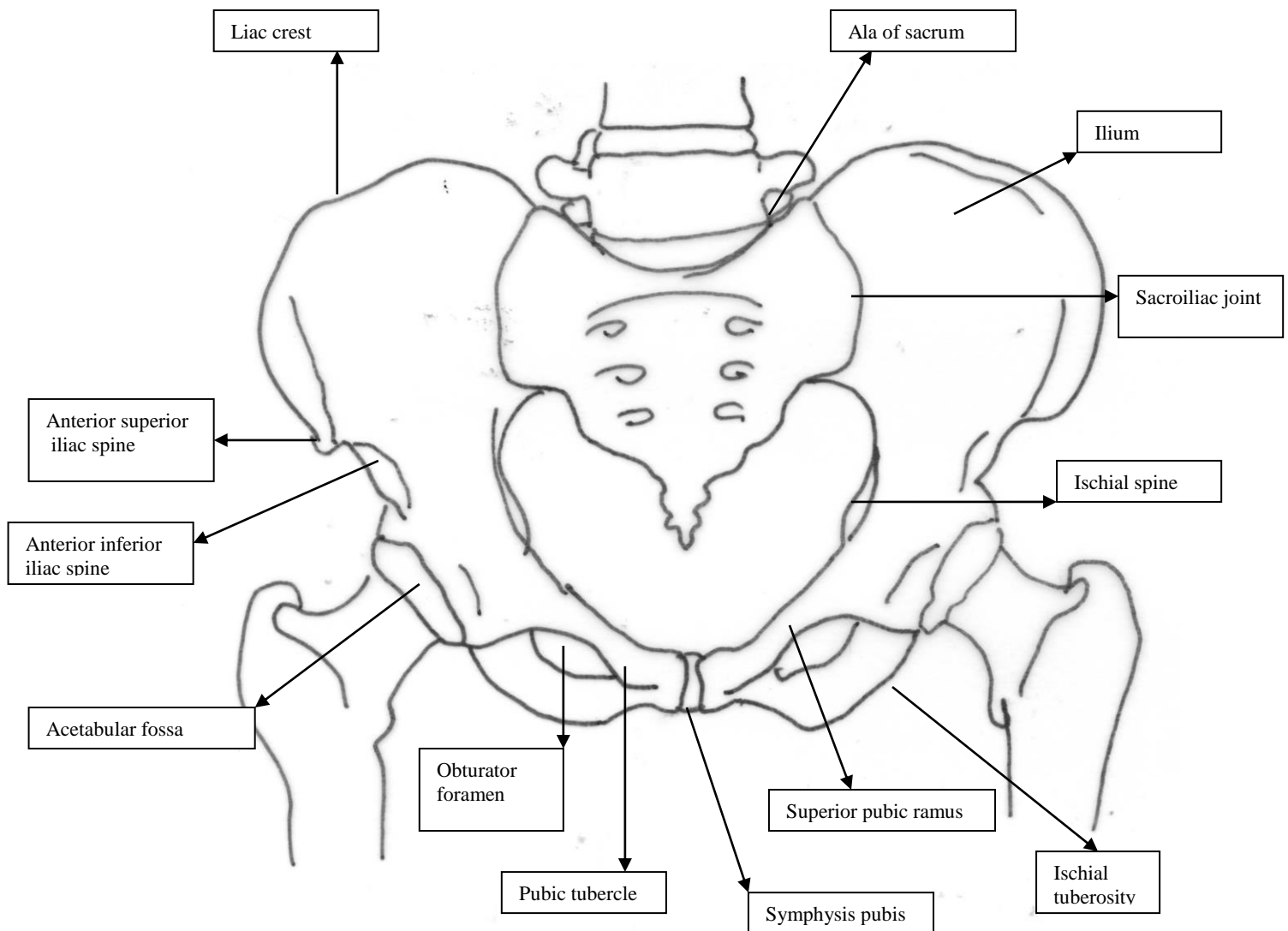
The lateral surface bears the **anterior, posterior and inferior gluteal lines** for the insertion of the gluteal muscles.

The inner surface consists of the **iliac fossa** and bears the **iliac tuberosity** for the insertion of the **sacroiliac ligament**. It also has **auricular surface** for articulation with the sacrum.

Posteroinferiorly, between the anterior inferior iliac spine and the pubic eminence there is a **groove for iliopsoas** muscle.

From the apex of the sacral auricular surface arises the **iliopectineal line** which passes forward to the superior ramus of the pubic bone. This line forms the inlet of the **true [minor] pelvis** which is formed by the inner surface of ischium, pubis, sacrum, coccyx and some part of ilium.

- **PUBIC BONE**
- **Body**, which bears the **pubic tubercle** on its superomedial aspect
- **Superior pubic ramus**     **pectinate line**, continuous with iliopectineal line  
    **pectineal surface** on its outer aspect, for the insertion of pectineal muscle



- *The bones of pelvis*

**iliopubic eminence** on its outer surface

- **Inferior pubic ramus**, joining the ischial ramus
- **Obturator foramen**, formed by the body and rami of pubis and the body and ramus of ischium

- **THE ISCHIUM**

- **Body**, vertically placed, covers the posteroinferior to the acetabulum area
- **Ischial spine**, lying posteriorly, which bears the **greater [upper]** and **lesser [lower] sciatic notch**
- **Ischial ramus** which joins the inferior pubic ramus to form the inferior boundary of obturator foramen
- **Ischial tuberosity** on its inferior pole, at the point where it joins the body

- **THE ACETABULUM**

All 3 previous bones fuse at the acetabulum forming **a socket for the femoral head** which bears:

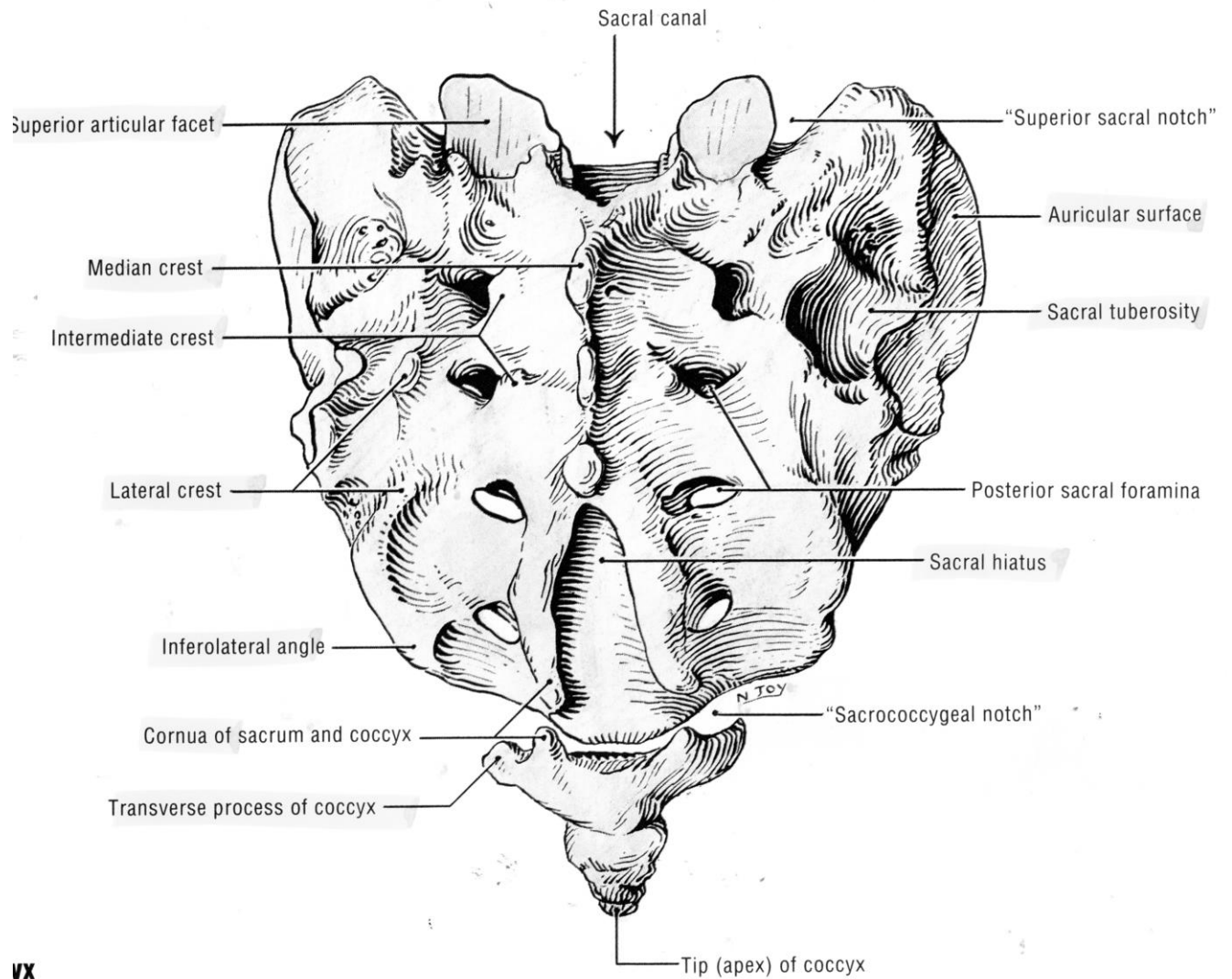
- **Articular surface**, wide crescentic, like a horseshoe
- **Acetabular fossa**
- **Acetabular notch**

## THE SACRUM

Is triangular in shape, formed by fusion of 5 vertebrae. The costal elements of sacrum fuse from inferiorly to superiorly starting at puberty; fusion is complete at the end of the 24<sup>th</sup> year. The bodies start fusing at the 17<sup>th</sup> - 18<sup>th</sup> year and fusion is complete by the 33<sup>rd</sup> year.

The **dural sheath** of the spinal canal terminates at the **second segment of sacrum**. Beyond this the sacral canal is filled with fatty tissue from the extradural space and the nerve filaments of **filum terminale**.

- **SACRAL PROMONTORY** → the anterior border of S1
- **INNER SURFACE**
  - a **central mass**, formed by the fused vertebral bodies
  - **4 anterior sacral foramina**
  - **lateral mass**, forming a fan-shaped area, the **ala of sacrum**
- **POSTERIOR SURFACE**
  - **superior articular facet of S1**
  - **sacral canal**
  - **median crest**, formed by the spinal processes above the canal [4<sup>th</sup> and 5<sup>th</sup> are absent]
  - **intermediate crest**, formed by the articular tubercles
  - **4 posterior sacral foramina**
  - **lateral crest**, formed by the fused transverse tubercles
- **LATERAL SURFACE**
  - posterosuperiorly bears the **sacral tuberosity** for attachment of the sacroiliac and interosseous ligaments



yx

- The sacrum & coccyx*



- anterosuperiorly has an **auricular ear-shaped surface** for articulation with the iliac bone
- **INFERIOR EDGE**
  - On the lateral aspect are the edge of the **lateral mass** and the **sacral cornuae**
  - Posteromedially terminates at the **sacral hiatus**, the **cornuae** and the **sacroccygeal notch**

## THE COCCYX

Is formed by fusion of the last 3-5 vertebrae

Superiorly it joins the sacral cornuae

Inferiorly, terminates at its tip or tail

## LIGAMENTS - JOINTS

### • SYMPHYSIS PUBIS

Is not a real joint. The bones are coated by hyaline cartilage, there is fibrocartilage in the midline and are surrounded by dense fibrous ligaments.

### • SACROILIAC JOINTS

A true synovium lined and cartilage covered joint.

### • LIGAMENTS

- **Sacroiliac ligament:** is dense, the strongest ligament in body. It is divided in 3 parts:

- anterior, covering the ala
- interosseous
- posterior [dorsal] part

- **Sacrospinous ligament:** arises from the ischial tuberosity and is attached to the side of sacrum and coccyx. With the lesser sciatic notch it forms the **lesser sciatic foramen**.

- **Sacrospinous ligament:** from the side of sacrum is attached to the ischial spine, forming the **greater sciatic foramen**.

- Anterior longitudinal ligament
- Iliolumbar ligament
- Supraspinous ligament
- Sacroccygeal ligament
- Obturator membrane

### • EXTERNAL LANDMARKS

The **dimple** constantly seen on each side of the posterior midline immediately above the buttock demarcates:

- Posterior superior iliac spine
- Centre of sacroiliac joint
- Level of second sacral vertebra
- End of dural canal

## DIFFERENCES BETWEEN MALE AND FEMALE PELVIS

**male:** heavier built, stronger muscles, stronger bone structure, defined surface markings, vertically placed and oval in shape obturator foramen

**Female:** wider and shallower pelvic cavity, the obturator foramen placed more transversely

- **ON PLAIN X-RAY:** the pelvic inlet has a heart shape in males while it is oval in females  
the inferior pubic ramus has an acute angle in males, wide in females  
there is a soft tissue shadow of the scrotum and penis in males
- **OBSTETRIC MEASUREMENTS**
- **Transverse diametre:** between the ischial tuberosities. Is 12.5cm at the inlet level, 10cm at the pelvic outlet and 11-12cm in mid-pelvis, the same as the anteroposterior diametre.
- **Anteroposterior:** from the pubis to the sacrococcygeal joint. 10cm at the pelvic inlet and 12.5cm at the pelvic outlet
- **Diagonal conjugate:** from the lower border of pubis to the sacral promontory. Is around 12.5cm. [if the promontory can be felt during vaginal examination then the pelvis is narrow]
- **VARIATIONS IN PELVIS**
- **Normal**
  - **gynaecoid**
  - **android**
  - **platypelloid** [shortened anteroposteriorly, widened transversely]
  - **anthropoid** [shortened transversely, lengthened anteroposteriorly]
- **Symmetrically contracted** [in women of small stature]
- **Rachitic flat pelvis:** forward projection of promontory while the coccyx tilts backwards. The inlet is narrow while the outlet is widened.
- **Asymmetrical pelvis**

## THE PERINEUM [MUSCLES OF THE PELVIC FLOOR]

### • PELVIC DIAPHRAGM

#### a. LEVATOR ANI

Is the largest and most important part of the perineum. Consists of 4 parts:

- **levator prostatae** [or **sphincter vaginae**]
- **puborectalis** [or **pubococcygeus**]
- **iliococcygeous** [weak muscle]
- **ischiococcygeous** [transforms into sacrospinous ligament]

The levator ani arises from the back of the pubis, the fascia of the side pelvic wall covering obturator internus and the ischial spine. It sweeps down in a series of loops, inserting in the perineal body, around the rectum and deep anal sphincter and in the coccyx.

Its inner surface is related to pelvic viscera while its perineal surface forms the inner wall of the ischiorectal [ischioanal] fossa.

#### b. COCCYGEUS MUSCLE

Covers the sacrospinous ligament.

### c. **OBTURATOR INTERNUS MUSCLE.**

Pads the side wall of the pelvis, escaping through the **lesser sciatic foramen**. The **obturator artery** [branch of the **internal iliac in 70%** of subjects] anastomoses with the pubic branch of the inferior epigastric artery [branch of the external iliac] escapes through the **obturator foramen** as well, accompanied by the **obturator vein** and **obturator nerve**.

The **internal pudental artery** and **pudental nerve** pass behind the sacrospinal ligament and re-enter the pelvis through the lesser sciatic foramen. Then they travel into the **pudental canal [Alcock's canal]**, covered by the obturator internus fascia and pierce the urogenital diaphragm at the lateral border of the ischiorectal fossa. The nerve gives three terminal branches: **inferior rectal nerve**, **perineal nerve** and **dorsal nerve of penis**.

### • **SUPERFICIAL MUSCLES**

By a line passing through the ischial tuberosities, in front of the anus, the perineum is divided into **anterior [urogenital]** and **posterior [anal] perineum**.

#### 1. **ANTERIOR PERINEUM [UROGENITAL TRIANGLE]**

##### • **Deep perineal pouch.**

Is formed by the deep layer of the perineal membrane [superiorly], the **external sphincter of the urethra** and the **deep transverse perineal muscle** [part of the urogenital diaphragm. It contains the two **glands of Cowper** in males and the **bulb** of clitoris in females.

##### • **Superficial perineal pouch**

Is formed by the **bulbospongiosus muscle** [covers the corpus spongiosum], the **ischiocavernosus muscle** [covers the corpora cavernosum] and the **superficial transverse perineal muscle**. In front lies the external layer of **superficial perineal fascia [Colle's]**. The pouch is pierced by the **vagina** in women while in men the skin has a **median raphe**.

#### 2. **PERINEAL BODY**

Is a **fibromuscular node** in the midline, between anterior and posterior perineum, into which the **anal sphincters**, the **bulbospongiosus**, the **transverse perineal muscle** and fibres of the **levator ani muscle** insert.

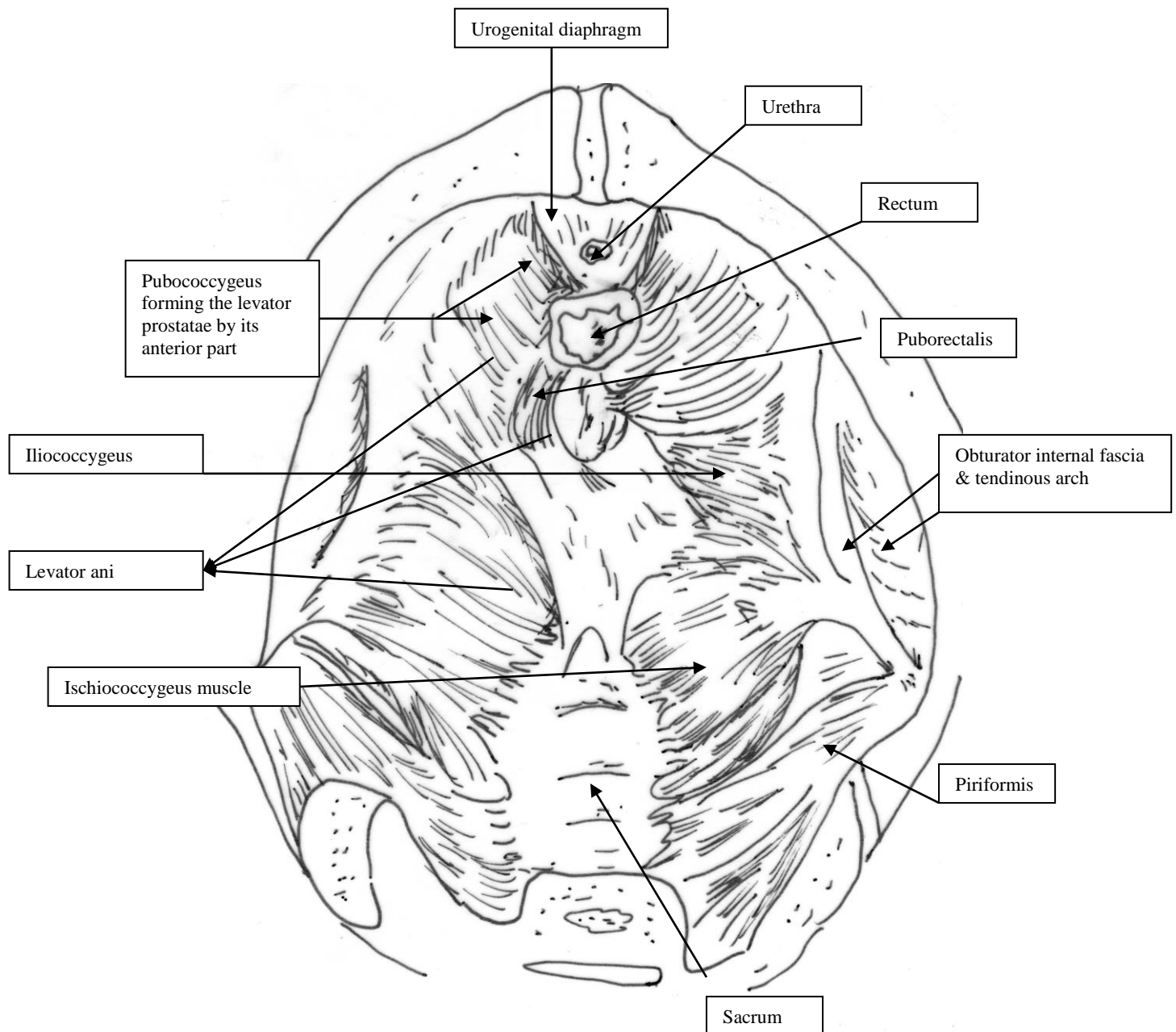
#### 3. **POSTERIOR [ANAL] PERINEUM**

Is the area between the ischial tuberosities and the coccyx. Comprises the **anus and its sphincters**, the **ischiorectal fossae** on each side and the **anococcygeal body**.

The ischiorectal fossa is a fat-filled space around the wall of the anal canal; the two fossae communicate with each other behind the rectum.

##### • **Relations:**

- **Laterally: fascia of obturator internus** [pudental or Alcock's canal, where the pudental vessels pass]
- **Medially: fascia over levator ani and anal sphincters**
- **Posteriorly: sacrotuberous ligament**, covered posteriorly by **gluteus maximus**



- *The floor of pelvis made by the levator ani and muscles that are parts of it [pelvic diaphragm]*

## THE POSTERIOR ABDOMINAL WALL

1. Posterior peritoneum
2. Retroperitoneal areolar tissue
3. Retroperitoneal organs: Kidneys and ureters, suprarenals, pancreas
4. Aorta and its branches
5. Inferior vena cava and its tributaries
6. Nerves and lumbar sympathetic chain
7. Lymphatics
8. Muscles
9. Bones

### BONES

- Bodies of lumbar vertebrae
- 12<sup>th</sup> rib
- Wings of sacrum
- Wings of ilium
- Sacrum

### MUSCLES

#### 1. DIAPHRAGM

Posteroinferiorly the lateral, median and medial arcuate ligaments and the two crura of the diaphragm are formed

#### 2. TRANSVERSUS ABDOMINIS APONEUROSIS

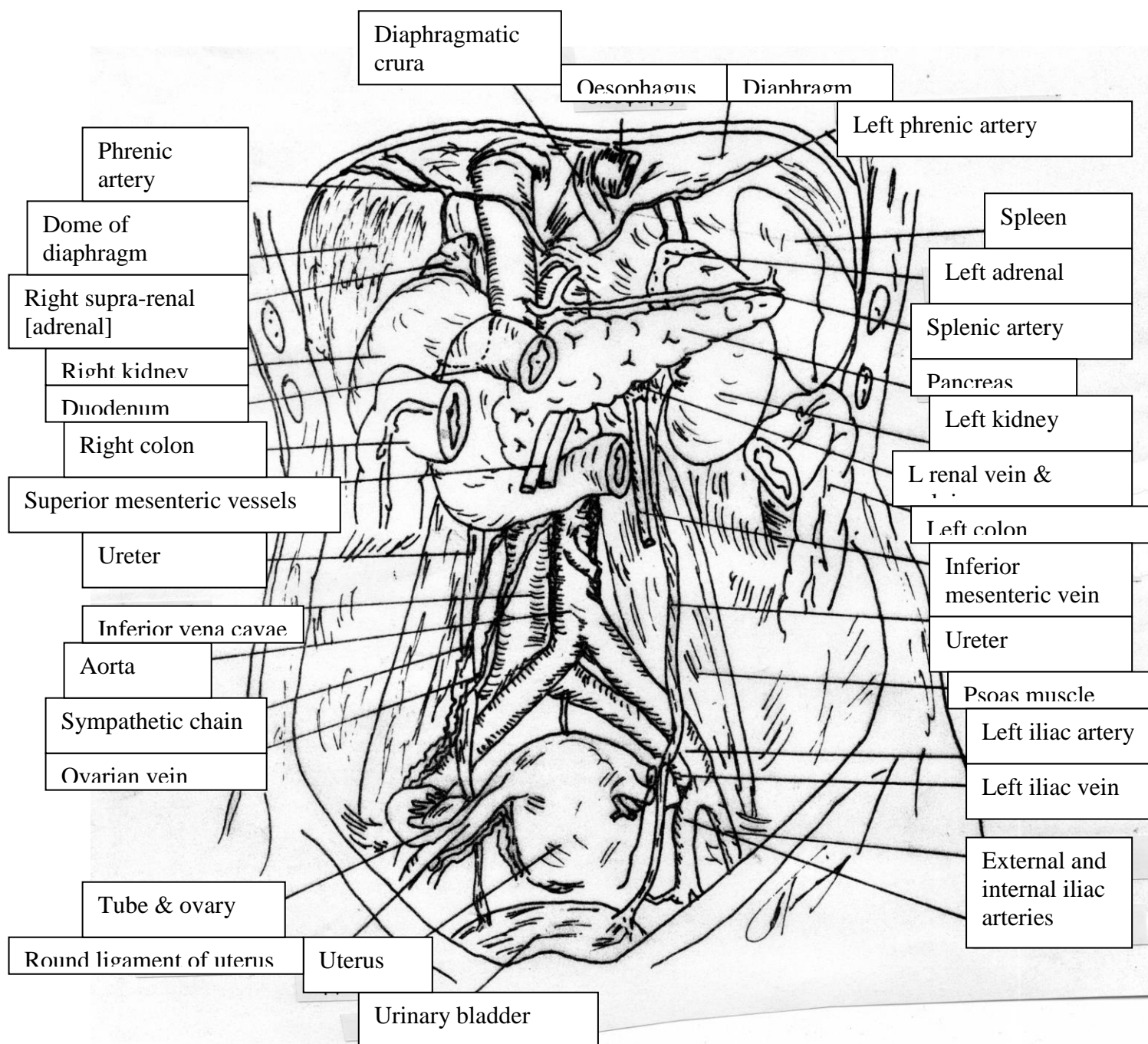
Passes downwards from the 12<sup>th</sup> rib to the iliac crest

#### 3. QUADRATUS LUMBORUM MUSCLE

Extends from the **lateral arcuate ligament** [formed by its fascia and the diaphragm] to the **iliac crest**, where it forms the **iliolumbar ligament**.

#### 4. PSOAS MAJOR

Arises from the **transverse processes of L1-L5 and bodies and intervertebral disks of T12-L5**. Its thickened fascia forms the **median arcuate ligament**. Passes downwards and outwards at the inner brim of pelvis, transforming to a tendon in front of the hip joint, which lies in the **iliopsoas groove**. It inserts into the **lesser trochanter of the femur** together with **iliacus muscle**. On the iliopsoas tendon lies the femoral artery. The **psaos fascia** is a compartment of the **lumbar fascia** so a lumbar infection may spread downwards across the muscle.



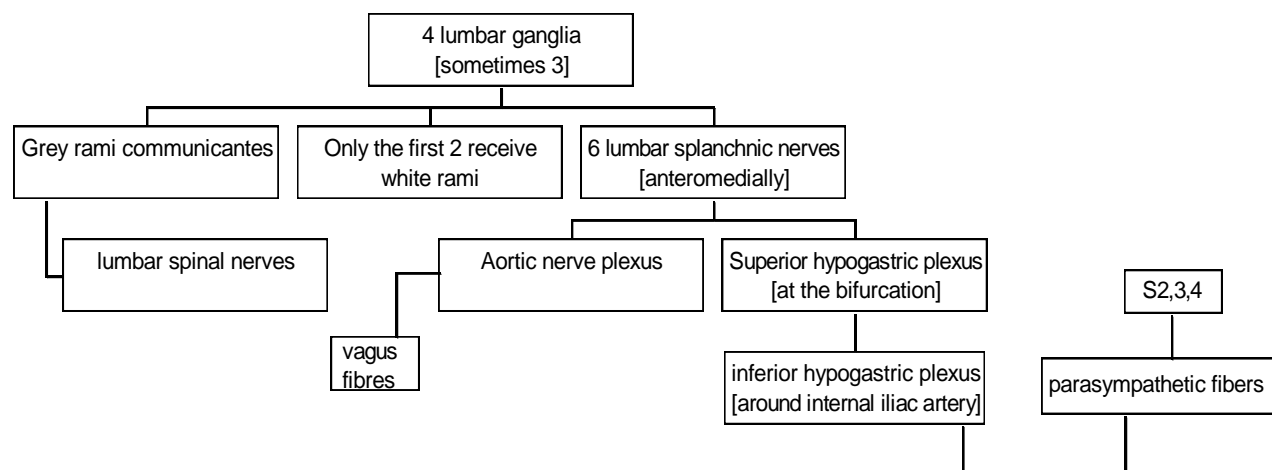
• *The retroperitoneal organs*

## NERVES

- **Medial border of psoas**
  - **SYMPATHETIC TRUNK:** lies on the side of vertebral bodies and the border of psoas
  - **OBTURATOR NERVE** [L2,3,4]
  - **LUMBOSACRAL TRUNK**
- **Piercing the psoas**
- **GENITOFEMORAL NERVE** [L1-2]
- **Lateral border of psoas**
  - **SUBCOSTAL NERVE** [T12], posterior to the lateral arcuate ligament and inferior to the 12<sup>th</sup> rib
  - **ILIOHYPOGASTRIC NERVE** [T12-L1]
  - **ILIOINGUINAL NERVE** [L1]
  - **LATERAL CUTANEOUS NERVE OF THE THIGH** [L2-3]
  - **FEMORAL NERVE** [L2,3,4]. Descends in the angle between the psoas and iliacus muscle.

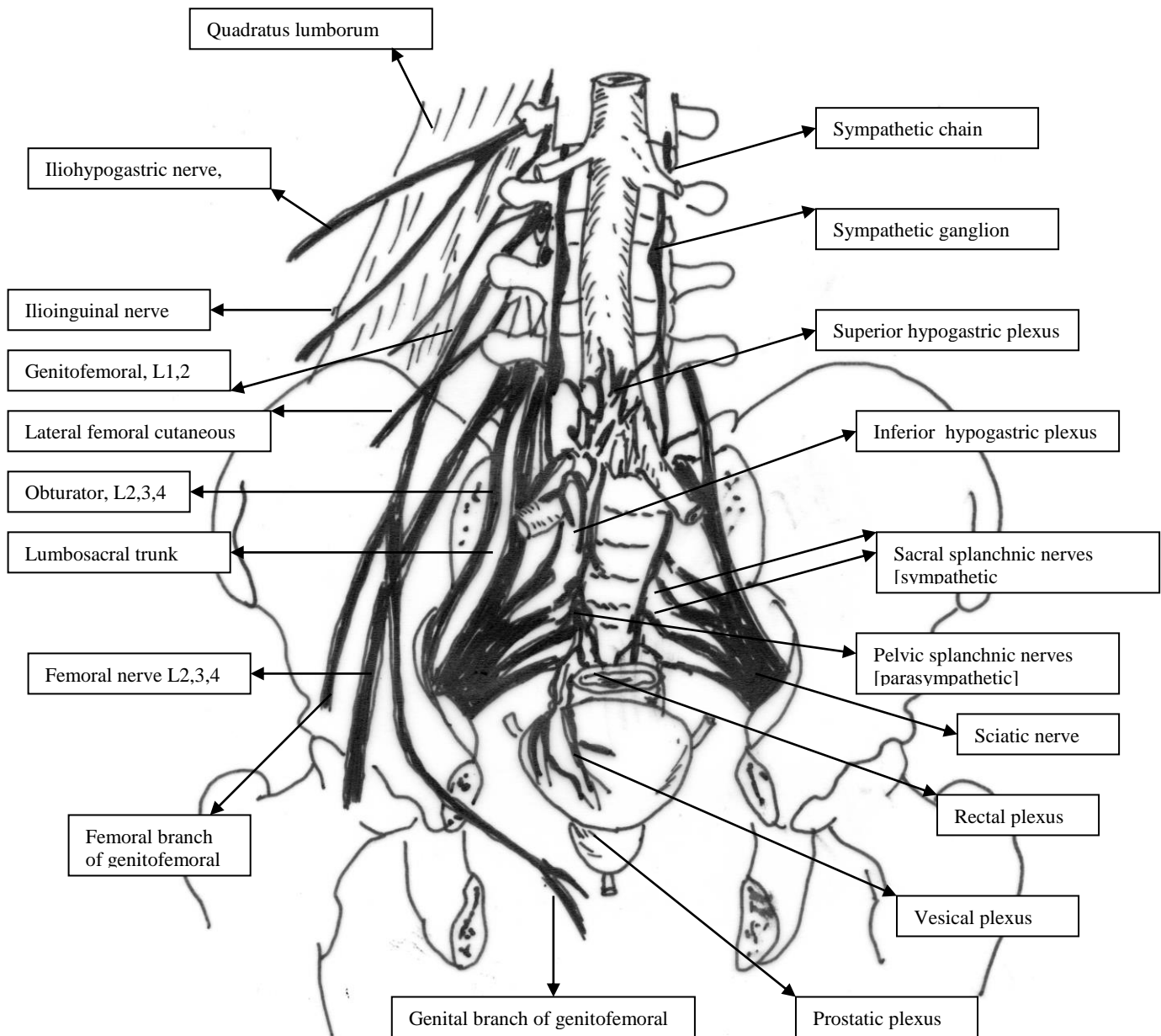
## THE LUMBAR SYMPATHETIC CHAIN

Commences deep to the median arcuate ligament. Lies against the vertebral bodies, overlapped by the aorta on the left and the inferior vena cava on the right. It descends into the pelvis, deep to the iliac vessels, to continue as sacral trunk



### • LUMBAR SYMPATHECTOMY

Transverse lateral incision at the level of the umbilicus. The peritoneum ant the attached on it ureter is pushed medially. The psoas major muscle and the genitofemoral nerve lying on it are identified. The aorta [or IVC] and the vertebrae are visible where the ganglia can be felt. The lumbar arteries lie deep to the chain while the lumbar veins may cross superficially [danger of haemorrhage]. The 2<sup>nd</sup> 3<sup>rd</sup> and 4<sup>th</sup> ganglia are excised.



- *Lumbosacral nerves on posterior abdominal & pelvic wall*



## **ADRENALS [SUPRARENAL GLANDS]**

The adrenals lie postero-medially and cephalad to the kidneys, between the latter and the diaphragm. The left is behind the stomach and the lesser sac, while the right is behind the right lobe of the liver.

- **STRUCTURE & FUNCTION**

They are formed by the **medulla** [inner zone] that derives from the embryonal nerve crest tissue and contains chromaffin cell which secrete **epinephrine**; and the **cortex** [outer zone], derived from the mesoderm and produces steroid hormones [**mineralocorticoids, glucocorticoids and sex hormones**]. They are innervated by the greater, lesser and least splanchnic nerves.

- **VASCULATURE**

- **Arteries**

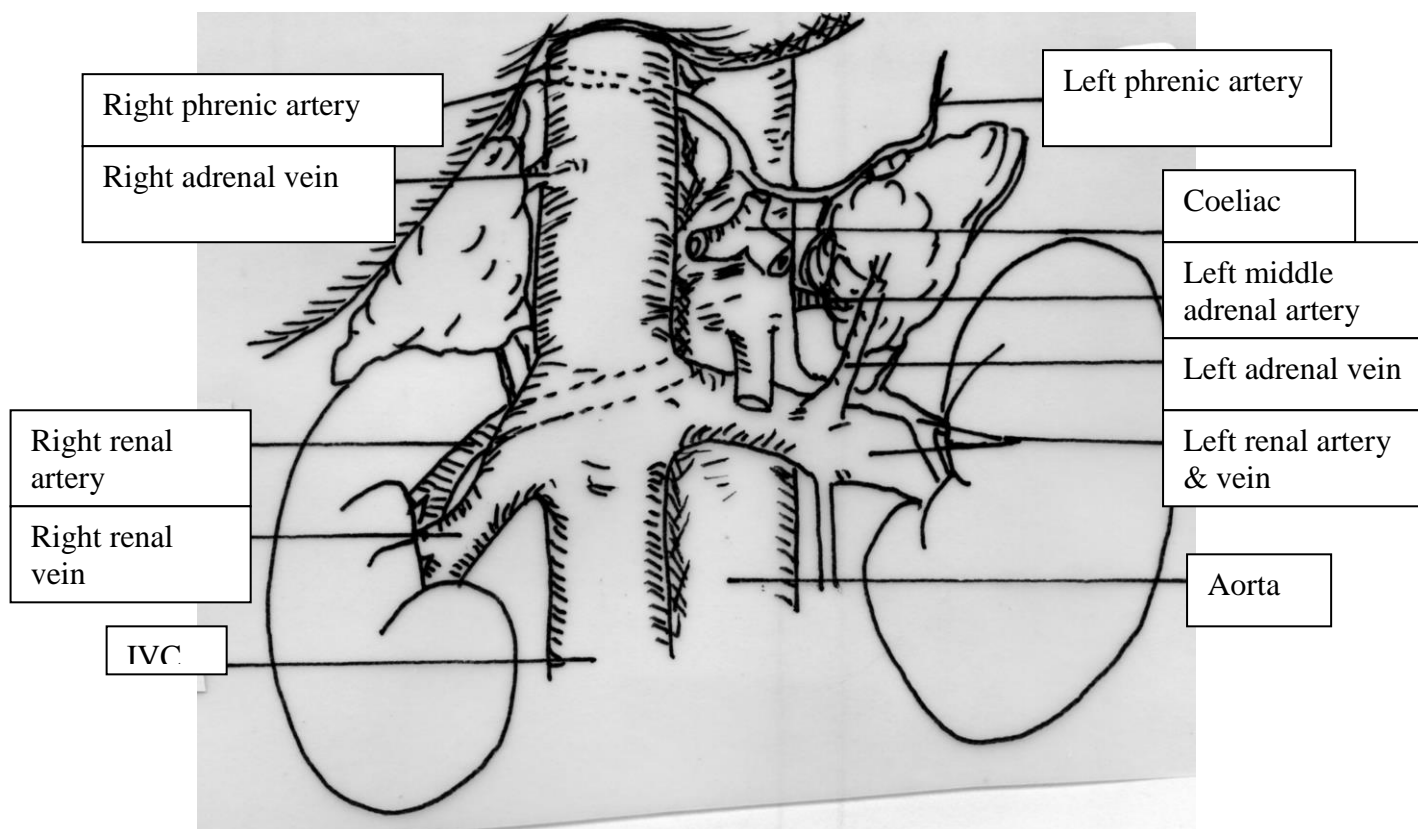
Each gland is supplied by 3 branches [**superior, middle and inferior adrenal arteries**], which arise respectively from **the inferior phrenic artery**, the **aorta** and the **renal artery**.

- **Veins**

There is only one single main **adrenal vein** which drains on the left to the **renal vein**, while on the right it is short and stubby and drains straight into the **inferior vena cava**.

- **CLINICAL CONSIDERATIONS**

- **PHEOCHROMOCYTOMA** is an adrenal medulary tumor causing paroxysms of hypertension due to excessive epinephrine release.
  - **ADRENALECTOMY** for functioning tumours should aim firstly at ligating the vein. The short right adrenal vein is the greatest danger in surgery as it often lies behind the IVC and can be easily detached with significant bleeding. The arteries are of no significance and there is no need to identify them.



- *The adrenals and their vasculature*

## THE INFERIOR VENA CAVA

Commences at L5 behind the right common iliac artery. Lies on the right side of the aorta until separated from it by the right crus of the diaphragm. Passes through the diaphragm at T8.

### • TRIBUTARIES

1. **Right common iliac vein**
  - internal iliac vein
  - external iliac vein
  - ilio lumbar
  - ascending lumbar
2. **Left common iliac vein**
  - internal iliac vein
  - external iliac vein
  - ilio lumbar
  - ascending lumbar
  - median sacral vein
3. **3-4 lumbar veins** on its posterolateral side
4. **Right spermatic vein** [testicular or ovarian] on its anterior surface
5. **Left renal vein**
  - left suprarenal vein
  - left spermatic vein
  - vein communicantes to azygos vein
6. **Right renal vein**
7. **Right suprarenal vein**
8. **Small direct hepatic veins**
9. **Inferior phrenic vein**
10. **Left hepatic vein**
11. **Middle hepatic vein**
12. **Right hepatic vein**

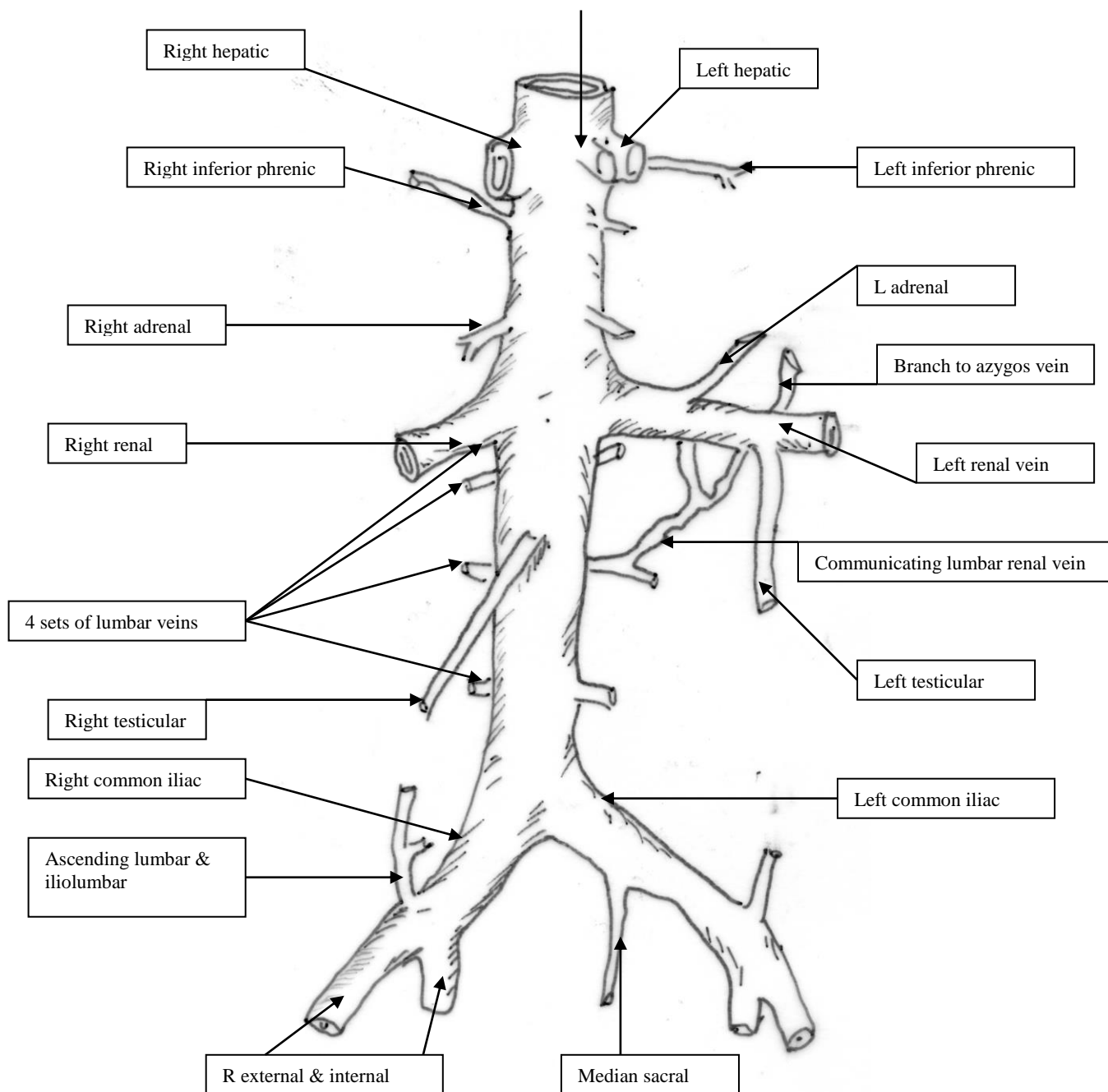
## THE AORTA

Enters the abdomen at the hiatus [T12] and bifurcates at the umbilicus level [L4]. Lies against the vertebral bodies.

### • BRANCHES

1. **Inferior phrenic arteries**
2. **Coeliac axis**
3. **12<sup>th</sup> intercostal arteries**
4. **Left suprarenal artery**
5. **Superior mesenteric artery**
6. **Left renal artery**
7. **Right renal artery**

Middle hepatic
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- *The Inferior vena cava tributaries*

8. **3-4 pairs of lumbar arteries**

9. **Spermatic arteries** [ovarian, testicular]

10. **Inferior mesenteric artery**

11. **Median sacral artery**

• **12. COMMON ILIAC ARTERIES**

It bifurcates at the level of the sacral promontory, in front of the sacroiliac joint. Just there it is crossed by the ureter. The left common iliac is crossed by the nerve plexus which controls ejaculation.

1. **EXTERNAL ILIAC ARTERY**

Runs at the pelvic brim, on the medial site of psoas major, having the external iliac vein on its posterolateral site proximally and anterolateral distally. It passes behind the inguinal ligament to become the common femoral artery at its lower border.

a. **Deep circumflex iliac artery**

b. **Inferior epigastric artery.**

2. **INTERNAL ILIAC ARTERY**

Passes downwards and backwards into the pelvis, sandwiched by the ureter anteriorly and the internal iliac vein posteriorly. At the upper border of the greater sciatic notch it divides into anterior and posterior division.

a. **Iliolumbar artery**

b. **Posterior division**

1. **Lateral sacral artery**

2. **Gluteal artery**

a. **superior gluteal**

b. **posterior gluteal**

c. **Anterior division**

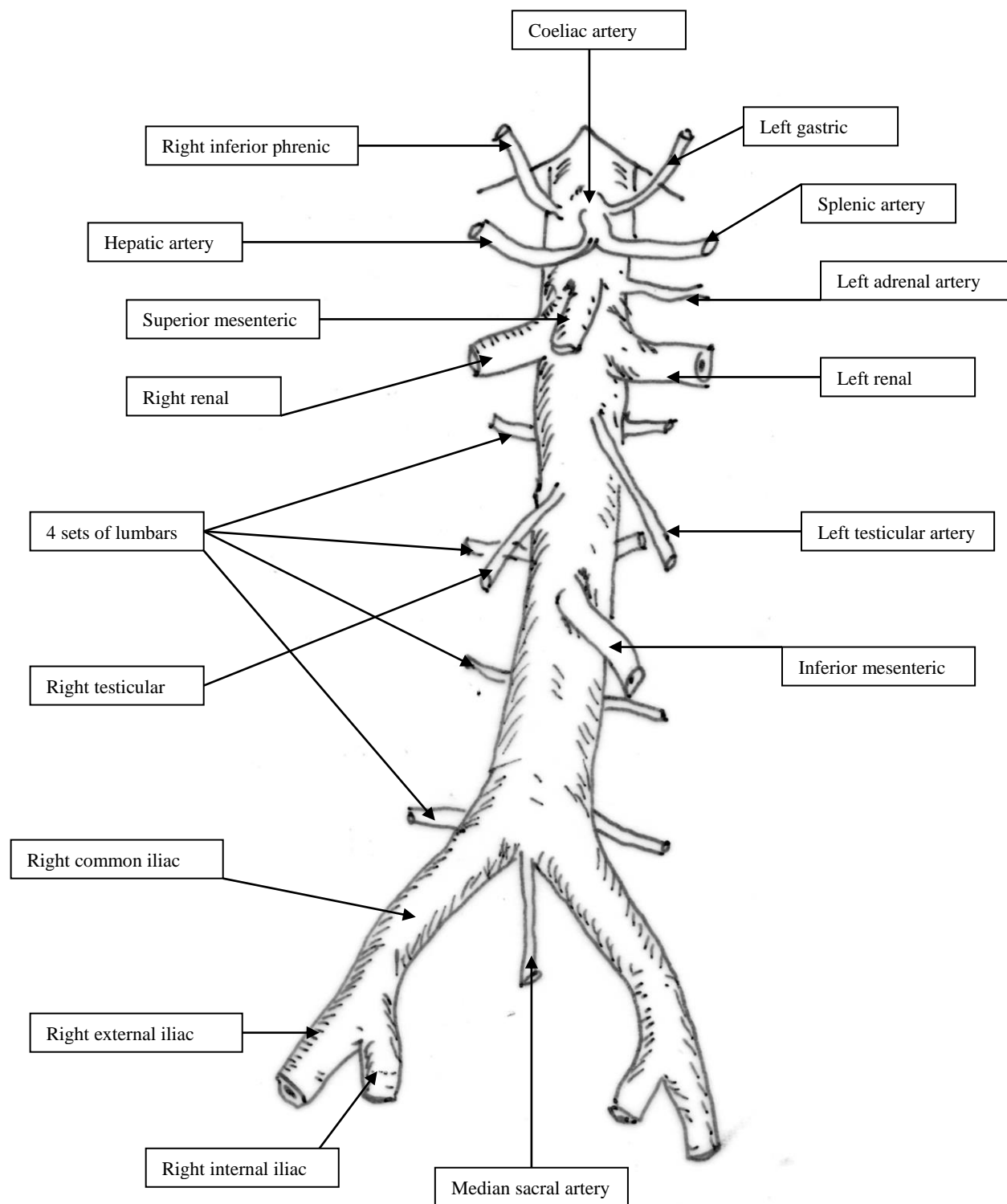
1. **Superior vesical artery**

a. **Uterine artery**

2. **Obturator artery**

3. **Internal pudental artery**

4. **Inferior vesical artery**



- *Branches of the abdominal aorta*

