

GYNECOLOGICAL ANATOMY FOR POSTGRADUATES



BY

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Preface

Knowing the detailed anatomy of female pelvis and pelvic organs is of fundamental importance to every obstetrician gynecologist. In the coming pages I tried to simplify -as much as I could- the anatomy of the female pelvic structures and organs followed by clinical hints of applied surgical anatomy. I divided the book into nine chapters; starting by external genitalia, and ends by pelvic lymphatics. I added some pictures to clarify the explanation and facilitate memorization of the knowledge. I wish this book be of value to my postgraduate students, and to my colleagues .



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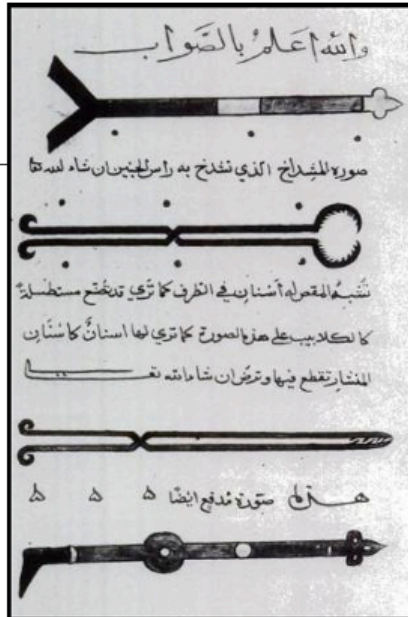
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Albucasis (Al-Zahwari) blistering a patient in the hospital at Cordova, 1100 AD.



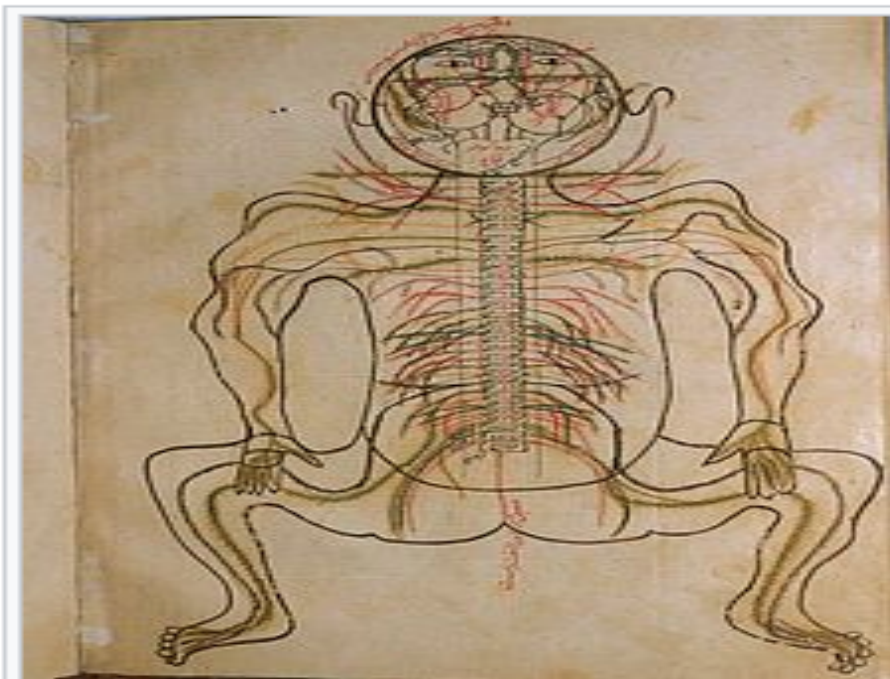
Page from a 1531 Latin translation by Peter Argellata of Al-Zahrawi's treatise on surgical and medical instruments.



Left image: Folio from the "Liber continens" by Al-Razi
 Right image: "Liber continens", translated by Gerard of Cremona, second half of the 13th century



Birth of a prince. Illustration of Rashid-ad-Din's *Jami' al-tawarikh*. 14th century. The astrologers have astrolabes.



Mansur ibn Ilyas: Anatomy of the human body (تشریح بدن انسان, *Tashrīḥ-i badan-i insān*), c. 1450, U.S. National Library of Medicine.



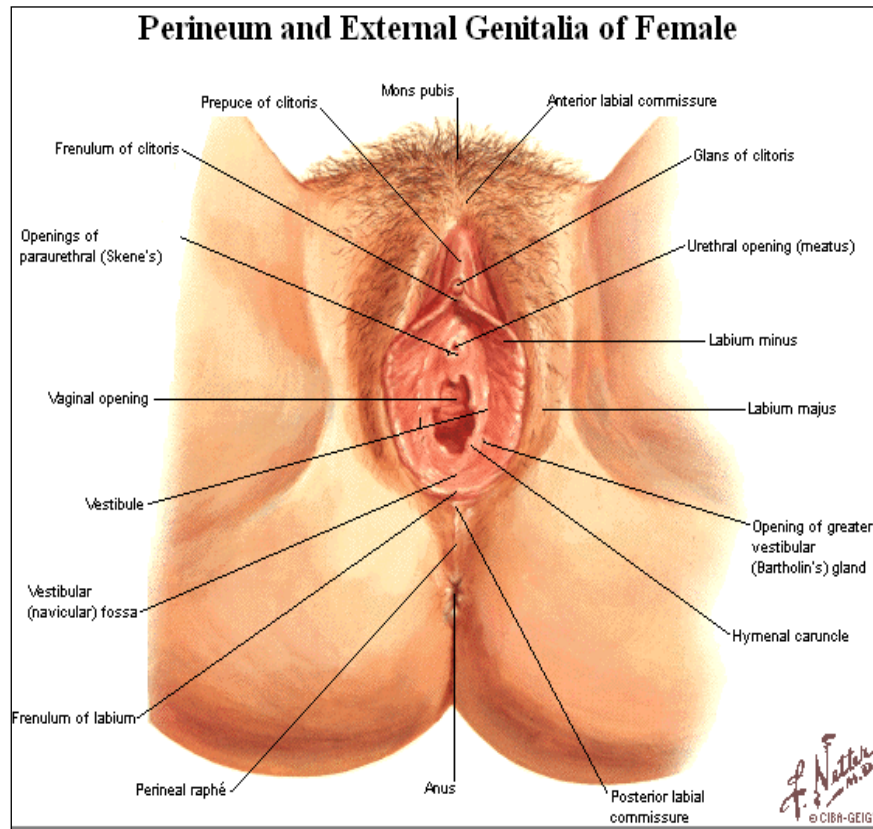
Hospital Building
("darüşşifa") of **Divriği Great Mosque**, Seljuq period, 13th century, Turkey



The Bimaristan of **Granada**

CHAPTER (1)

Anatomy of External Genitalia



VULVA: The gateway to genital tract. Vulva is Latin word means covering. It consists of labia majora and minora laterally, mons veneris anteriorly and Perineum posteriorly. These structures bound the clitoris, vestibule, external urethral orifice, vaginal orifice, the hymen and fourchette

Mons pubis:

Soft rounded mountain or cushion of fatty tissue which covers the front of symphysis pubis and it is covered with hair. It is named Mons Veneris after Mountain of Venus and after the Romans goddess Venus.

Manipulation of mons area results in slow sensual experience. It acts as coital buffer preventing pubic bones from impinging against each other, during sexual act .

Labia majora:

- Consists of 2 folds of skin enclosing fat and loose connective tissue and meet anteriorly to form the mons then narrowing posteriorly to merge into each other to become the perineal skin. Its

deep fatty portions contain the terminal portions of the *round* ligaments. It protects the inner sensitive parts of the vulva

- It is estrogen sensitive, so it becomes prominent from puberty onwards.
- It accumulates edema fluid as the S.C. tissue is very loose (as eyelids)
- It is sensitive to temperature change (Dartos' muscle or Dartos tunic) so, become wrinkled in cold whether and is large, softer in warm whether. (analogous to male scrotum)

Labia minora: (Nymphae):

- These are two delicate folds of skin lying medial to labia majora., consists of loose connective tissue, blood vessels, and large blood spaces resembling erectile tissue.
 - It has wide variation in shape and size. The size is a clinical index of the degree of estrogenisation at any age (in the natural state).
- It may be hypertrophied (congenital or acquired by local stimulation as masturbation)

Is important as clitoris as source of erotic arousal (↑ 2-3 times) and undergoes colour changes from pink to bright red to deep wine due to intense vascular engorgement

Pubic hair:

Mons veneris and labia majora covered by short, coarse, curly hair which has straight upper border in most female.

Male hair distribution (passing upwards onto the abdomen) in 25% of women and may signify virilizing influence in the patient. Vulval infection may lead to boils, furuncles and sebaceous abscess infestation with phthirus pubis

Vulval skin:

Covered with stratified sq. epith. The basal layer is cuboidal cells, produces the more superficial epidermal cells and rests upon vascular dermis which nourishes it. As cells produced, it pushes superficial cells that become isolated and less nourished → become keratinized and exposed to dermatological vulval lesions e.g. Herpes, Lichen sclerosis, vitilligo and carcinoma. Also pigmented lesions can occur e.g. nevi.

Vulval sebaceous and sweat glands:

Sebaceous glands open into hair follicles but not on the labia minora where hairs are absent, they open freely on the skin surface.

The vulval is good site for sebaceous cysts (as the scalp)

Its secretion acts as lubricant and waterproofing of vulval skin.

Vulval secretions has antibacterial power: due to [Water from sweat glands, Oily from sebaceous glands, Mucoïd from Bartholin glands, Together with acid secretions of vagina].

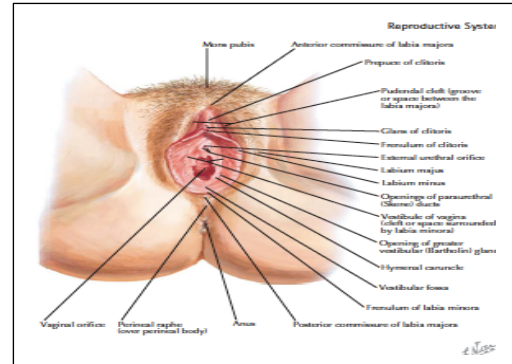
Fourchette :

The posterior union of labia minora across the midline behind the vaginal orifice.

Scarring indicate previous trauma due to coitus, childbearing or surgical operations

The vestibule of the vulva:

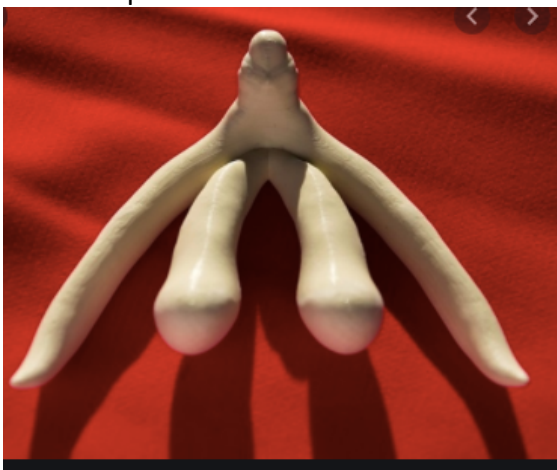
- Means entrance and is a triangular space bounded by:
 - Clitoris : anteriorly
 - Labia minora: laterally
 - Fourchette: posteriorly
- Open into it 4 canals:
 - 1-Urethra: anteriorly
 - 2-Vagina: posteriorly
 - 3-Tiny ducts of Bartholin gls: on each side



- The vestibule is wet in sexually responsive female i.e. penis is welcome due to secretions of Bartholin gls (coital lubricators). If the female is not responsive → dry vestibule which is usually emotional (worried or tense) or it may be due to damage or blockage of Bartholin duct.
- In vulvectomy done for lichen sclerosis or leukoplakia, the area of the vestibule is seldom affected

The clitoris:

- Means key in Greek i.e. key to women’s sexuality. It is the homologue of penis so, it is called penis of women or penis mullibris
- It is situated in the midline in front of the symphysis pubis where it projects as a small structure more easily palpable than visible.
- It is attached to the symphysis pubis by the suspensory ligament which is a small fibrous bands that extend from the lower border of the pubic arch onto the clitoris itself, to hold the clitoris in place and separate the 2 crura



Erectile tissue:

The clitoris arises by 2 crura attached mainly to ischiopubic rami and partly to the undersurface of the triangular ligament. The 2 crura unite to form the shaft which consist of 2 corpora cavernosa which are formed by large no of venous caverns. The shaft is capped by a round glans which is covered by means of mucus memb. containing many specialized nerve endings and so it is very sensitive to touch .It has abundant vascular supply from the dorsal artery of the clitoris which is the terminal branch of the internal pudendal artery which is itself the terminal branch of ant. division of internal iliac artery.

Prepuce or foreskin:

Is a delicate fold of tissue which cover the shaft and forms a tiny hood above the glans but does not completely cover it.

The prepuce is analogous to male foreskin and is formed by the labia minora which splits and join anteriorly in the midline. Posteriorly, a similar fold is formed in the same way and is called frenulum of the clitoris under the prepuce, a greasy secretion called smegma which is responsible for specific genital odour stimulating erotic effect on the opposite sex when the clitoris is erect, the foreskin normally retracts exposing the sensitive tip of the glans which protrudes to receive further stimulation by sexual contact.

Adherence of the foreskin to the glans or a redundant foreskin may result in ↓ed sensitivity of the organ. So, freeing the foreskin may thus be important in increasing the sexual response

Muscles of the clitoris:

-2 clitoral muscles on each side:

- Ischiocavernosus muscles: arises from the ischium (inferior ramus of ischium) and inserts into the corpora cavernosa of the clitoris and surrounding the base of the crura
- Bulbocavernosus muscle: arises from the perineal body around the bulb of the vestibule and insert into the dorsum of the clitoris when these muscles contract in response to sexual simulation, they trap blood in corpora cavernosa by compressing the dorsal vein of the clitoris → stiffening and erection

Arterial supply:

- Internal pudendal artery through its terminal branch dorsal artery of clitoris
- External pudendal artery which arises from the femoral artery

Venous drainage:

With that of the vulva into large venous plexus

Lymph drainage:

Skin of clitoris and prepuce: into superficial inguinal LN.
Glans + body : into superior ext. iliac LN.

Embryology:

Clitoris is developed from the phallic of urogenital sinus. It arises as a midline swelling at the cephalic and of urogenital sinus called genital tubercle

Nerve supply:

Pudendal nerve

The enhanced clitoral sensitivity is though to be dependent on an abundance of Dogiel krause corpuscles in the clitoris. There are considered to be the pressure endings of sexual perception in the genital area .

↓ of these receptors → less sensitive clitoris

Applied Anatomy:

- Circumcision may be indicated when there is
 - redundancy of prepuce
 - hypertrophy of clitoris

It may involve removal of prepuce only as in type I or removal of the whole clitoris as in type II and III.

Circumcision may lead to sexual dysfunction in female

- Androgen excess may lead to clitoriomegaly as in CAH and in non adrenal androgenisation. The size of the clitoris depends on the amount rather than the duration of androgen excess and its time of onset
- Differences bet. the penis and clitoriomegaly

The bulbs of the vestibule:

In female, this structure is perforated by the vagina (not by the urethra as in male) and thus it forms 2 masses or bulbs of erectile tissue situated deep in the substance of the labia majora

They are named the bulbs of the vestibule as they encircle the vaginal introitus at the vestibule

- Sexual excitement → contraction of bulbocavernosus that compresses the veins draining the vestibular bulbs → vulval erection → adds to friction at coitus → lengthening the vulvovaginal clasp over erectile penis
- Trauma of the bulb of vestibule → heavy bruising due to extreme vascularity

Bartholin glands: greater vestibular glands:

Their function as coital lubricators was 1st described by Casper Bartholin in 1677

-The name greater vestibular glands is due to the fact that they open into the vestibule of the vulva. (while the lesser vestibular glands are the tiny mucus secreting glands in the wall of the urethra)

-The Bartholin glands are the homologue of Cowper's glands in male They lie on either side of vaginal entrance buried deep in the posterior part of the labia majora in contact with the bulb of the vestibule

-The normal gland has a size of a broad bean and is not palpable unless altered in size or consistency by disease. Its shape is oval .

-The glands are compound racemose in type which means that the acini are arranged in clusters around branching ducts like grapes on stalks i.e. There is one main duct and many smaller subsidiary ducts the main duct opens on the inner side of each labium majus at the junction of the ant. 2/3 and post 1/3 just in front of the hymen the duct is 1.25 – 2 cm in length

Histology :

It is compound racemose gl. with the acini lined by single layer of columnar epith. or cuboidal epith

The duct is lined by multilayered columnar cells (compound columnar) and not by transitional epith. as is usually state.

Embryology:

The gland arises from vestibular endoderm

Applied anatomy :

1. Produces mucus alkaline fluid → coital lubricator
2. Swellings of Bartholin are situated in the post 1/3 and swellings elsewhere on the vulva are never of Bartholin gl. Origin.
3. Excision of the gl. May → brisk haemage as it is in contact with the bulb of vestibule
4. Bartholin gl. Carcinoma: lymphatic drainage is partly superficial to inguinal nodes and partly deep to the internal iliac gp. So drainage into deep glands from superficial organ makes it difficult to treat
5. Bartholin duct cyst: it is cystic dilatation of the main duct of the gland and rarely involves the glandular tissue it self. It occur when the duct becomes obstructed and the gland continue to secrete its lubricating fluid behind the obstruction the result is therefore a cyst of the duct and never of the gland it self.
6. Excision of the cyst is rarely performed since its drainage by ward catheter or Foley's catheter will permit normal function
7. The duct opening at the introitus is not normally visible but when the gland is infected, it may be evidenced by presence of tiny red pouting spot which may exude pus

The hymen:

Was the name of the god of marriage and the hymenus was the song sung at marriage ceremonies .

It is not peculiar to human. A similar obstacle found in nearly all female animals in whom it is know to burst shortly before sexual maturity is reached .

It is designed to prevent sexual intercourse before sexual maturity .

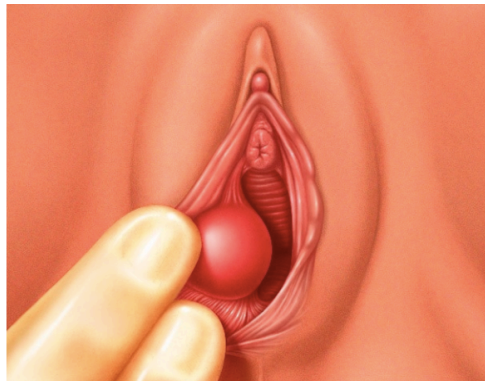
It is a delicate thin elastic diaphragm which partly closes the vaginal entrance at the site where canalization of the vagina from above and from below meet.

It may differ in thickness from that of spider web to a fleshy memb. the hymenal aperture which allows the passage of menstrual blood is variable in size but in adult vagina, it only admits the tip of small finger the shape of the orifice is also variable but mostly appear as a single central aperture and less after as a longitudinal slit. Rarely, the opening is duplicated, cribriform or even imperforate

Embryology:- Embryologically, this imperforate hymen occur when the septum which closes the lower end of the vagina (complete at 1st but at alder stage centrally perforated to form the hymen) remains imperforate

Applied Anatomy

- 1- Intact hymen is not an absolute proof of virginity and ruptured hymen is not an absolute proof that coitus has occurred
- 2- At 1st coitus, the hymen is relatively an a vascular structure and in most cases bleeding is insignificant or it may be absent also coitus produces posterolateral basal tear
- 3- Childbirth results in destruction of the hymen → remnants called carunculae myrtiformis. This effect upon the hymen is the most constant of all signs of parity
- 4- The imperforate hymen: haematocolpos → haematometra → haematosalpinx



← Right Bartholin Cyst



Anatomical changes that occur in the vulva with age

1- During infancy and childhood: estrogen absent, vulval skin delicate and thin

- The labia minora and vaginal introitus assumes a more exposed position so that the vagina becomes more prone to infection
- Labial adhesions or conglutination of the labia in the newborn .

Treatment : fine probe

2- At puberty: The mons and labia majora become filled out and prominent so that the labia minora and vaginal orifice become hidden and protected by the overlying structures.

3- After menopause: The labia majora, minora and mons shrink down again due to ↓ed estrogen
This explains the vulval atrophy after menopause

Arterial supply of the vulva:

The vulva is extremely vascular. Supplied by

- Superficial and deep ext. pudendal arteries: from femoral artery

- Internal pudendal artery: from int. iliac artery
 - The vessels freely anastomose, so if int. iliac ligation, the vulva will not suffer
 - The vulva and perineum has remarkable healing power

Venous drainage of the vulva:

Veins corresponding to arteries which it self drain into the internal iliac vein also saphenous vein drains portion

- Vulval haematoma commonly occurs with trauma of childbirth
- Vulval varicosities: results from obstruction of venous circulation in the pelvis or abdomen as in later months of pregnancy
- The long saphenous vein: drains a portion of vulval venous return so, most vulval varicose veins may be improved if long saphenous v. ligated

Lymph drainage of the vulva

- Vestibule and perineum → superficial inguinal LN situated in the superficial fascia (superficial to fascia late) of the groin just below the poupart's ligament
- Clitoris: deep inguinal nodes (Cloquet or femoral nodes) situated deep to the fascia late of the femoral canal

Vulval lymphatic drainage is predominantly superficial, so it is less serious condition than cancer cx.

The lymphatics from each side of the vulva communicate freely with each other in unilat. growth, lymphatics of contralateral side are involved in 50% as compared with 80% when growth is situated in the midline

Nerve supply of the vulva: pudendal nerve

Which is derived inside the pelvis from S1,3,4 roots of sacral plexus since all structures supplied by it are in the perineum, it has to find its way out of the pelvis until it reaches the perineal area where it splits up into various branches

It escapes from the pelvis through the greater sciatic notch and crosses behind the ischial spine and curls around it so as to pass through the lesser sciatic notch in order to gain access again into the pelvis to the Alcock's canal accompanying the int. pudendal artery.

Both these structures lie on the lateral wall of the ischioanal fossa in Alcock's canal and thereafter expend themselves by supplying the skin organs and muscles of perineum.

Pudendal nerve is the chief responsible for pelvic maneuvers e.g.copulation, parturition, micturition, defecation plus erection and ejaculation. So, it is called the great nerve of the perineum

To control these maneuvers, it must supply all sensory fibers to the skin of the anus, vulva, vagina, urethra and clitoris and supply motor fibers to all the voluntary fibers of muscles of the pelvis including the levator ani and ext. anal sphincter

- The rich sensory innervation of the vulva → makes itching as a prominent symptom. This in contracts with the somatic innervation of insensitive vagina whose main nerve supply is autonomic in type

- Pudendal nerve block anaesthesia: given to anaesthetize the pudendal nerve while crossing the ischial spine

Development of external genitalia

The primitive cloaca becomes divided by a transverse septum (called urorectal septum) into an anterior urogenital portion and a posterior rectal portion

The urogenital portion of cloacal memb. breaks down slowly shortly after division is complete

The urogenital portion is called the urogenital sinus and develops further into 3 portions:

- 1- Phallic part: external expanded portion
- 2- Pelvic part: deeper narrow (bet. the phallic part and the region of the mullerian tubercle)
- 3- Vesicourethral part: connected superiorly to the allantois

Externally, in the phallic region, the genital tubercle forms a conical projection around the ant. part of the cloacal memb.

Proliferation of mesoderm round the urogenital sinus leads to formation of

- Medial pairs of swellings called genital folds
- Lateral pairs of swellings called genital swellings

Up to this stage (at 10w), development is the same in male and female i.e. neutral primordium. Then differentiation occur:

▪ In female:

- The bladder and urethra from the vesical portion of urogenital sinus
- The vestibule: from the pelvic and phallic portions
- The clitoris: from the genital tubercle which enlarges only slightly
- The labia minora: develops from the genital folds which remain unfused
- The labia majora: develops from the genital swellings which enlarge and fuse in front of the anus to form the posterior commissure
- Greater vestibular gl. of Bartholin, lesser vestibular gl.: arise from the vestibular endoderm

This occurs in female in whom testicular androgen is absent also occur in male pseudohermaphrodite in whom there is absence of androgen effect as in androgen insensitivity

▪ In male

With androgen secretion, the following occur:

- Genital tubercle: greater enlargement to form the penis
- Genital folds: fuse over a deep groove formed bet. them to become the penile part of male urethra
- Genital swellings: enlarge and fuse to form scrotum

The homologues of the ext. genitalia in male and female:

Female	Male
<ul style="list-style-type: none"> • Labia minora • Labia majora • Bulbocavernosus • Ischiocavernosus muscle (RT., LT) • Bulbs of vestibule • Crura, corpora cavernosa, glans of clitoris • Bartholin glands (RT., LT) • Paraurethral gl. of Skene • Round and ovarian ligaments 	<ul style="list-style-type: none"> • Edges of incised penile urethra • Incised scrotum • Bulbospongiosus • Ischiocavernosus muscle (RT., LT) • Incised bulb of the penis and corpus spong. • Spilt corpora cavernosa and glans of penis • Bulbourethral gland (Cowper's gl.) • Prostate • Gubernaculum testis.

Due to similarity in structure, female homologues have often similar function and also predilection to same pathology;

- *Scrotum*: similar appearance and behavior to labia majora
- *Corpora cavernosa* and glans penis in male are almost identical with female homologues in erectile behavior
- *Corpus spongiosum* similar in erectile behavior to bulb of vestibule
- *Bulbospongiosus* in male act as sphincter that empty the bulb of the penis and spongy urethra (during ejaculation, the muscle lying under perineal skin is seen and felt to contract (convulsively). The female counterpart act as sphincter to the distal vagina
- *Ischiocavernosus* is responsible for penile erection in male and clitoral erection in male
- *Bulbourethral glands* and Bartholin gl. Both contribute to sexual secretion
- *Prostate* and paraurethral gland. of Skenes are vulnerable to similar pathology e.g. gonococcal invasion
- *Gubernaculum* and female counterparts act as gonadal tractors

Chapter (2) Female genital mutilation [cricumcision]

Definition:

It includes all procedures involving partial or total removal of any of the vulval structures or other genital structures for cultural or other non – therapeutic reasons

Classification:

The different types of female genital mutilation known to be practiced are as follows

Type I: (Sunna)

Excision of the prepuce of the clitoris with or without part of labia minora

Type II:

Excision of the clitoris totally or partially with partial or total excision of labia minora. It is the most common type done.

Type III: (Infibulation or pharonic or Sudanese circumcision)

Excision of the whole clitoris, whole labia minora and the labia majora especially their inner sides and closure of the orifice by suturing together what is left of the labia majora leaving a very small opening to let urine and menstrual blood pass

Type IV: (unclassified)

This includes:

1. Pricking or incising the of the clitoris and/or labia
2. Stretching of the clitoris/or labia.
3. Cauterisation by burning of the clitoris and surrounding tissue
4. Scrapping of tissue surrounding the vaginal orifice(Anguria cuts)
5. Cutting of the anterior vaginal wall to facilitate labor, and treat other problem according to some tribian thoughts (Gishiri cuts).
6. Introduction of corrosive substances or herbs into the vagina to cause bleeding or for the purposes of tightening or narrowing it.
7. Any other procedure that falls under the definition of female genital mutilation

Epidemiology :

- Most of girls and women undergoing genital mutilation live in 28 African country and some live in Ascia
the cases found in Europe, Australia, Canada and USA are primarily among immigrants from Africa and south western Asia
- It is estimated that over 130 million girls and women in Africa have undergone some form of genital mutilation

- The commonest type of female genital mutilation is excision of the clitoris and labia minora 80%
the most extreme form is infibulation (15%) and is much higher in Djibouti, Somalia, northern Sudan. Also reported in southern Egypt, Eritrea, Sudan, Ethiopia, Kenya. Mali, Nigeria
- Currently, it is estimated that at least 2 million girls are at risk of genital mutilation every year

Circumcision in Egypt:

Motives for female circumcision in Egypt are;

1- Psychosexual reasons:

Reduction or elimination of sensitive tissue of genitalia esp. clitoris in order to attenuate sexual desire in female to maintain chastity and virginity before marriage and fidelity during marriage

2- Familial and sociological reasons

3- Religious reason

belief that circumcision is recommended by religion. This may be the reason behind naming it Tahara (i.e. purification)

4- Myths

- Circumcision reach by the girls to puberty
- Promotion of child survival
- Promote hygiene and provide aesthetic appeal (as they consider the female ext. genitalia and unsightly).

Historical background:

- No documents that clear prove that this custom originated in Egypt or to ascertain whether started in some African country then was adopted in Egypt. Or whether it was a pharonic custom that continued to exist in the country unit now
- Also, it is not an Islamic practice as evidenced by:
 - 1- The operation is not known in other Islamic countries e.g. Saudi Arabia
 - 2- Both Moslems and Copts in Egypt practice circumcision
 - 3- There is strong evidence that it was carried out before Christianity and Islam in Egypt

Islam opinion:

No text in Islamic religion which recommends or prohibits female circumcision but references to it are made in some uncertified 'Hadith' of the prophet Mohammad (God's prayers upon him). So, the conclusion of Islamic opinion is that whereas male circumcision is a commendable act, female circumcision is not.

Christian opinion:

Also no relation to Christianity as Christians in Europe, America, etc. do not practice such operation

The operation in Egypt:

- Type I and type II are the types performed in Egypt
- 95% of female are circumcised mainly in rural areas. Those who escaped it constitute the higher sociocultural class of women
- Female circumcision frequently done at home by midwife, daya and women of similar category
- Scissors, razor blade or scalpel are used, without anaesthesia, without antisepsis and without medication given
- To stop bleeding, primitive means are used in the form of ground coffee or even oven ashes
- The age of girl at the time of operation is usually about 10y. but the range is from 3-10y.
- The person responsible for making a decision in the family to circumcise a girl is primarily the mother

Indications for female circumcision: [very limited indications]

- 1- Phimosis: because it collects smegma → irritation and masturbation
- 2- Hypertrophy of the clitoris
- 3- Hypertrophy of the labia (disturb the female and her husband)
- 4- Redundancy of the prepuce → interfere with sexual satisfaction

Complications and hazards of female genital mutilation:

May be immediate, remote or psychological

[A] Immediate complications:

- 1] Shock: may result from
 - Psychological shock: due to fear and painful sensation esp. when done without anaeth.
 - Haemorrhage: may be severe to cause shock and even death infection: esp. with anaerobic org
- 2] Pain: severe pain that may continue for several days after the operation
- 3] Bleeding: the most dangerous
 - may be severe to cause shock or even death if untreated
 - may occur due to injury of the clitoral artery
- 4- Infections:
 - e.g. urethritis, cystitis, abscess and up to septicemia
 - certain infections are however important due to their severity and the bad prognosis as tetanus, AIDs and Hepatitis C which result from using one instrument in multiple operations
- 5] Damage to urethra, vagina or anus: (injury)
 - liable to occur due to undeveloped state of the genitalia and the struggle of the girl held forcibly during the operation

- 6] Urine retention: usually in pharonic cirrcumcision due to sutures or infection or reflex from pain
- 7] External deformation: due to tissue adhesions that result in deformities as a result of infection

[B].Remote complications:

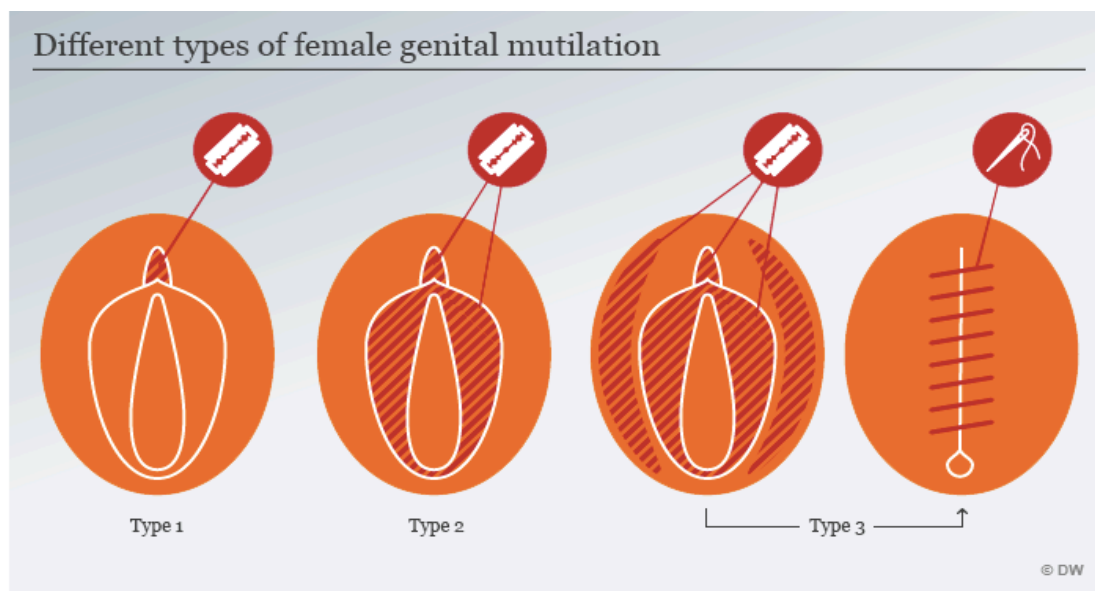
- 1) Keloid
A common complication of infibulation → thick scar which is tough and often hypertrophied
- 2) Neuroma: (Nerve tumour)
The scar of keloid may be the site of neuroma at the point of section of the dorsal nerve of the clitoris
- 3) Dermoid cyst
Implantation dermoid cysts may grow to a large size and occasionally get infected with abscess formation
- 4) Bartholin cyst
Or abscess may result from cutting or blocking the ducts during infibulation
- 5) Cryptomenorrhea
- 6) Anal intercourse and painful coitus
dysparuenia due to tight circumcision, pain or spasm of vagina may be factors that divert to anal intercourse which may lead to funnel anus, anal fissures and occasionally incompetence of anal sphincter
- 7) Defloration injury
- 8) Decreased libido: leading to marital problems
- 9) Difficulty in achieving orgasm leading to pelvic congestion
- 10) Infertility
- 11) Obstet. complications
 - a- Soft tissue obstruction
 - b- Prolonged 2nd stage
 - c- Vulval and perineal tears
 - d- ↑ incidence of necrotic fistula
 - e- ↑ incidence of forceps and C.S

[C].Psychological complications: depend on;

- Degree of mutilation
 - Age at which circumcision done
 - Use of anaesthesia
- 1) Damage to marital relation: due to frigidity or vaginismus which may be reflection of psychic trauma of circumcision pain or due to cut sensory pathway
 - 2) Use of drugs by male: on assumption that it will solve their problems and prolong sexual act.

The Medicalization of Female Genital Mutilation :

WHO has consistently and unequivocally advised that female genital mutilation in any form should **not** be practised by health professionals in any setting including hospitals or other health facilities. The WHO's position rests on the basic ethics of health care whereby unnecessary bodily mutilation cannot be condoned by health providers. Genital mutilation is harmful to girls and women and medicalization of the procedure does not eliminate this harm. Medicalization is also inappropriate as it reinforces the continuation of the practice by seeming to legitimize it. In communities where infibulation is the norm it has been noted that many families revert to clitoridectomy when health education programmes commence. However, the formal policy messages must consistently convey that all forms of female genital mutilation must be stopped.

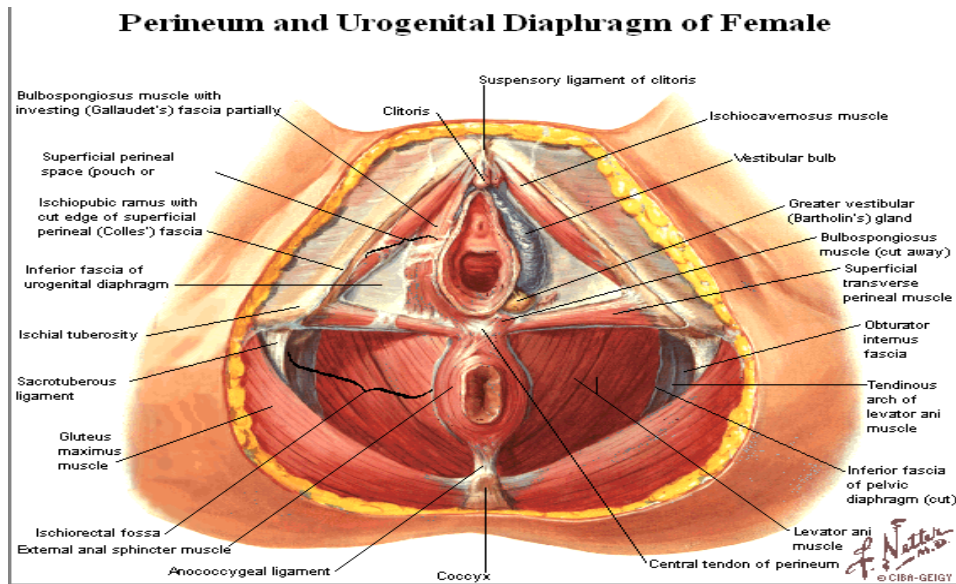


CHAPTER : (3)

- Female perineum
- Anal triangle
- Ischiorectal fossa
- Urogenital triangle
- Superficial perineal pouch
- Deep perineal pouch
- Perineal body



The Female Perineum



It is the outlet of the pelvis which is diamond shaped

It has 4 angles and 4 sides:

- **The anterior angle:** formed by lower border of symphysis pubis
- **The posterior angle:** formed by the tip of the coccyx.
- **The 2 lateral angles:** formed by the 2 ischial tuberosities
- **The 2 anterolateral sides:** formed by the pubic arches
- **The 2 posterolateral sides:** formed by the 2 sacrotuberous ligaments

Divisions:

The diamond shaped space is divided into 2 triangles by a transverse septum of ligamentous and muscular tissue formed by transverse perineii muscles and the base of the urogenital diaphragm .The urogenital triangle anteriorly and the anal triangle posteriorly

The Anal Triangle

Contains:

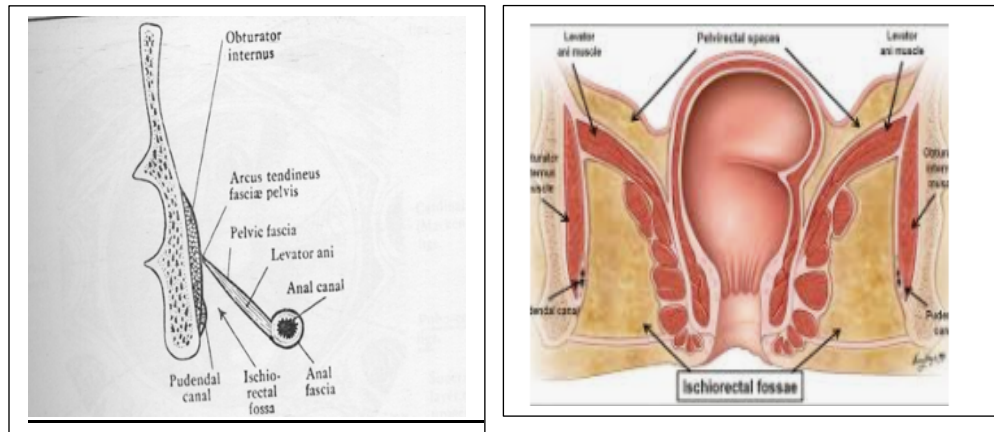
- 1- The termination of anal canal and its sphincters
- 2- The anococcygeal body
- 3- The ischioanal fossa

The anococcygeal body:

It is a mass of fibrous and muscular tissue between the tip of the coccyx and the anal orifice.

The muscular tissue is formed by the levator ani and sphincter ani externus.

The ischiorectal fossae:



These are 2 pyramidal spaces, one on each side of the anal canal and rectum
Each fossa lies below the lateral part of the pelvic diaphragm and has an apex, base and 4 walls.

- **The apex:** is directed upward and formed by meeting of the lateral wall with the medial wall i.e the origin of the levator ani from the fascia of obturator internus
- **The base:** is directed downwards and is formed by the ischial tuberosity and skin and fascia on which we sit.
- **The lateral wall:** is formed by obturator internus muscle covered by obturator fascia which splits in its lower part forming the pudendal canal.

This canal is directed forwards and downwards extending from the lesser sciatic notch till the posterior border of the perineal membrane where the canal ends by opening in the deep perineal pouch, and it contains the pudendal nerve above and the internal pudendal vessels below the nerve.

- **The medial wall:** formed by the levator ani (upp 2/3) and is sloping and external anal sphincter (lower 1/3) and is vertical.
- **The anterior wall:** formed by the posterior border of the perineal membrane with the superficial transversus perineii below it and the deep transversus perineii above it.
- **The posterior wall:** formed by the lower border of gluteus maximus muscle and the sacrotuberous ligament.

Contents of ischiorectal fossa;

1. **Ischiorectal pad of fat:** semiliquid fat which allows dilatation of the rectum and anal canal during defecation.
2. **Pudendal canal:** containing pudendal vessels and pudendal nerve.

3. Inferior rectal nerve and vessels:

- **Inferior rectal nerve:** arises from the pudendal nerve in the pudendal canal and pierces the medial wall of the pudendal canal and crosses the ischiorectal fossa from its lateral wall to the medial wall supplying the levator ani, sphincter ani externus and the skin around the anus
- **Inferior rectal artery:** arises from the internal pudendal artery in the pudendal canal and accompanies its nerve.

4- Posterior labia nerves and vessels: (branches of pudendal) pierce the medial wall of the anterior part of the pudendal canal, cross the anterior part of the ischiorectal fossa, pass into the superficial perineal pouch to supply the labia majora and the anterior part of the perineum.

5- Perineal branch of the 4th sacral nerve:

Passes into the fossa at the side of the coccyx to supply the levator ani and sphincter ani externus and skin.

6- Perforating cutaneous branches from S2: which curve around the lower border of the gluteus maximus to supply the skin of the buttock.

Clinical importance

- 1- Infection may occur from boils of the skin around the anus or from within rectum and anal canal .
An abscess may be formed in this fat and may rupture in the rectum and skin near the anus forming anal fistula
- 2- The 2 fossae communicate with each other behind the anus and thus infection from one fossa can pass easily to the other.
- 3- The structures in the fossa are not very important and the fossa can be safely incised when infected
- 4- Pudendal nerve block

The perineal floor is bounded by skin and 2 layers of superficial fascia

- Superficial fatty layer
- Deep memb. layer (Colle's fascia)

The Colle's fascia continues anteriorly as scarpas fascia on the anterior abdominal wall. It surrounds the vestibule and its contents and winds round the transversus perineii superficialis muscle to blend with the base of the urogenital diaphragm immediately in front of the ischial tuberosities. Laterally, it is attached to the ischiopubic rami.

The Urogenital triangle or Triangular ligament:

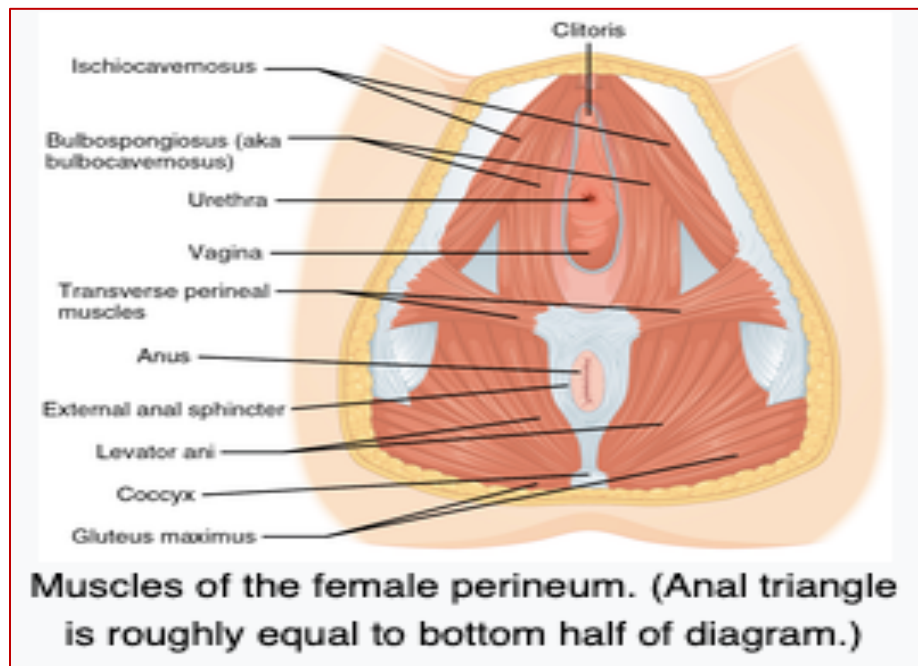
Is a structure which consists of a *sheath of muscle* enclosed between 2 *triangular fascial membranes*.

The muscle sheath is formed by:

- 1- Transversus perineii profundus.
2. Sphincter urethrae membranacea

The 2 fascial membranes are:

- 1- *Superior fascial layer*: formed by pelvic fascia and it is thin and weak
- 2- *Inferior fascial layer*: called the perineal membrane and is tough and fibrous



These 2 fascial layers fuse superiorly to form the transverse perineal ligament while they fuse inferiorly at the central point of perineum. Here, the colles fascia winds round the transversus perineii superficialis and blends with the superior fascial layer of the urogenital diaphragm. The space between the 2 fascial layers is known as the deep perineal pouch while the space bet. the inferior layer and the colle's fascia is the superficial perineal pouch . Except for the fusion above and below, the 2 fascial layers are separated by an interval 1.25cm. Between the apex of the urogenital diaphragm and the arcuate pubic ligament, there is a space occupied by the deep dorsal vein of the clitoris passing into the pelvis to join the venous plexus at the neck of the bladder.

Superficial perineal pouch:

Is a space between the inferior layer of urogenital diaphragm and colle's fascia

- **Roof** : perineal membrane
- **Floor** : colle's fascia
- **On each side** : pubic arches to which are attached the roof and floor
- **Posteriorly** : fusion of the roof and floor
i.e. this pouch is closed posteriorly and on each side but open anteriorly as the colle's fascia continues as Scarpa's fascia. So, if ruptured urethra → urine accumulates and ascends in the anterior abdominal wall.

Contents:

[1]. Bulb of vestibule: One on each side of the vaginal orifice. It is pear shaped vascular body and become narrow anteriorly and united between the urethra and clitoris by venous plexus called the commissure of the bulb.

[2] Crura of the clitoris: On each side of the margin of the pubic arch.

[3]. Superficial perineal muscles:

• *2 ischiocavernosus muscles:*

Ensheathing the crus of the clitoris

Arises from the medial aspect of the inferior ramus of the ischium and is inserted into the lateral aspect of the crus.

It is innervated by the perineal branch of pudendal n.

It compresses the crus blocking venous flow → Stiffness of the clitoris and erection

• *Bulbospongiosus muscle:*

This muscle blend with the sphincter ani externus and form a figure of 8 around the vagina and anal canal.

It arises from the central point of perineum, passes forward around the orifice of the vagina forming a weak sphincter

It surrounds the bulb of the vestibule and is inserted into the body of the clitoris on its dorsal aspect .

It is innervated by the perineal branch of the pudendal nerve

It compresses the erectile tissue (bulb of vestibule) and also compresses the dorsal vein of the clitoris → erection

• *Superficial transverse perineal muscles:*

Arises from the ischiopubic ramus and blends with its fellow of the apposite side in the central point of perineum

[4] Nerves, vessels and lymphatics:

• *2 labial nerves:*

Are branches of the perineal nerve which is one of the 2 terminal branches of pudendal nerve as it passes in the pudendal canal (in its post. part.).

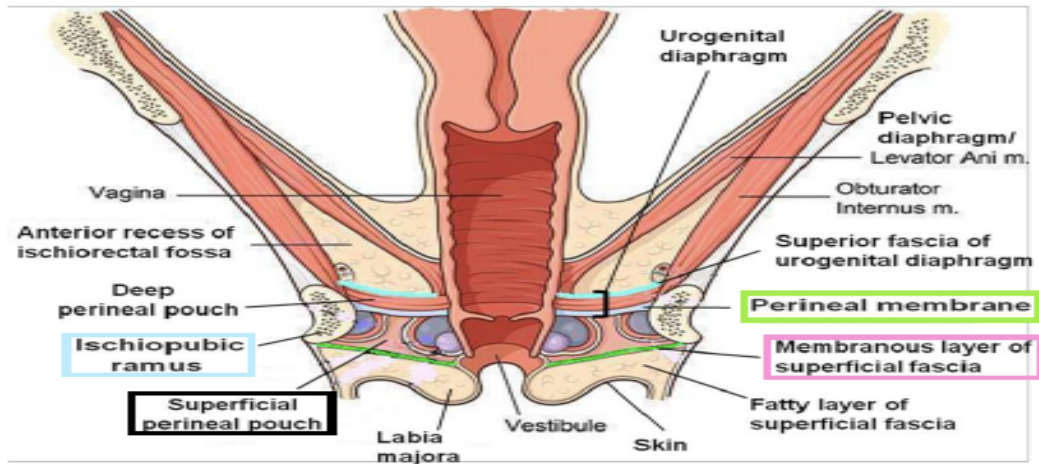
Near the anterior end of the canal, the perineal nerve give 2 labial nerves which perice the medial wall of the anterior part of the pudendal canal and cross the ant. part of ischioanal fossa to enter the superficial perineal pouch to supply the labia majora and the ant. part of the perineum

• *2 labial arteries:*

Arise from the internal pudendal artery in the pudendal canal and accompany nerves in the superficial perineal pouch → gives the transverse perineal arteries to the superficial transversus perineii muscle.

• *Perineal branch of the post. cutaneous nerve. of the thigh:* which pierces the floor to enter the thigh.

- **Perineal branch of the 4th sacral nerve:** which enter the pouch by peircing its floor.



Contents of Superficial Perineal Pouch

1. Bulbs of vestibule: on each side of vaginal orifice.	
2. Crura of clitoris (crura: plural of "crus")	
3. Superficial perineal muscles: <i>(see slide 6 for a picture of the muscles)</i>	a) Ischiocavernosus muscle: covers crus of clitoris on each side.
	b) Bulbospongiosus muscle: surrounds orifice of vagina and covers vestibular bulb.
	c) Superficial transverse perineal muscles
4. Greater vestibular glands: on each side of vaginal orifice.	
5. Perineal branch of pudendal nerve: supplying muscles & skin.	

Deep perineal pouch:

Is a space between the 2 fascial layers of the urogenital diaphragm

- **Floor:** perineal memb.
- **Roof:** pelvic fascia
- **Anteriorly:** Roof and floor fuse forming transverse perineal lig.
- **Posteriorly:** fusion of the pelvic fascia with the posterior border of perineal memb.

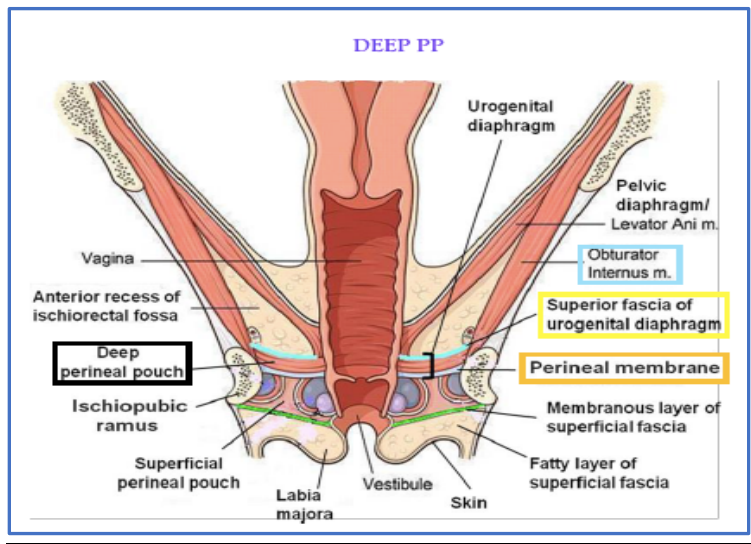
- **On each side:** fusion of the roof and floor with the pubic arch so, this pouch is closed anteriorly, posteriorly, and at the side and contains the membranous urethra. So, if memb. urethra ruptured, the extravasated urine collects in the deep perineal pouch

Contents

- 1- Membranous urethra surrounded by sphincter urethrae membranacea
- 2- The transversus perineii profundus
- 3- Part of the vagina
- 4- Blood vessels and nerves to clitoris, labia, bulb of vestibule

Contents of Deep Perineal Pouch

1. Part of urethra
2. Part of vagina
3. Sphincter urethrae and Sphincter vaginae muscles; which is pierced by urethra & vagina.
4. Deep transverse perineal muscles
5. Internal pudendal vessels
6. Dorsal nerve of clitoris



The perineal body:

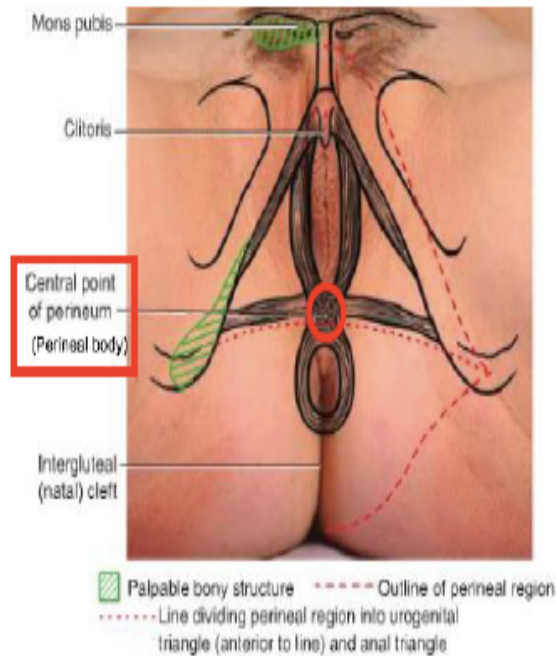
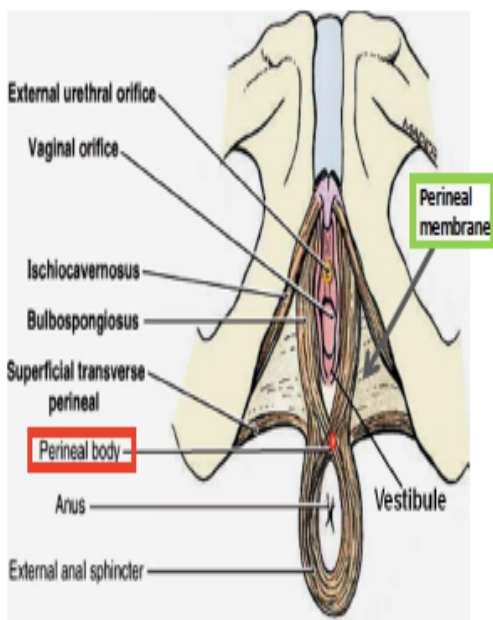
It is a fibromuscular nodule with the muscles predominating and it lies in the middle line at the junction between the anterior and posterior triangles of perineum (urogenital and anal) and between the vagina and anal canal

It is a point of attachment of the following muscles as they meet and fuse

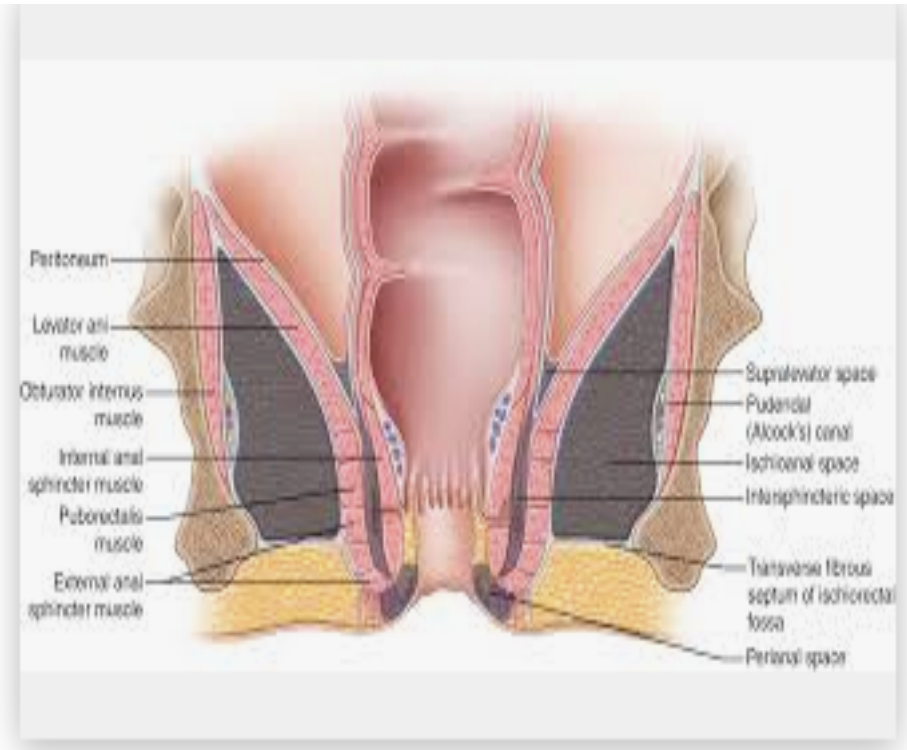
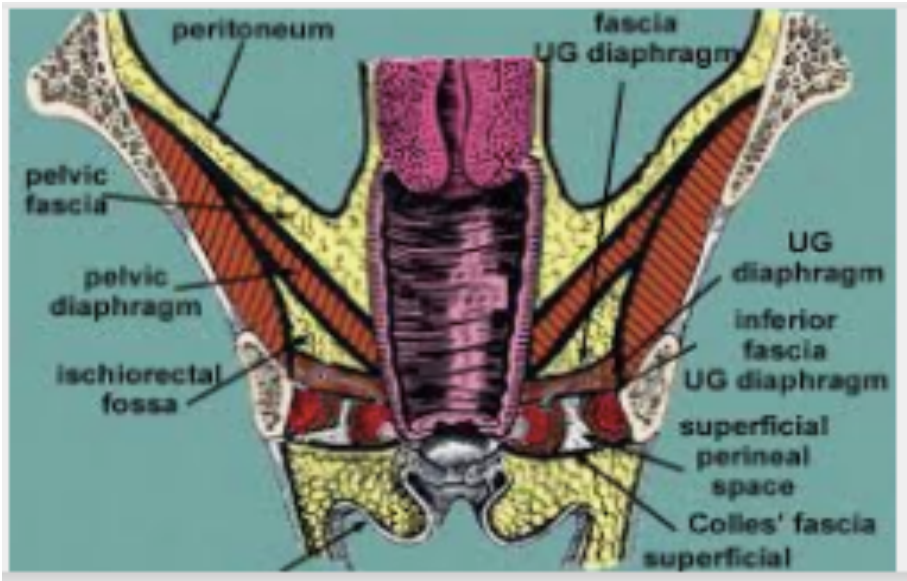
- 1- Anal sphincter
- 2- Bulbospongiosus
- 3- 2 transverse perineii
- 4- 2 levator ani

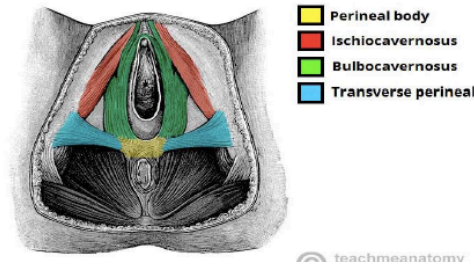
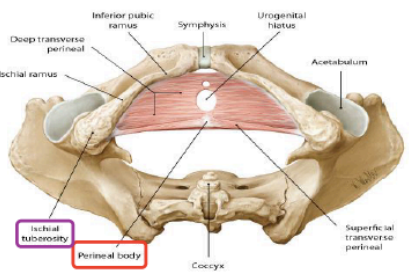
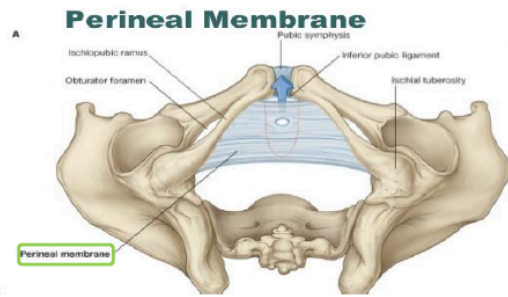
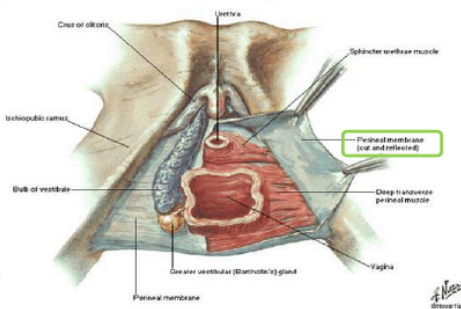
Clinical importance:

- 1- 3rd degree perineal tear and hidden tears (dashboard perineum)
- 2- Garrulity of the vagina
- 3- Genital prolapse



HELPFUL IMAGES AND DIAGRAMS





Pudendal Canal

o The pudendal canal is a fascial canal formed by obturator fascia, located on the lateral wall of the ischiorectal fossa.

Contents:

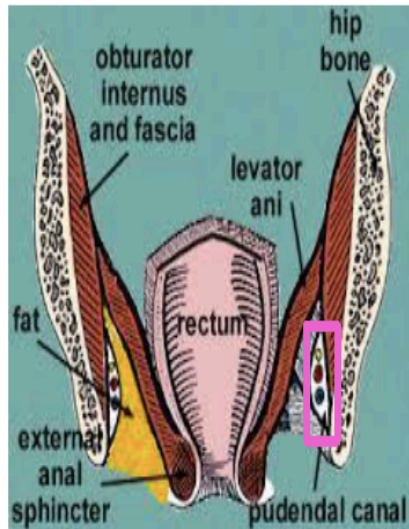
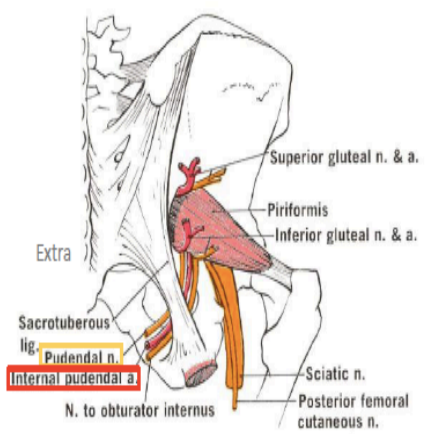
1. Pudendal nerve.
2. Internal pudendal vessels (artery and vein).

Mnemonic:

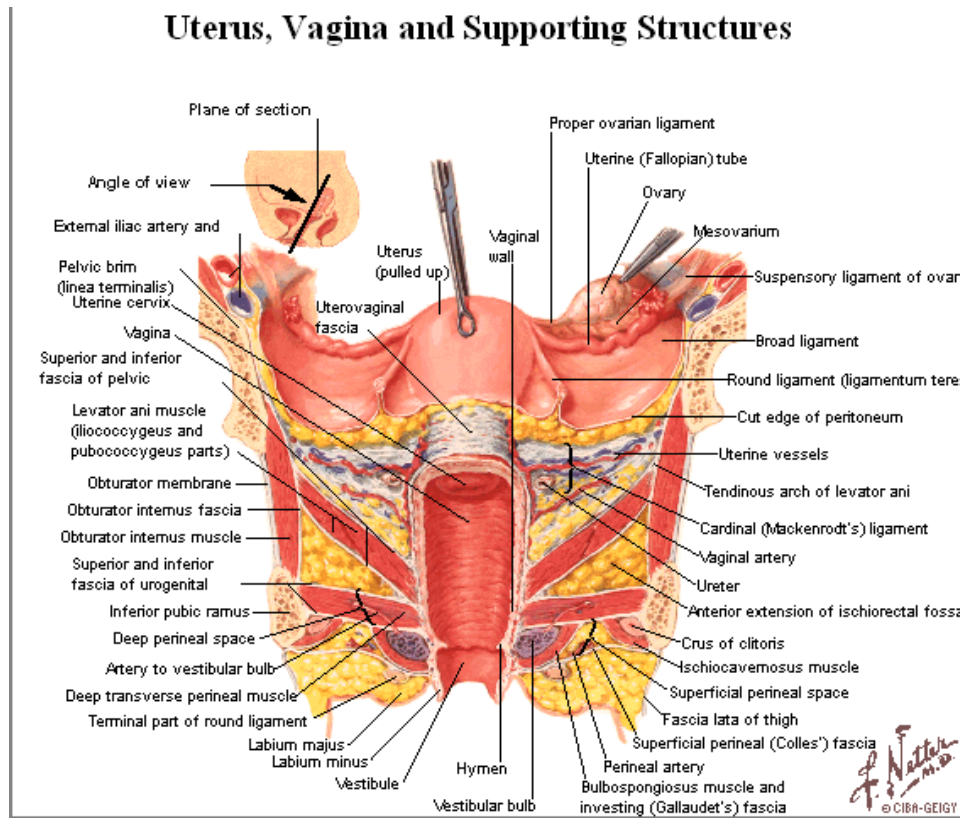
VAN



Vein
Artery
Nerve



CHAPTER (4)
Anatomy of the vagina



-The word vagina means **sheath** as its main function is to unsheathe an erect penis
 -The sexually unstimulated vagina is only a potential cavity with its anterior and posterior walls in close apposition. As sexual tension starts, lengthening and widening of the upper 2/3 of the vaginal barrel occurs. By the time penetration occurs, the vagina is already in an expanded state with its vault pulled up (tented) and its anterior and posterior walls separated and thus is converted from a potential cavity into an actual cavity.

-Sims discovered that vaginal funneling was **most exaggerated** in knee chest and Sim's position making vaginal vault to balloon while the lower end remains narrow. This discovery revolutionize treatment of vesicovaginal fistula.

The vagina is divided into 3 parts:

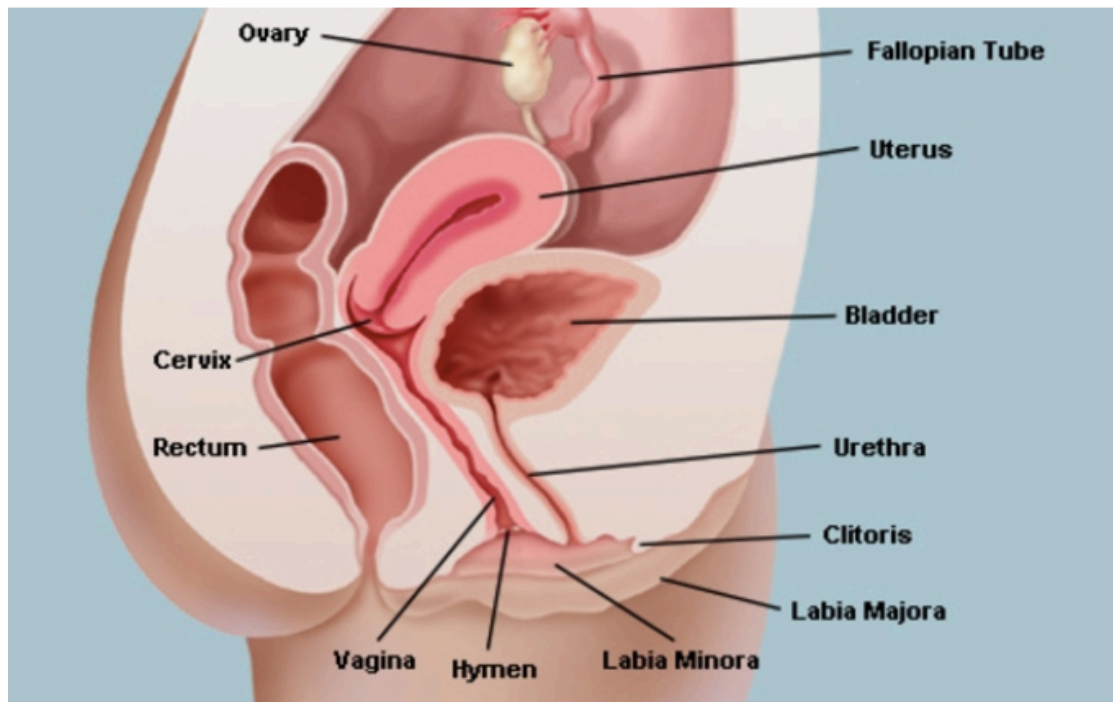
- 1-Upper Vagina:** is wide and capacious above the level of the levator ani and is called the vaginal vault
- 2-Middle vagina:** is narrower middle portion bounded by the levator ani
- 3-Lower vagina:** is the constricted lower end partially closed by the hymen and perineal muscle.

Direction of the vagina

-It is directed obliquely upwards and backwards from the vulva to the uterus at an angle of about 45° with the horizon.

-The long axis of the vagina is parallel with the plane of the pelvic brim and at right angle to the uterus:

- This direction is optimal for coitus
- It corresponds to the lower part of curve of Carus
- It decreases of the angle of the vagina to guard against prolapse.



The vaginal vault (vaginal fornices):

- The anterior vaginal wall is perforated by the cervix and blends with its musculature and the 2 organs are being inseparably welded together leading to formation of 4 fornices described as *anterior*, *posterior* and 2 lateral fornices according to its relation to the cervix.
- The pelvic contents can be palpated through the thin wall of the vagina at the fornices

The structures palpated through the ant. fornix are:

- 1-The body of anteverted uterus
- 2-Tumours of the uterus
- 3-The bladder when full is felt as central cystic swelling lying behind the symphysis pubis

The structures palpated through the posterior fornix are:

- 1- Body of retroverted uterus
- 2- Prolapsed ovaries
- 3- Tumors of the uterus & ovaries

4- Pelvic hematocoele 5- Uterosacral ligament (best through PR) 6- Rectum and sigmoid

The structures palpated through the lateral fornices:

- 1-The ovaries and small ovarian tumors (large tumors are heavy enough to fall into the pouch of Douglas).
- 2-The fallopian tube: not palpated unless thickened by pathology. (tubal preg., inflammation of tube)
- 3-Swellings of broad ligament
- 4- Appendix, caecum, colon: In **right fornix**: caecum palpated as gurgling, spastic or tender mass, while in **left fornix**: tenderness of sigmoid (diverticulitis)
- 5-The ureter as it winds forwards round the lateral fornix.

The size of the fornices; depend on the size of cervical portion inside the vagina. -The posterior fornix is always the deepest.

-When there is congenital elongation or hypertrophy of cervix → deep fornices with old age, the cervix may flush with the vaginal vault.

-The posterior fornix is anatomically larger and clinically more imp. So, it is a unique fornix

-Its increased size is due to the fact that the cervix opens into the top of the anterior vaginal wall. So the posterior vaginal wall is 1 inch longer

The posterior fornix act as:

- Receptaculum seminis
- Receptaculum penis
- Hook for Hodge smith pessary
- Hook for contraceptive diaphragm

The anterior and posterior vaginal walls are normally in contact but the lateral walls remain rigid especially in the middle of the vagina due to the *pull of the levator ani*, so, this region appear on transverse section as an H shaped cleft.

The vaginal rugae:

The vaginal walls are thrown into rugae (transverse folds) which are particularly marked anteriorly and posteriorly in the lower 2/3 of vagina and are known as ant. and post. columns which indicate that the vaginal canal is developed by canalization and fusion of 2 separate halves (Mullerian ducts). These rugae allow great distention during childbirth. They are prominent in nullipara and smoothed out by stretching of repeated childbirth until they disappear resulting in smooth vagina in highly parous women.

It also acts as friction apparatus sharing in vulvovaginal response helping orgasm in both male and female together with gripping effect of levator, bulbocacemosus muscle and erection of the bulb of vestibule.

Relations of the vagina:

Anterior relations:

- **Upper 1/3:** separated from bladder base by loose areolar tissue which is easily separated during hysterectomy. There is considerable lymphatic and vascular connection between the upper vagina and bladder base. Also, vaginal fistula occurs in prolonged labor. Honeymoon cystitis in

newly married couples especially with high perineum → urge to pass urine during or immediately after intercourse

- **Lower 2/3:** is in contact with the urethra and the lower ½ of the urethra is firmly embedded in the ant. vaginal wall which is difficult to separate in various sling operations for stress incontinence.

Posterior relations:

- **Upper 1/3:** separated from the pouch of Douglas and peritoneal cavity only by thin portion of the vaginal wall and peritoneum. This allows easy access of peritoneal cavity for both diagnostic and therapeutic purposes. (culdescopy and colpotomy)
- **Middle 1/3:** separated from the lower part of the rectum by pelvic cellular tissue and rectovaginal septum.
This septum allows independent movements of the vagina and rectum and allows easy separation of the rectum from the vagina as during operation of post. colporrhaphy
- **Lower 1/3:** separated from the anal canal and anal sphincter by this septum and muscles of the perineal body.
It is common site of tears during childbirth

Lateral relations:

- **Upper 1/3:** is in intimate contact with pelvic cellular tissue. The terminal part of the ureter passes over the lateral fornix and is crossed by the uterine artery about ½ inch below and lateral to the cx.
Injuries to the ureter may occur during operations in this area e.g. vaginal and abdominal hysterectomy
- **Middle 1/3:** blend with levator ani
- **Lower 1/3:** related to the:
 - Bulbocavernosus muscle
 - Bulb of vestibule
 - Bartholin gland

Also, Gartner duct starts near the ovary coming down from the broad ligaments, runs down to the sides of the body of the uterus and cx to run anterolaterally in the vaginal wall to disappear ultimately near the lower end of the vagina.

In most cases, the duct becomes occluded at birth. Occasionally portions of the duct remain → distention cysts.

It is usually a symptomatic and rarely require treatment except when large. In this case, it must carefully excised as their relation to the ureters in the region of the lateral vaginal fornix is intimate.

The vaginal epithelium:

Exactly like skin, the vaginal walls are lined by stratified squamous epithelium on connective tissue containing *blood vessels and nerves*. So, the term vaginal **skin** is more accurate. The only difference from the ordinary skin is the absence of hair follicles, sebaceous and sweat glands.

The connective tissue underlying has cone like projections known as papillae which extend into the epithelium → wavy line of junction bet the 2 tissues which ↑ nourishment of the epithelium.

The armor plate epithelium is impervious to microorganisms as it is multilayered (up to 40 layers) and superficial layers are cornified This armor plate protects against coital trauma, microorganisms and prolapsed vagina against external insults.

It continuously desquamates by proliferation of basal cells that push the superficial cells outwards which die and then desquamates. This form the basis of Pap test, karyopyknotic index and the exfoliated cells take part with Doderlin's bacilli, vaginal transudate and some cervical mucus forming normal vaginal discharge (like curdled milk).

The musculofascial envelope of the vagina:

Below the epithelium and subepithelium layers is a powerful elastic musculofascial layer. This layer is continuous as a smooth sheet with the front, back and sides of the supravaginal cx. as the uterus and vagina have developed embryologically from mullerian duct.

Muscle layers consists of:

1- Inner circular and

2-Outer longitudinal: this layer is continuous with the superficial muscle fibers of the uterus

Outside the muscle. layer, there is an outermost coat of C.T containing larger blood vessels. This musculofascial layer make the vagina one of the toughest and most distensible membranes of the body to withstand sexual activity and childbirth

Anatomical changes that occur in the vagina with age:

Estrogen → vaginal epith. proliferation with deposition of glycogen → Doderlin bacilli act on glycogen → lactic acid → vaginal acidity PH (4.5 – 5.5). The acid vagina → bacteriostatic effect. Doderlin bacillus → vaginal policeman .

Infection frequently occur from one week to puberty and also postmenopausally but the vagina resist insults from puberty to menopause.

Arterial supply

- Upper 2/3: by vaginal artery (branch of uterine)
- Lower 1/3: by internal pudendal artery.

This generous bl. supply from 2 sources → rapid healing

The vaginal artery form a plexus around the vagina and from this plexus, a median artery arises on each of the anterior and posterior walls called azygos vaginal artery

The arteries in the vagina are tortuous and spiral and so it allows excessive distention of the vagina during parturition

Venous drainage:

Into rich venous plexus (formed of intercommunicating uterine, vaginal, vesical and rectal plexuses) which drain into the int. iliac vein

This venous drainage into rich plexus has its clinical imp. in:

- 1- Vaginal hematoma may occur during delivery of the fetus
- 2- Metastasis may occur in the vagina months or years after ttt of cancer body
- 3- Vaginal lubrication during coitus (sweating phenomenon)
- 4- The venous pelvic plexus also freely anastomose with the vertebral venous plexus, so septic emboli, organisms and malignant cells from the pelvis are able to reach the heart and lungs and finally to brain

Lymph drainage

- *Upp. 2/3*: into ext. and int. iliac nodes (as the cx)
- *Lower 1/3*: into superficial inguinal nodes

Nerve supply:

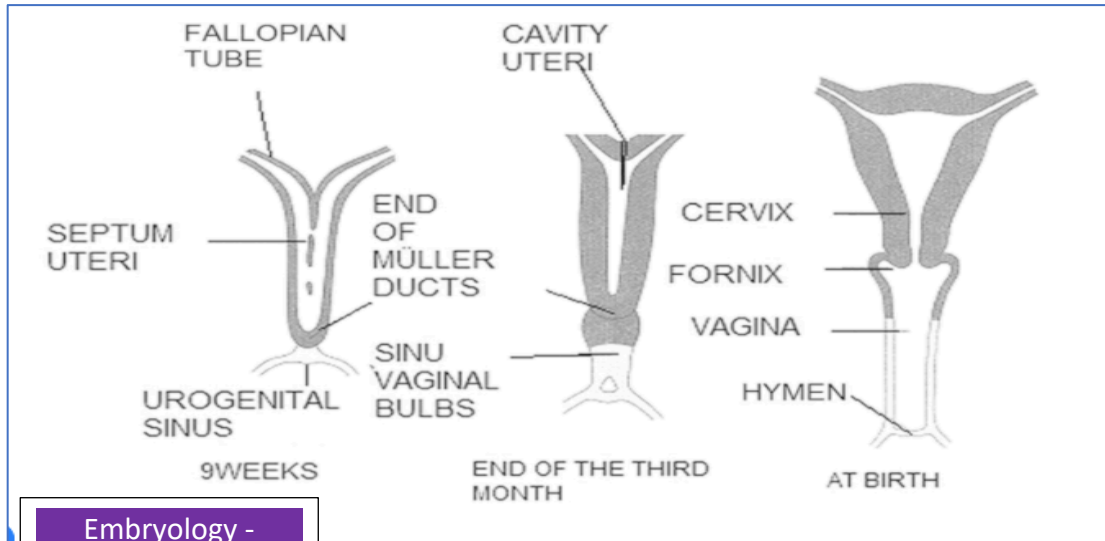
- Autonomic (predominant); via pelvic plexus of Frankenhauser.
 - Somatic (scanty); via pudendal nerve (mainly the lower third)
- So, the vagina is relatively insensitive organ in contrast to vulva which has predominantly somatic via pudendal nerve and scanty autonomic. So, the vulva is sensitive organ. Nerves rung along the vagina in a wavy pattern to prevent overstretch when vagina is distended. In **vaginitis** (monilia, trichomonas) → itchy vulva
 - Vaginal orgasm is **not** as common as clitoral orgasm

Embryology

The vagina is formed from the lower ends of the 2 Mullerian ducts which become canalized and finally fuse to form single vagina.

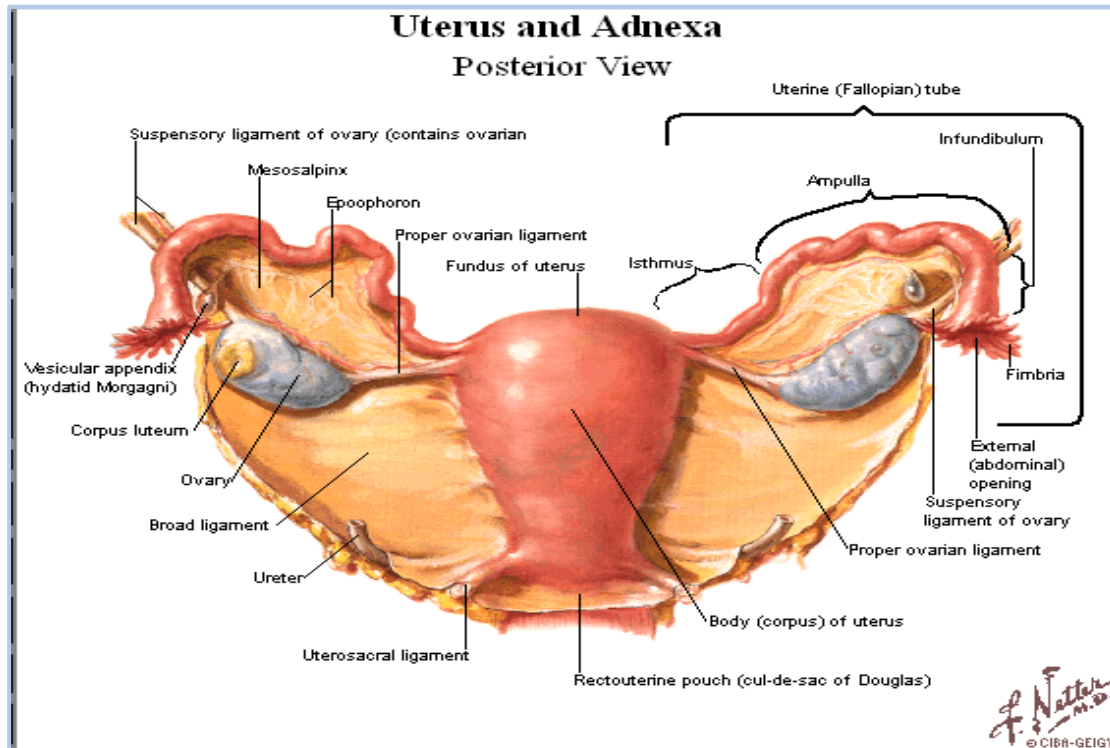
Congenital malformation occur when Mullerian ducts fail to develop → congenital absence of vagina or fail to fuse (septate vagina) or fail to canalize (atresia of vagina)

During development, the lower part of the fused Mullerian ducts beyond the uterine lumen remain solid (Mullerian tubercle) and proliferate to give rise to solid outgrowths which grow caudally and then become canalized and finally fuse to form the upper 4/5 of the vagina which open into the urogenital sinus. The caudal ends are closed by a septum which is complete at 1st but later become excavated centrally to form the hymen. At least, the distal end of the vagina is formed from urogenital sinus



Embryology - vagina-uterus

Anatomy of the Uterus



The uterus is derived from the Greek [hysteron] and meaning womb.

Shape: It is pyriform shaped organ

Composition:

- **Fundus:** upper part which lies above the openings of fallopian tubes.
- **Body:** main part which lies bet. these openings and the isthmus
- **Isthmus:** constricted part which is about 0.5cm long in non-pregnant.
- **Cervix:** narrow terminal part which is cylindrical in shape and starts at the isthmus and ends at the external uterine orifice which opens into the vagina

The angles formed by the union of tubes with the uterus are known as superior angles or cornu. The cervix perforates the ant. vaginal wall and the part which lies within the vagina is the portio vaginalis while the part above is the supra-vaginal cervix.

-Size: It is about 7.5cm long, 5cm wide at the fundus and its walls are about 1.25 cm thick . All dimensions are ↑ed by about 1.2cm in women who have born children

-Weight: The virginal uterus weighs 50 gm. Parous uterus weighs 50-60 gm
After delivery weighs 908 gm.

-Position:

It is situated in the pelvic cavity behind the bladder, in front of the rectum, below the intestine and above the vagina.

Its level in the pelvis is at or slightly below the brim of the pelvis with the ext. os at about the level of ischial spines.

When the cervical axis is hinged anterior to the vaginal axis the uterus is anteverted. When the cervical axis is hinged backward to lie posterior to the vaginal axis, the uterus is retroverted.

Also, if the ling axis of the endometrial cavity is hinged forward in relation to the axis of the cervical canal, the body of the uterus is anteflexed and if it is hinged backwards in relation to the cx, the uterus is retroflexed.

The uterus is usually not situated in the middle line but inclines to the right and is slightly twisted in that direction

Relations: It has 3 surfaces & 2 borders:

Superior surface: Is convex and directed forwards forming the greater part of fundus

Anterior surface; Is flat and directed downwards and slightly forwards

- **Upper part:** related to uterovesical pouch and intestines in front of it.
- **Lower part and cervix:** related to bladder trigone separated only by loose areolar tissue. As the bladder fills, it displaces or alter AVF position of uterus. Because of relation of cx to bladder trigone, infected cx produces urinary symptoms. Also there is direct lymphatic connection between the cervix and the adjacent bladder trigone. The bladder trigone must be dissected of the cx during the operation of total hysterectomy.

Posterior surface: Is convex and related to the pelvic colon, rectum, coils of small intestine in the rectovaginal pouch. Posterior to the cx run the uterosacral lig. embracing the lower 1/3 of the rectum.

Lateral borders: related to:

-The broad ligaments and its contents including the uterine vessels and the parametrium posterolateral to the cervix on each side lie the uterovaginal nerve plexus of Frankenhauser.

-The ureter crossed by the uterine artery lies directly lateral to the cervix and winds round the lateral fornix of the vagina to reach the bladder base. Also, attached to the supra-vaginal cervix is the Mackenrodt's ligament.

- The distance of the ureter from the healthy cervix is about 1.5cm and is even less with enlarged, infected or cancerous cervix.
- In paracervical block, local anesthetic is infiltrated postero-lateral to the cervix on each side thus blocking both plexuses of Frankenhauser.

The uterine cavity:

Is triangular in shape with its base above and apex below and with ant. and post. wall in close apposition (potential cavity)

The length of uterine cavity is about 3.5cm but longer in multipara. Its base communicates with the uterine tubes and its apex represents the internal cervical os.

The isthmus uteri:

It was described as the circular borderline area bet. the body and cx. It is indicated by a slight constriction on the surface of the uterus and roughly corresponds to the level of the internal os and the line of reflection of the peritoneum from the body of the uterus to the superior surface of the bladder.

It measures from 5-10 mm in length in non pregnant uterus . Its wall has smooth muscle and is bounded below by fibrous cx and blending above with uterine musculature

Some consider it as a part of the body and not consider it as separate entity.

The mucosa of the isthmus is similar to that of the corpus but less well developed. Its response to hormonal stimuli is relatively small so that it does not develop premenstrual hypertrophy or predecidua compacta

There is biochemical difference bet. the mucosa of the isthmus and that of the body in that the isthmic mucosa contain only small amount of glycogen

In the pregnant uterus :

The length of the cervix does not change significantly during early pregnancy. In 3rd month, the isthmus elongates with the rest of uterine musculature. The isthmus forms modified decidua but this is very limited because the compacta is not well developed and the spongiosa is thin .

The canal of the isthmus is gradually absorbed into the general uterine cavity which descends to the level of the int. os about the 4th month and the isthmus now becomes the lower uterine segment.

During late pregnancy and labor, the isthmus becomes the LUS which is thinner lower part of the uterus in front of which the bladder is situated and in which the incision is made in the modern LSCS

The cervix: neck of womb or pelvic tonsil:

Is cylindrical, 1 inch long and 1 inch in diameter with spindle shaped canal 1/2 of cervix projects into vaginal vault as portio-vaginalis and the upper 1/2 is the supra-vaginal cervix

Supravaginal cervix:

-Encircling this part are attached the main supports of the uterus. (Mackenrodt's, uterosacral ligament, pubocervical ligaments).

-Supravaginal elongation occur due to holding the cx up by the cardinal ligament and uterosacral ligament while dragging by the prolapsed vaginal walls with cystocele and rectocele. The result of these 2 opposing forces is stretch and elongation of the cervix.

In operative maneuvers, take care of injuring the ureter 1.5 cm lateral to the supravaginal cervix.

Cavity of the cervix:

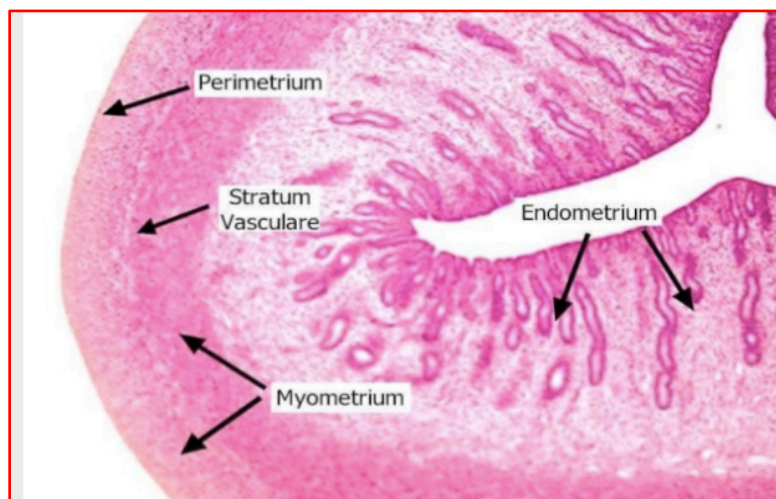
Is fusiform, starts at the int. os and ends at the ext. os the mucus membrane. of cervical canal in nullipara consists of several folds. Vertical folds on ant. and post. walls from which oblique folds radiate. (arbor vitae or tree of life) these folds tend to disappear after the 1st pregnancy. The folds converts small surface area into extensive surface area. So, it gives numerous recesses for harboring pathogenic organisms

The external os:

Is circular and smooth in nullipara but in multipara it is transverse slit and often fissured. The orifice is surrounded by ant. and posterior lip. The vaginal portion is directed obliquely downwards and backwards and impinges on post vaginal wall

Histology of the uterus

A) Histology of the body:



• **Uterine musculature:** arranged in 3 distinct layers

1- The outer layer: longitudinal layer in which the bulk of the fibers are distributed over the fundus. Its function is mainly expulsive

2- The middle layer: thick layer of interlacing muscle fibers in which lie large vessels which are surrounded by sphincter like whorls of fibers which form figure of 8 around the vessels (live ligature). They produce hemostasis after delivery or abortion

3- The inner layer: arranged circularly, sparse at the fundus but strongly developed at the tubal ostia and at the internal os where it forms sphincters.

The internal os sphincter when torn → incompetent os

Fallopian sphincter → prevent regurgitation of menstrual blood

The thick myometrium represent the 1st line of defense against corpus cancer. So, extension of corpus cancer is slower than other tumors of genital tract

• **The endometrium:**

Made up of single layer of columnar epithelium, glands and stroma

-The endometrium thickness varies during cycle

-The glands are simple tubular structure lined by col. cells similar to that covering the endometrial surface. The glands produce thin, watery, alkaline secretion (uterine milk) which is nutritive and supportive to fertilized ova before implantation and provide a medium over which sperm glide.

There is no submucosa and the endometrium is inserted directly into the underlying muscle layer.

This explains the occurrence of adenomyosis by dipping of the endometrial glands into myometrium and also overzealous curettage → Asherman syndrome. The stroma surrounds mainly the glands and is made up of very vascular reticular network of connective tissue containing in its meshes a large no. of small oval or spindle cells. The stroma cells become changed into decidual cells during pregnancy

• **Peritoneal coat:**

Covers the uterus with the exception of

- Lateral border of uterus

- Part of supra-vaginal cervix.

- Whole of intravaginal cervix.

• From the anterior surface of the uterus, the peritoneum is reflected to the superior surface of the bladder forming shallow uterovesical pouch.

• From the post. surface of the uterus, peritoneum is continued down as far as the upper 1/3 of the vagina when it is reflected to the ant. surface of the rectum forming the rectovaginal pouch

• From the lat. border of the uterus, 2 layers of peritoneum on each side are reflected to the lat.

• pelvic walls forming broad ligament of the uterus.

The level of the line of reflection of peritoneum from the ant. surface of the uterus to the bladder is important as it coincides with the level of the isthmus and internal os.

- For about 0.5cm above this point, the peritoneum is separated from the body of the uterus by a variable amount of extraperitoneal connective tissue but in other parts, peritoneum is firmly adherent to the uterine musculature

Rectovaginal pouch

Its upper boundaries are formed by peritoneum reflected over the utero-sacral ligaments forming the called sacro-genital folds.

On the lateral aspect on each side of these folds are the shallow pararectal fossae

The lower extremity of the rectovaginal pouch is attached to the perineal body by rectovaginal septum which is a thickened strand of extraperitoneal connective tissue. since developmentally it is formed by the fusion of the 2 layers of peritoneum resulting in obliteration of the caudal end of the pouch, it is comparable to the fascia of Denovielier's in the male.

The rectovaginal pouch contains parts of the pelvic colon, some coils of small intestine and perhaps a prolapsed ovary

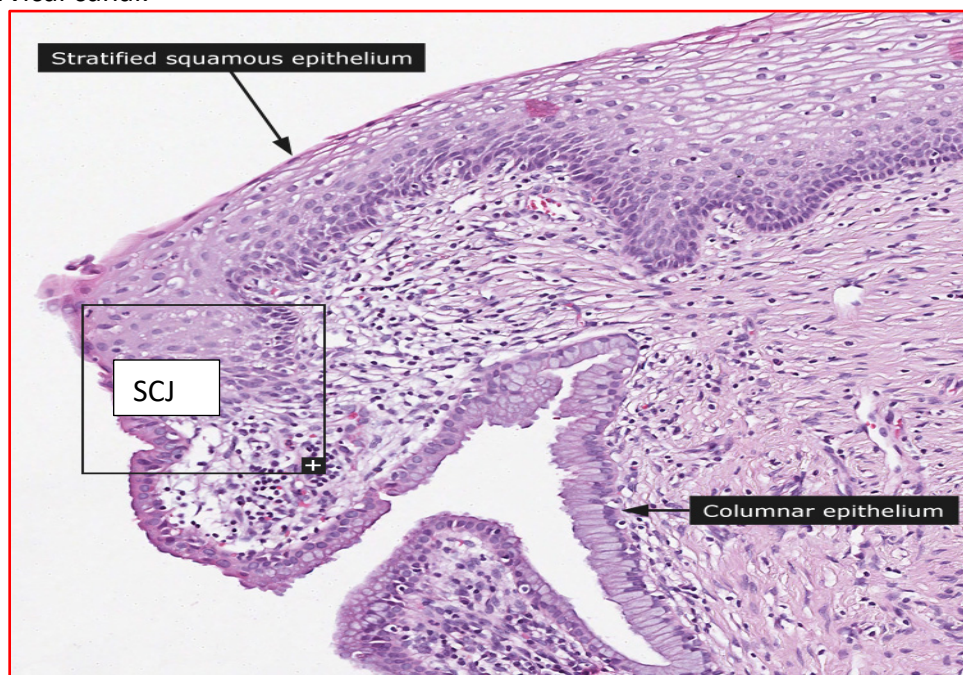
This pouch is enormously enlarged during pregnancy for its caudal end remains attached to the perineal body while the anterior attachments of the uterosacral ligaments which from the superolateral boundaries rise with the cx of the uterus

Histology of the cervix:

Epithelium: the portio vaginalis is covered by stratified squamous epith. which is directly continuous with the vaginal epithelium & ends abruptly at the margin of external os.

The cervical canal is lined by tall columnar epithelium with basal nuclei and is ciliated. This epithelium is interspersed numerous branching mucus secreting glands

The squamous. epithelium gives the portio vaginalis pale pink color in contrast to the red color of endocervical canal.



The junction of the 2 different epithelia is called squamo-columnar junction where they meet at the external os.

The cervical glands are compound racemose glands which are deeply burrowing into the cervical stroma and not shallow, simple tubules as in the body of the uterus. So, cervicitis has tendency to chronicity

The cervical goblet cells which have basally situated nucleus and open end towards the lumen secrete cervical mucus which when normal kills germs and when abnormal kills sperms

The stroma of the cervix

The cervix unlike the body has no specialized stroma

The racemose glands are embedded in common clay, an ordinary fibromuscular elastic tissue in which the muscular and elastic elements greatly outweigh the fibrous elements and so permits extreme elasticity

If this tissue is torn or deficient → cervix becomes incompetent

The outer muscle coat of cervix;

[Inner circular and outer longitudinal layers]

The longitudinal muscle bands of the body of the uterus continues down towards the cervix with their ends overlapping anteriorly and posteriorly but leaving a relative weakness laterally. So, tears of the cervix during childbirth are always lateral and pulling of the ant. and post. lip of the cx apart → ectropion

Changes in the uterus with age:

- ◆ In **childhood**, the cervix is larger than body 2:1
- ◆ At **puberty**, the body grows faster so that the ratio is 1:2
- ◆ After **menopause**, the body atrophies so that the body to cx is 1:2
- ◆ At **birth** the long axis of the uterus almost (correspond with that of the vagina but as the body of the uterus grows and ↑ in weight, it normally bends forwards at the isthmus (anteflexion) and at the same time, the cervix is carried backward towards the post. vaginal wall (anteversion)

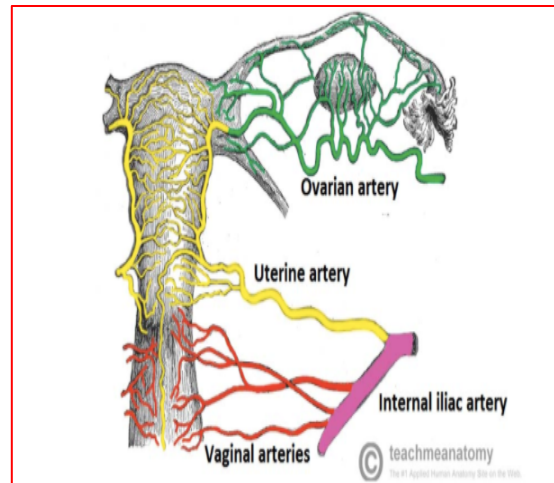
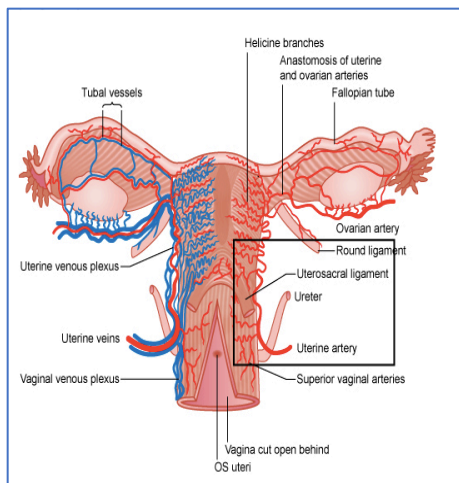
Changes in the uterus with parity;

- ◆ With each pregnancy, large amount of elastic tissue is deposited in and around the blood vessels of the uterus.
- ◆ Most of this is absorbed after each pregnancy but small quantities of elastic tissue remain as a permanent landmark of pregnancy so, parous uterus can be recognized histologically by the unusual amount of elastic tissue in its vessels and the amount of elastic tissue in any myometrium is proportional to the number of pregnancies

Arterial supply of the uterus:

-About 1/4 of the bulk of the myometrium is occupied by large blood vessels. i.e. it is an extremely vascular organ

- Bl. supply is mainly from the uterine artery
 - The artery arises directly from the internal iliac artery but it more commonly arises in common with another branch especially the obliterated umbilical artery. or superior vesical artery
 - The artery lies behind the peritoneum, runs along the post. border of ovarian fossa with the ovary immediately in front of it and it descends downwards and forwards to reach the pelvic floor where it lies on the Mackenrod's ligament.
 - At 1st, it is almost parallel with the ureter then it turns abruptly medially to cross over the ureter in order to reach the base of the broad ligament.
 - It rides the ureter about 1.5cm from the lat. vaginal fornix then, it ascends upwards to run a corkscrew tortuous course to the sides of the uterus to end at the superior angle by anastomosing with the ovarian artery
 - As it reaches the lateral border, the gives small vessels which are distributed over the surface of the uterus where there is free anastomosis with the vessels of the opposite side. So if one ut. artery tied → no interference with bl. supply to the uterus
- The uterine artery anastomoses freely with the ovarian artery near the superior angle and with the vaginal artery at the lower part of the supra-vaginal cervix.
- As a result of anastomosis with the azygos vaginal artery, an arterial circle is formed called coronary artery of the cervix.



A series of radial arteries come off at right angles from the uterine artery as it courses along the side of the uterus the radial arteries penetrate the myometrium and then divides in the inner 1/3 of the myometrium into (straight – spiral) arterioles. The straight arterioles pass only as far as the basal portion of the endometrium while the spiral arterioles follow a longer coiled course to supply the superficial portion of endometrium So, the superficial 2/3 of the endometrium has separate blood supply from the basal 1/3

Arterial supply of the cervix:

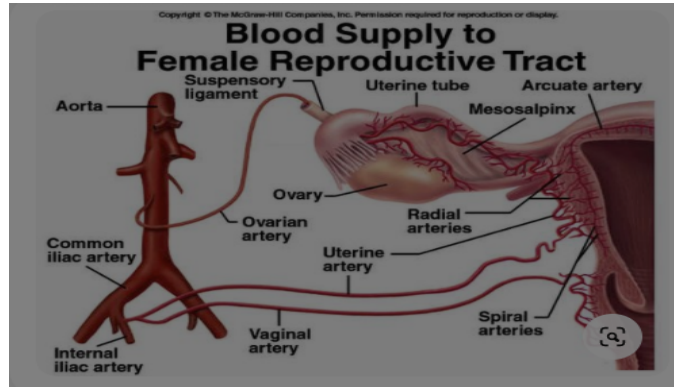
The cervical branch of the uterine artery given off just before the uterine artery turns upward to begin its corkscrew course up to the side of the uterus. It reaches the substance of the cervix by running in the substance of the cardinal ligament as it inserts into the substance of the cervix.

In Fothergil operation, blood supply to cervix must be controlled by ligating and dividing the cardinal ligaments where they join the cervix.

Venous drainage of the uterus:

The uterine vein and pampiniform of veins in the broad ligament are draining from the uterus into the vena cava through the internal iliac and ovarian vein

Congestion of pampiniform plexus → varicocele of broad ligament during pregnancy. → dull constant ache



Ligation of vena cava combined with the ovarian vein ligation result in almost complete obstruction of the whole pelvic venous return.

This controls all thromboembolic insults from the pelvis to the lungs without resource to anticoagulants or any other medical treatment.

In such cases, the following collaterals aid the return of blood from the pelvis

- 1- The intervertebral venous plexus
- 2- The lumbar venous plexus
- 3- The superficial and deep veins of the anterior abdominal wall
- 4- The rectal venous plexus: because of the free communication bet. the portal and systemic veins

Lymph drainage of the uterus:

The cervix is supplied with plentiful lymphatics while the body with scanty lymphatics. This explains the early dissemination in cancer cx and hence poor prognosis and the late dissemination in carcinoma of the body of the uterus, and hence the good prognosis

● **Cervix:** 3 sets drain in 3 different directions

- 1- Laterally and anteriorly in front of the ureter to end superficially in the ext. iliac nodes. (more favorable)
- 2- Laterally and behind the ureter through the parametrium down to the int. iliac nodes up the common iliac nodes → paraaortic nodes. (most dangerous)
- 3- 3rd set posteriorly in the uterosacral ligament to end in the sacral nodes in the hollow of the sacrum

● **Body of uterus**

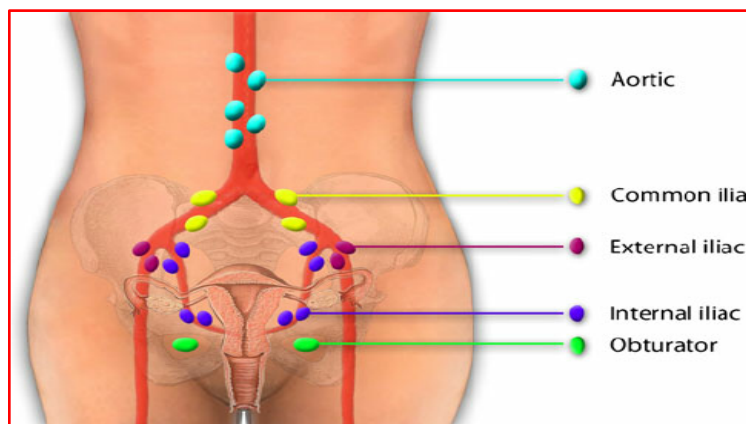
2 networks (one under endometrial and other under myometrial) → scanty collecting vessels from the uterine body and *run in 3 sets as follows:*

1- main set from fundus laterally through the broad ligament along the infundibulo-pelvic ligament then follow a long course along the ovarian vessels to the paraaortic lymph nodes.

The relatively poor lymphatic supply with the long course of the lymphatics is partly responsible for the better prognosis of uterine malignancy

2- Few lymphatics from the fundus follow the round lig of the uterus to terminate in the LN

3- Set of lymphatics from the lower body of the uterus → laterally together with lymphatics of the cervix → external iliac group of lymph nodes, so, carcinoma involving the lower body is treated in the same way as carcinoma of the cervix.



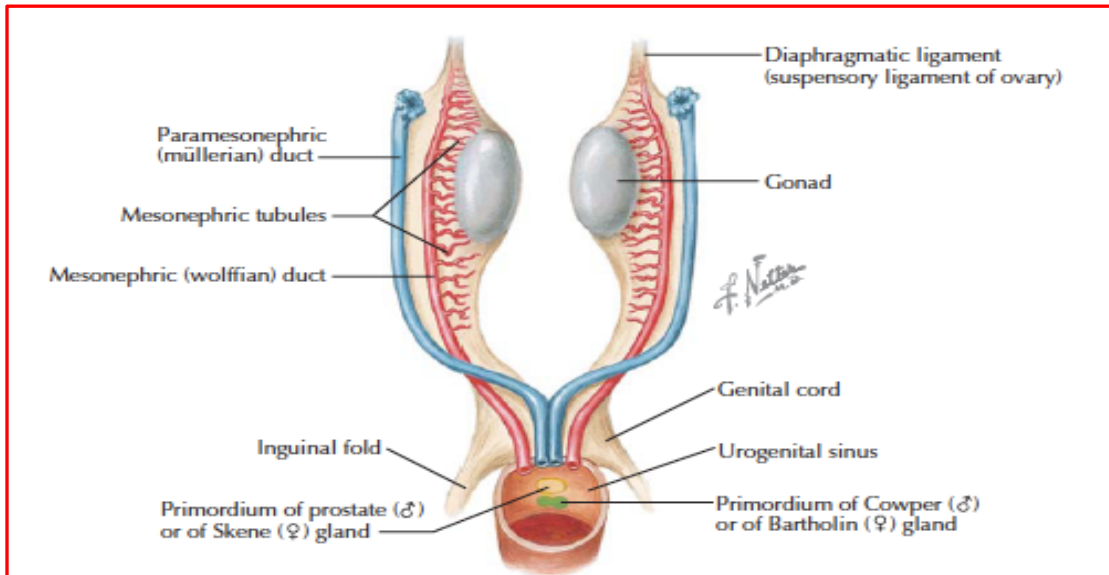
Nerve supply

Sympathetic: presacral nerve (hypogastric plexus)

Parasympathetic: sacral plexus (nervi erigentes) S2,3,4

EMBRYOLOGY

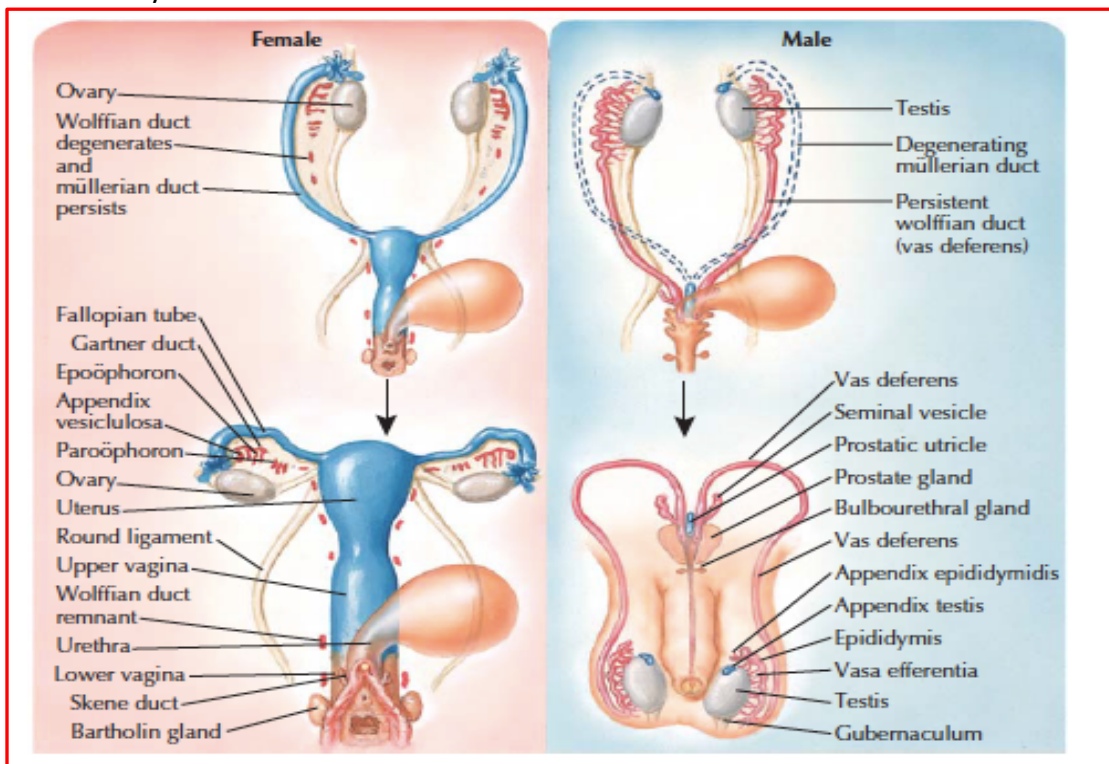
- ◆ When the embryo reaches a size 10mm at 35-36 days, a groove of fold appears on the dorsal aspect of the coelomic cavity lateral to the wolffian ridge.
- ◆ This groove becomes closed to form a tube called the paramesonephric duct or mullerian duct.
- ◆ The duct grows caudally and then crosses the body cavity transversely in front of the mesonephric duct (wolffian duct) and then turn again in a caudal direction
- ◆ The caudal end close while the cranial end remains open.
- ◆ The upper vertical and transverse parts of the ducts become the uterine tubes with abdominal ostia.
- ◆ The lower vertical parts fuse from below upwards to form the uterus. At 1st a septum separating the 2 ducts which later on disappear and a single cavity is formed (uterus).
- ◆ So, for normal uterus to develop, it is necessary for the 2 parallel symmetrical Mullerian ducts, equal in size , shape and growth to meet in the midline and then by 3 stages of:
 - (1). Ducts canalization
 - (2).Ducts fusion of duct walls
 - (3). Disappearance of the formed septum to become single organ

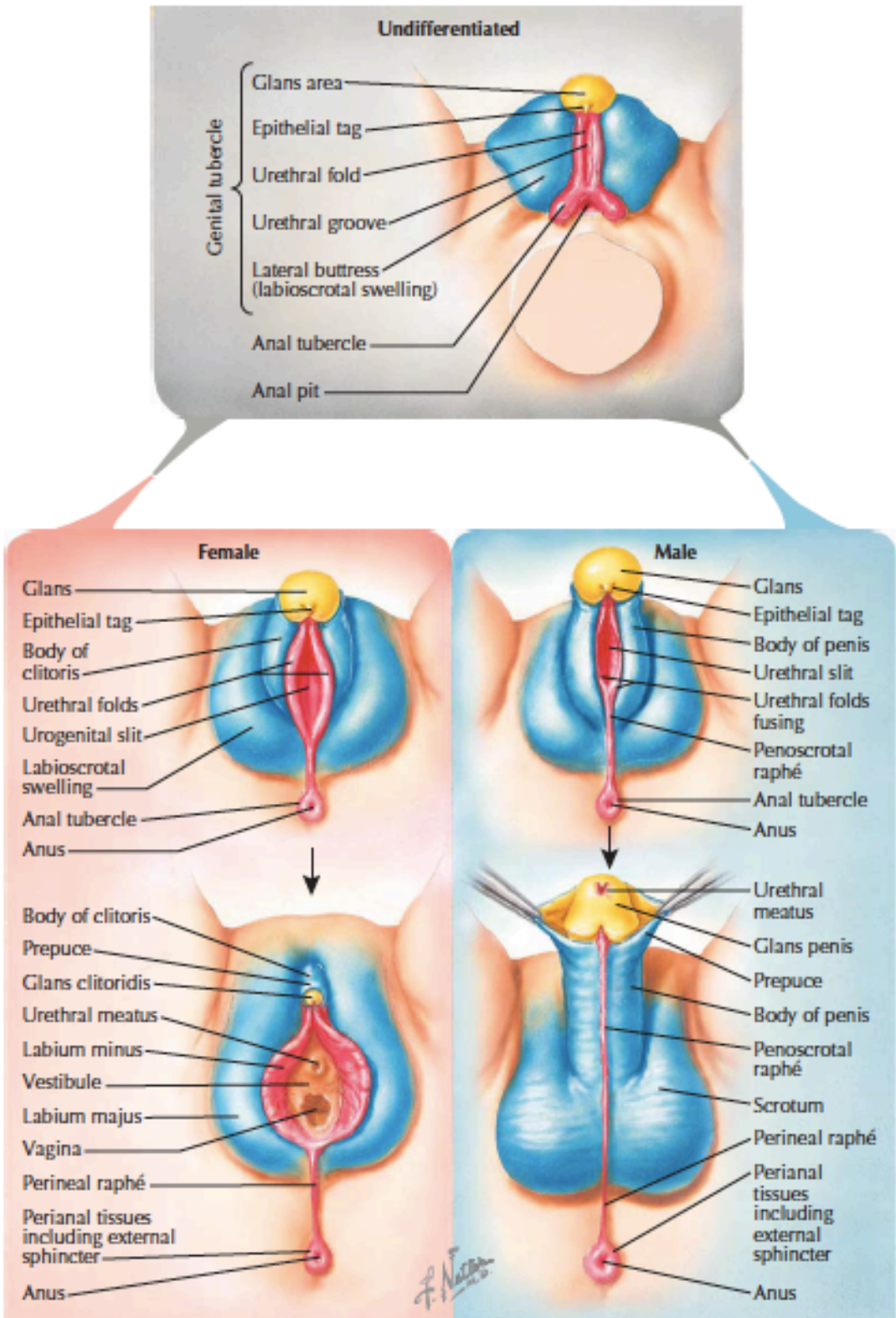


The urogenital fold:

Is present in early embryo and contains the origins of the wolfian and Mullerian duct i.e. the primordia of both urinary and genital tract.

So, if there is genital tract malformation, look for associated malformation in the urinary tract and vice versa

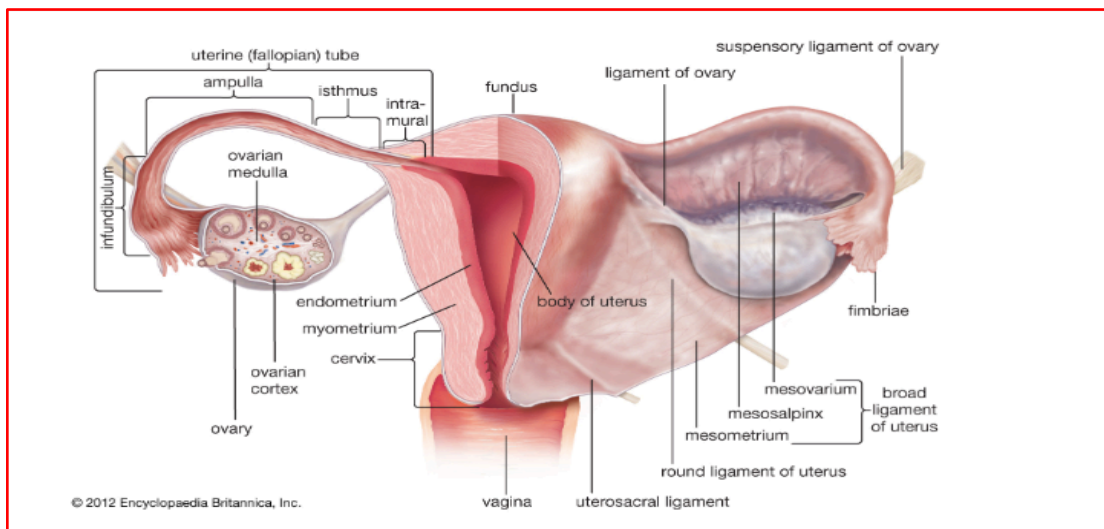




The ligaments of the uterus

The Broad ligament

- ◆ Each ligament consists of a double fold of peritoneum reflected from the lateral wall of the uterus to the lateral pelvic wall.
- ◆ It is with the uterus like a bat with outstretched wings.
- ◆ The superolateral border of the ligament form the infundibulo-pelvic fold
- ◆ The inferior border of the broad ligament. reach the pelvic floor where they come into contact with the extraperitoneal connective tissue, some of which ascend between the 2 layers of the broad ligament to form the parametrium.
- ◆ Attached to the post. layer of the broad ligament by a short double fold of peritoneum known as the mesovarium is the ovary.
- ◆ The part of the broad ligament which lies above the mesovarium is called the mesosalpinx and the part below it is the mesometrium.



Contents

- 1- The fallopian tube.** Enclosed in the upper free border with the tubal ostium opening directly into the peritoneal cavity. Tubal pregnancy may rupture through the inferior surface into broad ligament → broad ligament hematoma or broad ligament pregnancy
- 2- The round ligament.** Attached below and in front of the uterine tube raising a peritoneal fold
- 3- The ovarian ligament.** Attached below and behind the fallopian tube
Both round and ovarian ligaments lie as a whole or in part within the layers of the broad ligament.
- 4- The uterine vessels and ovarian vessels:** uterine vessels as they ascend along the lateral border of the uterus and ovarian vessels as they pass to the ovary between the 2 layers of the infundibulo-pelvic ligament. The uterine vessels and ovarian vessels form an important anastomosis in the broad ligament. So, the uterus will survive ligation of

both uterine arteries and division of both ovarian arteries will not compromise the vitality of the ovaries or tubes

5- The nerves and lymphatics: passing to and from the uterus and ovary lie within the broad ligament.

6- The pelvic cellular tissue (parametrium). The upper 1/2 of each broad ligament is narrow and contains a little loose cellular tissue. In the lower 1/2 or base, which widens considerably, the cellular tissue become more plentiful and thickened and condensed. This forms the cardinal Mackenrodt's ligament, in which lies:

- a. The terminal part of the ureter
- b. The uterine artery
- c. The paracevical nerves (Frankenhauser plexus)
- d. The lymphatic plexuses

7- The Wolfian remnants in the broad ligament. Lie within the mesosalpinx are certain vestigial structures which are: (a). *Epoophron*: which lie above the ovary, and (b). *Paroophron*: which lie between the ovary and body of the uterus. Both are remnants & the mesonephric tubules (wolfian body) and the **Gartner duct** is the remnant of the mesonephric duct (wolffian duct)

The origin of structures is as follows:

The mesonephros follows the pronephros as the primitive kidney.

It consists of a series of tubules which lie in the intermediate cell mass and extend throughout the thoracic and upper lumbar region

Each tubule opens into the mesonephric duct and this duct ends in that part of the hind gut which later become the bladder, urethra and vestibule

The mesonephric tubules are collectively known as the wolffian body and the mesonephric duct as the wolffian duct.

The wolffian body as it grows, it bulges into the coelomic cavity as the wolffian ridge.

The wolffian body lies immediately dorsolateral to the genital ridge (developing ovary)

Most of the tubules disappear at an early stage of fetal life but a few remain and these by linking up with the sex gland in male become the efferent ducts of the testis and the epididymis while their ducts become the ductus deferens (vas deferens).

In female: fail to link up with sex glands, so give

- Epophron, paroophron and their duct remain rudimentary to give Gartner's duct

The duct is blind laterally but it may divide into branches forming structures known as the **Koblet's tubules**. Another tubular mesonephric tubules remnants is seen near the fimbriated end of the tube and is known as the **hydatid of Morgagni**.

A) The parovarian or broad ligament cyst arise from any of the tubules as they are blind and are lined by epith. which is able to secrete clear serous fluid.

These cysts are always situated bet. the 2 leaves of the B.lig. bet. the ovary and tube

B) Hydatid of Morgagni: in commonest variety of parovarian cyst and the only which is pedunculated. The pedicle is always thin and so, it may twist and become gangrenous

C) The parovarian cyst is distinguished from ovarian cyst in

- It is unilocular
- The f.t is tightly stretched across the cyst
- The ovary does not form part of its walls
- The peritoneum is easily stripped off, so simple to shell out.

Embryology:

The Mullerian ducts collect a thick mesodermal pad around them, at their fused portions to form the musculature of the body and cx of the uterus. This condensation raises the peritoneum into 2 folds one on either side of the uterus to form the broad ligament.

The round ligament

Each ligament is a flattened cord about 12cm long and is attached to the body of the uterus below and in front of uterine tubes. It lies at 1st bet. the 2 layers of the broad ligament under the anterior leaf of the broad ligament and passing upward, forward and laterally and crossing the structures running in the upper part of the lateral pelvic wall and then crosses the psoas and ext. iliac vessels and hooking round the inferior epigastric artery.

It enters the abdominal inguinal ring and runs inside the canal where it breaks up into strands which end in the labium majus.

So, the ligament has a V-shaped course, the apex of the V being at the abdominal inguinal ring

The round ligament is mostly composed of fibrous tissue but in addition, there is admixture of muscles at:

- The cranial end: unstriped muscle fibers which are reflection of the longitudinal muscle fibers from the uterine wall
- The caudal end: voluntary muscles which are reflection from the internal oblique and transversalis muscles which arch over the inguinal canal.

Applied anatomy:

- 1- Aid to some extent in maintaining normal position of uterus.
- 2- In pregnant uterus: act as guy ropes steadying the uterus and preventing the uterine fundus from rising during contraction helping descent of the presenting part
- 3- During pregnancy, it becomes hypertrophied and become easily palpated the inguinal canal and may become a site of considerable pain in one side or the other which disappear when pt. lies on side of pain
ttt: position + analgesic
- 4- The ligament is used to correct RVF by, *plication* or *Ventrosuspension*
- 5- In the fetus, a process of peritoneum called *processus vaginalis* surround the upper part of the ligament in the inguinal canal and is usually obliterated at birth. If it remains open, it is known as the **canal of Nuck**

and may form sac for inguinal hernia. If only partly obliterated, it may give rise to hydrocele of the round ligament.

Blood supply

- Pelvic portion: supplied by a branch from the union of the ovarian and uterine arteries at the superior angle of the uterus called Samson artery
- Inguinal portion: supplied by a branch from the inferior epigastric artery.

Embryology

As the primitive gonad grows, it bulges through the posterior peritoneal covering of the coelomic cavity causing a peritoneal fold to appear at its upper and lower ends. This peritoneal fold is called the *diaphragmatico-inguinal fold*

The upper end of this fold develops into the infundibulo-pelvic ligament. The mesoderm that is covered by the lower end of the fold becomes tough and form a sub-peritoneal ligament (**the gubernaculum**) that connects the lower end of the gonad to the abdominal parietals at the inguinal region . The gubernaculum is caught in the middle portion by the condensing mesoderm that will form the muscles of the body of the uterus. It is divided in the full term child into 2 portions;

- Proximal → ovarian ligament
- Distal → round ligament

It is responsible for the descent of the ovary from its original lumbar position to its pelvic site in the full term fetus.

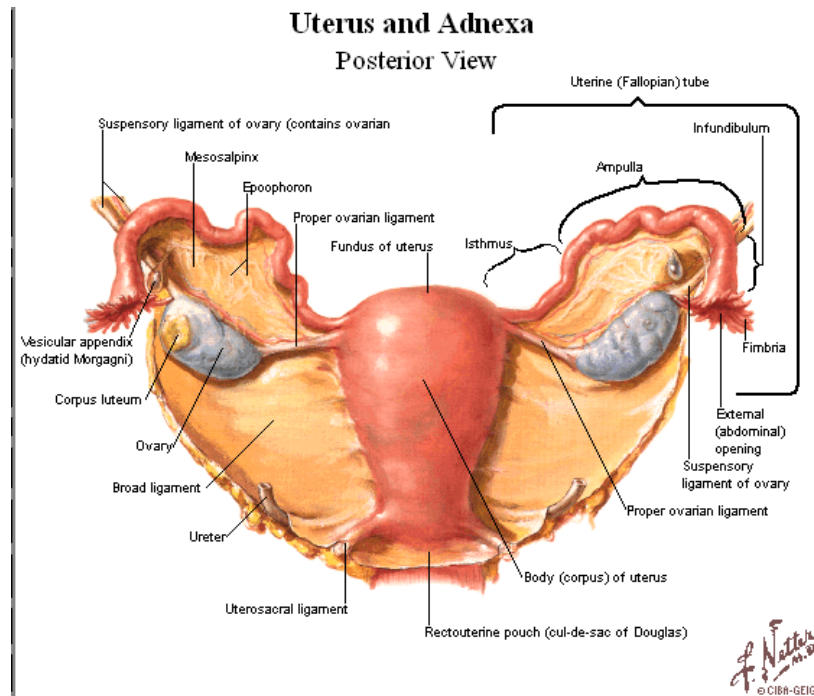
The ovarian ligament

Each ligament is a round fibromuscular cord which joins the lower pole of the ovary to the cornu of the uterus . It is similar in structure to the round ligament and embryologically continuous because they correspond to the simple gubernaculum cord or tractor of the male embryo . In the male, the cord draws the testis down via the inguinal canal into the scrotum . In the female, the upp. part of this cord is connected to the ovary as the ovarian ligament while the lower part passes through the inguinal canal to the labium majus as the round ligament of the uterus. So, theoretically, these 2 ligaments should be continuous but the continuity between them is interrupted during embryonic life by the presence of the developing uterus

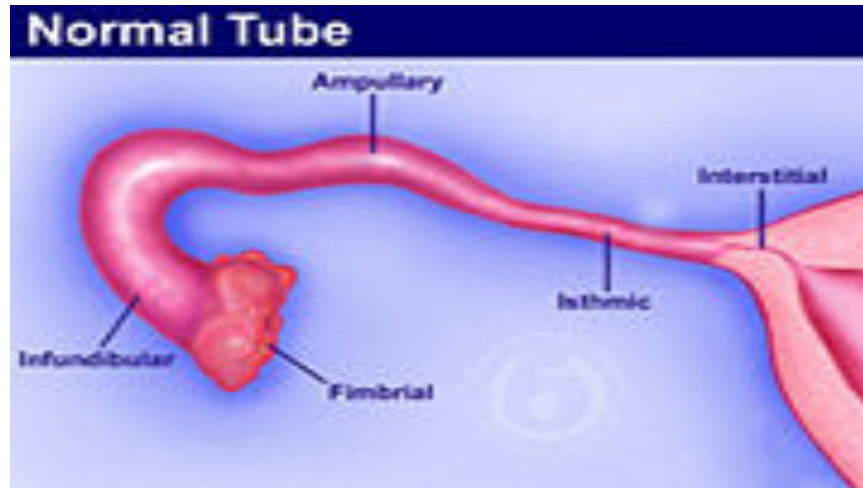
Applied anatomy:

- If ligament is long → prolapsed ovary in D.P. → dysparuenia .
- If the tube is immobilized by adhesions, the ovary through its contractile ovarian ligament is able to move to the tubal fimbriae.

CHAPTER (5)
Anatomy of the fallopian tube



- Each tube is 10 cm long and opens in the uterine cavity at one end and in the general peritoneal cavity at the other end, Accessory ostia is present in 7%, so, in female is direct connection bet. the exterior of the body and the general peritoneal cavity.
- Each tube lies between the 2 layers of the broad ligament and passes outwards and backwards. Its outer 1/2 comes to lie in direct contact with the ovary, as it ascends over the mesovarian border and tubal pole, descends on the free border and finally comes to rest on the medial surface
- Each tube consists of 4 parts:
 - 1- interstitial portion
 - 2- isthmus
 - 3- Ampulla
 - 4- Fimbrial portion



- [1]. **Interstitial part.** It is narrow portion lying within the wall of the uterus. It is about 2.5cm long and its lumen is very narrow about 1mm at the opening into the uterine cavity. **Interstitial pregnancy** is surrounded by thick vascular uterine muscle, so → severe bleeding when ruptured. Postpartum and post-abortion infection is common to involve this part and obstruct its fine lumen. Utero-tubal anastomosis is difficult at this site.
- [2]. **Isthmus.** Is straight part 2.5cm long and the diameter 2.5mm the tubal muscular wall is thick and the lumen is narrow. Ectopic pregnancy rupture early due to rigid isthmus → profuse hemorrhage as the isthmus is very vascular. This part is ligated or divided during the op. of tubal sterilization
- [3]. **The ampulla.** Is the curved dilated portion 5cm long and with maximum diameter 6mm. The muscle wall is thin and distensible and relatively a vascular. Ectopic pregnancy tends to be of longer duration as it is distensible. Tubal masses are retort shape as the unaltered thin isthmic end connects the distended ampulla to the cornu of the uterus. Salpingostomy is performed in this part
- [4]. **The ifundibulum (fimbrial end).** At the abdominal ostium, the diameter is 2mm and is trumpet shape. It consists of series of fimbriae which radiate from the abdominal ostium. One of these fimbriae is longer and arches round to obtain attachment to the outer pole of the ovary so that it forms a ciliated bridge through which the egg can travel

Relations of the fallopian tube

Superior relation. Coils of intestine and pelvic colon related to t. tube and caecum and appendix related to the Rt. tube. So, appendicitis may → Rt. salpingitis while diverticulitis → Lt. salpingitis

Inferior relation. Broad ligament and its contents

Posterior relation. Ovaries, back of B.lig. and pouch of Douglas

Lateral relation. The ureter on the lat. pelvic wall covered by peritoneum. So the tube affected by infection or endometriosis may adhere the tube to the lat. pelvic wall and the ureter becomes distorted.

Histology of Fallopian tube .:

Like the wall of the uterus it is formed of 3 layers

- **The peritoneal layer.** Called mesosalpinx and carries blood supply to the tube. It covers the fallopian tube. except its inferior surface. During salpingectomy, the affected tube and mesosalpinx s grasped and clamped as blood vessels run to the tube through the mesosalpinx

- **The muscular layer.** a)- Inner circular b)- Outer longitudinal

It becomes progressively thinner from the isthmus to the fimbriated end while the lumen becomes progressively broader. Tubal transport of the ovum needs efficient peristalsis.

Also tense patient tense tube.

- **The mucus membrane layer.** Thicker at the ampullary end than at the uterine end. Throughout the tube, the mucous membrane is thrown into folds or plicae which are low and only 4-6 in no at the interstitial end and become higher and ↑ in no in the isthmus and ↑ still further in the ampullary portion. The plicae become more complex with hundreds of tracks at the fimbrial end, the fimbrial plicae run beyond the abdominal ostium to become the tubal fimbriae . This arrangement is like railway terminals. The mucosa is composed of single layer of cells most of which are ciliated columnar epithelium. In the fimbriae all cells are ciliated . Another type of cells is unciliated columnar secretory epithelium. (**goblet cells**) which secrete protein rich serous fluid that nourish the ovum and keep plicae separate. A 3rd type of cells is the peg cells which represent collapsed goblet cells which discharged its secretion

Tubal transport system: composed of 3 elements

- 1- Tubal and ovarian fimbriae for picking up of the ovum as they sweep over the surface
- 2- Smooth muscle in the tubal wall responsible for tubal peristalsis
- 3- The cilia of tubal epithelium: ciliary current with rapid stroke towards the uterus and slow return stroke

Arterial supply

Mainly from tubal branches of the ovarian artery which anastomoses with the uterine artery to form an arcade of vessels in the mesosalpinx this → great power of recovery from inflammation

Venous drainage

Via pampiniform plexus and ovarian veins

Nerve supply

As the ovary the tube is supplied by both motor and sensory sympathetic. And parasympathetic that accompany the ovarian vessels and pass via the infundibulo-pelvic ligament to reach the hilum of the ovary, and tube . The segmental supply for the tube is T11, or T12 . Pain arising from tubal pathology is referred to the region of the iliac fossa.

Sympathetic overactivity → spasm of the tube and infertility

Lymph drainage : The same as that of the ovary

Embryology : See before

Anatomy of the ovary

The ovary is the female gonad or sex gland. Surface appearance. It is oval in shape and pinkish grey. The surface is smooth during childhood but irregular during reproductive life due to presence of large follicles, cysts or corpora lutea. Puckering and wrinkling ↑ with age. Size of the ovary. Is variable in different individuals 2.5 – 3.5cm in length, 2cm in width, 1.25cm thick.

Weight of the ovary: About 6-8gm but ↓ to 2gm in postmenopausal.

Position of the ovary: In nullipara, it lies in shallow fossa on the lateral pelvic wall known as fossa ovarica of **Waldyer** present in the angle bet. the external iliac vein and the ureter immediately below the bifurcation of the common iliac artery. The position is influenced by pregnancy and surrounding pathology. During pregnancy, it is influenced by the movement of the uterus and broad ligament and after labor, it may never regain its normal position especially if involution is imperfect. The relation bet. the ovary and ureter carry danger to the ureter when dealing with any ovarian pathology (endometriosis, infection, tumors).

Relations of the ovary

The long axis of the ovary lies in a vertical plane so that it has an upper and lower pole, anterior and posterior borders, medial and lateral surfaces.

- **Anterior border:** Attached to the post layer of the broad ligament by double layer of peritoneum called mesovarium through which pass the ovarian vessels and nerves to enter the hilum of the gland
- **Posterior border :** Directed backwards and is free. It is separated from the ureter and int. iliac a. by peritoneum
- **Superior pole (tubal pole):** Is in direct contact with the ampulla of the uterine tube and is attached to the infundibulopelvic ligament
- **Inferior pole: (uterine pole);** Directed towards the uterus and is attached to the ligament of the ovary
- **Medial surface :** Is in contact with the abdominal ostium of the tube and is directed to the rectovaginal pouch and is related to coils of the ileum
- **Lateral surface :** In contact with the ovarian fossa.: *The fossa is bounded by:* External iliac vein: superiorly, Ureter + int. iliac a: posteriorly, Obliterated umbilical artery, Superior vesical vessels, Obturator nerve and vessels. Between these structures and the ovary is the peritoneum and extraperitoneal connective tissue.

If the vermiform appendix descend below the pelvic brim, it is likely to lie in direct contact with the Rt. ovary.

Attachments of the ovary

1- Ovarian ligament:

Attached to the lower pole of the ovary and to the body of the uterus immediately below and behind the f.t. if long → prolapse of the ovary. Shortening will lift the ovary (oophropexy)

2- Mesovarium: mesentery of the ovary :

All vessels and nerves leave at this point to the post. leaf of the B.lig. by short peritoneal fold

3- Infundibulopelvic ligament

Attached to the upp. pole of the ovary

It is also known as the ovarioepelvic fold.

When it is excessively long → prolapse of the ovary this ligament contain ovarian vessels and by ligating it, the greater part. of bl. supply is controlled.

This ligation is an essential step in hysterectomy when the ovaries are to be removed Also, the ovarian vessels have tendency to retract so, the infundibulopelvic pedicle should always carefully be watched for haemostasis after ligation

The ovary is the only organ in the abdominal cavity which is not clothed by peritoneum. So does not interfere with ovulation. This explains the rapid spread of ovarian cancer

Histology of the ovary

- **The germinal epithelium**

Single layer of flattened cells constituting the surface epith. of the ovary.

The layer is continuous at the hilum with the peritoneal endothelium of the post. leaf of the B.lig. (both have common origin from the primitive coelomic epith).

This layer is embryologically continuous with epith. of uterine and tubal mucosa it has an extraordinary potential for neoplastic growth and the chief source from which ovarian tumors derived .

- **Tunica albuginea**

Strong layer of condensed ovarian stroma beneath the germinal epith. Which is the fibrous capsule of the ovary.

It gives the ovary the characteristic white color and protect the deeper structures of the ovary (armor plate of the ovary).

It is thickened in stein leventhal syndrome .

It allows the ovary to be sutured with out the sutures pulling out in the operation of wedge resection .

- **The ovarian cortex**

Lies below the tunica albuginea and is the main functional part of the ovary and it surrounds the medulla

It contains collection of primordial follicles supported and held together by ovarian stroma. It has highly cellular appearance with darkly staining nuclei .

- **The ovarian medulla**

The area of entrance and exit of vessels and nerves and is called the hilum of the ovary

.

Immediately around the hilum is the ovarian medulla and is composed of ordinary fibrous tissue

It contains no follicles but contain only B.Vs and functionless remnants of tubular structure which in the male give testicles (rete ovarii) .

Changes in the ovary with age

- **At birth**

It is long, thin, lobulated, smooth surface which is full of primordial follicles

Between birth and puberty

The ovary grows in size due to ↑ stroma only as no further deposition of follicles occur
 Its function remain quiescent with bursts of activity due to pituitary stimulation but not sustained enough, so → follicular atresia → follicles are reduced from the initial at birth to 300.000 at 7 year and 50.000 at puberty

Reproductive period

The ovary shows various stage of development (primordial follicles, ripe follicles, corpus luteum, corpus albicans)

The en mass development of follicles is essential for the ultimate maturity of a single successful one

Postmenopausal (senile) ovary

The ovary has no primordial follicles. Only ovarian stromal tissue and scars of formerly active corpora lutea and atretic follicles

The surface of the ovary is shrunken and corrugated

The size is ↓ed to 1.5 x 0.75 x 0.5cm

So, the ovary if palpable in postmenopausal is suspicious of ovarian neoplasm (PMPO syndrome)

Arterial supply: ovarian artery

It is long slender artery which is a branch of abdominal aorta just below the renal arteries and on the right side crosses the IVC, right ureter and Rt. psoas and on the Lt. side, it crosses the Lt. ureter and Lt. psoas muscle .

The artery descends over the pelvic brim by crossing the ext. iliac artery, runs between the 2 layers of the infundibulo-pelvic ligament and thus reach the hilum of the ovary by passing bet. the layers of the mesovarium

During its course, it gives branches to the

- Ureter
- Fallopian tube
- Round ligament

and near the uterus, it finally anastomoses with the uterine artery to form a continuous arcade in the broad ligament.

Venous drainage: ovarian veins

Situated mainly in the mesosalpinx where they give rise to the pampiniform plexus

At the outer end of each B.lig., the veins of this plexus coalesce to form a single venous trunk (the ovarian veins) which follows the ovarian artery out of the pelvis to terminate directly into:

- The IVC on the Rt. side
- Renal on the Lt. side
- The ovarian vessels are long because of descent of the gonads from the loin to the pelvis
- The utero-ovarian anastomosis: if uterine a. ligated, the uterus is not affected and ligation of both ovarian arteries will not affect the ovaries and tubes

- The site where the ovarian vessels cross the ureter and int. iliac artery on the lateral pelvic wall is one of the danger areas where it is possible to damage the ureter during surgery
- The pampiniform plexus may be engorged during pregnancy → B.lig. varicocele → may cause lower abdominal pain during pregnancy. The veins disappear after pregnancy
- The ovarian vein syndrome: occasionally, the Rt. ovarian vein may run an aberrant course and in this way → ureteral compression → hydroureter and hydronephrosis

Lymph drainage: 3 directions

- Main group accompany ovarian vessels to paraaortic nodes
- Some channels to the opposite ovary via the ovarian lig.
- Other channels via the ovarian and round lig. to the superficial inguinal LN.

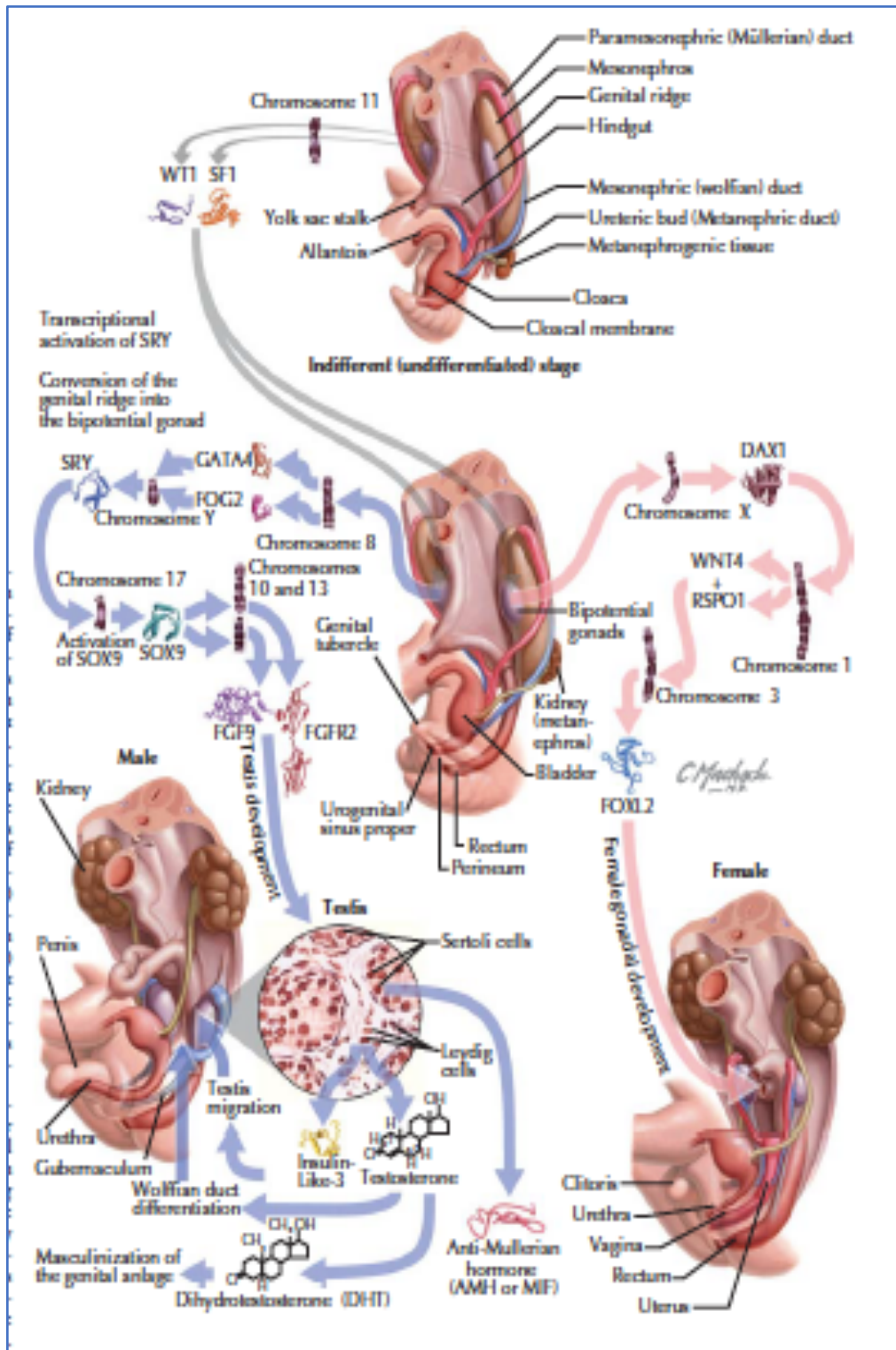
The communication of lymphatics across the fundus explains why ovarian cancer is most often bilateral and so, a radical operation with removal of the uterus and both ovaries should always be carried out.

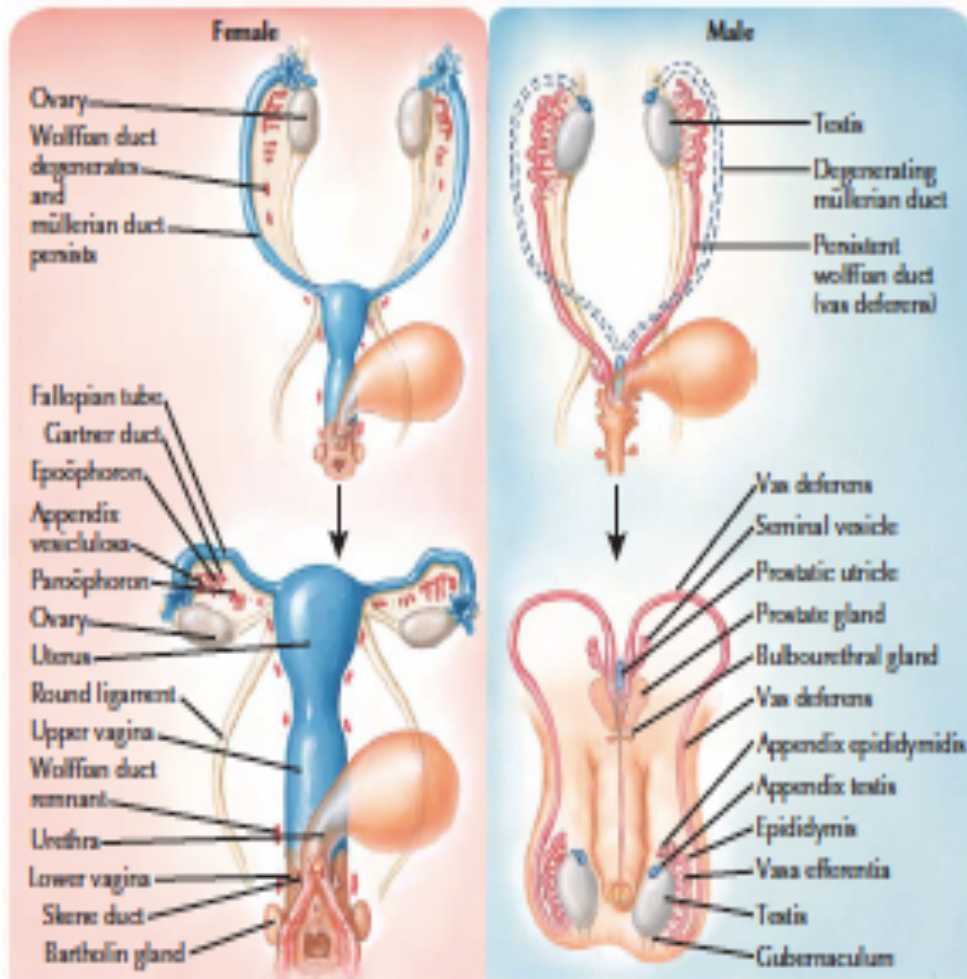
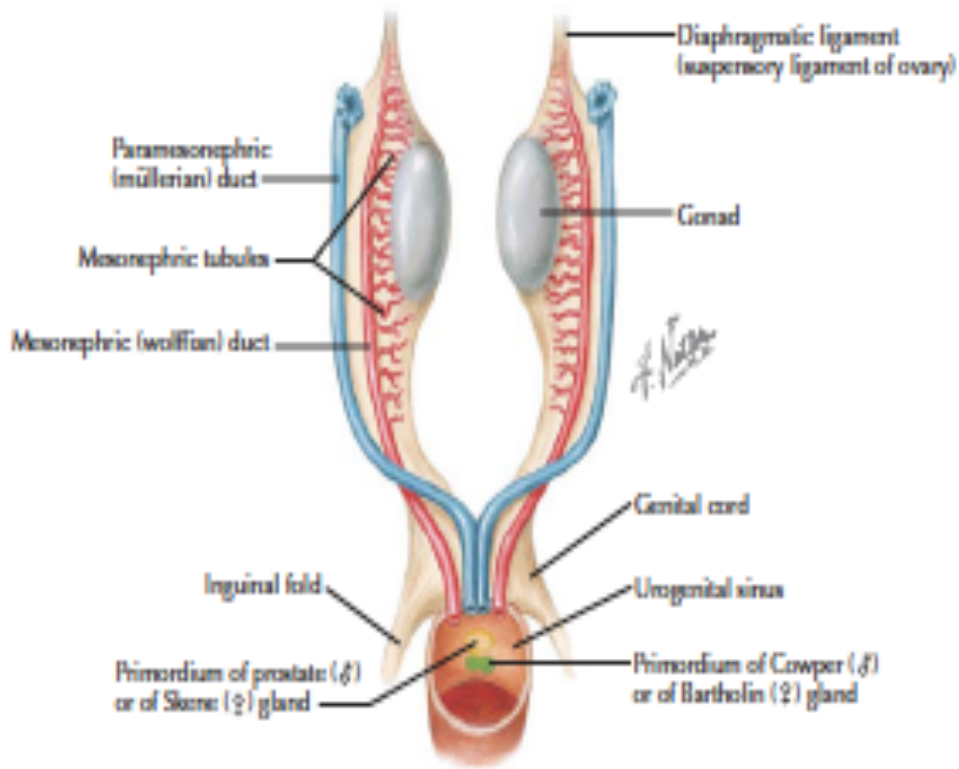
Nerve supply:

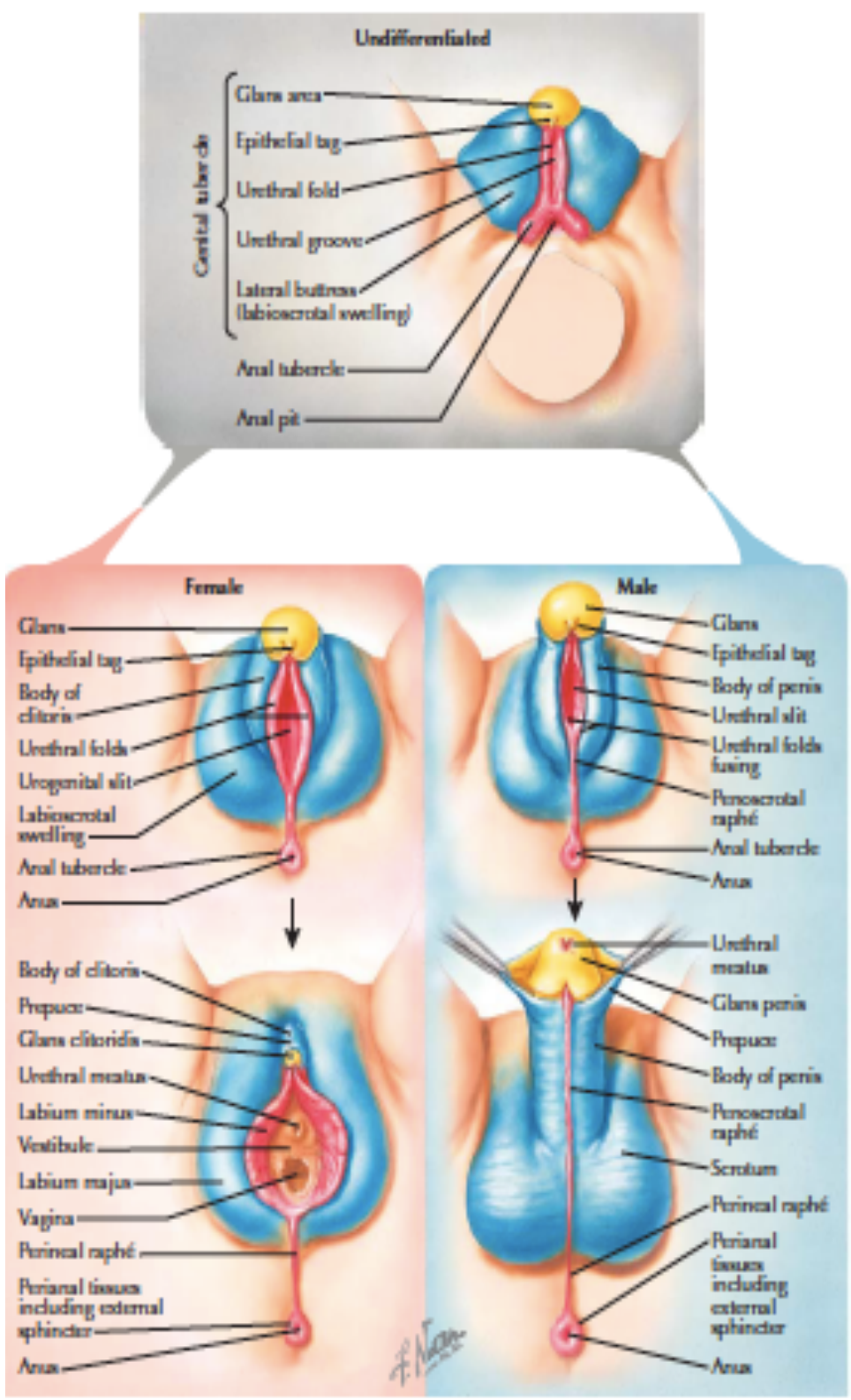
Both motor and sensory parasympath. and sympath. which accompany the ovarian vessels from the abdomen to pass into the infundibulopelvic lig. to reach the hilum of the ovary the segmental nerve supply of the ovary is from T10 – T11

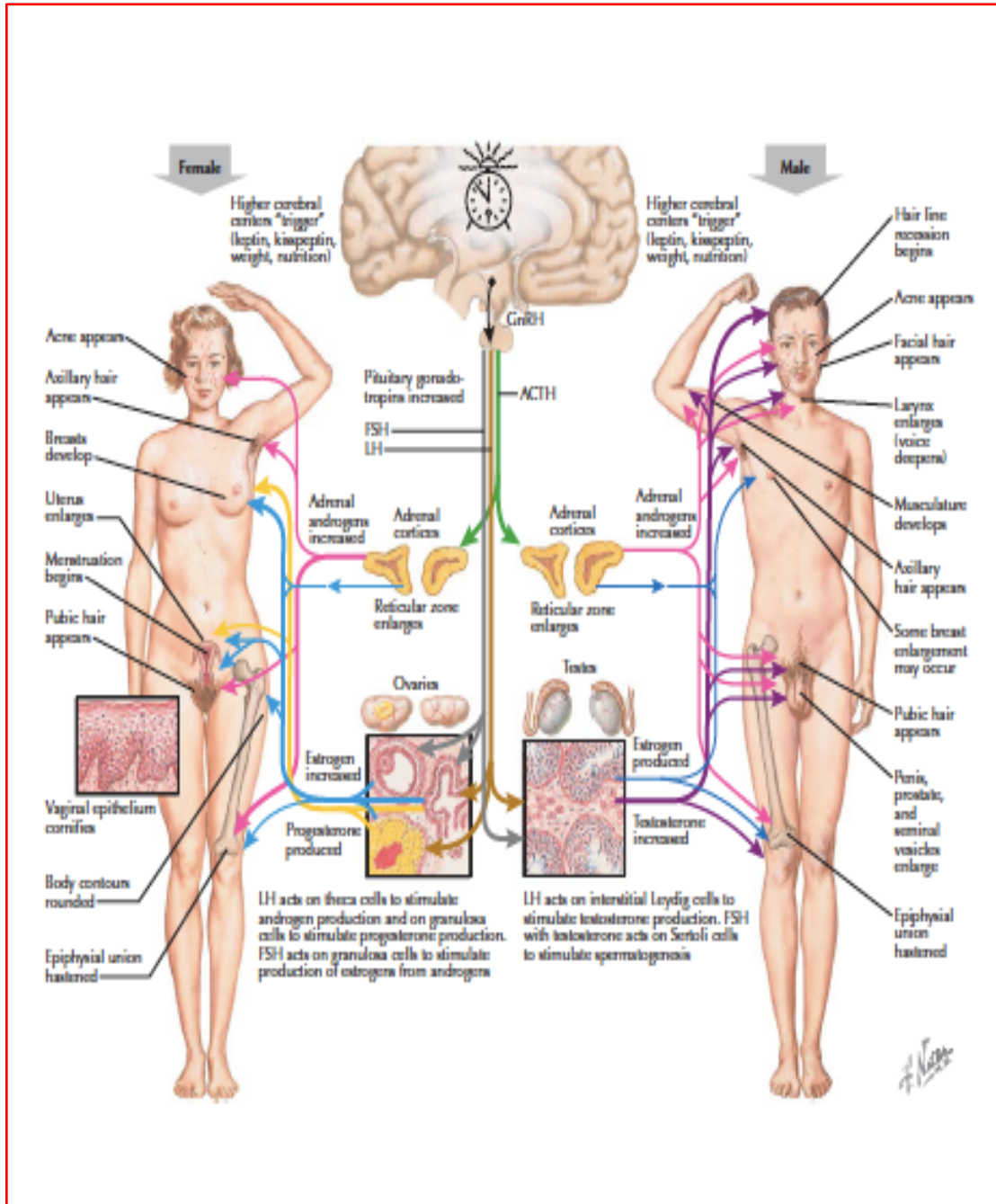
- The operation of ovarian neurectomy is simply done by dividing the ovarian nerve supply by division of the infundibulopelvic ligament as the whole nerve supply run in the easily accessible infundibulopelvic ligament
- The segmental skin innervation of the ovary and f.t. (T10, 11, 12) is an area (band) spreading horizontally round the body between:
 - 1st and 4th lumbar spine posteriorly
 - Upper border at the umbilicus anteriorly

DEVELOPMENT OF REPRODUCTIVE SYSTEM IN SKETCHES





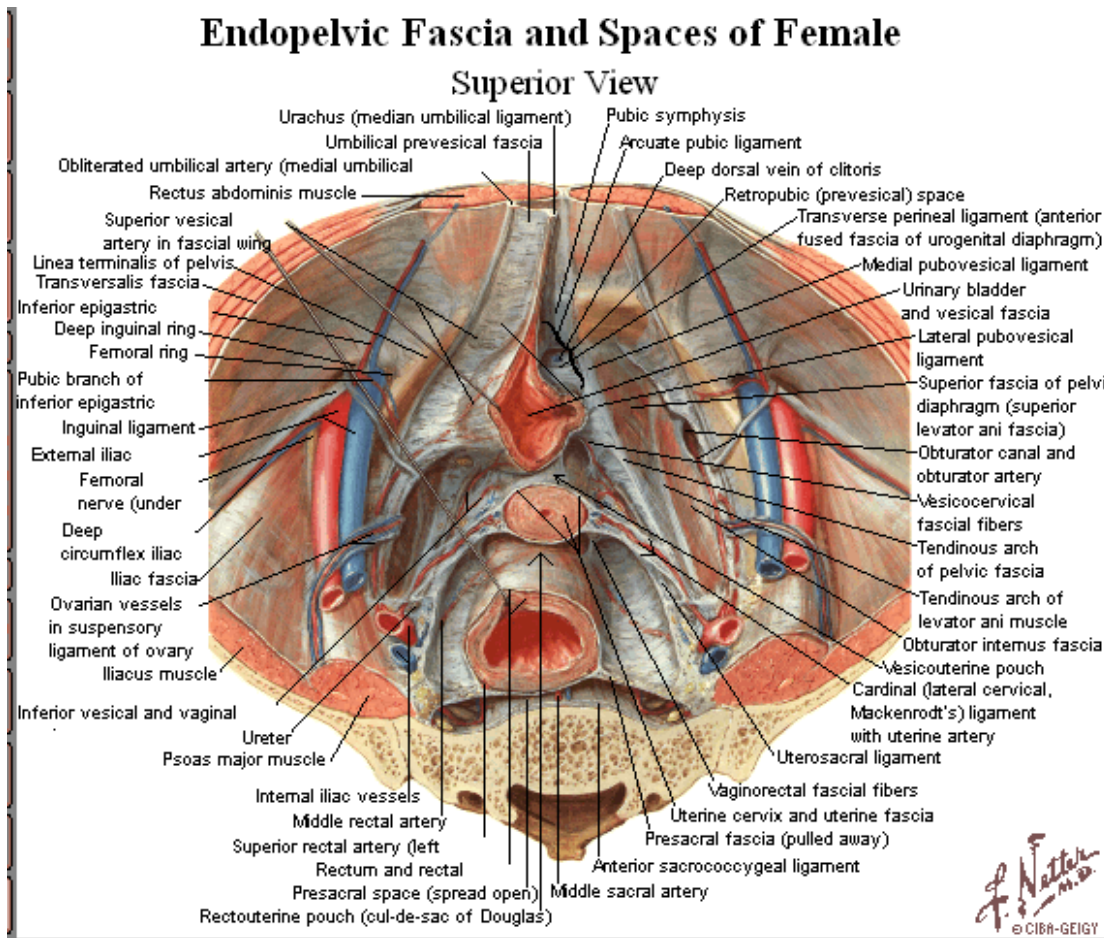




CHAPTER [6]

- [Anatomy of the pelvic fascia](#)
- [Pelvic spaces](#)
- [Fascial ligaments](#)
- [Supra-vaginal & rectovaginal septa](#)
- [The female pelvic floor](#)
- [Levator ani muscles](#)

Anatomy of pelvic fascia



The fascia of the body consists of:

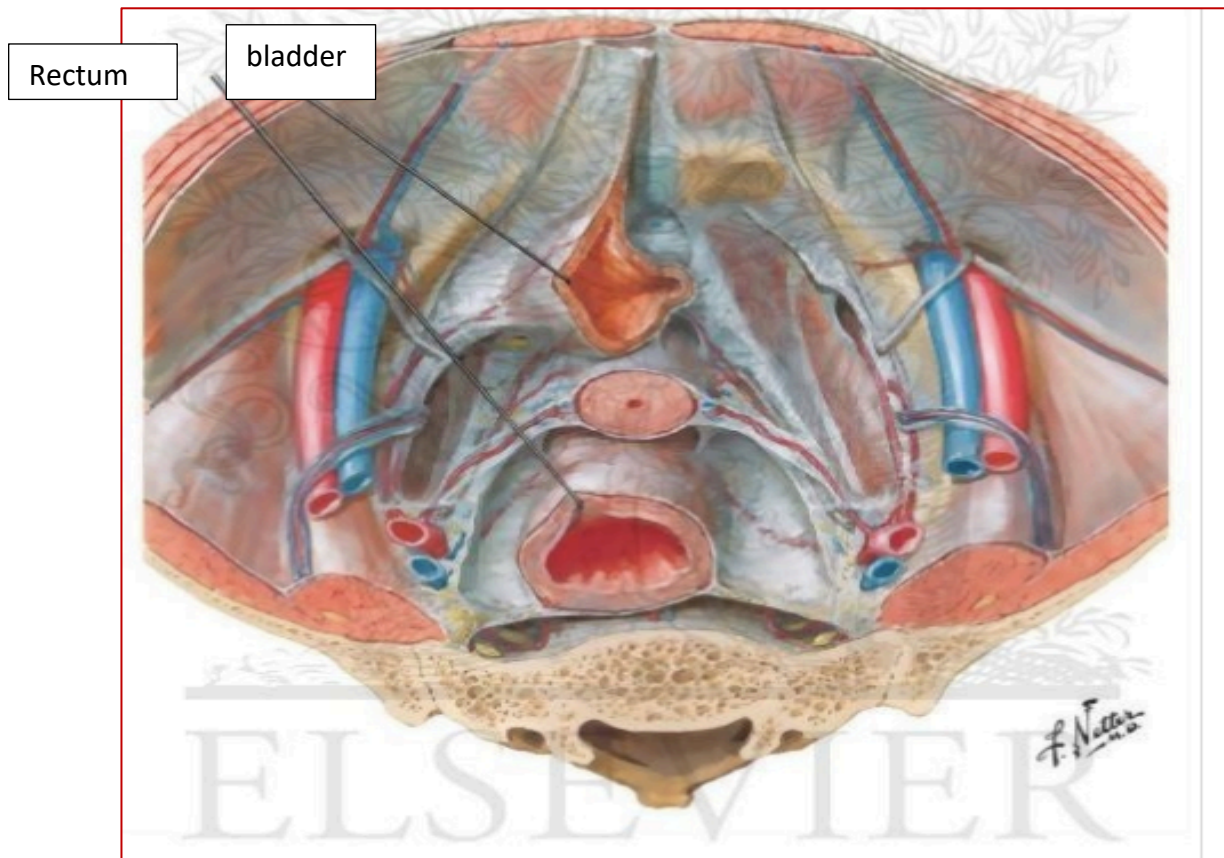
- 1- **Superficial layer:** areolar tissue and fat
- 2- **Deep layer:** fibrous tissue which is tough and inelastic membrane throughout the body except in the abdominal wall. It forms a continuous layer throughout the body that:
 - a- Covers the surfaces of muscles and ensheath them and gives attachment to them
 - b- Blends with ligaments
 - c- Fuses with subjacent periosteum as it passes over body surfaces

The pelvic fascia:

It is continuous with fascia transversalis lining the abdominal cavity. It is called the **endopelvic fascia**, and consists of (parietal layer – visceral layer)

1- THE PRIETAL LAYER:

- It extends from the sacrum over the piriformis (and the sacral plexus over it) to the anterior part of the capsule of the sacroiliac joint.
- It lines the obturator internus muscle and blends with the obturator membrane.
- It is attached to the body of the pubis where it surrounds the levator ani origin
- It runs down on the anteroinferior border of the obturator internus and is attached to the inferior rami of the ischium and pubis forming the superior layer of urogenital diaphragm.
- At the falciform margin of the ischial tuberosity, it blends with the fascia of **Colles** and sacrotuberous ligament and passes to the ischial spine and blend with the sacrospinous ligament. From this point, it passes to the margin of the greater sciatic notch and then over the piriformis and then back to the sacrum

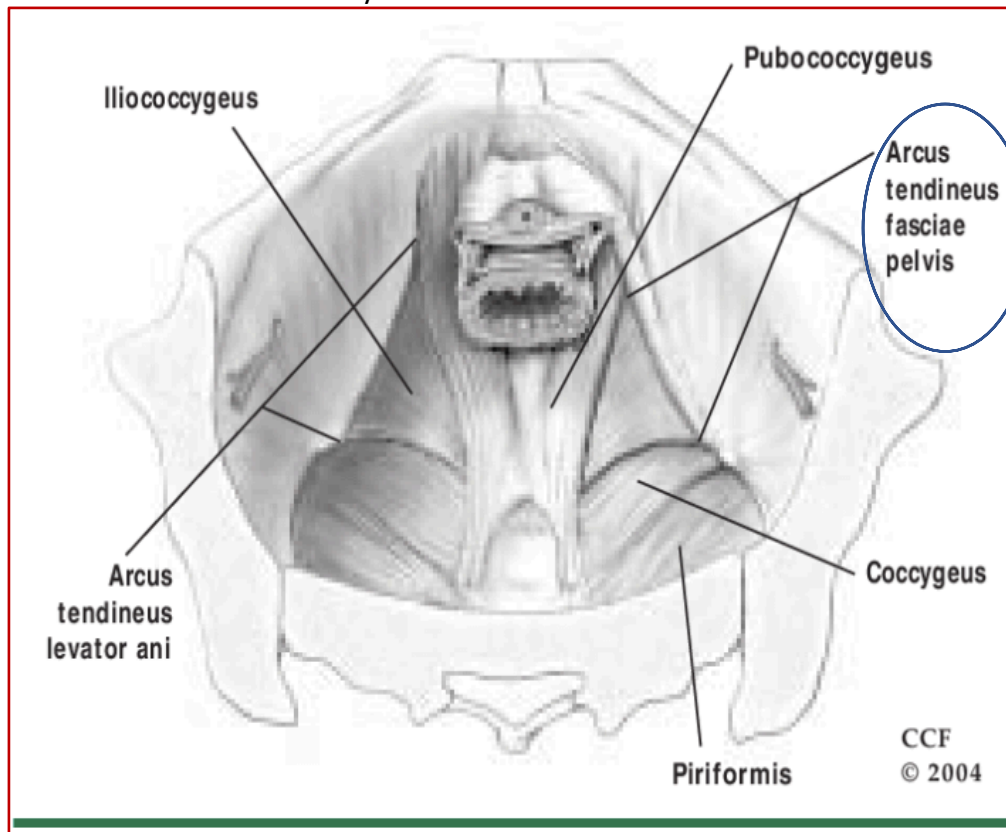


Arcus tendineus fascia pelvis (white line):

A line running from the body of the pubis to the ischial spine that represent the blend of fascia that ensheaths the levator ani with the fascia lining the obturator internus forming thickened fascial band which is silvery white

The levator ani takes origin from this line.

The lower layer of fascia surrounding the levator ani is known as the anal fascia which forms the medial boundary of the ischioanal fossa



*The arcus tendineus divides the pelvic fascia lining the obturator internus (obturator fascia) into 2 parts (a) **Above the arch**: lies in the pelvis, and (b) **Below the arch**: lies in the perineum forming the lateral wall of ischioanal fossa. In this wall, the pudendal (or Alcock's canal) is present and contain the internal pudendal vessels and pudendal nerve.*

Pelvic fascia covering the pelvic floor:

The most important part of the endopelvic fascia runs from the lateral pelvic wall to the adjacent viscera and covers the pelvic surface of **the levator ani**.

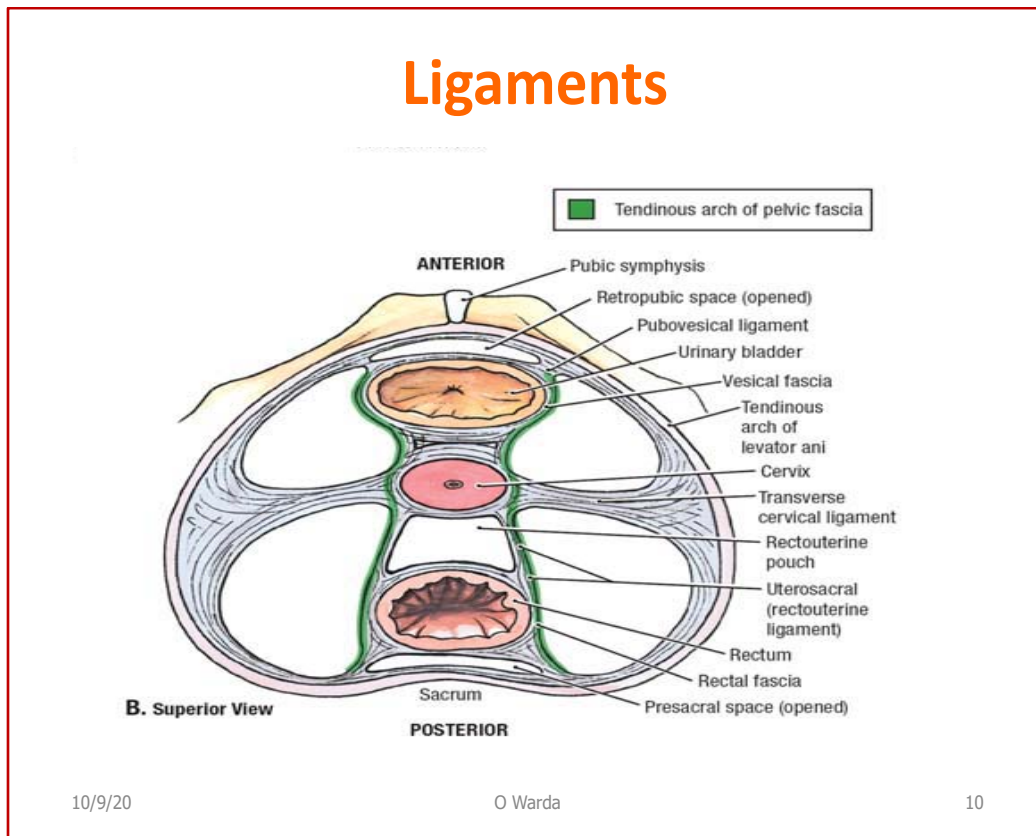
This fascia gets its strength from collagen and elastic fibers content which provide rigidity and tensile strength that provide extra-strength for the pelvic floor in order to support the weight of pelvic viscera and aid in the sphincteric mech. of the levator ani.

Pelvic fascia forming the powerful ligaments:

-Thickened bands in this fascia are reinforced by condensation of **superimposed connective tissue, voluntary muscle of the pelvic floor & involuntary muscle of pelvic viscera**.

-These bands forms **ligaments** that radiate outward from the cervix and vaginal vault to the pelvic wall like spokes of wheel as follows

- 1- Laterally to the pelvic wall: *Mackenrodt's lig.*
- 2- Posteriorly to the sacrum: *uterosacral lig.*
- 3- Anteriorly to the pubis: *pubo-cervical lig. or fascia*



These ligaments are not purely fibrous and the ratio of muscle to fibrous tissue varies but usually 1:3

The smooth muscle content make them powerful and contractile structures

[1] .Pubo-cervical ligaments:

Consists of 2 horizontal parallel strands on either side of midline attached anteriorly to the pelvic surface of the body of the pubis and posteriorly to the vaginal vault and supra-vaginal cervix adjacent to it.

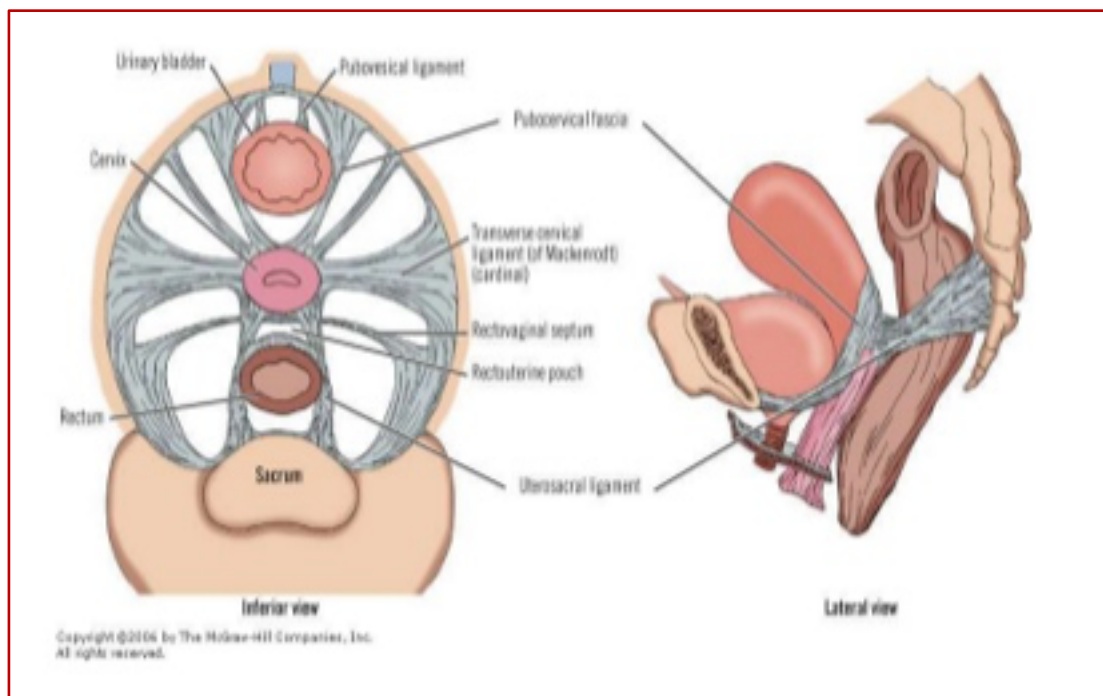
While passing backwards from the pubes, the ligaments become attached to the neck of the bladder and from this part, strands radiate laterally across the pelvic floor to the arcus tendineus.

The pubo-cervical ligament and the lateral strands constitute *the true ligament of the bladder* and support it. These ligaments are concerned with maintaining the normal angle of 45° bet. the vagina and the horizontal relaxation of these ligaments → herniation of the bladder through the unsupported anterior vaginal wall.

[2] .Cardinal (Mackenrodt's) ligaments:

Also called *lateral or transverse cervical ligament*. It is attached to the vaginal vault and adjacent supravaginal cx and run transversely across the pelvic floor to the arcus tendineus.

It consists of 3 strands (triradiate) and are better developed .These ligaments act as **the main uterine and vaginal vault support** suspending them to the lateral pelvic wall. They are named cardinal because they are essential or cardinal to normal support of the uterus and vaginal vault.



[3].Utero-sacral ligaments:

Attached to vaginal vault and supra-vaginal cervix and pass backwards around the pouch of Douglas to become attached to the middle (3rd piece) of the sacrum. It is considered a **true** anatomical ligament as it attaches an organ (uterus) to a bone (sacrum)

They are better developed near the cx origin and contain connective tissue, muscle fibers, important B.Vs, the nervi erigentes and the lymphatics draining the cx of the uterus to the sacral group of L.N.

So, in acute infl. condition, in T.B. and in cancer, these lymph vessels are infiltrated at an early stage and rectal exam. give evidence

These ligaments encourages anteversion of the uterus

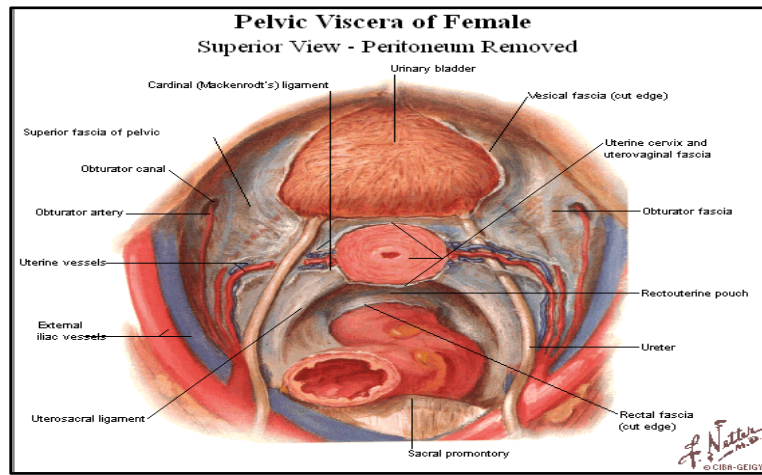
Applied anatomy /Clinical importance:

- 1- The main support of the uterus, vagina and bladder
- 2- If the ligaments are torn or overstretched during childbirth → prolapse
- 3- The strength of Mackenordt's ligaments is tested as during vaginal hysterectomy, the cervix can't be pulled down easily until the Mackenrod't's ligaments are severed.
- 4- The smooth muscle / fibrous tissue ratio is important. The variability is constitutional. The less the smooth muscle and elastic fibers content, the weaker is the supporting ability of these ligaments
- 5- The elastic recoil of the ligaments: apply traction with volsellum → observe rapidly with which the uterus spring back to the original position, without dislocation
- 6- They constitute an important lymphatic pathway for cervix & upper vagina.
- 7- Menopausal atrophy of ligaments → 80% of all cases of uterine prolapse occur postmenopausal

2 -THE VISCERAL LAYER

It is a reflection of the fascia covering the levator ani over the pelvic viscera

- It covers the bladder and upper urethra, uterus vagina, rectum and anal canal
- The smooth muscle fibers of these organs infiltrate between strands of fibrous making the visceral fascia inseparable from the wall of the organ.
- A band of pelvic fascia anchors the floor of the rectovaginal pouch of peritoneum to the central point of perineum and is known as the rectovaginal septum.



- It is formed by obliteration of the distal part of peritoneum pouch of the embryo and so it is comparable to the fascia of **Denonvilleier**, in the male

The pelvic cellular tissue → **Packing material of the pelvis**

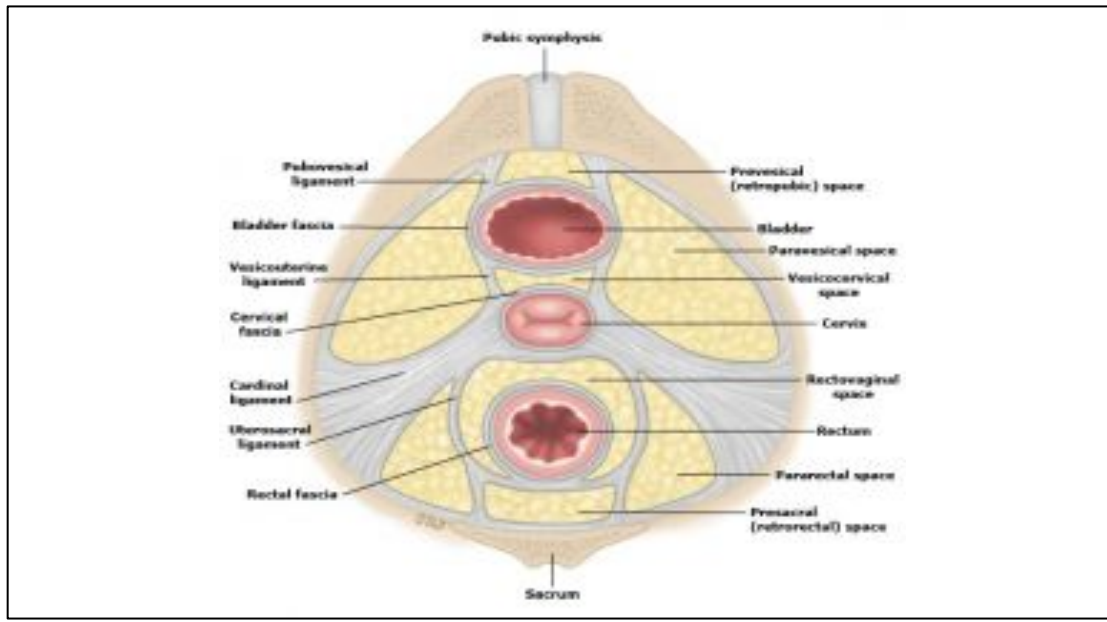
- It is sub-peritoneal connective tissue with variable amount of adipose tissue which lies between the peritoneum and pelvic fascia and is attached to both of them.
- It completely fills the *space of Retzius* and pass backwards and envelops the sides and base of the bladder. It *surrounds the whole vagina* and is especially thick around the vault and adjacent supra-vaginal cervix but *is absent from the body and fundus of the uterus* where the peritoneum lies in direct contact with the visceral layer of pelvic fascia.
- That part in relation to the vaginal vault and supra-vaginal cervix and insinuates itself between the broad ligament is called **parametrium**.
- It fills the space between the pelvic floor and *rectovaginal pouch* and completely surrounds the rectum.

Clinical importance:

- 1- The pelvic cellular tissue allow pelvic organs to become distended
- 2- Parametrium: parametritis → firm mass extending outwards to pelvic wall after resolution → isolated nodules may remain for years of for life
- 3- **Strong tubular sheaths** for ureter, round ligaments, blood vessels, nerves, and lymphatics. These tubular sheaths serve for ;

- mainly protective to prevent compression
- Infection in the pelvis may spread to remote regions, e.g. along the ureter to perinephric region, or long round ligament to the groin, or along external iliac artery to the thigh. Or along gluteal vessels to the buttocks

Pelvic connective tissue spaces



There are connective tissue spaces between the pelvic organs that permit the relatively independent function. These spaces are potential spaces and are filled for the most part with loose areolar tissue. They are devoid of blood vessels and nerves and are readily converted into actual spaces by blunt dissection.

These spaces are divided by connective tissue septa that not only afford mechanical support but also provide the physical routes for blood vessels, lymphatics and nerve tissue to and from the pelvic organs.

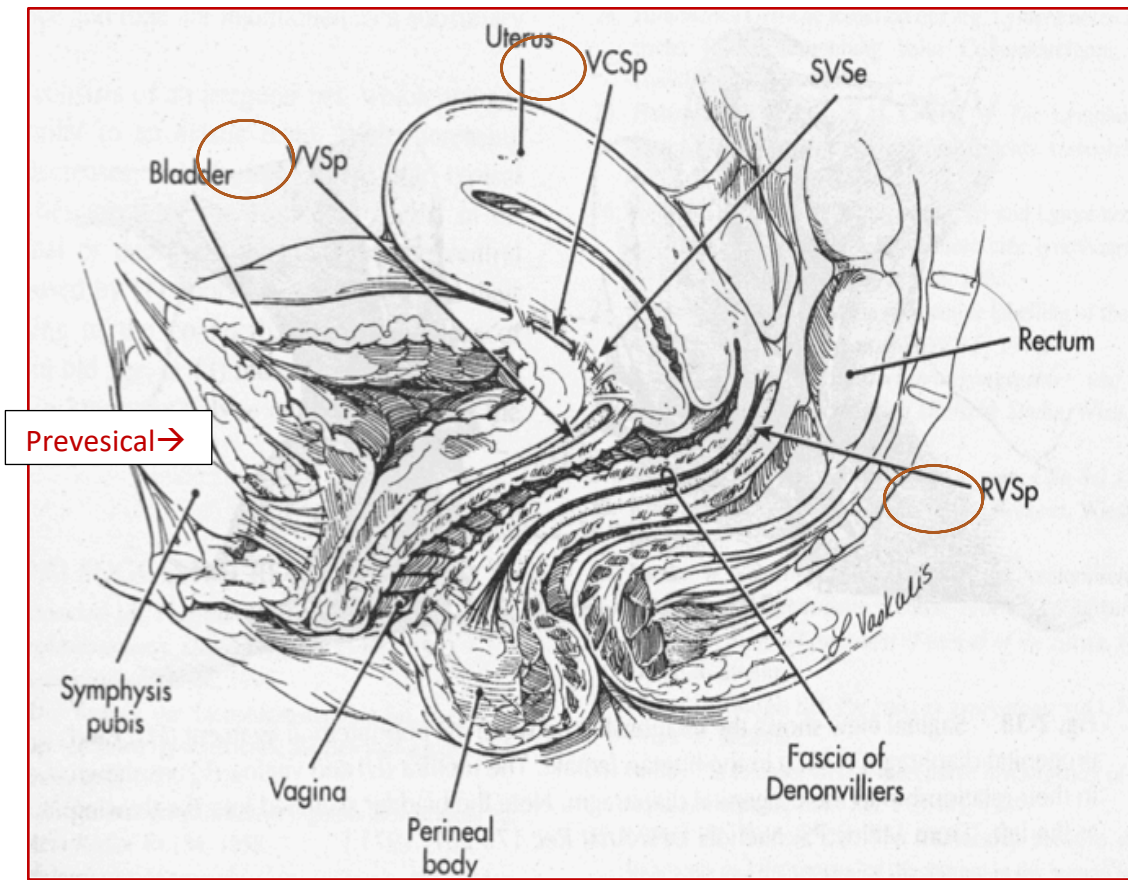
The anatomic ligaments form natural barrier to the spread of infection, cancer and hematomas. The septa form natural routes for transmission of infection and malignancy arising from the pelvic organs.

The cardinal ligament extends laterally from the central portion of the upper vagina and cervix.

A vertical pillar or septum extends along each side of the 3 essential pelvic organs (urinary, genital, rectal) from the pubis to the coccyx, intersect the cardinal ligaments and ensures both attachment and continuity with connective tissue capsules of each of the 3 essential organs.

So, in conclusion, the subperitoneal area of the true pelvis is partitioned into potential spaces by various organs and their respective fascial coverings and by the selective thickenings of the endopelvic fascia into ligaments and septa.

These spaces are: (1). prevesical space (Retzius), (2) paravesical spaces, (3)vesicovaginal space, (4).rectovaginal space, (5).pararectal spaces, (6).retrorectal space, (7).presacral space



1-Prevesical space of Retzius:

Is a fat filled space bounded:

Anteriorly: by the pubic bone covered by the transversalis fascia and extending to the umbilicus between the lateral umbilical ligaments (obliterated umbilical arteries)

Posteriorly: the anterior wall of the bladder. It separated from the paravesical space by the ascending bladder septum (bladder pillars)

Clinical importance

- 1-Upon entering the space, the pubourethral ligaments may be seen inserting in the posterior aspect of the symphysis pubis as a thickened prolongation of the arcus tendinous fascia
- 2- Combined abdominal and vaginal bladder neck suspensory procedures usually enter the Retzius space between the arcus tendinus and the pubourethral ligament

2-Vesicovaginal space:

Lies in the midline and is bounded by:

Anteriorly: the bladder adventitia

Posteriorly: the anterior vaginal wall adventitia

Laterally: the bladder septa or pillars

Superiorly: by the point of fusion between the bladder adventitia and the vaginal adventitia. This point is called the supravaginal septum or vesicovaginal ligament

Inferiorly: the vesicovaginal space is limited by the fusion of the urethral and vaginal adventitia

Clinical importance

Tear of the fascial investments and thickenings medially. Transversely or laterally allow herniation and development of a cystocele

3-Vesicocervical space:

Is a continuation of the vesicovaginal space superiorly above the supravaginal septum

Posteriorly: the adventitia of the cx and vagina

Anteriorly: the bladder adventitia

Superiorly: the vesicouterine peritoneal pouch

Inferiorly: the supravaginal septum

Cutting the supravaginal septum (SVSe) establishes communication between the vesicovaginal space and vesicocervical space

4-Rectovaginal space:

Extends between the vagina and rectum. It is bounded by

Anteriorly: the rectovaginal septum (firmly adherent to post aspect of the vagina)

Posteriorly: the anterior rectal wall

Laterally: the descending rectal septa separating the rectovaginal space from the pararectal space on each side

Superiorly: peritoneum of Douglas pouch

Inferiorly: the perineal body

Clinical importance

The rectovaginal septum divides the pelvis into rectal and urogenital compartments allowing the independent function of the vagina and rectum.

An anterior rectocele after results from a defect or an avulsion of the septum from the perineal body. Reconstruction of the perineum is critical for the restoration of this important compartment separation as well as for support of the anterior vaginal wall

5-Retrorectal space: bounded

Anteriorly: by the adventitia of the rectum

Posteriorly: by the anterior aspect of the sacrum

Laterally: it communicates with pararectal spaces, laterally above the uterosacral ligament and extends superiorly into the presacral space

6-Presacral space:

Is the superior extension of the retrorectal space and is bounded

Anteriorly: by the deep parietal peritoneum

Posteriorly: by the anterior aspect of the sacrum

Clinical importance

This space contains the middle sacral vessels and the hypogastric plexus between the bifurcation of the aorta. Presacral neurectomy requires a good familiarity and knowledge of this space

7-Paravesical spaces: (bilateral; right & left)

Lie above the cardinal ligament and its prolongation bounded

Medially: by the bladder pillars

Laterally: by the pelvic walls (the fascia of obturator internus and levator ani).

Superiorly: by the lat. umbilical ligament

8-Pararectal spaces: (bilateral ; right & left)

Bounded;

Medially: by the rectal pillars

Laterally: by the levator ani.

Posteriorly: above the ischial spine by the antetolat. aspect of the sacrum

It is separated from the retrorectal space by the posterior extending descending rectal septa.

The supravaginal septum (SVSe)

Represents the point of fusion between the connective tissue support of the bladder and that of the upper vagina and cervix.

Clinical importance

1- Cervical cancer may directly invade the wall of the bladder along this septum

2- The connective tissue of the septum may be softened considerably in pregnancy with the ↑ in elasticity that occur to accommodate the necessary stretching as the uterus enlarges as well as the contraction of the uterus in labor with minimal alteration in bladder function

3- This softening accounts for the ease with which the bladder may be bluntly separated from the LUS. and cervix at CS in contrast to need for sharper surgical division of these organs in the non- pregnant state.

4- The vaginal operator may incise directly through the point of fusion between the bladder and vagina providing access to the vesico-uterine peritoneal fold. The abdominal operator will first enter the anterior peritoneum continuing the dissection beneath the connective tissue capsule of the uterus beneath or through the supra-vaginal septum which is the principle of the so called endofascial abdominal hysterectomy

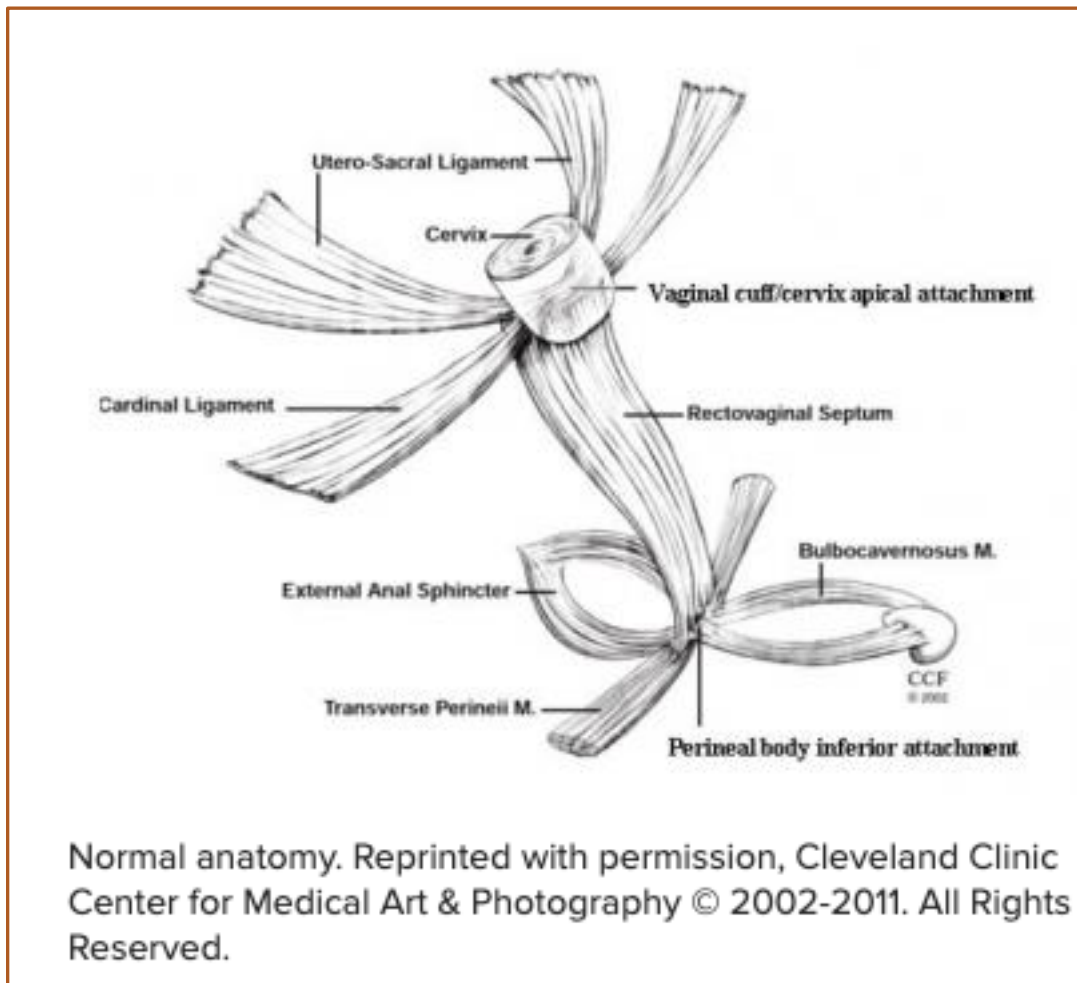
The rectovaginal septum:

This septum represent fusion of the walls of the fetal peritoneal pouch

It extends from the caudal margin of the cul de sac to the proximal edge of the perineal body

It consists of dense collagen, abundant smooth Ms. Fibers, coarse elastic f. demonstrated by special stain (Orzien)

- Avulsion of septum → rectocele , constipation
- Failure of normal fusion early in life may → cong. enterocele due to deep cul de sac

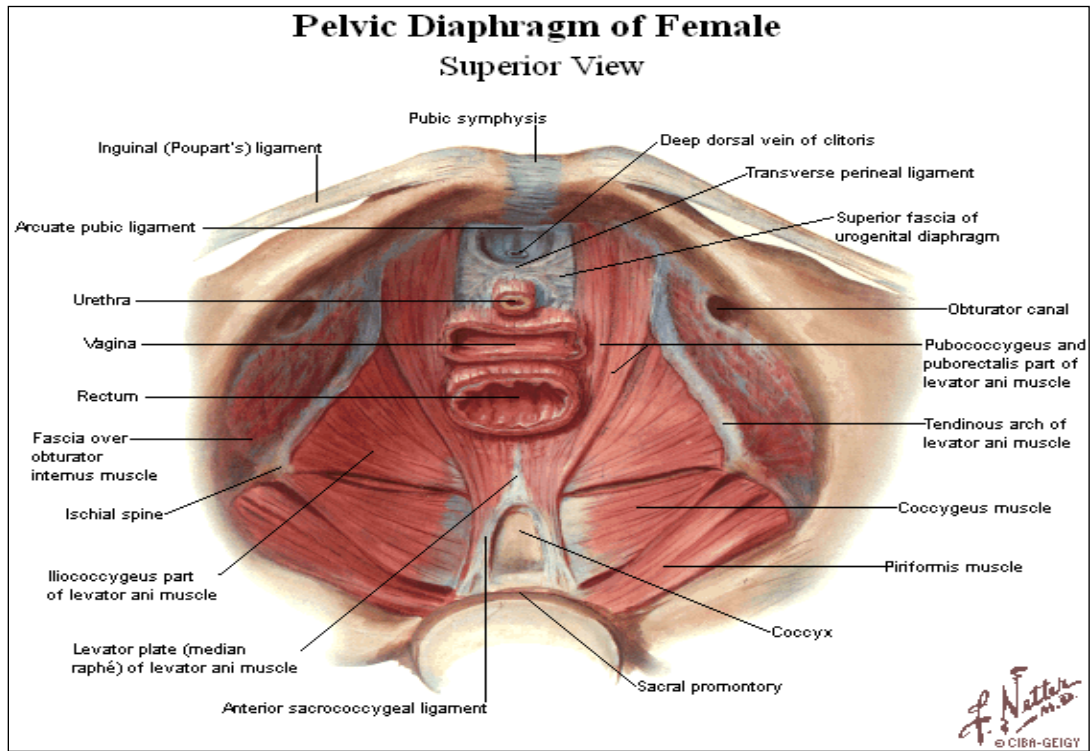


The pelvic floor

Comprise all the structures from the peritoneum on the inner aspect to the skin on the outer aspect with the pelvic floor muscles sandwiched between them

It consists of the following structures from above downwards;

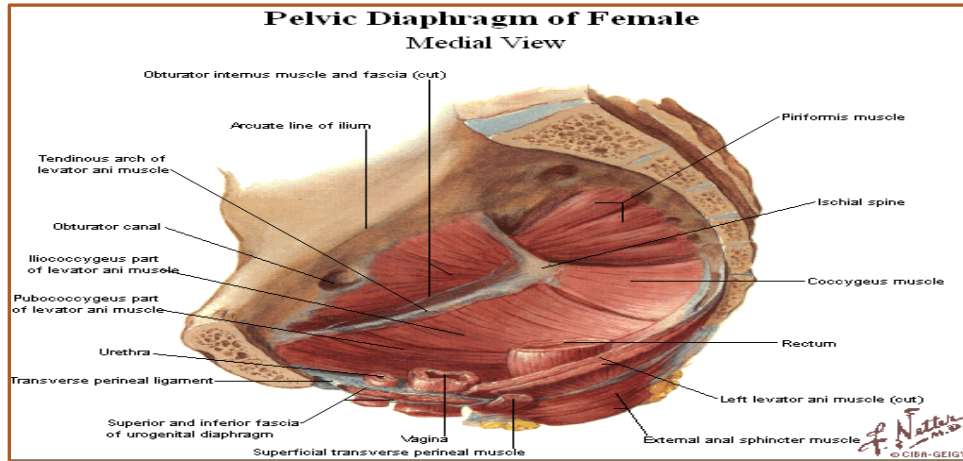
- 1- pelvic peritoneum
- 2- Extraperitoneal connective tissue
- 3- The levator ani muscles which form the pelvic diaphragm
- 4- The perineal muscles which include superficial and deep transverse perineal muscles, the bulbocavernosus, the ischiocavernosus and the external anal sphincter
- 5- Subcutaneous fat and fascia
- 6- Skin



The pelvic diaphragm

- Is a muscular diaphragm. Concave superiorly.
 - It separates the pelvic cavity from the perineal space below.
 - It is formed by the levator ani and coccygeus muscles
- It is covered by the parietal layer of pelvic fascia.
- It has 2 apertures:

- Anterior gap (urogenital hiatus)** : transmits the urethra and vagina
- Posterior gap (rectal hiatus)** : transmits rectum and anal canal.

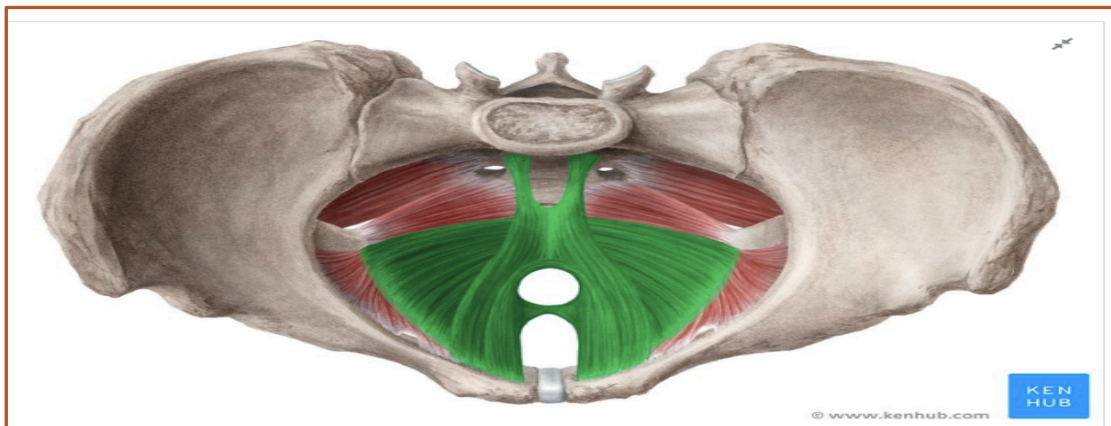


The levator muscle:

-This muscle with its fascial covering on its upper and lower surfaces is like a hammock suspended bet. the inner surfaces of the pelvic walls

-It is the most important muscle in the pelvis and is regarded as the true pelvic diaphragm.

-During evolution, it has been relieved from certain duties but required to undertake increasing responsibilities. It was responsible for moving the tail but as a result of assumption of the erect posture by man and atrophy of the tail to the rudimentary coccyx, the original tail-moving has been altered to supporting function to prevent the pelvic viscera from falling out of the pelvis and resist the repeated ↑ in intraabdominal pressure which occur with every day physiologic activity

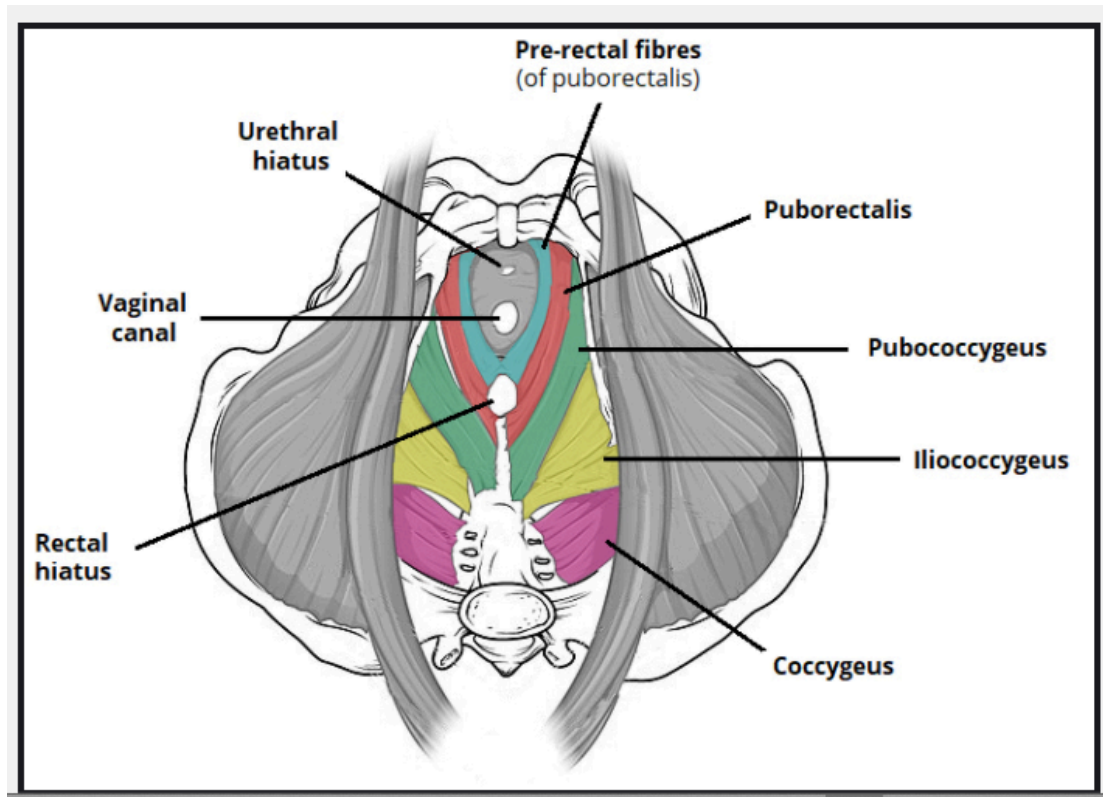


-The levator ani muscles being made up of voluntary striated muscle exhibit a basic tone which responds immediately to pressure from above by ↑ed contraction and tonus.

The idea being to resist overstretching which in turn could lead to loss of strength and tearing its fibers.

-The levator fascial envelopes are not only firmly attached to the side walls of the pelvis but also they are firmly attached to the urethra, vagina and rectum as they pass through the pelvic floor aperture by surrounding them with tough connective tissue coats

-Weakened levator fascia by tearing during childbirth, lead to rectocele and cystocele



Origin and insertion:

The levator ani muscles has lateral origin and central insertion where in the midline, it blends with its fellow of the opposite side.

Origin: from

1. Posterior (pelvic aspect) aspect of the body of the pubis
2. Arcus tendineus fascia pelvis (white line of pelvic fascia)
3. Pelvic aspect of the ischial spine.

(i.e. it has bony origin anterior and posterior **but** the greater part of the muscle arises from the parietal layer of pelvic fascia)

Insertion

The muscle sweep downwards, backwards and medially to be inserted from before back into the (1) vagina, (2). perineal body, (3).anal canal, (4).

anococcygeal body, (5).lateral border of the coccyx and (6). lower part of the sacrum

Nerve supply

- 1- Perineal branch of the 4th sacral nerve
- 2- Inferior hemorrhoidal nerve (branch of pudendal n S2,3,4)

Components of levator ani

- 3- Pubococcygeus: master sphincter + pelvic diaphragm
- 4- Iliococcygeus + ischiococcygeus: weight supporter + pelvic diaphragm

A) Pubococcygeus portion: The most important component. It arises from the pelvic aspect of the body of the pubis and from this origin on either side of the body, its fibers sweep backwards as 3 distinct bands:

1- The most medial fibers: pubovaginalis

Blend with the intrinsic muscular coat of the urethra and from a u-shaped loop around the vagina and are inserted into the lateral and posterior wall of the vagina

2- The intermediate fibers: puborectalis

From U-shaped loop around the anorectal junction and are inserted into the lateral and posterior wall of the anal canal between the sphincter ani externus and sph. ani internus blending with these 2 muscles and is inserted into the anococcygeal body

3- The most lateral fibers: pubococcygeus proper

Have Y shaped insertion into the lateral margin of the coccyx.

So, the pubococcygeus muscle is inserted from before backward into

- 1- Bladder neck 2- Vaginal wall 3- Perineal body
- 4- Rectal wall 5- Anococcygeal raphe 6- Tip of the coccyx

The fibers which pass between the rectum and vagina to be inserted into the perineal body are known as the **fibers of Lushka** which is part of the pubovaginalis.

B) Iliococcygeus portion: Arises from that part of the white line that lies behind the obturator canal. It blends with the lateral fibers of pubococcygeus proper and is inserted into the lateral margin of the coccyx

C) Ischio-coccygeus muscle: (coccygeus): Arises from the pelvic aspect of the ischial spine and is inserted into the lateral border of the coccyx and the last piece of the sacrum. This muscle in man is known as coccygeus

Structures in Relation to the Pelvic Floor:

The pelvic floor has

- Upper concave pelvic surface
- Lower convex perineal surface

The whole muscle is enveloped by anal fascia which is part of the pelvic fascia

Pelvic surface: is related to

- 1- The bladder anteriorly lying on the pubovaginalis
- 2- The uterus and vagina behind the bladder, the vagina passing through the hiatus urogenitalis
- 3- The broad ligament lateral to the uterus
- 4- The pelvic c.t. lying on the pelvic floor and ascending bet. the layers of the B. ligament as the parametrium
5. The ureters lying on the floor beneath the B.lig. and passing forwards to lie in relation to the lateral vaginal fornix
6. The uterine arteries above the ureter and ascending in the lateral uterine wall
7. The vaginal arteries below the ureters and descending in the lateral vaginal wall
8. The rectum lying behind the uterus and vagina
9. The peritoneum of the rectovaginal pouch separated from the floor by pelvic connective tissue and pelvic fascia

Perineal surface:

- 1- The pad of fat filling the ischiorectal fossa containing the inferior rectal vessels and nerves
- 2- The perineal branch of the 4th sacral nerve passing transversely to supply the pelvic musculature.

The pelvic floor aperture (the Achilles hell of pelvic diaphragm):

-The space in the midline between the **pubococcygeus muscle** which allow the urethra, vagina and rectum to pass through is the weakest and most vulnerable

portion of the pelvic floor and is known as the pelvic floor aperture or urogenital hiatus.

-This space is practically closed by contraction of bubo-coccygeus muscle.

-Childbirth → damage with incomplete closure of aperture. So, surgical reconstruction of damaged pelvic floor in every surgical procedure for genital prolapse

Function of pelvic diaphragm

• **Pubococcygeus portion:** sphincter function of vagina, rectum, bladder *This action can be demonstrated by;*

1- Interruption of urinary stream → elevation of bladder → maintaining the urethero-vesical junction (angle)

2- A finger in the vagina, ask the patient to contract her levator → virtual closure of vag. orifice

3- A finger in the rectum → the anus and rectum becomes occluded and strongly pulled forwards the symphysis pubis if the patient suddenly contract her levator

Clinical importance:

1- Pelvic floor exercises cure mild cases of stress incontinence

2- Vaginismus is due to extreme degree of involuntary spasm of the muscle

3- Enhanced sexual pleasure produced by rhythmic contraction of this muscle

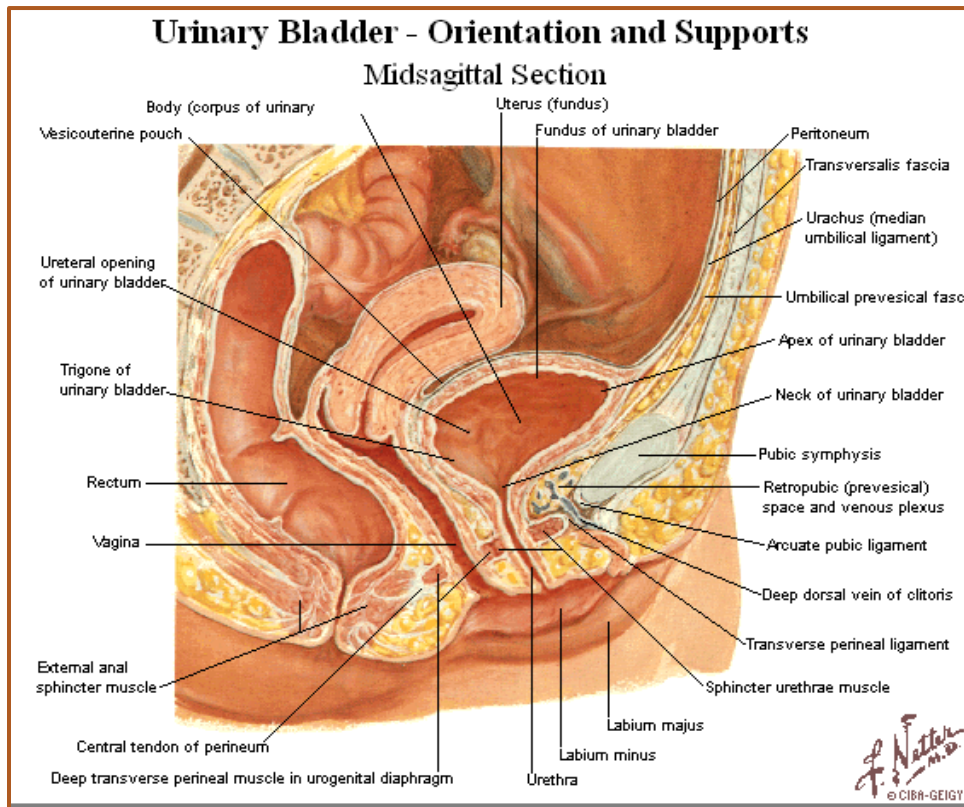
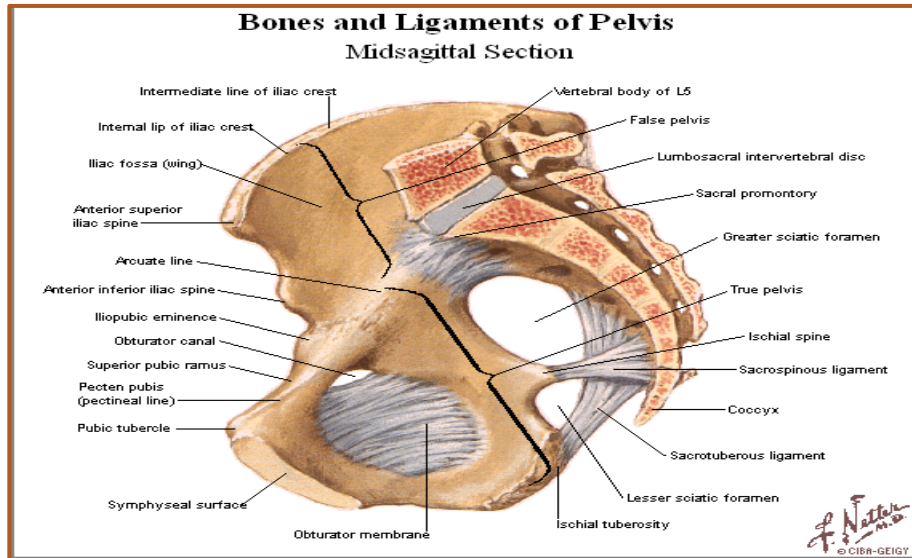
4- Sling action of puborectalis → slow descent of fetus

5- The rectal shelf: the forward sloping the rectum formed by the pull of pubo-rectal sling provides support for the bladder and vagina

• **Iliococcygeus portion** - → Support the whole weight of pelvic viscera

• **Ischiococcygeus** - → Support the pelvic viscera + stabilizes sacrum

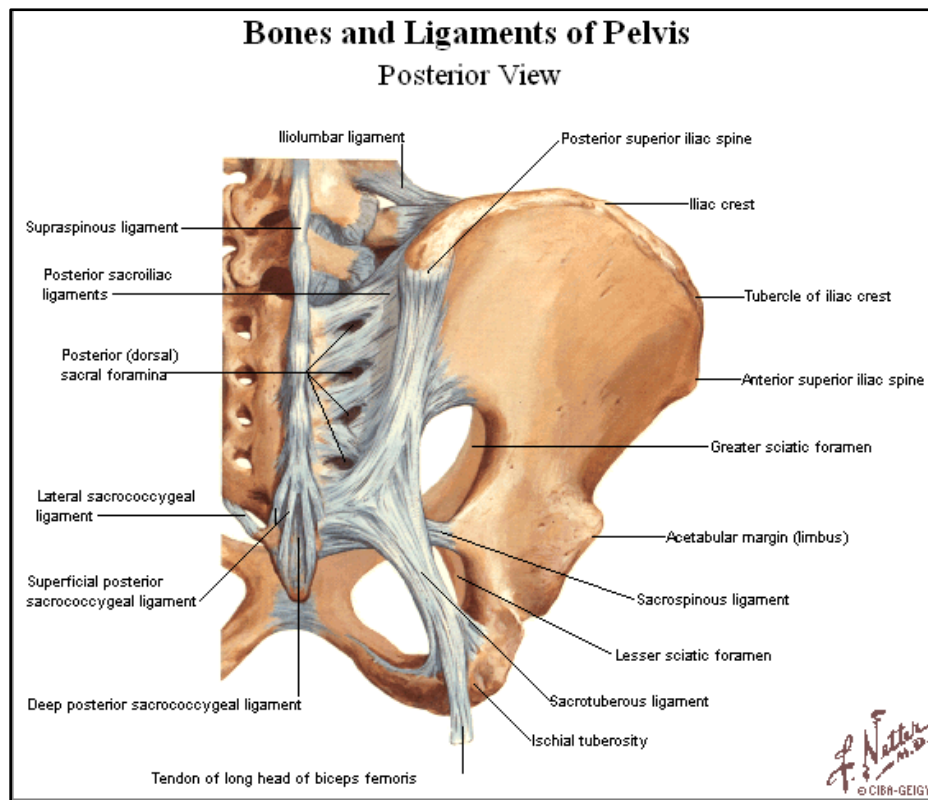
Important Images for revision



CHAPTER (7)

- **Anatomy of the sacrum**
- **Anatomy of the sacroiliac joint**

Anatomy of the Sacrum



- The sacrum forms the posterior wall of the bony pelvis suspended between the 2 innominate bones at the sacroiliac joints
- When the subject is in the upright position, the sacrum lies obliquely and nearly in horizontal than vertical plane
- ***It is wedge shape with its base above and apex below and is composed of 5 vertebrae fused together***

The base: [or superior surface]

- Has median oval articular area which articulates with the body of the 5th lumbar vertebrae
- The anterior margin of this articular area is known as the sacral promontory
- On either side of the promontory are the alae which form the superior surface of the lateral masses and has shallow grooves which carry the lumbosacral trunk on each side .
The lateral masses are the fused costal and transverse processes of the sacral vertebrae
- The anterior borders of the alae + sacral promontory form the posterior boundary of the pelvic brim of the inlet

The apex:

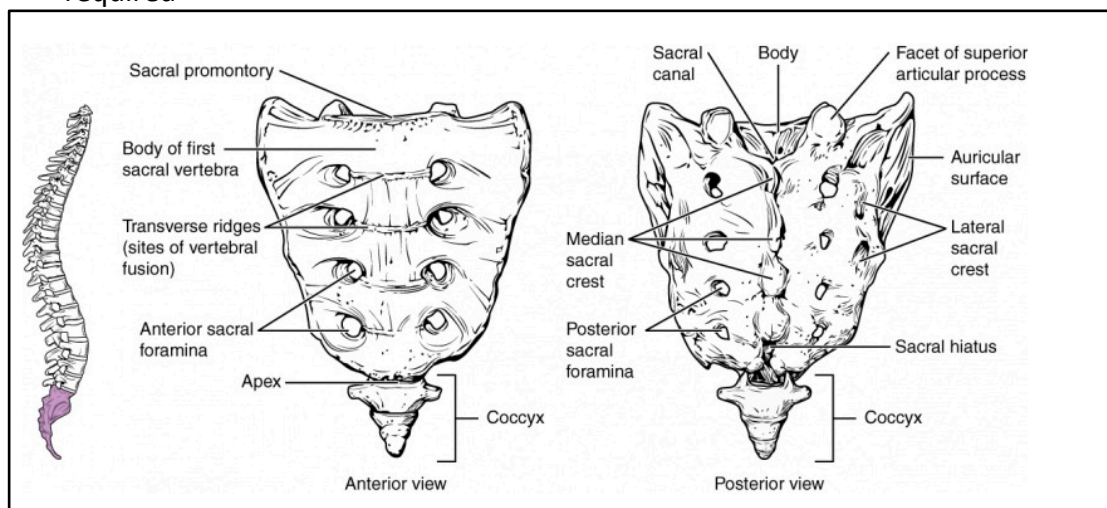
Formed by the lower surface of the 5th sacral vertebra which articulates with the body of the 1st coccygeal vertebrae at the sacrococcygeal joint

Anterior or pelvic surface

- Is concave and has 4 transverse ridges which are ossified intervertebral discs lying between the bodies of the vertebrae they give attachment to the anterior longit. ligaments of vertebral column.
- Lateral to the ridges are the 4 sacral foramina from which emerge they 4 anterior sacral rami of the sacral nerves and through which enter the lateral sacral vessels
- The piriformis muscle takes origin from the anterior surface of the 2nd, 3rd, 4th sacral vertebrae between the foramina
- The coccygeus muscle with the sacrospinous ligament is inserted into the body and border of the 5th sacral vertebra

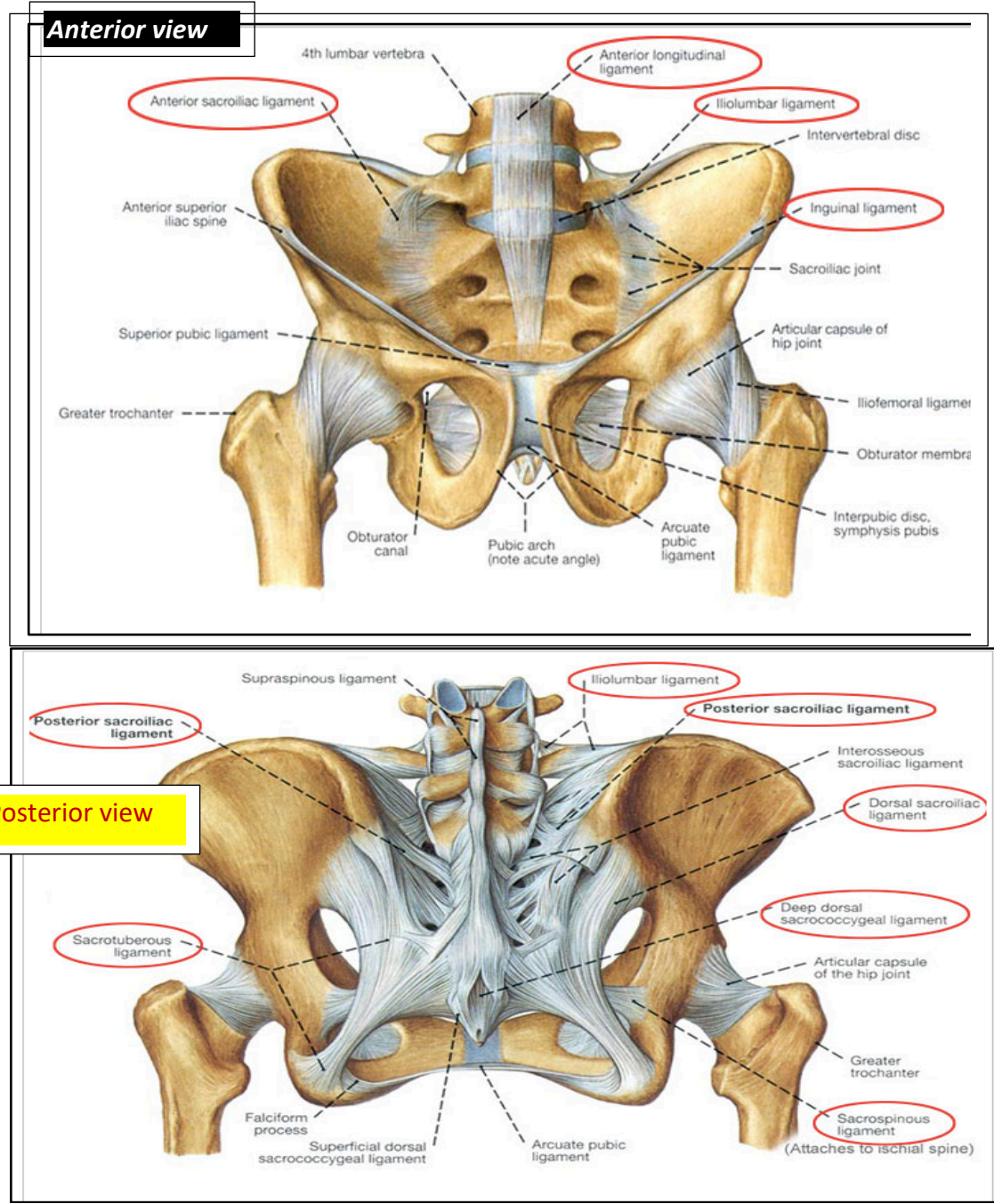
Posterior surface

- Is convex and presents a median sacral crest formed by the fusion of the sacral spines
- Lateral to this crest are the sacral grooves and lateral to these grooves are the posterior sacral foramina
- The posterior sacral foramina gives exit to the posterior rami of the sacral nerves and to the terminal branches of the lateral sacral vessels
- The sacral foramina are bounded laterally by the sacral tubercles which give attachment to the long and short sacroiliac ligaments
- The sacrum is tunneled by the sacral canal which transmits the terminal filament of the spinal cord and the roots of the sacral and coccygeal nerves surrounded by the dura mater which ends at the level of the 2nd sacral vertebrae
- Lateral and superior to the canal, 2 articular facets which articulates with inferior articular facets on the neural arch of the 5th lumbar vertebra.
Lateral and inferior to the canal are 2 cornua which articulates with similar cornua on the coccyx
- The lower opening of the sacral canal is known as the sacral hiatus through which caudal analgesia is given by special needle in the space. Bet. the 2 sacral cornua. It abolishes pain of uterine contraction but also abolishes bearing down. so, operative delivery is required



Lateral border of the sacrum

- Has an auricular articular surface which articulates with similar surface on the ilium
- The anterior sacroiliac ligaments are attached to the margin of bone in front of this articular surface while the interosseous sacroiliac ligament are attached to the rough area behind this surface.
- The lateral border of the 5th sacral vertebra gives attachment to the sacrospinous lig. and the coccygeus muscle.



Concavity of the sacrum: the sacra in female are classified into:

Curved : 45%, **Shallow**: 30%, and **Flat to convex**: 25%

A flat sacrum is likely to present serious obstetric difficulties by reducing the posterior sagittal diameter → does not allow internal rotation → deep transverse arrest of the head.

Width of the sacrum:


The female sacrum is wide as indicated by the high sacral index

(Breadth at base / Anterior length] x100

Average index in female 112

While in male it is 106

Sacral index		
<ul style="list-style-type: none"> • Sacral index (SI): calculated as breadth of base divided by anterior length of sacrum multiplied by 100. 		
	Male	Female
Sacral index	112	116



Anomalies of the sacrum:

1. Sacralization of the 5th lumbar vertebra (high assimilation pelvis)

Pelvic cavity is deepened, promontory abnormally high, usually with flattening of the sacrum → head tend to be arrested at the brim and absence of sacral curve → head is unable to rotate

2. Lumbarisation of 1st sacral vertebra (low assimilation pelvic)

No obstet. problem

3. Hiatus sacralis: the dorsal wall of the sacral canal may be entirely absent or its lower margin is absent. That is why caudal analgesia is not widely accepted

4. Congenital absence of ala of the sacrum

- *Naegel's pelvis: one ala absent*

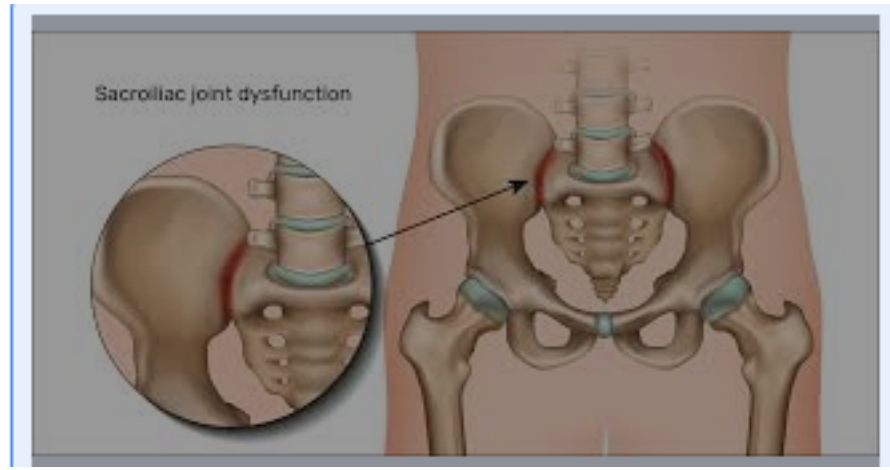
- *Robert pelvis: 2 ala absent*

- **A rough clinical rule:** back ache located over the sacrum is probably due to pelvic disease. If back ache is localized between the top of the sacrum and a horizontal line drawn through the lowest part of the rib cage, it is probably postural in origin

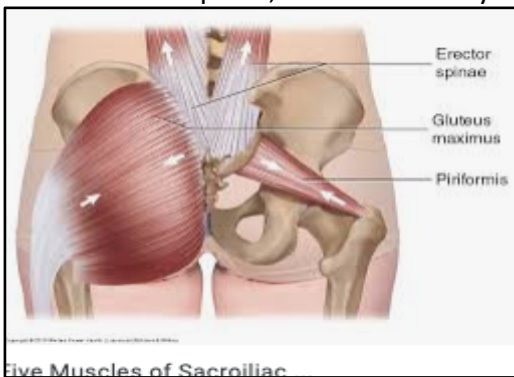
- **Coccydynia:** occasionally sacrum is fused with coccyx fracture dislocation with characteristic crock when the fetal head is born, the pain may vary severe, prolonged and incapacitating

It is prolonged because the joint is always affected by the sphincteric function of the pubo-coccygeus i.e. can't be put in rest.

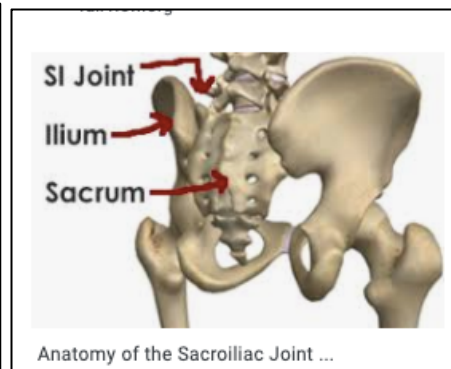
Anatomy of the Sacroiliac Joint



- It is an articulation between the auricular surfaces of the ilium and sacrum
- It is the largest and most important of the pelvic joints
- It is subjected to severe strain since the weight of the body is transmitted through this joint to the L.L.
- It is described as:
 - Diathrodial:** because it is synovial joint allowing movement **heteromorphic:** its articulation surfaces are not alike.
 - Atypical hinge joint:** as it not only allow movement through a horizontal axis but also permits the sacrum to glide on a vertical axis between the 2 innominate bones to very slight extent
- The joint has a capsule which is attached to the margin of the articular surfaces and is reinforced by some of the most powerful ligaments in the body
- Within the capsule, there is small synovial cavity lined by synovial membrane.



Five muscles of sacroiliac joint



Ligaments of the joint:**1- Anterior sacroiliac ligament:** (short interosseous fibers)

Which run from the preauricular sulcus on the ilium to the anterior aspect of the ala (margin of bone in front of articular surface)

2- Interosseous sacroiliac ligament

Which is attached to the rough area behind the auricular surface on the ilium to the rough area behind corresponding surface on the sacrum

3- Short posterior sacroiliac ligament

Which lie behind the interosseous ligament

It is attached to the iliac tuberosity on the 1st and 2nd vertebra of the sacrum

4- Long posterior sacroiliac ligament

Attached to the posterosuperior spine of the ilium to the tubercles of the 3rd and 4th sacral vertebrae.

Accessory ligaments**1) Sacrotuberous ligament**

Attached to the posterosuperior and posteroinferior iliac spines to the tubercles of the 3rd, 4th, 5th sacral vertebra and to the lateral border of the coccyx and is attached below to the falciform margin of the pelvic aspect of the ischial tuberosity.

3 muscles blend with ligament (gluteus maximus, piriformis and biceps femoris) which play a part in stabilizing the sacroiliac joint

2) Sacrospinous ligament: triangular ligament

Attached to the ischial spine by its apex and by its base to the lateral border of the 5th sacral and 1st coccygeal vertebra.

Both ligaments transform the greater and lesser sciatic notches into foramina. They are larger in female

Structures lying in front of the joint:***From above downwards →***

- | | | |
|-----------------------------|-----------------------|----------------------|
| 1. Common iliac vessels | 2. Iliacus muscle | 3. Psoas muscle |
| 4. Obturator nerve | 5. Iliolumbar vessels | 6. Lumbosacral trunk |
| 7. Superior gluteal vessels | 8. First sacral nerve | 9. Piriformis |

Structures behind the joint →

Deep muscles of the back and gluteus maximus

Blood supply:

- | | | |
|-----------------------|---------------------------|-----------------------------|
| 1. Iliolumbar vessels | 2. Lateral sacral vessels | 3. Superior gluteal vessels |
|-----------------------|---------------------------|-----------------------------|

Nerve supply

1. Posterior rami of S1, S2
2. Obturator nerve may give small branch to the joint

Mechanics of the joint

- *The joint is subjected to massive strains as the full weight of the body is transmitted through it to the limb in the erect position . The great force transmitted to the upper sacrum by the weight of the vertebral column tends to cause the sacral promontory to rotate forwards and the coccyx to rotate backwards*

A rocking movement with proportionate instability of this joint would then occur if no ligaments which resist this tendency.

The sacroiliac ligaments which are powerful do not allow forward rotation of the upper sacrum while the sacrospinous and sacrotuberous lig. do not allow backward rotation of the lower sacrum

By this mechanics, the joint remains stable and locked. Thus allowing minimal movement and ensures strength and stability of the whole pelvic girdle especially during locomotion

The range of movement at full term is 3 times the maximum in the non pregnant state Softening of these ligaments occur and stretch allowing separation of the auricular surfaces and also of symph. pubis → ↑ pelvic capacity

The ligaments may not completely involute during purpeurium esp. when aggravated by physical stress → which explain the chronic back ache which commenced during the 1st pregnancy

Separation of the legs > 80° in symphysiotomy may result in damage of the sacroiliac joint → difficulties in locomotion this is avoided by

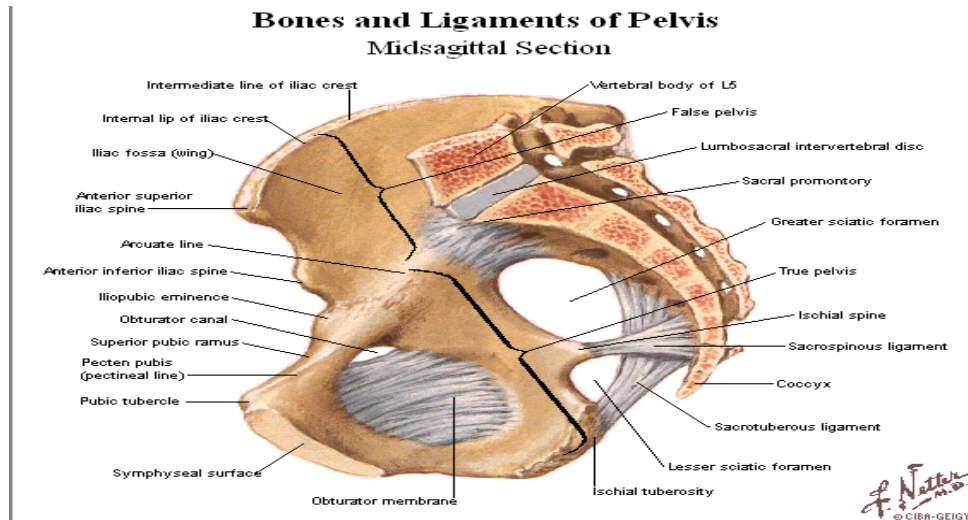
- Avoid separation of symphysis > 3.5.cm
- Parital S.C. symphysiotomy

CHAPTER (8)

- Anatomy of the Posterior Pelvic Wall
- Anatomy of the Lateral Pelvic Wall
- Anatomy of the ischial spines
- Anatomy of the Symphysis Pubis
- Anatomy of the Pelvic Peritoneum
- Anatomy of the Anterior Abdominal Wall

Anatomy of the Posterior Pelvic Wall

The posterior wall of the pelvis is formed by the sacrum in the midline and the piriformis muscle laterally



Structures lying on the sacrum:

1. The median sacral artery
2. The sympathetic chain
3. The ganalion impar
4. The coccygeal body

Structures lying on the piriformis:

1. The lumbosacral trunk
2. The sacral plexus
3. The internal iliac artery and vein
4. Branches from the posterior division of int. iliac artery & vein

iliolumbar, lateral sacral, superior gluteal.

The pelvic **colon** runs transversely from the left to right in front of the posterior pelvic wall. The upper part of the wall is covered by peritoneum which is reflected around the pelvic colon forming pelvic mesocolon while the lower part of the wall is in direct contact with the rectum in the midline with **no peritoneum** intervening

Between the lateral Pelvic wall and the posterior pelvic wall:

Is a wide interval divided into 2 foramina by **the sacrospinous ligament** with the **coccygeus** muscle on its pelvic aspect and the **sacrotuberous** ligament.

*The upper recess is known as **the greater sciatic foramen** and is partially occluded by the piriformis muscle as it passes to its insertion into the lower limb.*

*The lower recess is known as **small sciatic foramen** and since it lies below the pelvic floor, it is situated in the **perineum**.*

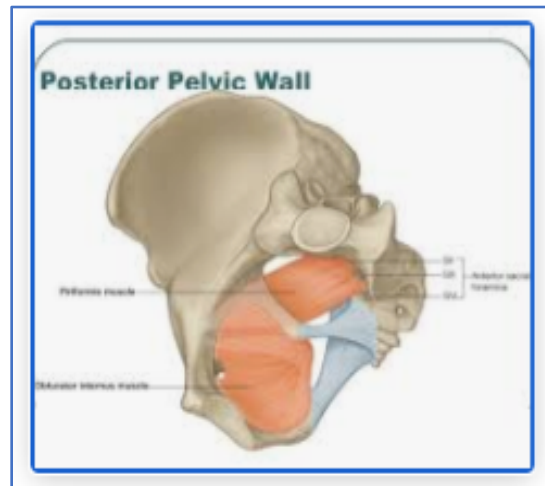
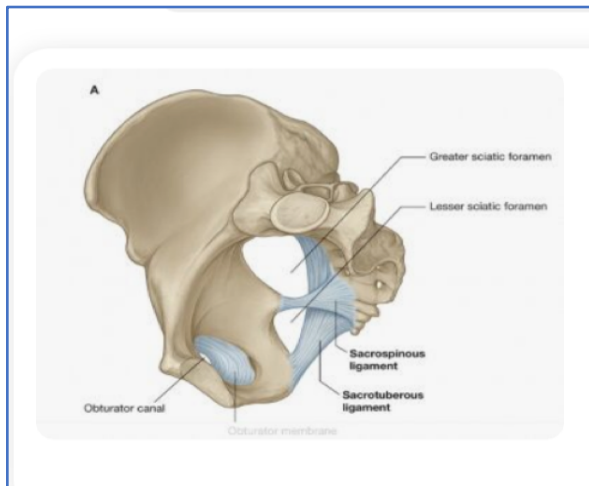
It is almost completely occluded by the tendon of **obturator internus** which passes to the lower limb.

(A). Passing from the greater sciatic foramen out of the pelvis are:

• ***Above the piriformis:*** → The superior gluteal vessels and nerves

• ***Below the piriformis:***

- 1- Sciatic nerve
- 2- Post. cut. N. of the thigh
- 3- Inferior gluteal vessels and nerves
- 4- Nerve to obturator internus and superior gemellus
- 5- Nerve to quadratus femoris and inferior gemellus
- 6 -Internal pudendal vessels and pudendal nerve.

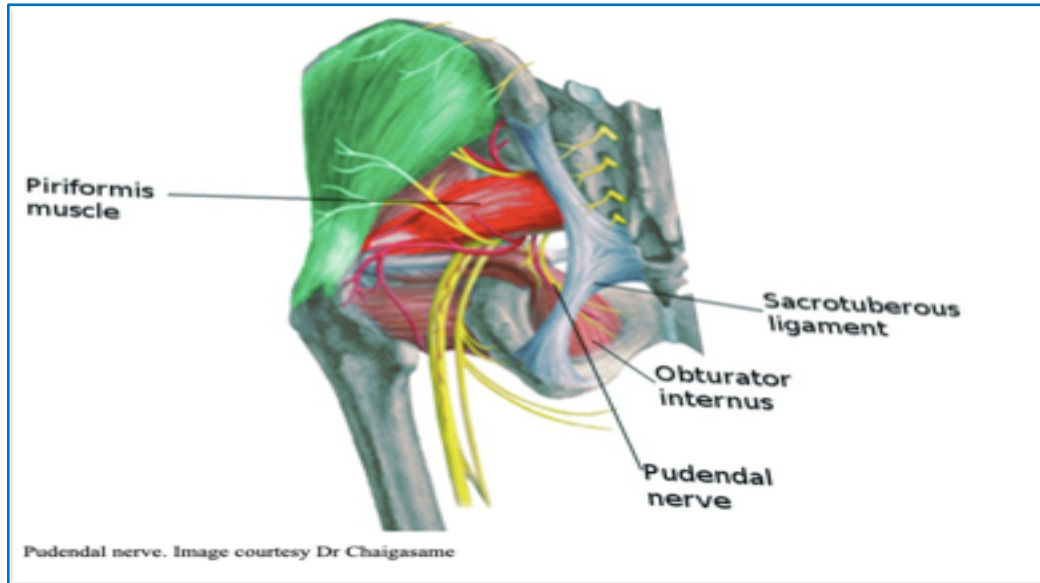


(B) Passing through the small sciatic foramen:

In addition to the obturator internus tendon which is passing out of the perineum, the following passing into the perineum:

- 1- Internal pudendal vessels and nerves
- 2-Nerve to obturator internus

N.B. the internal pudendal vessels and nerves and nerve to obturator pass out of the pelvic through the greater sciatic foramen and wind round the ischial spine or sacrospinous ligament.



Applied Anatomy/Clinical importance:

1 .Pudendal nerve block

Technique: (Site of injection is either transcutaneous or trans vaginal)

-10ml. syringe with 12cm needle 0.5 lignocaine used. A point halfway between the anus and the ischial tuberosity is defined. Small skin wheal is raised.

-2 fingers in the vagina and the ischial spine is identified. The needle is passed through skin and tissues of the ischiorectal fossa and directed by the fingers in the vagina to the ischial spines.

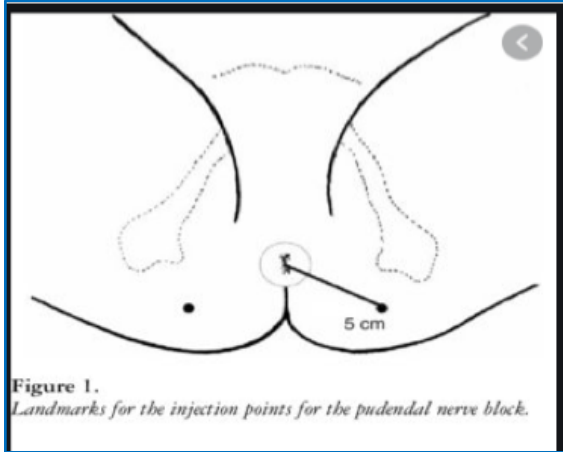
-When the tip of the needle reached a point slightly lateral, inferior and deep to the spine, the plunger is withdrawn to avoid blood vessels and 10ml. is injected.

-However, more complete anesthesia for operative delivery obtained by continuing as follows:

- Withdraw the needle to superficial fascia then its tip is directed forwards and subcutaneously until it lies lateral to the clitoris and 5ml. of soln. is injected to block the ilioinguinal nerve then the procedure is repeated on the other side

- Then infiltration of episiotomy for fear of possibility of abnormal nerve supply but before episiotomy, the needle is redirected to the ischial tuberosity and 5ml. soln. is injected to block branches of the posterior femoral cutaneous nerve.

[2] .The relationship of sacral plexus to the posterior pelvic wall may : This is important in that *obstetrical paralysis or puerperal neuritis* which is due to injury of sacral plexus during childbirth especially prolonged labor, instrumentation, CPD .The condition is manifested by numbness , foot drop and abnormal ankle and knee jerk and in severe cases, wasting and atrophy of muscles may follow.



Pudendal Nerve Block **Important!**

- o Pudendal nerve block is used in providing **analgesia** for the second stage of labour (الولادة) to provide anesthesia of the perineum in order to create or repair an **episiotomy** (An episiotomy is a surgically planned **incision** on the perineum and the **posterior vaginal wall** during second stage of labor to prevent perineal tear).
- o Method: can be done by **transvaginally** or through **perineal** approach.



الفرق بين الاثنين انه الأول يكون من جوى لازم الدكتور يدخل من المهبل ، بينما الطريقة الثانية تكون من برا الدكتور يحس العظم بعدين يدخل الإبرة على طول.

Transvaginal method:

- The needle is passed **through the vaginal mucous membrane** toward the ischial spine.
- After the needle is passed through the **sacrospinous ligament**, the anesthetic solution is injected around the pudendal nerve

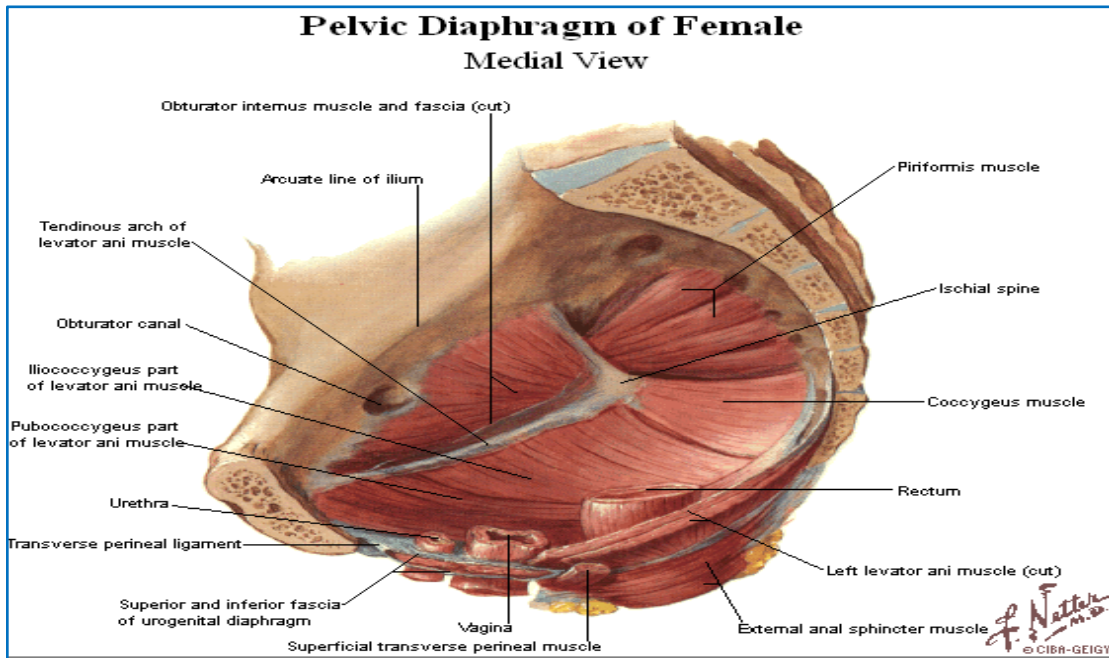
Perineal method:

- The ischial tuberosity is palpated **subcutaneously** through the buttock. (needs experience)
- The needle is inserted on the **medial side of the ischial tuberosity** to a depth of about 1 in. (2.5 cm) from the free surface of the tuberosity.
- The anesthetic is injected around the pudendal nerve.



The cut is made in an oblique line so we don't cut the perineal body

Anatomy of the Lateral Pelvic Wall



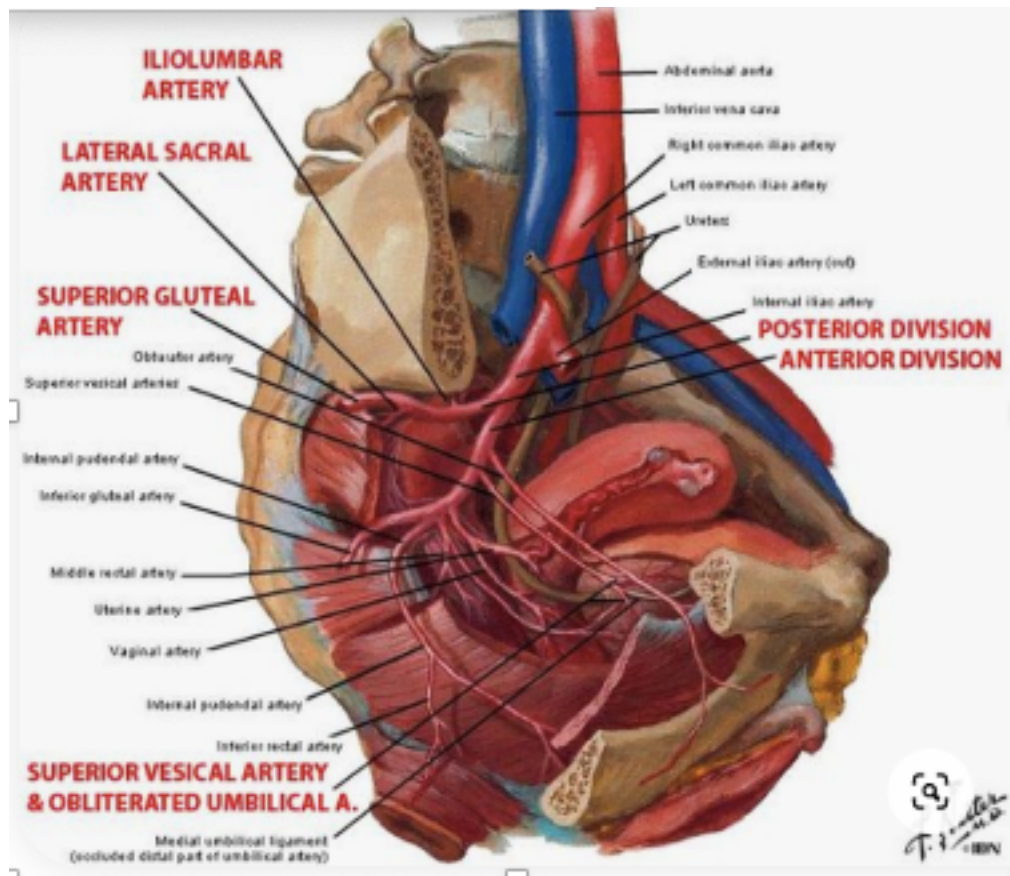
- It is lined by the obturator internus muscle covered by the obturator internus fascia which is part of the parietal layer of pelvic fascia .
- The upper margin of this wall is formed by the psoas major as it passes forward along the brim of the pelvic to reach the thigh.

Running forwards on the psoas are the external iliac vessels, the artery lying above the vein.

Running forwards on the obturator internus are:

- 1- Obliterated umbilical artery 3-Obturator nerve
- 5-Uterine vessels
- 2-Superior vesical vessels
- 4- Obturator vessels 6- Vaginal vessels

in that order from above downwards. The arteries are the forwardly directed branches of the internal iliac artery



Crossing the lateral pelvic wall are :

- 1-The *round ligament* of the uterus anteriorly, the *ureter* posteriorly and between these structures, the *infundibulopelvic fold* containing the ovarian vessels, nerves and lymphatics.
- 2-The descending limb of the pelvic colon is in direct relation of the left lateral pelvic wall
- 3-The transverse limb may reach the Rt. lateral pelvic wall.
- 4-Not infrequently, the appendix descends into the pelvic cavity and is then likely to lie in direct contact with the Rt. ovary and tube.

Applied Anatomy :

The lateral pelvic wall contain important and delicate structures that may be exposed to injuries (thin walled veins and ureter) during certain operative procedures as :

1. Internal iliac ligation .
2. Pelvic lymphadenectomy .
3. Removal of tuboovarian masses adherent to the lateral pelvic wall

Anatomy of the ischial spines

- Is a bony projection from the ischial part of the innominate bone
- It separates the greater sciatic notch from the small sciatic notch
- The coccygeus muscle is attached to its pelvic aspect and the sacrospinous ligament to its lateral aspect.

-The pudendal nerve leaves the pelvis through the greater sciatic notch and then curls round the ischial spine accompanying the internal pudendal vessels, then reenter the lesser sciatic notch to lie on the outer wall of the ischioanal fossa in Alcock's canal

The ischial spine is an easily palpable landmark in the pelvis and thus it is a useful clinical level to remember.

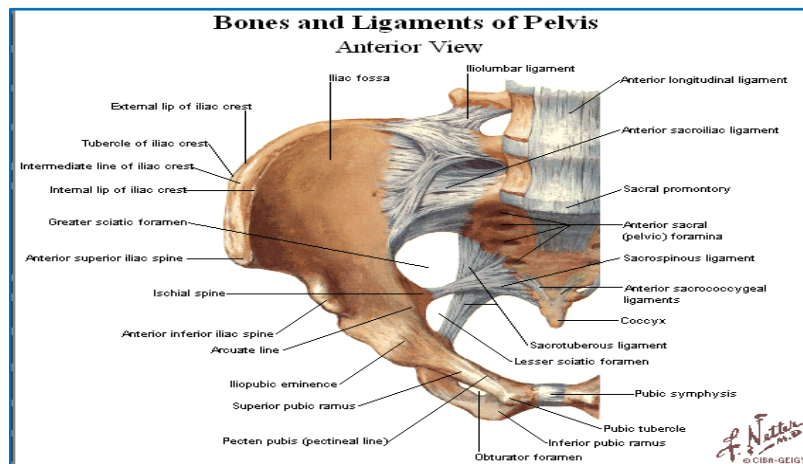
Applied anatomy/ Clinical importance

- 1- It is the plane of least pelvic dimension
- 2- Internal rotation occurs when the occiput is at this level
- 3- The head is considered engaged when the vault is felt vaginally at this level
- 4- The obstet. axis of the pelvis changes its direction at this level
- 5- Forceps should be applied only when the head is felt at this level (midforceps)

or below this level (low forceps)

- 6- Pudendal nerve block
- 7- The levator ani muscles are situated at this level
- 8- The external os of cervix is normally felt at this level if below it → prolapse
- 9- The vaginal vault is approximately at this level
- 10- The ring pessary should be introduced above this level to be retained above

the levator ani muscle.



Anatomy of the Symphysis Pubis

- It is an articulation between the bodies of the pubic bones
- It is 2ry cartilaginous joint at which very little movement take place normally
- The articular surfaces of bone are covered with hyaline cartilage and united by an articular disc of fibrocartilage in the center of which there is a cavity caused by absorption of the fibrocartilage
- The joint has no capsule or synovial memb.
- The stability of the symphysis depends less on the fibrocartilage than the fibrous investments which it receives from the anterior, posterior, superior and arcuate (subpubic) ligaments

Ligaments

- Are strong anteriorly and inferiorly but weak posteriorly and superiorly
- The anterior ligaments are re-inforce by the aponeurosis of the rectus abdominis

and the ext. oblique muscle

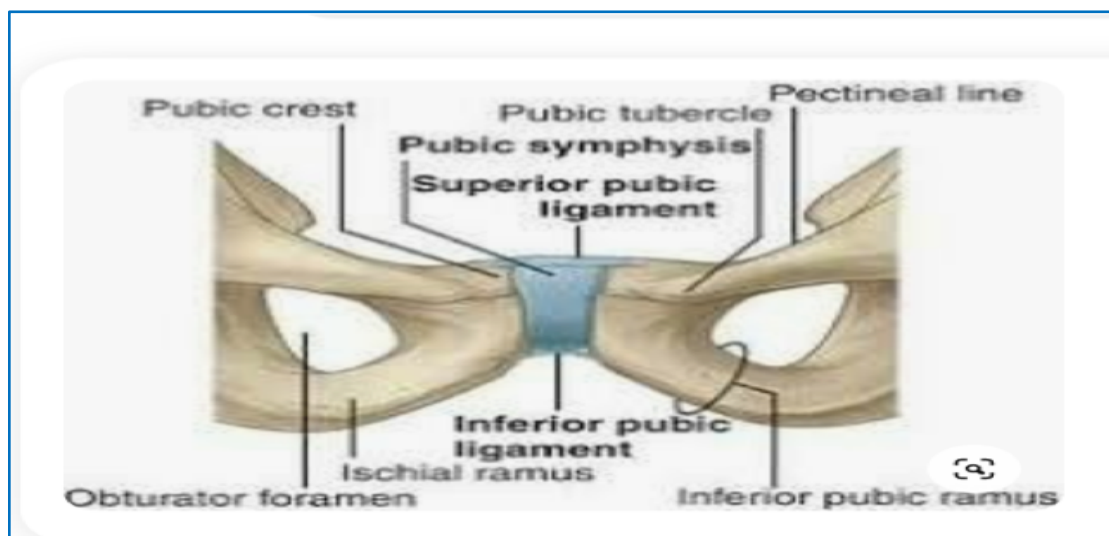
- The inferior ligament (arcuate or subpubic) is of great importance anatomically

and surgical and it is of considerable thickness and strength

It forms the superior boundary of the pubic arch and is attached above to the interpubic disc and laterally to the adjacent sides of the descending rami of the pubes.

Its lower border is free and separated from the triangular ligament by a transverse oval interval through which the dorsal vein of the clitoris passes backward to the interior of the pelvis

The symphysis pubis may be entirely absent giving rise to split pelvis and is usually associated with **ectopia vesica (bladder extrophy)**



Applied Anatomy :

- **Symphysiotomy** is division of the pelvis through symphysis
- Division of the joint practically never presents any difficulty as separation of the pubic bones during pregnancy normally occur

Symphysiotomy: results in a temporary increase in pelvic diameter (up to 2 cm) by surgically dividing the ligaments of the symphysis under local anesthesia. This procedure should be carried out only in combination with vacuum extraction..

-Symphysiotomy in combination with vacuum extraction is a life-saving procedure in areas where caesarean section is not feasible or immediately available. Symphysiotomy leaves no uterine scar and the risk of ruptured uterus in future labours is not increased.

-These benefits must, however, be weighed against the risks of the procedure. **Risks** include *urethral and bladder injury, infection, pain and long-term walking difficulty*. Symphysiotomy should, therefore, be carried out only when there is no safe alternative.

Indications : (1).contracted pelvis; (2).vertex presentation; (3).prolonged second stage; (4). failure to descend after proper augmentation; (5). failure or anticipated failure of vacuum extraction alone.

Pre-requisites for symphysiotomy:

1. fetus is alive;
2. cervix is fully dilated;
3. head at -2 station or no more than 3/5 above the symphysis pubis;
4. no over-riding of the head above the symphysis;
5. caesarean section is not feasible or immediately available;
6. the provider is experienced and proficient in symphysiotomy.

Technique:

- Ask two assistants to support the woman's legs with her thighs and knees flexed. The thighs should be abducted no more than 45° from the midline. (*Abduction of the thighs more than 45° from the midline may cause tearing of the urethra and bladder*).
- Perform a mediolateral episiotomy. If an **episiotomy is already present**, enlarge it to minimize stretching of the vaginal wall and urethra.
- Infiltrate the anterior, superior and inferior aspects of the symphysis with lignocaine 0.5% solution.

Note: Aspirate (pull back on the plunger) to be sure that no vessel has been penetrated. If **blood is returned in the syringe with aspiration**, remove the needle. Recheck the position carefully and try again. Never inject if blood is aspirated. *The woman can suffer seizures and death if IV injection occurs.*

- At the conclusion of the set of injections, wait 2 minutes and then pinch the incision site with forceps. If the **woman feels the pinch**, wait 2 more minutes and then retest. **(Anaesthetize early to provide sufficient time for effect.)**
- Insert a firm catheter to identify the urethra.
- Apply antiseptic solution to the suprapubic skin.
- Wearing high-level disinfected gloves, place an index finger in the vagina and push the catheter, and with it the urethra, away from the midline



- With the other hand, use a thick, firm-bladed scalpel to make a vertical stab incision over the symphysis.

- Keeping to the midline, cut down through the cartilage joining the two pubic bones until the pressure of the scalpel blade is felt on the finger in the vagina.
- Cut the cartilage downwards to the bottom of the symphysis, then rotate the blade and cut upwards to the top of the symphysis.
- Once the symphysis has been divided through its whole length, the pubic bones will separate.
- After separating the cartilage, remove the catheter to decrease urethral trauma.
- Deliver by vacuum extraction. Descent of the head causes the symphysis to separate 1 or 2 cm.
- After delivery, catheterize the bladder with a self-retaining bladder catheter.
- There is no need to close the stab incision unless there is bleeding.

POST-PROCEDURE CARE:

- If **there are signs of infection** or the woman currently has fever, give a combination of antibiotics until she is fever-free for 48 hours:

- ampicillin 2 g IV every 6 hours;

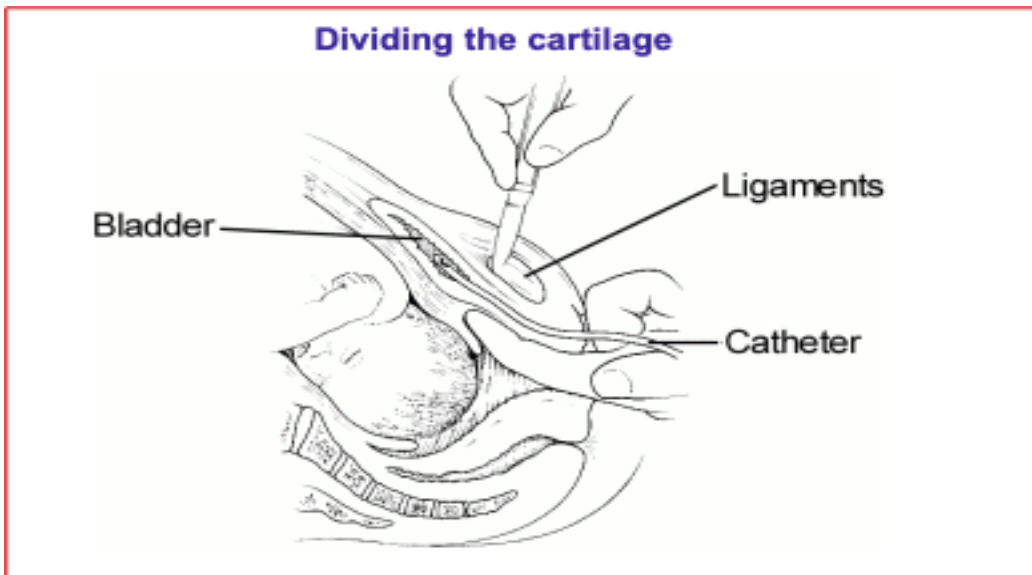
- PLUS gentamicin 5 mg/kg body weight IV every 24 hours;

- PLUS metronidazole 500 mg IV every 8 hours.

- Give appropriate analgesic drugs.

- Apply elastic strapping across the front of the pelvis from one iliac crest to the other to stabilize the symphysis and reduce pain.

- Leave the catheter in the bladder for a minimum of 5 days.



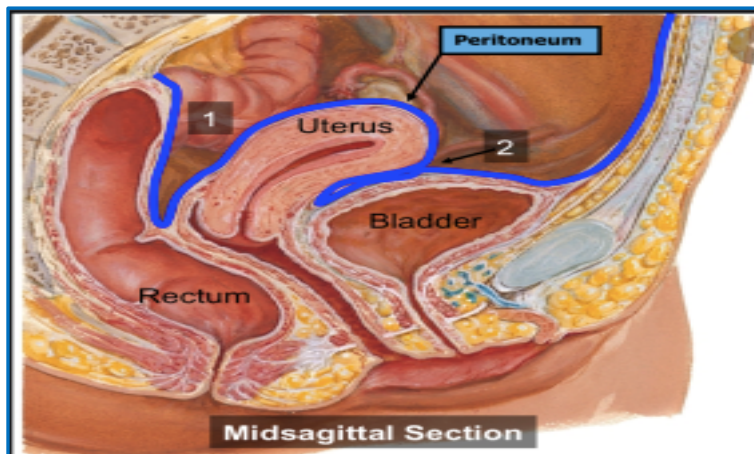
- Encourage the woman to drink plenty of fluids to ensure a good urinary output.

- Encourage bed rest for 7 days after discharge from hospital.
- Encourage the woman to begin to walk with assistance when she is ready to do so.
- If **long-term walking difficulties and pain** are reported (occur in 2% of cases), treat with physical therapy.

Anatomy of the Pelvic Peritoneum

The peritoneum consists of a layer of flat epithelium which is smooth and glistening. It secretes a thin film of lubricant which keep the peritoneal surface moist and provide necessary lubrication for the movement of different organs . A slight excess of peritoneal fluid always gravitate into the pouch Douglas ® occasional gush of fluid when the pouch is opened during vaginal surgery . This fluid allow cytological examination to diagnose ovarian cancer and also for bacteriological examination in case of PID . The surface area is great (equal the surface area of skin) this give the peritoneum the power for both production of fluid (as in ascites) and absorption (as with inflammatory exudate and pus in peritonitis and in peritoneal dialysis)

Peritoneal reflections:



Peritoneal reflections of female pelvis ,(follow the numbers on the **figure below** for more illustrations)

The peritoneum :

1. Descends on anterior abdominal wall (loose attachment allows insertion of bladder as it fills).
2. Reflects onto superior surface of bladder, creating supravescical fossa.
3. Covers convex superior surface of bladder and slopes down sides of roof of UB to ascend lateral wall of pelvis, creating a paravesical fossa on each side.

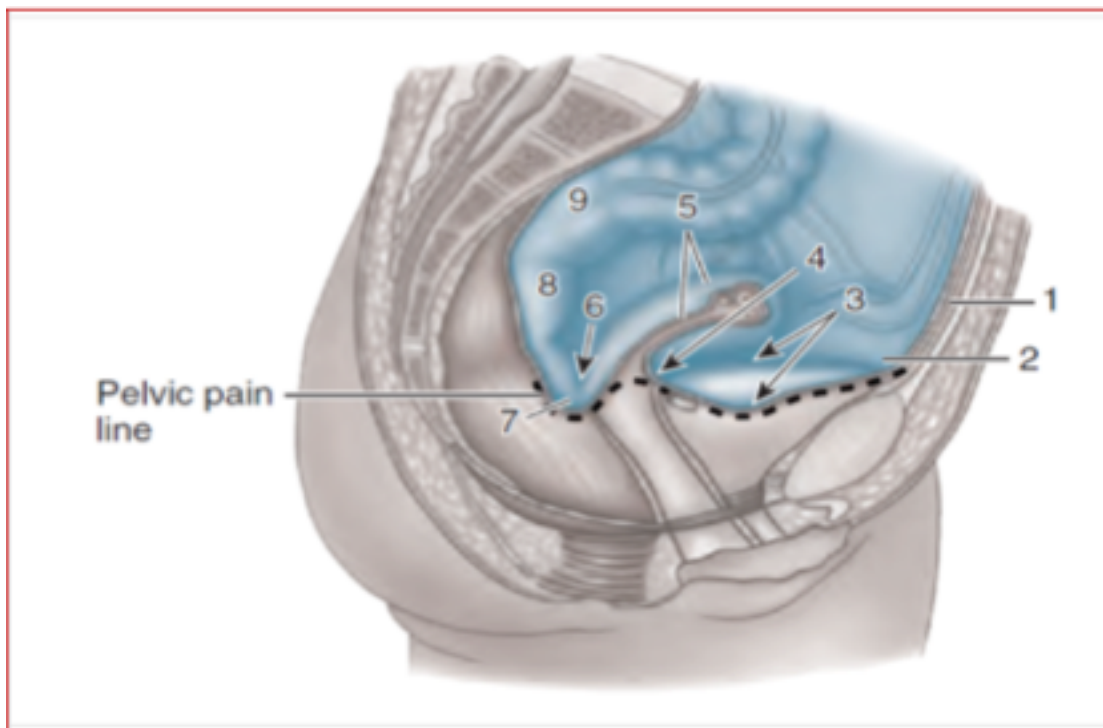
4. Reflects from bladder roof onto body of uterus forming vesico-uterine pouch. 5. Covers body and fundus of uterus and posterior fornix of vagina; extends laterally from uterus as double fold or mesentery—broad ligament that engulfs uterine tubes and round ligaments of uterus and suspends ovaries.

6. Reflects from vagina onto rectum, forming recto-uterine pouch (Douglas pouch).

7. Recto-uterine pouch extends laterally and posteriorly to form a pararectal fossa on each side of rectum.

8. Ascends rectum; from inferior to superior, rectum is subperitoneal and then retroperitoneal.

9. Engulfs sigmoid colon beginning at rectosigmoid junction.



Boundaries of Douglas pouch:

- ***Anterior boundary;***

Peritoneum covering the back of the uterus which continues downward to cover the post. fornix vagina. The pouch of Douglas is thus separated from the vagina only by the thin vaginal wall and peritoneum of the post. fornix.

Definite weakness exists in this area, so:

1. Posterior colpotomy for diagnostic exploration. 2. Culdoscopy
3. Entering peritoneal cavity in surgical operation e.g. vaginal hysterectomy
4. It is weak spot through which enterocele can occur

• **Posterior boundary;**

- 1-The anterior wall of the rectum
- 2-Pelvic abscess may spontaneously rupture into the rectum

• **Lateral boundaries;**

The uterosacral ligaments round the sides of the rectum they are best palpated by PR . They are used in repair of hernia of Douglas pouch by suturing them together in the midline.

• **Floor;**

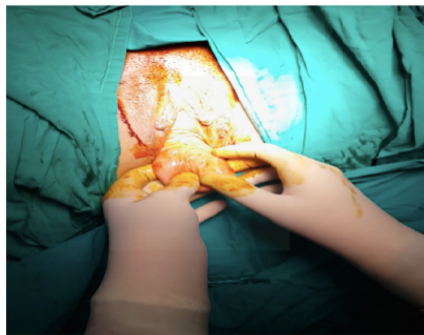
Reflection of peritoneum from the rectum to the upper vagina and uterus
 The floor of pouch of Douglas is about 7cm above the anal orifice. So, it is easily reached by an examining finger in the rectum or vagina

Anatomy of hernia of Douglas pouch (enterocele)

In most women, the floor of pouch of Douglas does not extend lower than the upper quarter of the posterior vaginal wall but in some women, this pouch is congenitally much deeper. Such a deep culdesac may act like the thin end of wedge by which means the hernial sac in response to childbirth weakness and ed intraabdominal pressure over many years becomes progressively deeper as it burrows and dissect downwards in the fascial space between the posterior vaginal wall and the anterior rectal wall (i.e rectovaginal septum)

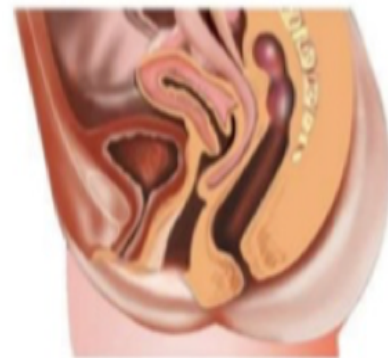


Post-hysterectomy vaginal vault prolapse



Osama Warda

20



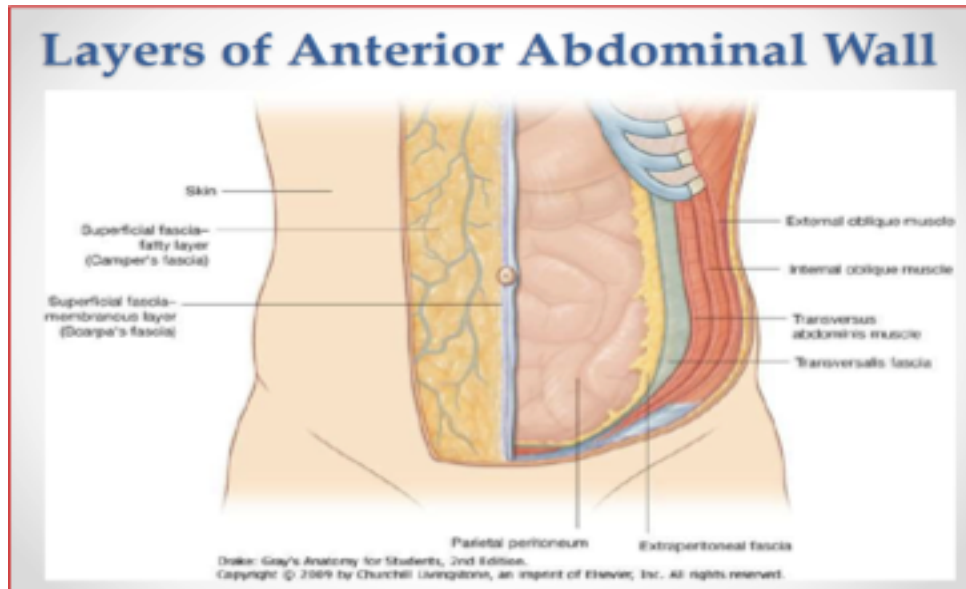
Enterocele

Retroperitoneal tissues:

A variety of structures and tissues are found lying behind the posterior parietal peritoneum of the abdomen and pelvis . From these retroperitoneal tissues, there may arise rare extragenital pelvic tumors which may obstruct the birth canal at the time of delivery e.g. pelvic kidney, lymphoma, fibroma , anterior meningioma, anterior vertebral tumors.. The most common is retroperitoneal **hematoma** following vaginal or abdominal surgery.

Anatomy of the Anterior Abdominal Wall

The layers of the anterior abdominal wall include skin, subcutaneous tissue, fascia, muscle and peritoneum.



Fascia of the anterior abdominal wall:

- Only superficial fascia (no deep fascia in order not hinder respiration or eating heavy meal)
- The superficial fascia covering the lower part of ant. abd. wall is formed of 2 layers

a) Superficial fatty layer (called **camper's** fascia)

b) Deep membranous layer containing no fat (called **Scarpa's** fascia)

- **The superficial fatty layer** may be several centimeters thick and is similar to

and continuous with the superficial fat of the rest of the body.

It is continuous downwards with a similar and corresponding layer of fascia in the thigh

It is also continuous backwards with the superficial fascia of the perineum

- **The deep membranous layer** forms a continuous sheet across the middle line and is attached to the linea alba as it passes across it.

Scarpa's fascia of the abdomen is prolonged backwards into the perineum to

form Colle's fascia which form the roof of the superficial perineal pouch

- **Fascia transversalis:** lies deep and lines the abdominal cavity and is separated

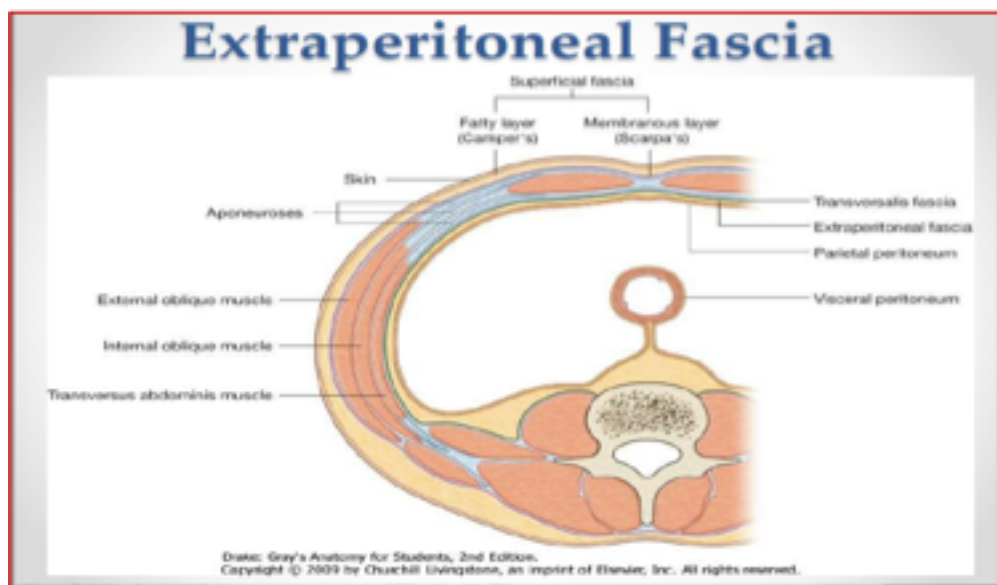
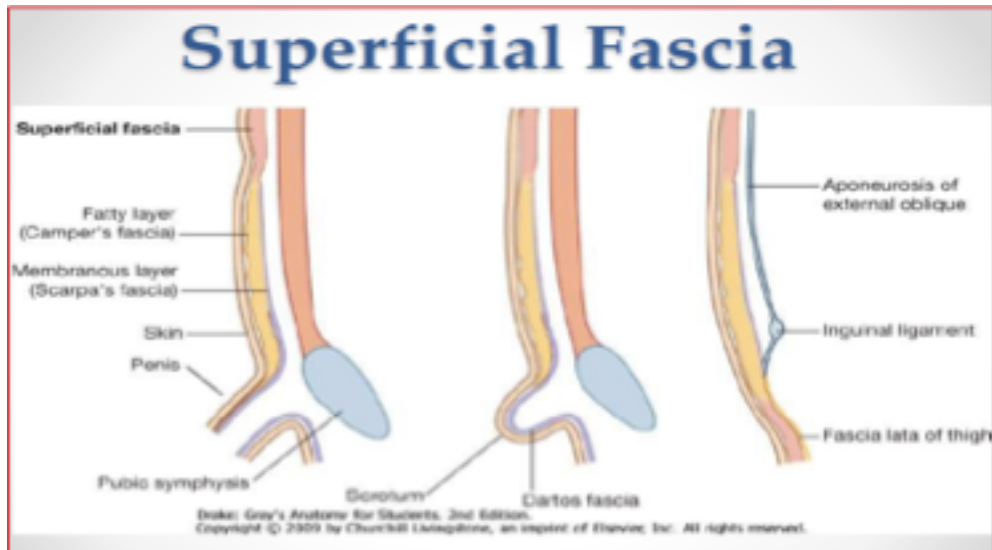
from peritoneum by extraperitoneal fat

Anteriorly: uninterrupted sheet

Posteriorly: blends with renal fascia

Superiorly: blends with fascia of the undersurface of the diaphragm **Inferiorly:** fuses with the inguinal and forms the post. wall of inguinal canal

It is also carried with femoral vessels into the thigh forming the anterior wall of femoral sheath and about 1cm above the middle of inguinal ligament, it is invaginated at the deep inguinal ring by the round ligament.



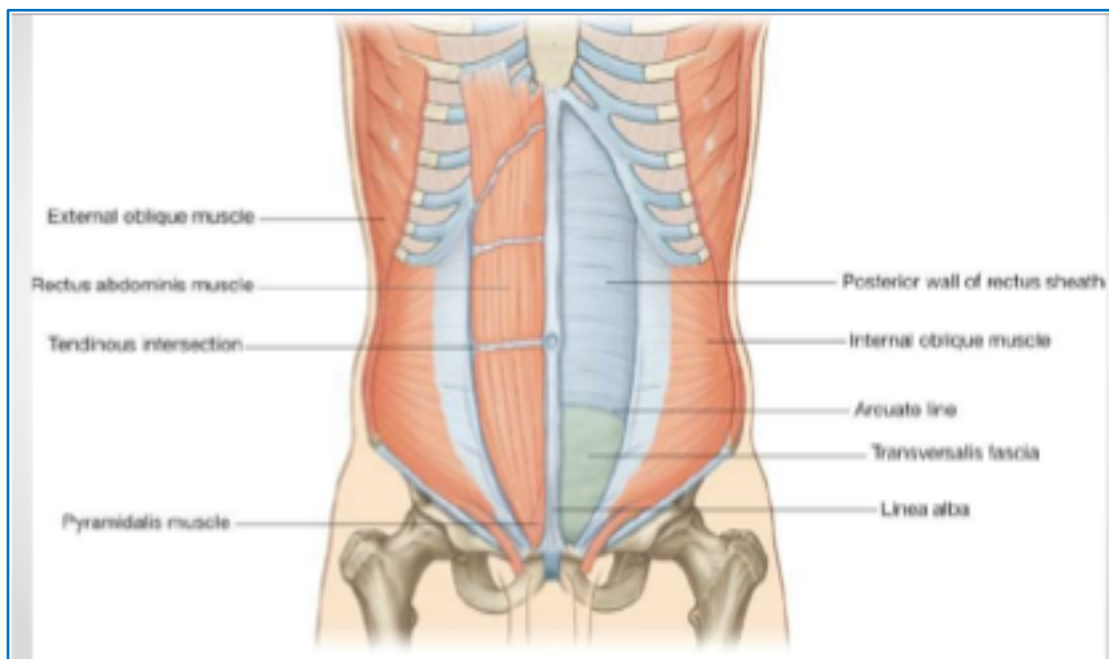
The muscles of the abdominal wall:

The anterolateral muscles of the abdominal wall are 5 Muscles:

2 vertical muscles : 1- Rectus abdominis 2-Pyramidalis

3 flat muscles : 1- External Oblique 2-Internal Oblique 3-Transversus abdominis

Rectus abdominis muscle



-These are 2 long and powerful muscles which lie on each side of the middle line of the abdomen from the sternum (above) to the pubis (below)

-The upper end of the muscle is 3 times as broad as its lower end and the 2 muscles are separated from each other by the linea alba. The linea alba is as narrow as a line only below the umbilicus where the 2 recti muscles are almost in contact with each other but above umbilicus the linea alba is 1.5cm thick

- The upper end is about 3 inches wide and is attached by fleshy fibers to the front of the 3 costal cartilages 5,6,7 and the xiphoid process
- The lower end is narrow (only 1 inch) wide and is attached by a tendon to the pubic crest and the symphysis pubis.

- Its lateral margin is convex and is indicated on the surface by a shallow skin groove called linea semilunaris
- The rectus muscle is divided into segments by 3 and sometimes 4 tendinous intersection

1st: near the xiphoid process

2nd: 1/2 way bet. the xiphoid cartilage and the umbilicus 3rd: at the umbilicus

4th: if present is somewhere below the umbilicus

They are adherent to anterior wall of rectus sheath so that the rectus muscle does not slide freely in its sheath.

The External Oblique muscle and aponeurosis

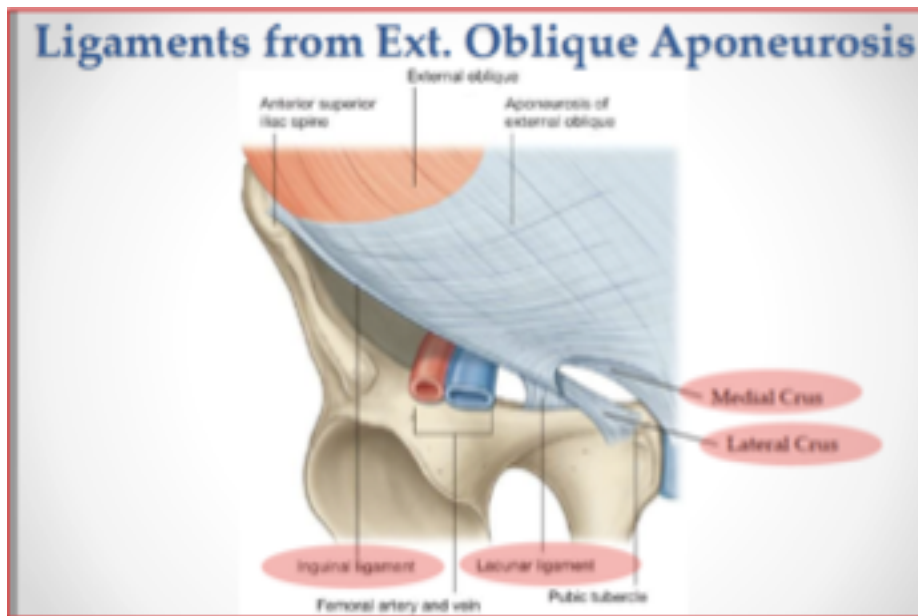
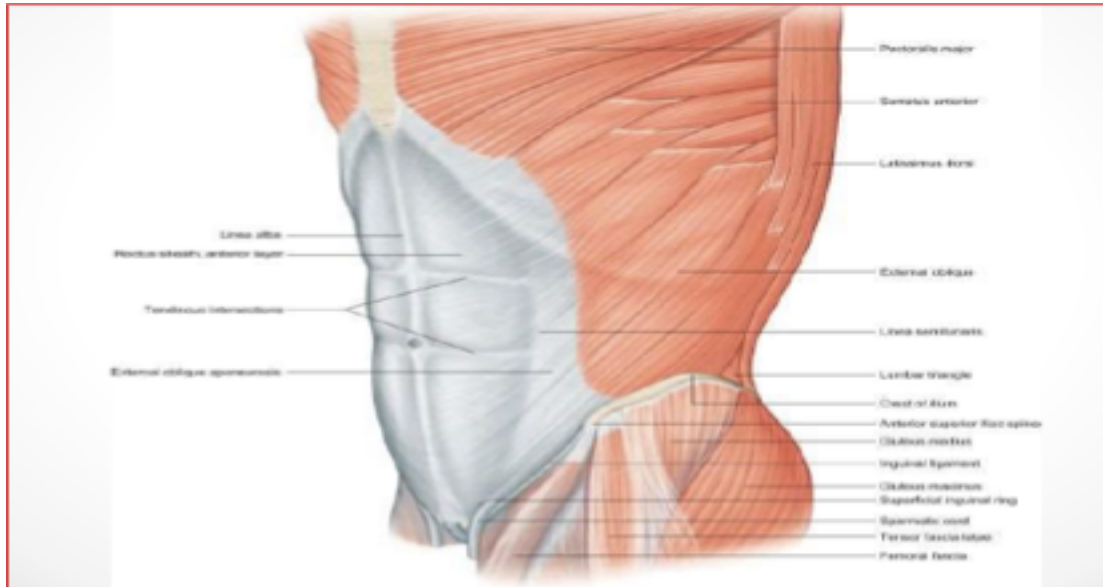
-This is a broad and thin muscle. The fleshy fibers of which pass from above downwards and medially

-It is fleshy above and laterally and aponeurotic every where else

-The dividing line between the fleshy and aponeurotic parts curves upwards and medially from the anterior superior iliac spine to reach the costal margin which it meets at the lateral border of rectus muscle.

-Origin: from above downwards, It has an extensive origin by fleshy digitations from the outer surfaces of the lower 8 ribs (from 5 to 12) a hand's breadth above the costal margin. These slips interdigitate with:

- The slips of origin of serratus anterior muscle (the serratus ant. arises from the outer surfaces of the upper 8 ribs)
- The part of the latissimus dorsi muscle which arises from the lower 3 or 4 ribs



-Insertion:

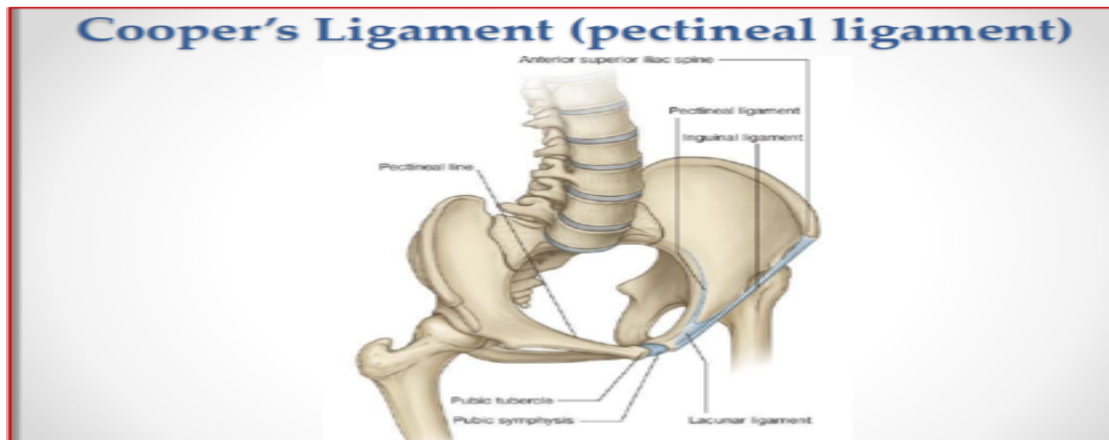
- The most posterior fibers remain fleshy and descend vertically to be inserted into the anterior 1/2 of the outer lip of the iliac crest.

-The remaining fibers pass from above downwards, forwards and medially and end in an extensive, thin but strong aponeurosis which pass medially to fuse with the aponeurosis of the opposite side along the midline:

→from the xiphoid process to the symphysis pubis along the linea alba.

→The lower border of the aponeurosis extends from the anterior superior iliac spine to the pubic tubercle and is folded backwards and upwards upon itself to form a free rolled edge called the inguinal ligament (Poupart's lig)

→The muscle has 2 free edges (post. muscular edge – inferior aponeurotic edge) →Above and medial to the pubic tubercle, the aponeurosis of the ext. oblique is invaginated at the external abdominal ring by the round ligament



The internal oblique muscle

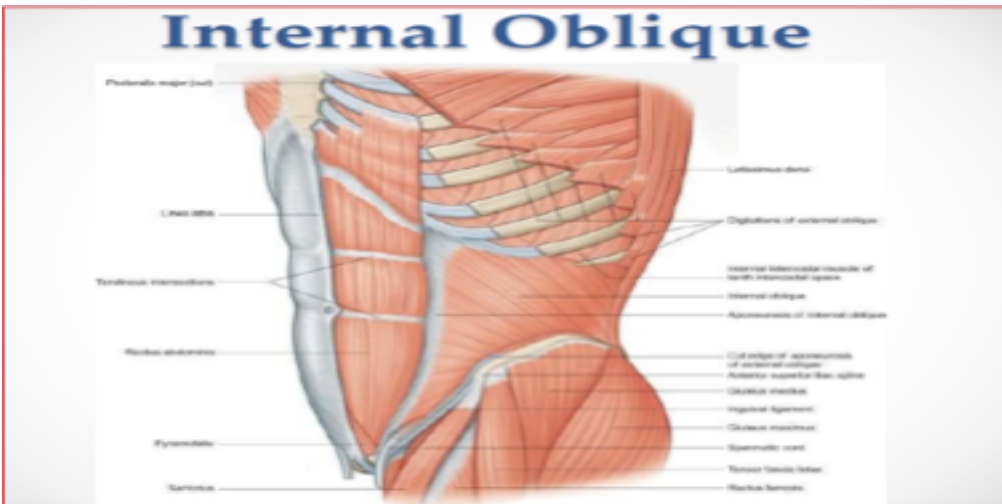
- It is the thickest of the 3 muscles of the anterior abdominal wall
- It arises below and is inserted above and its fibers run **at right angles to the fibers of the ext. oblique of its own side but in the same direction as the fibers of the ext. oblique of the opposite side.**
- It is muscular over the lateral 1/2 and aponeurotic over the medial 1/2 of the abdominal wall
- Origin:** From below upwards: (inguinal origin – iliac origin – lumbar origin)

- a) The lower (antero-most) fibers arise from the lateral 2/3 of the inner surface of the inguinal ligament (inguinal part of the muscle)
- b) The middle fibers arise from the ant. 2/3 of the intermediate area of the iliac crest (iliac origin)
- c) The highest (posterior most) fibers arise from the lumbar fascia (lumbar origin)

-Insertion

- a) The highest fibers run upwards and medially to be inserted into the last 3 or 4 ribs and costal cartilages
- b) The lowest fibers arch downward and medially above the spermatic cord and then descend behind it to reach the pubic crest and the adjoining part of the pectineal line of the pubis
- c) The remaining and main part of the muscle ends in a broad aponeurosis whose line of attachment passes upwards along the costal margin to the xiphoid process then downward along the linea alba to the symphysis pubis

N.B.: the int. oblique does not extend upward beyond the costal margin while the ext. oblique arises a hand's breadth above the costal margin



- As the aponeurosis reaches the lateral border of rectus muscle, it splits into 2 layers: anterior and posterior which help to form the rectus sheath
- The anterior layer passes forward in front of the rectus muscle and is fused with the aponeurosis of the ext. oblique to form the ant. wall of the rectus sheath
- The posterior layer passes behind the rectus muscle and is fused with the aponeurosis of the transversus muscle to form the posterior wall of the rectus sheath
- Below a point 1/2 way between the umbilicus and the symphysis pubis, the aponeurosis of the internal oblique does not split but passes as a whole (undivided) in front of the rectus muscle and helps to form the ant. wall of rectus sheath in this region

The Transversus Abdominis muscle

-The deepest and thinnest muscle of the abd. wall and arises from behind and runs transversely to be inserted in the midline

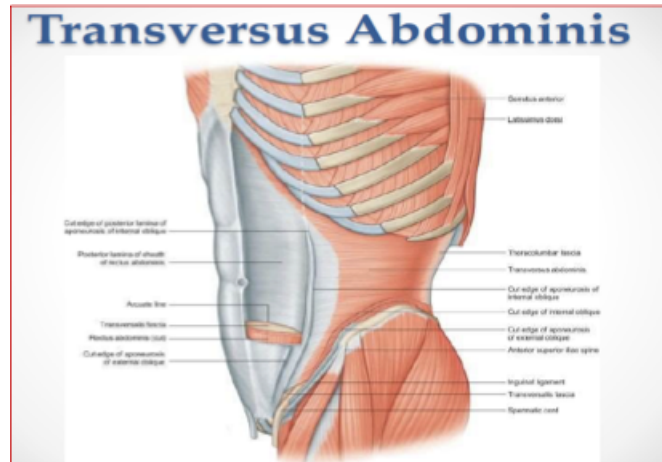
Origin: -Along a continuous line from the:

- a- Lateral 1/3 of the inner surface of inguinal lig. (inguinal part)
- b- Ant. 2/3 of the inner lip of the iliac crest (iliac part)
- c- Lateral edge of lumbar fascia (lumbar part)
- d- Deep surfaces of the lower 6 ribs (costal part)

-It has therefore an inguinal, iliac, costal and lumbar origin -All the origins except the lumbar are fleshy

Insertion: is completely aponeurotic

- The highest fibers (costal) are short and pass to the xiphoid process



- The line of insertion then descends through the linea alba to the symphysis pubis

From the xiphoid process to a point midway bet. the umbilicus and pubis, the aponeurosis passes behind the rectus but below this point it passes in front of the rectus

- The lowest fibers (inguinal part) join the deep surface of the lowest fibers of the internal oblique to form the conjoint tendon

The Rectus Sheath

- In the thorax, the rectus muscle lies on the 5th, 6th and 7th costal cartilages and is covered only by the aponeurosis of the external oblique.
- From the xiphoid process to a point midway between the umbilicus and pubis, the muscle is enveloped by a sheath formed by the splitting of the aponeurosis of the internal oblique.

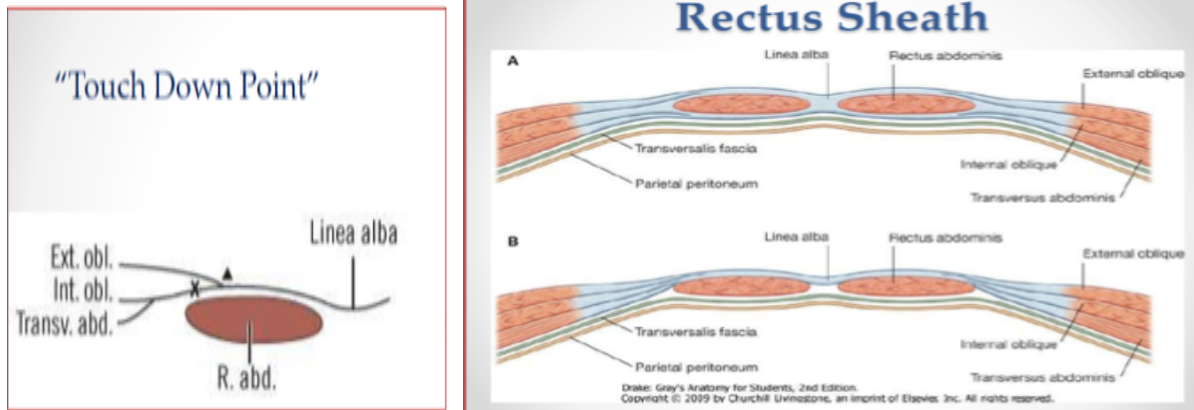
The aponeurosis of the external oblique reinforces the anterior wall and the aponeurosis of the transversus reinforces the posterior wall.

- Below a point midway between the umbilicus and the pubis, the muscle is covered in front by the aponeurosis of the ext. oblique, internal oblique and transversus muscle, there is thus no posterior wall and the muscle lies on the fascia transversalis, the extraperitoneal fat and peritoneum .

- The posterior wall of the sheath at the point midway bet. the umbilicus and the pubis, ends in a free crescentic border known as the arcuate line.

Contents of rectus sheath:

- 1- The rectus muscle
- 2- Pyramidalis muscle when present
- 3- Lower 6 thoracic nerves
- 4- Superior epigastric vessels



Nerve supply of abd. wall muscles : From

- 1- The lower 6 thoracic nerves
- 2- The iliohypogastric nerve (L1)
- 3- The ilioinguinal nerve (L1)

Clinical importance/ applied anatomy:

- 1- Incision along the lat. border of rectus @ denervation of the muscle @ weakness
- 2- Elevation of rectus sheath during Pfannenstiel incision @ stretches perforating nerves @ may leave an area of cutaneous anaesthesia
- 3- Ilioinguinal and iliohypogastric can be entrapped in the lateral closure of transverse
- 4- A minimal loss of skin sensation can result from abd. incision @ numbness of skin below a T. incision is frequent. If incision extends laterally @ numbness of skin of the upper anterior thigh

Vascular supply of abdominal wall:

- Skin and subcut tissue ; by superficial epigastric vessels
 - Musculofascial ; by (1). **Inferior epigastric** and (2). **Superior epigastric**
- Both the inferior epigastric and superficial epigastric arteries run similar course towards the umbilicus.

Clinical importance

1-Lateral laparoscopic trocars placed in lower abdomen may @ injury of both vessels 2-Just above the symphysis, the vessels lie about 5.5cm from the midline while at the level of the umblicus, they are 4.5cm from the midline .

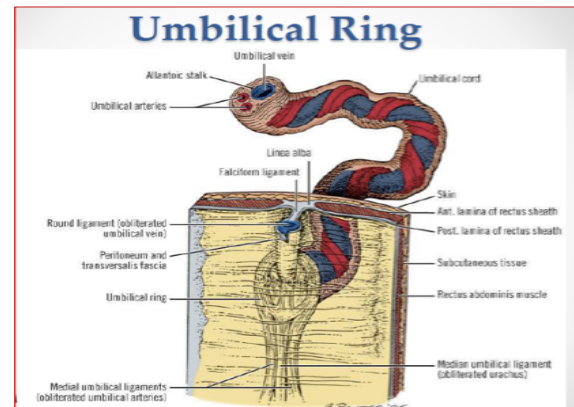
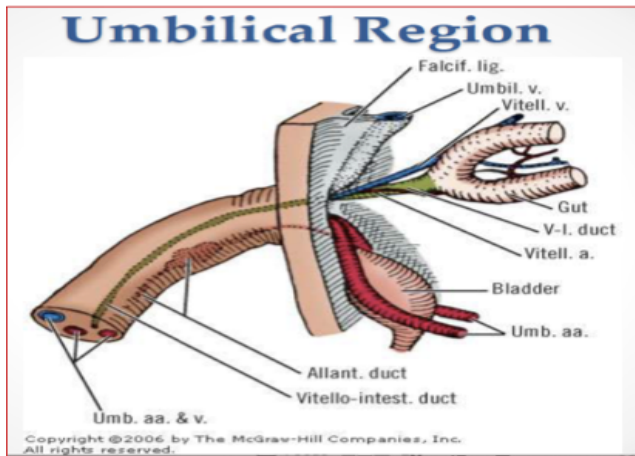
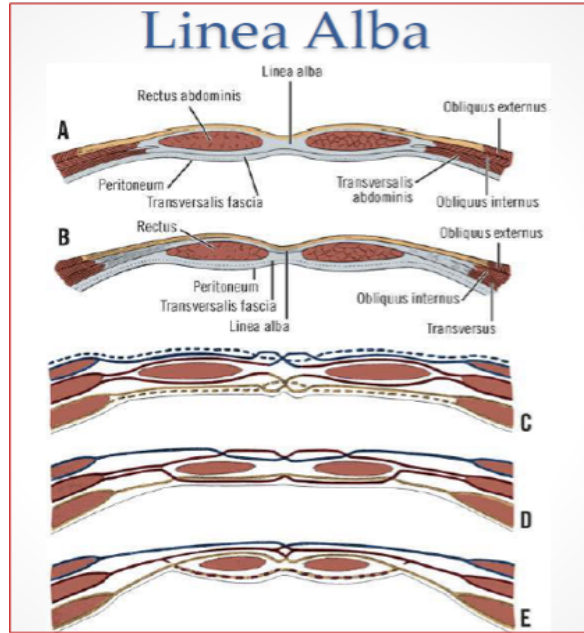
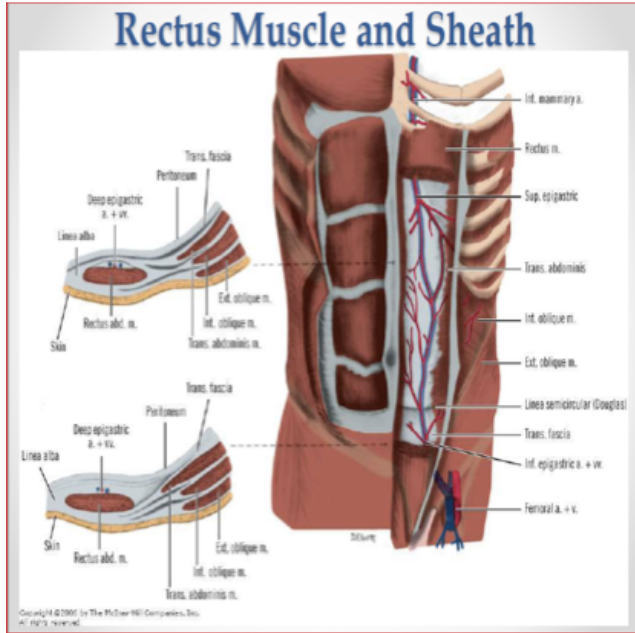
3-So, trocars are placed lateral or medial to a line connecting these points` liability of their injury of these vessels

4--The location of inferior epigastric can be seen by following the round lig. to its point of entry into the inguinal ring recognizing that the vessels lies just lateral to this point

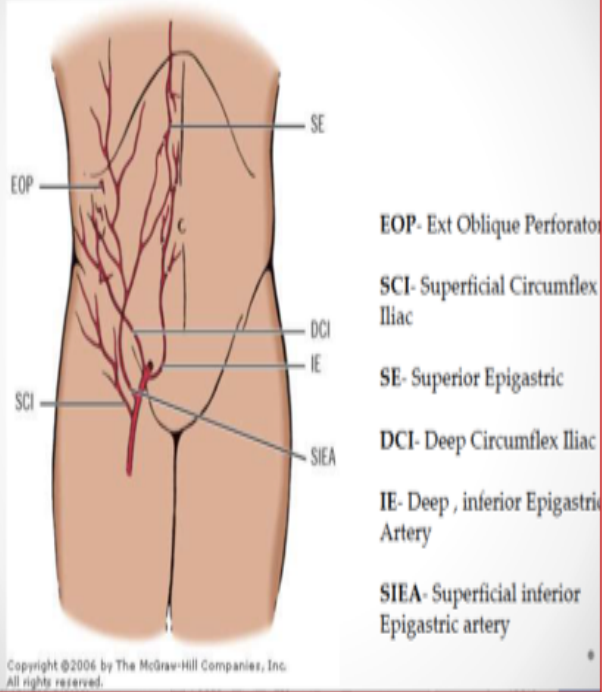
Comparison between the upper and lower 3/4th of the anterior abdominal wall

Upper midline	Lower midline
Linea alba well developed	Linea alba poorly developed
Right & left recti well separated	Right & left recti close together
Anterior & posterior layers of the sheath present	Only anterior layer of sheath present
Aponeurosis of external oblique weak or absent	Aponeurosis of external oblique strong & well developed.

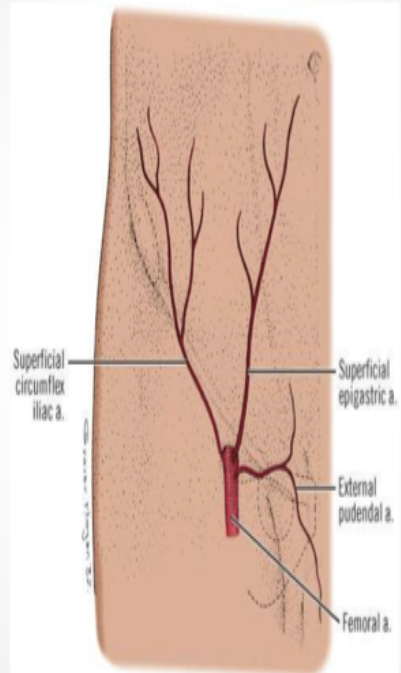
IMPORTANT IMAGES



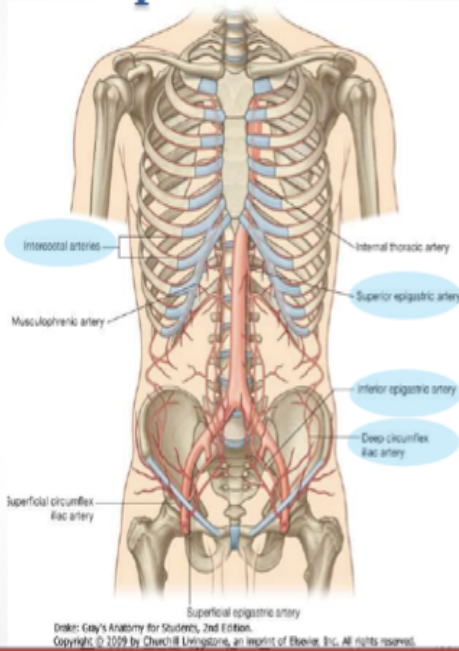
Vessels of anterior abdominal wall



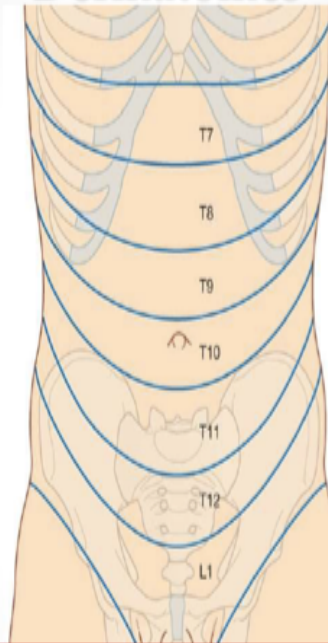
Superficial Arteries



Deep Arteries



Dermatomes



CHAPTER (9) The pelvic lymphatic system

Lymphatic vessels and nodes lie in the extraperitoneal connective tissue and because they are embedded in adipose tissue, they are extremely difficult to be located unless they are a seat of pathological disturbance .

Lymphatic vessels are developed from veins and tend to follow the course of veins draining a particular organ and regions

The lymph nodes which are fillers along course of the vessels are usually aggregated into small groups in close contact to large blood vessels

Groups of nodes concerned with draining of the pelvis:

- | | | |
|------------------|-------------------|----------------|
| 1-External iliac | 2. Internal iliac | 3.Common iliac |
| 4.Aortic | 5. Inguinal | |

External iliac group:

Superior group: larger group, lies above the vein

Inferior group : smaller group lies below the vein

Efferents from the external iliac group drain into the common iliac.

Internal iliac group:

1- Nodes which lie adjacent to int. iliac vessels

2- Node or nodes lying at the base of B.lig. in close relation to cx.

3- Inferior sacral nodes: divided into:

- Lateral set: on the medial aspect of internal iliac vessels.
- Medial set: lie along the median sacral vessels in the midline and extends behind the rectum.

Common iliac group:

- **Medial (subaortic) group:** On the medial aspect of common iliac vessels
 - **Lateral group:** On the lateral aspect of common iliac vessels
- Efferent drain into the aortic group.

Aortic group: surrounds the aorta

1-Preaortic: in front of the aorta

2- Retroaortic: behind the aorta

3- Lateral aortic: on the IVC on the Rt. side on the sympath. chain on Lt. side

The medial border of psoas on each side useful guide to precise position of these nodes.

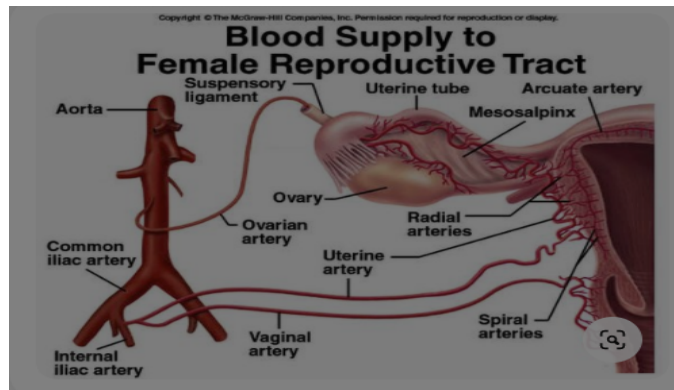
Efferents from these nodes pass into the lumbar trunk which terminate into cisterna chyli.

Superficial inguinal nodes

Lie in the superficial fascia in the groin. It consists of **medial** and **lateral** groups just below the inguinal ligament in the adult.

Efferents drain into superior external iliac group via the deep subinguinal

Blood supply to the pelvis



Abdominal aorta

The abdominal portion begins at the level of the 12th thoracic vertebra and runs downward along the front of the vertebral column and bifurcates at the level of the 4th lumbar vertebra to form the Rt. and Lt. common iliac arteries.

The IVC runs immediately on its right

In the lower part of its course, ovarian and inferior mesenteric branches arise from the front while the median sacral and lumbar branches arise from the back.

Pelvic arteries

3 primary vessels are responsible for arterialisation of the pelvis:

- The common iliac arteries
- The inferior mesenteric artery
- The ovarian arteries

The common iliac arteries:

The most predominant arteries of the pelvis

It is the terminal division of the aorta at the 4th lumbar vertebra

Course: it runs oblique and lateral course and is approximately 5cm in length

Branches: 1 - External iliac. 2- Internal iliac

Venous drainage: lie posterior and slightly medial to the arteries, drain into the IVC

The external iliac artery:

Origin: lateral bifurcation of the common iliac artery begins opposite the sacroiliac joint

Course: runs along the medial border of psoas muscle and lateral pelvic wall and becomes the femoral artery after passing under the inguinal ligament to supply L.L

Branches:

- 1- *Superficial epigastric*: supplies the skin and subcut. tissue of the lower anterior abdominal wall
 - 2- *Superficial circumflex iliac*: supplies the skin and subcut. tissue of the flank
 - 3- *Inferior epigastric*: supplies the musculofascial layer of the lower anterior abdominal wall
 - 4- *Deep circumflex iliac*: supplies the musculofascial layer of the lower abdominal wall
 - 5- *External pudendal*: supplies the skin and subcut. tissue of the pubis and anterior vulva
- Venous drainage:** lie posterior and then medial to the artery as it enters the anterior thigh. It drains into the common iliac veins

The internal iliac (hypogastric) artery:

The main vascular supply of the pelvis

It is the common stem of origin of all the arteries of the pelvis except for 3:

- 1- Superior rectal a: the principal rectal artery, a branch of inferior mesenteric
- 2- Median sacral: continuation of the aorta
- 3- Ovarian arteries: branches of the aorta

Origin: from the common iliac artery which divides into its 2 branches (external – internal) iliac opposite the sacroiliac joint of the pelvis

Course: the internal iliac artery descends under cover of peritoneum into the true pelvis for about 4cm before dividing into anterior and posterior divisions.

Relations of the 4cm artery in its journey are as follows:

- Anteriorly: the ureter
- Posteriorly: the internal iliac vein
- Laterally: the large external iliac vein
- Medially: covered by peritoneum

- Bilateral internal iliac ligation is a life saving procedure in P.P hage and in cases of uncontrollable pelvic hage.

The surgeon should ligate the artery below the posterior branch which is approximately 4cm distal to the common iliac artery.

Also, the internal iliac artery is surrounded by vulnerable structures which may be easily damaged during ligation as the ureter and the large thin walled veins especially when the operative field is obscured by alarming hage

The internal iliac artery is double the size of the external iliac artery prenatally and only 1/2 its size postnatally, why?

Branches of internal iliac artery:

The 4cm long internal iliac artery ends at about the upper margin of the greater sciatic notch by dividing into anterior and posterior divisions:

The posterior division has: 3 parietal branches

The anterior division has: 3 parietal branches – 4 visceral branches

The 3 parietal branches of the posterior division:

(iliolumbar, lateral sacral and superior gluteal) which mainly supply the bone, muscle and fascia of the posterolateral quadrant of the pelvic wall

a) Iliolumbar artery:

ascend deep to the psoas muscle and divide to supply the iliacus and quadratus lumborum

b) 2 lateral sacral arteries:

Pass downwards and medially in front of the sacral plexus lateral to the anterior sacral foramina towards the sacrum each lateral sacral artery divides into 2 branches and the resulting 4 branches pass through the 4 anterior sacral foramina, cross the sacral canal and come out through the 4 posterior sacral foramina to supply the muscles and skin of the back of the sacrum

c) Superior gluteal artery: Is the direct continuation of the posterior division and leaves the pelvis through the upper part of the greater sciatic foramen (above the pyriformis) to enter the gluteal region and supply the gluteal musculature.

The 3 parietal branches of the anterior division:

(obturator artery, inferior gluteal artery and int. pudendal artery) supply the parietal of the anterolateral quadrant of the pelvic wall, the buttock and perineum

a) Obturator artery:

Arises next to the umbilical artery and passes downwards and forwards along the side wall of the pelvis accompanying the obturator nerve to pass to the obturator canal. It supplies the obturator internus muscle.

Before leaving the pelvis, it gives a pubic branch which anastomoses with the pubic branch of the inferior epigastric artery behind the body of the pubis. In 25% of people, the obturator artery does not arise from the internal iliac and in this case, the pubic branch of the inferior epigastric artery becomes large enough to replace the obturator artery itself and is called an abnormal obturator artery

b) Inferior gluteal artery:

The larger of the terminal trunk of the ant. division

It leaves the pelvis through the lower part of the greater sciatic foramen and with the superior gluteal artery, it supplies much of the buttock and back of the thigh.

c) Internal pudendal artery:

The smaller of the 2 terminal branches of the int. iliac a.

It descends anterior to the pyriformis and pierces the pelvic fascia then leaves the pelvis through the inferior part of the greater sciatic foramen, and curls around the ischial spine (together with the pudendal nerve). Then it passes through the pudendal canal with the pudendal nerve about 4cm above the ischial tuberosity.

It then proceeds forwards above the inferior fascia of the urogenital diaphragm and divides and divides into a no. of branches:

- *Inferior rectal branch:* supplies the skin and musculature of the anus and anastomoses with the superior and middle rectal arteries
- *Perineal artery:* supplies much of the perineum and small branches supply the labia, vestibular bulbs and vagina
- *Dorsal artery of the clitoris:* the termination of the internal pudendal artery

The 4 visceral branches of the anterior division are given off as the vessel passes down the pelvis from the brim to the outlet.

As it passes by each organ, it contributes a blood supply, thus expending itself until it finally terminates

a) Umbilical artery

- In the fetus, this artery is a large vessel which is the main continuation of the internal iliac artery carrying unoxygenated blood from the fetus to the placenta through the umbilicus
- In the adult, only the proximal 3-5cm of the artery is open i.e has lumen and contains blood while the remaining part of the umbilical artery is obliterated forming fibrous cord called the lateral umbilical ligament.

The obliterated umbilical artery passes forwards along the lateral border of the upper surface of the urinary bladder and ascends as the lateral umbilical ligament along the post. surface of the ant. abdominal wall to reach the back of the umbilicus

- 2 or 3 superior vesical arteries arise from the proximal part of the umbilical artery (before it becomes the lat. umbilical lig.) to supply the upper surface of urinary bladder

b) Uterine artery: Passes along the root of the broad lig. and about 2cm from the cx. it crosses above and in front of the ureter. Then, it runs tortuously along the lateral margin of the uterus between the layers of the B.lig. it supplies the cx and body of the uterus, part of the bladder and one branch anastomoses with the vaginal artery. The branches of uterine artery pass circumferentially around the myometrium giving coiled radial branches which end as basal arteries supplying the endometrium

c) Vaginal artery :

Replaces the inferior vesical a. in female

It passes forwards and medially on the levator ani to reach and supply the vagina

It sends branches to supply the inferolateral surface of the bladder

d) Middle rectal artery:

Is a small branch passing medially to the rectum to supply the musculature of the lower rectum and anastomoses with the superior and inferior rectal arteries.

The ovarian artery:

Is a long slender artery which arise from the anterolateral aspect of the aorta just below the origin of the renal artery.

The Rt. artery crosses the anterior surface of the vena cava, the lower part of the abdominal ureter and then lateral to the ureter enter the pelvis via the infundibulopelvic ligament.

The left artery crosses the ureter almost immediately after its origin and then travels lateral to it crossing the bifurcation of the common iliac artery at the pelvic brim to enter the infundibulopelvic ligament.

Both divide to send branches to the ovaries through the mesovarium.

Small branches pass to ureter, fallopian tube and one branch passes to the cornu of the uterus where it freely anastomose with branches of uterine artery to produce continuous arterial arch

Venous drainage:

The ovarian and uterine trunks drain into a pampiniform plexus of veins in the B.lig. near the mesovarium which can sometimes be varicose

The Rt. ovarian vein drains into IVC and the left usually into the Lt. renal vein

The inferior mesenteric artery:

Origin: arises 3-4cm above the bifurcation of the aorta from the ventral surface.

Course: it descends at 1st in front of the aorta and then to the left of it to cross the left common iliac a. medial to the left ureter and continues in the mesentery of the sigmoid colon into the lesser pelvis

In the lesser pelvis, it continues as the superior rectal artery supplying the upper rectum and anastomosing with the middle and inferior rectal arteries.

Branches:

- 1- Left colic: supplies - Left T. colon. - Splenic flexure - Descending colon
- 2- Sigmoid: supplies the sigmoid colon
- 3- Superior rectal: divides into 2 terminal branches to supply the rectum

Venous drainage: inferior mesenteric vein empties into splenic vein

Middle sacral arteries

Midline unpaired vessel arising from the posterior terminal aorta. It courses over the lower lumbar vertebrae, sacrum and coccyx

It supplies bony and muscular structures of the posterior pelvic wall

Venous drainage: paired midline sacral veins usually drain into the lt. common iliac vein

Lumbar arteries

Segmental branches arising at each lumbar level from the posterior aorta

It supplies the abdominal wall musculature (external oblique, internal oblique, transversus abdominis)

Venous drainage: to IVC

Clinical importance of blood supply of the pelvis

1- **The bloody angle of the pelvis:** the parietal vessels of the posterior division pass deeply between the trunks of the lumbosacral nerve plexus and also between the coccygeus and pyriformis muscle.

It operative surgery, because of their short length, these vessels retract behind and between these structures which make the control of bleeding very difficult. So, the posterolateral quadrant is called the bloody angle of the pelvis

2-Collateral circulation in the pelvis:

When bilat. int. iliac and ovarian ligation is done, blanching or gangrene of pelvic organs does not occur because the anastomotic channels between the parietal branches of the anterior and posterior divisions of the int. iliac with the femoral, lumbar arteries and aorta (through its terminal median sacral artery) are sufficiently numerous to prevent this.

The collat. Circulation is do efficient that cases were reported to sustain normal development of a full term child after ligation.

Collateral circulation of the pelvis:

Aorta:		
<ul style="list-style-type: none"> • Ovarian artery • Superior rectal a. 	<ul style="list-style-type: none"> → → 	Uterine artery Middle rectal a. Inferior rectal a. (int. pudendal)
<ul style="list-style-type: none"> • Lumbar arteries • Vertebral arteries • Middle sacral artery 	<ul style="list-style-type: none"> → → → 	Iliolumbar artery Iliolumbar artery Lateral sacral artery
External iliac		
<ul style="list-style-type: none"> • Deep circumflex iliac a. • Inferior epigastric a. 	<ul style="list-style-type: none"> → → 	Iliolumbar a. Superior gluteal a. Obturator a
Femoral		
<ul style="list-style-type: none"> • Medial circumflex femoral • Lateral circumflex femoral 	<ul style="list-style-type: none"> → → 	Obturator a. Inferior gluteal a. Superior gluteal a. Iliolumbar a.

Venous drainage

Common iliac veins:

Result from union of the external and internal iliac veins anterior to the sacroiliac joints. They ascend obliquely to end at the Rt. side of the 5th lumbar vertebra, uniting at an acute angle to form the inferior vena cava.

The left common iliac vein lies medial to the left common iliac artery and is longer than the Rt. vein because it crosses the middle line. The Rt. vein ascends behind its own artery

External iliac vein:

Begins behind the inguinal ligament (as a continuation of the femoral vein) where it is related to the medial side of its own artery. As it ascends up through the pelvis, it lies posteromedial to the artery and is in contact with the upper part of the side wall of the pelvis (laterally) and with the peritoneum (medially)

Internal iliac vein:

Is formed by the union of veins which correspond to branches of the internal iliac artery (except the ilio-lumbar which ends in the common iliac vein) the tributaries from the viscera form venous plexuses (vesical, uterine, vaginal and rectal plexuses)

The internal iliac vein is formed immediately above the greater sciatic foramen and passes forwards and upwards posteromedial to its own artery to join the ext. iliac vein on the medial border of the psoas major to form the common iliac vein

- **Inferior gluteal veins:**

These venae comitantes of the inferior gluteal artery which begin proximally and posterior in the thigh where they anastomose with the medial circumflex femoral. They enter the pelvis low in the greater sciatic foramens joining to form a vessel opening into the distal part of the internal iliac vein

- **Internal pudendal veins**

These venae comitantes of the internal pudendal artery

- **Obturator vein**

Begins in the proximal adductor region and enters the pelvis superiorly in the obturator foramen and runs back and up on the lateral pelvic wall to end in the internal iliac vein

- **Lateral sacral veins:**

Accompany the lateral sacral arteries being interconnected by a sacral venous plexus

- **The vesical plexus**

It envelops the lower border communicating vaginal plexus. It is drained by several vesical veins which usually unite to enter the internal iliac vein

- **The vaginal plexus:**

Flanking the vagina, they connect with uterine, vesical and rectal plexuses and are drained by vaginal veins.

- **The uterine plexus**

They extend lateral to the uterus in the broad lig. communicating with the ovarian and vaginal plexuses they are drained by 2 uterine veins on each side, arising inferiorly in the plexuses at level of ext. os and draining to the internal iliac veins.

- **Rectal plexus:**

Surrounds the rectum connecting anteriorly with the uterovaginal plexus

It consists of :

- Internal part: beneath rectal and anal epith.
- External part: outside the muscular layer

The internal plexus drain mainly in the superior rectal vein to inf. Mesenteric

The external plexus drain mainly in the inferior inf. Mesenteric which drain into the internal pudendal to int. iliac

The middle part by the middle rectal vein to int. iliac

The inferior mesenteric is a tributary of the portal vein so, communication between portal and systemic circulation is established. The superior rectal vein are without valves.

The junction of portal and systemic venous drainage in the anal canal is the place where pile formation occur.

The ext. plexus of veins around the rectum may produce troublesome bleeding when the rectum is exposed and mobilized upward into its normal position in the operation of rectocele repair (post. colporrhaphy)

Ovarian veins

Each of them forms a plexus in the B.lig. near the ovary and uterine tube, communicating with the uterine plexus. 2 veins arise from this and ascend across the ext. iliac artery with the ovarian artery valves may occur in them

Like the uterine veins, they are much enlarged in pregnancy

Middle sacral veins

Paired midline sacral veins usually drain into the lt. common iliac vein

Venous drainage of pelvic organs and its clinical importance

- 1- Venous drainage of ext. genitalia
- 2- Venous drainage of vagina
- 3- Venous drainage of uterus
- 4- Venous drainage of f.t
- 5- Venous drainage of ovary
- 6- Venous drainage of bladder
- 7- Venous drainage of rectum

