
بسم الله الرحمن الرحيم

THE DEVELOPMENT AND ANATOMY OF THE FEMALE SEXUAL ORGANS AND PELVIS

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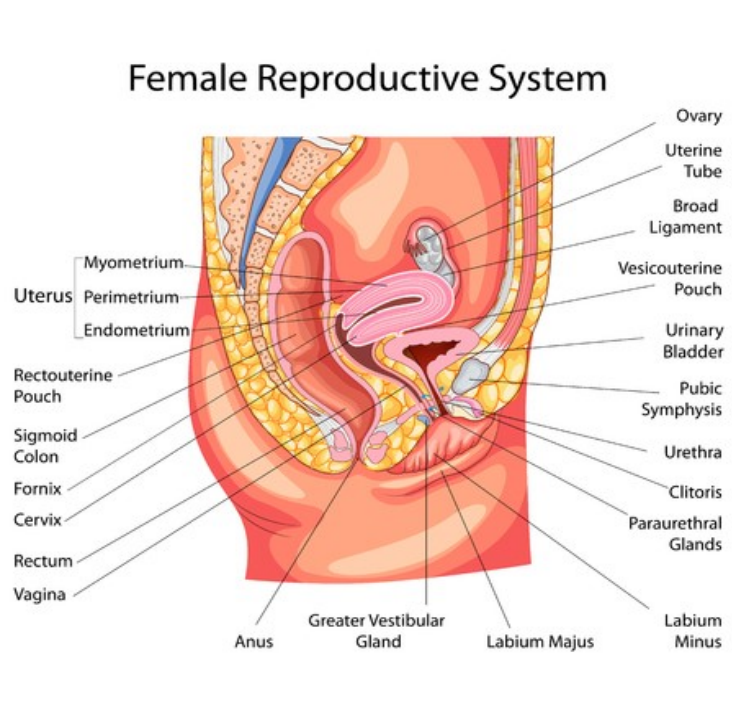
LEC 1/5TH STAGE /2021-2022

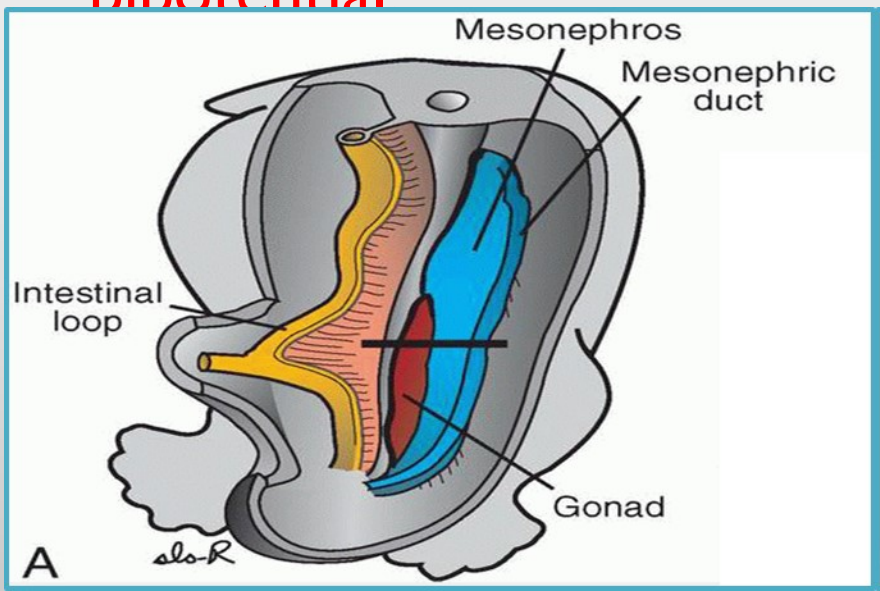


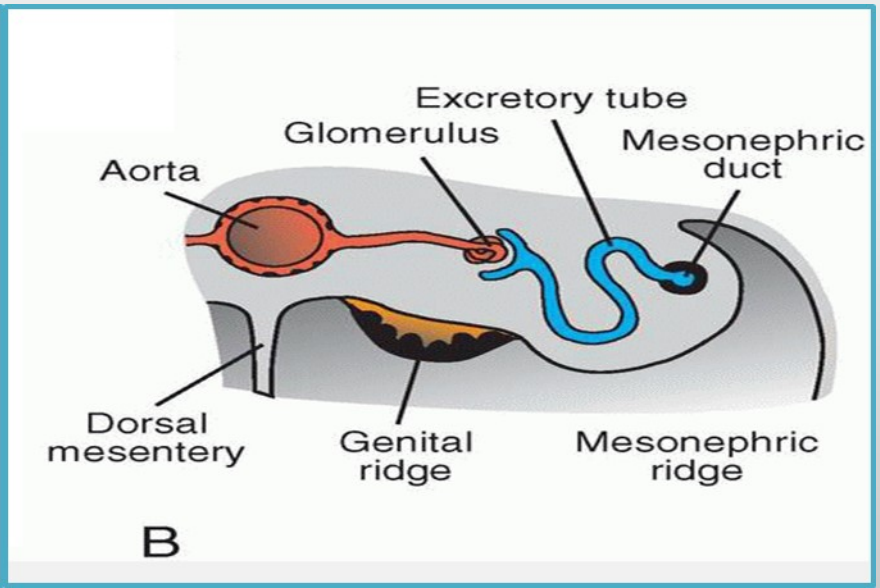
LEARNING OBJECTIVES

- Understand that sexual differentiation and development begin in early embryonic life.
- Understand the embryonic development and the anatomy of the perineum, the vagina, cervix and uterus, the adnexa and ovary and the bladder and ureters.
- Describe the blood supply and lymphatics of the perineum and pelvis.
- Understand the innervation of the perineum and pelvis.
- Understand the vulnerability of certain structures in gynaecological surgery.
- Describe the structural anomalies resulting from Müllerian tract disorders.

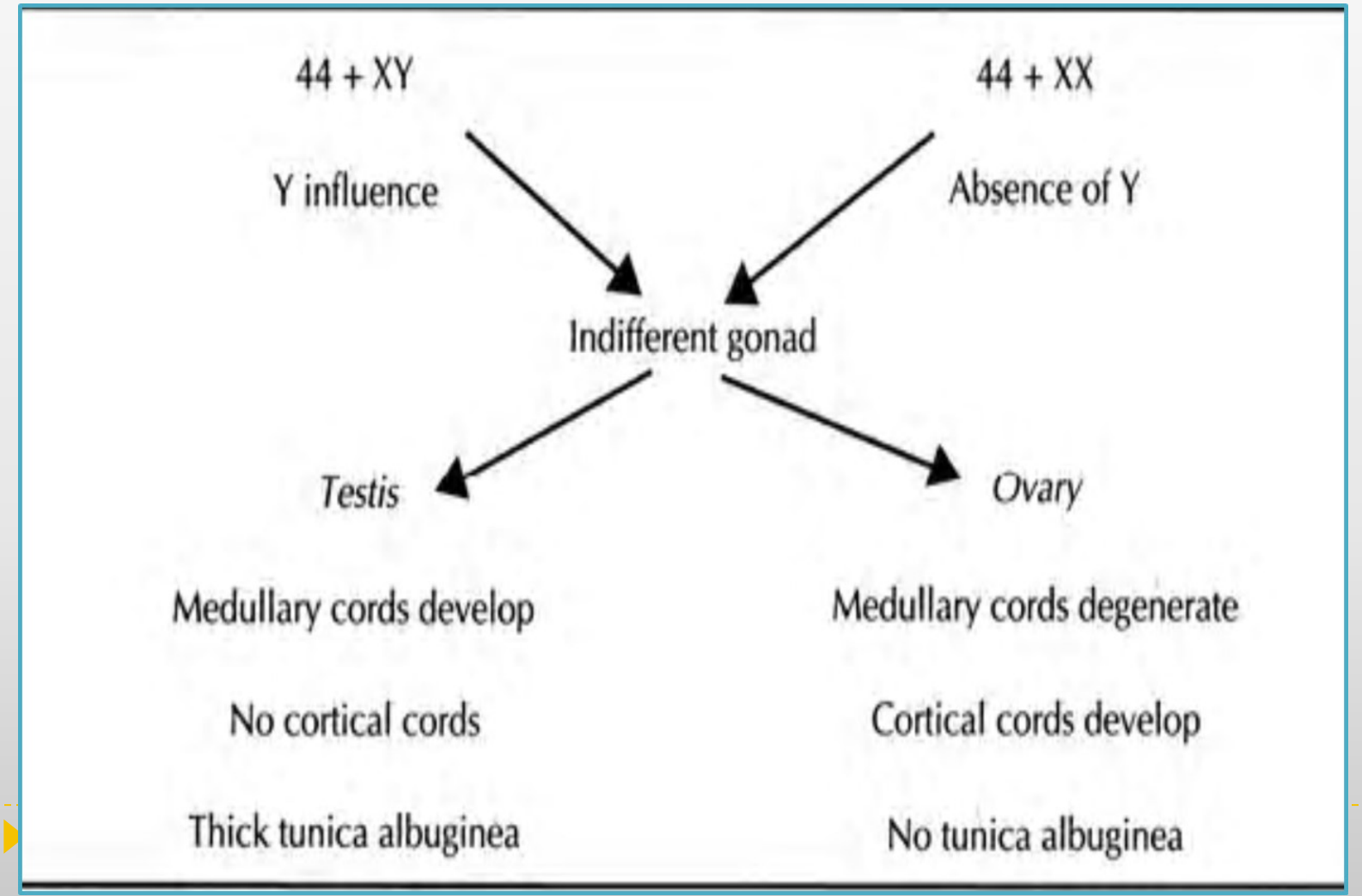
Sexual differentiation of the fetus and development of sexual organs

- The gonadal rudiments appear as the 'genital ridge' overlying the embryonic kidney in the intermediate mesoderm during the 4th week of embryonic life
- They remain sexually undifferent until the 7th week
- The undifferentiated gonad has the potential to become either a testis or an ovary, and hence is termed bipotential



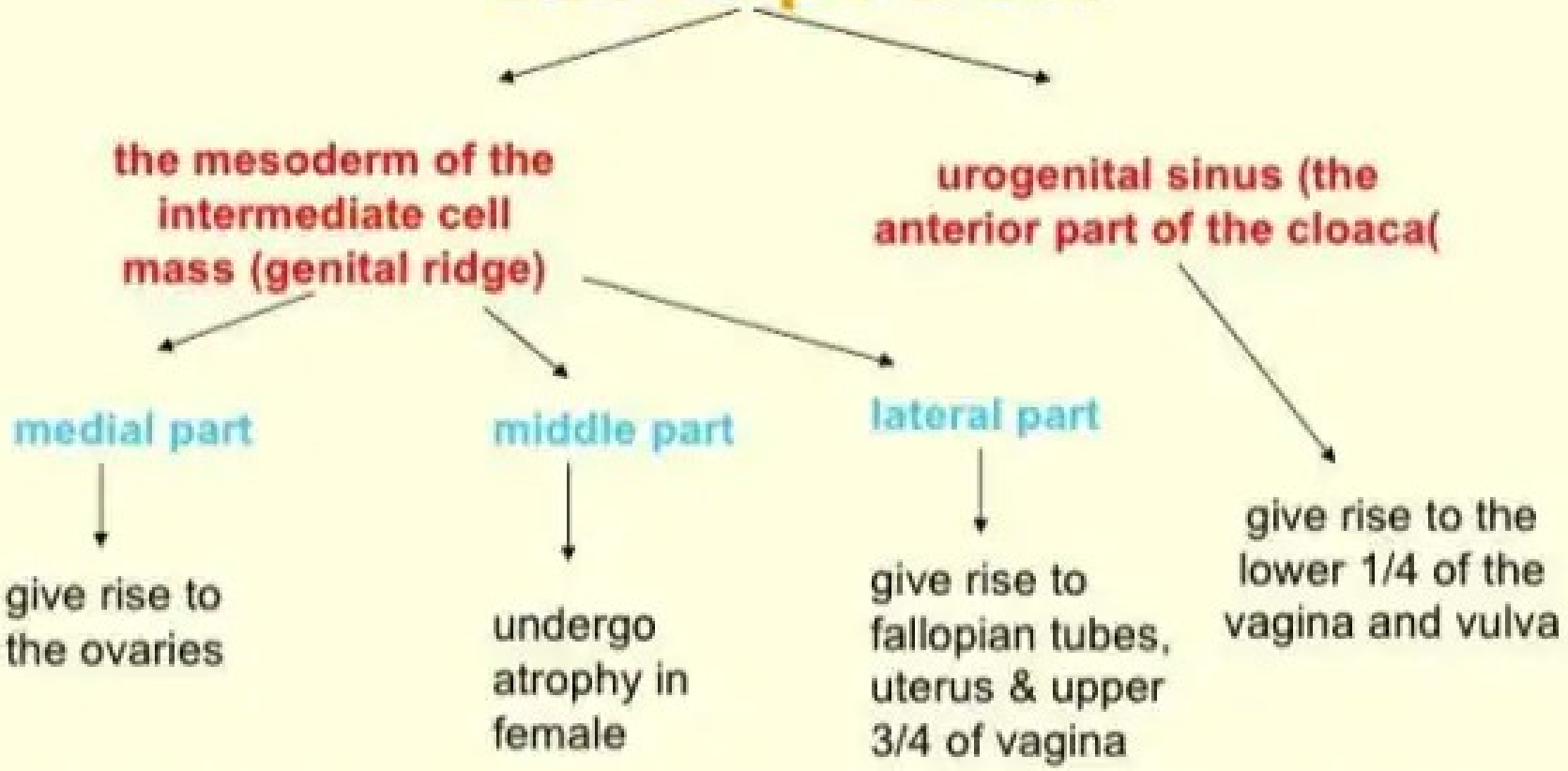


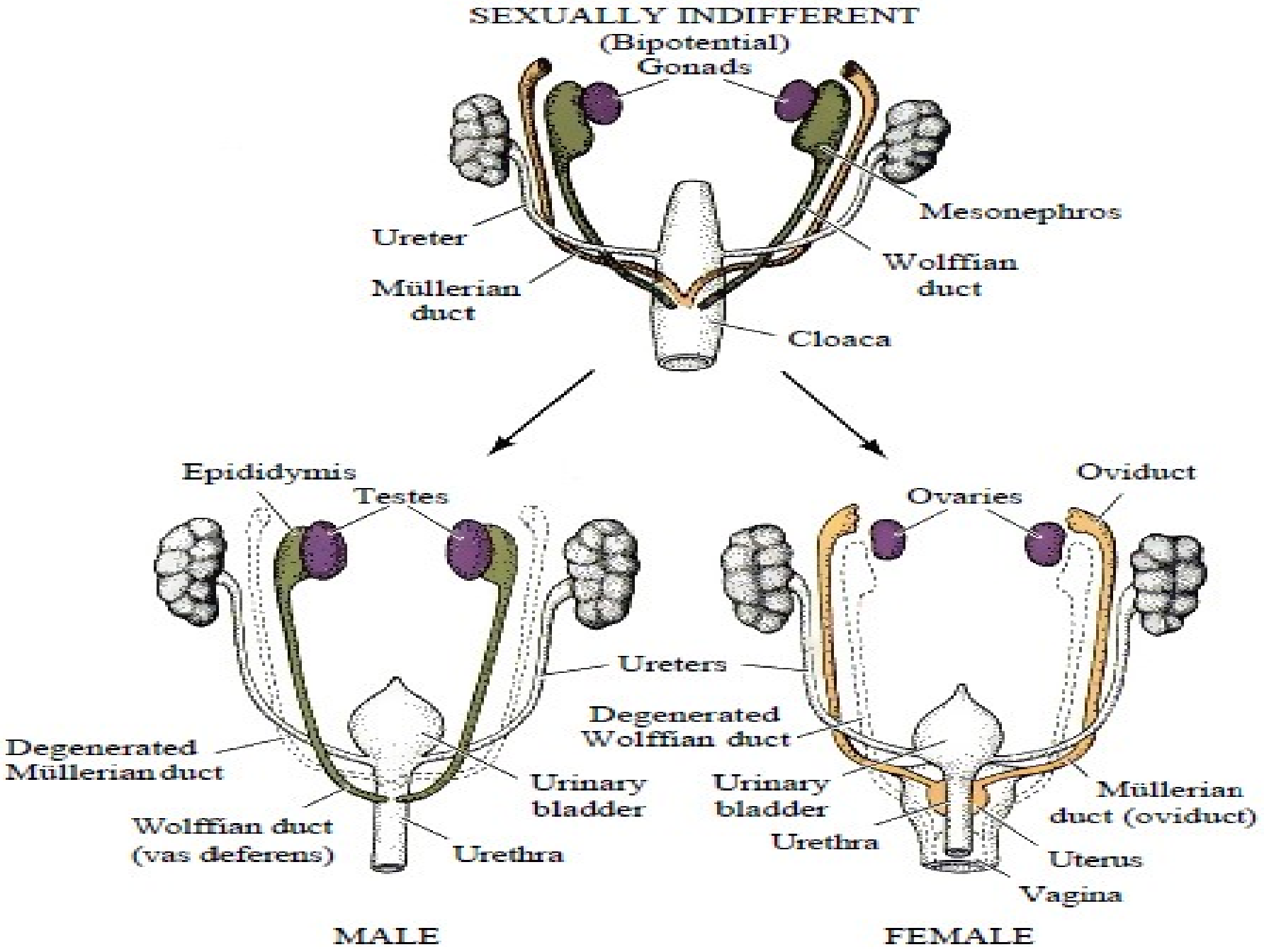
- In the male the activity of the SRY gene (sex-determining region of the Y chromosome) causes the gonad to begin development into a testis.
  In the past, ovarian development was considered a 'default' development due solely to the absence of SRY, but in the last 10 years ovarian-determining genes have also been found that actively lead to the development of a female gonad.



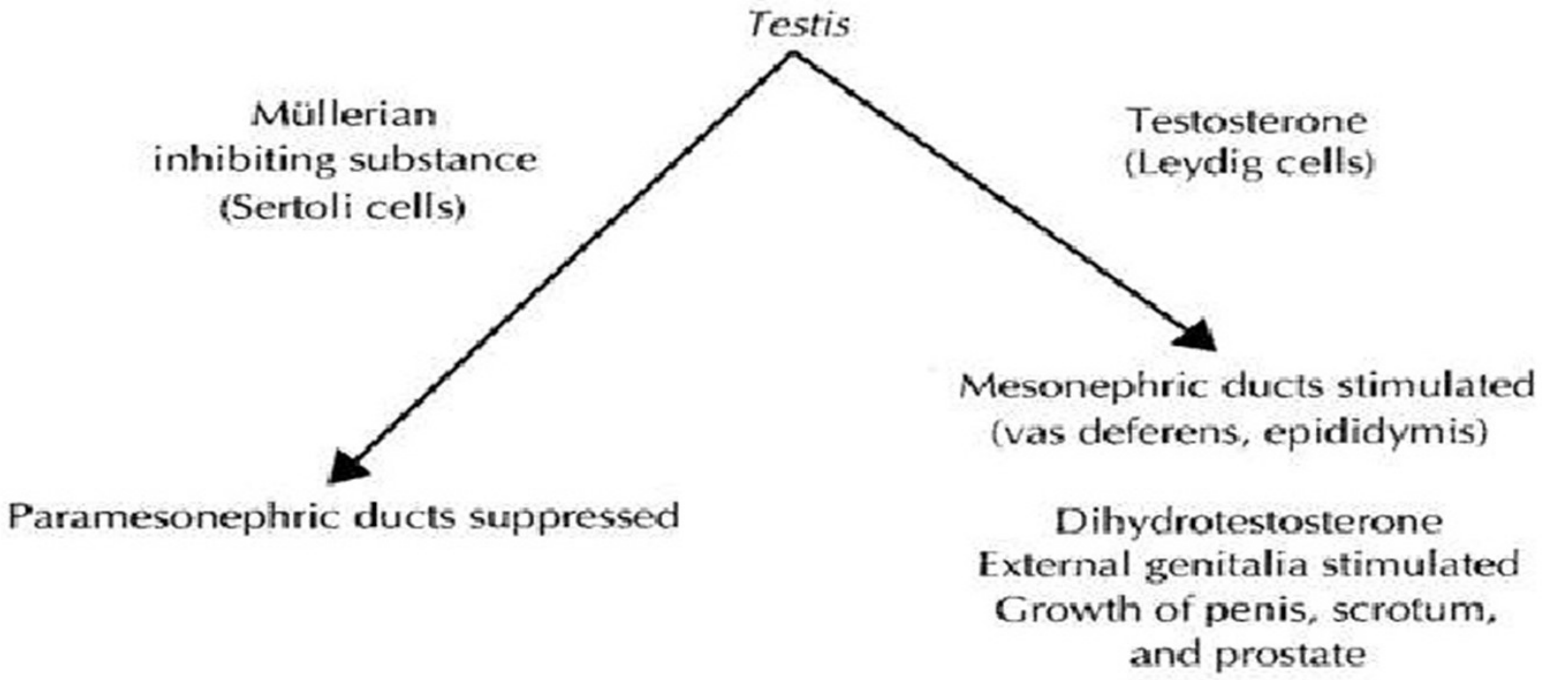
Embryology of the female genital tract

The urogenital system (U.G.S) develops from



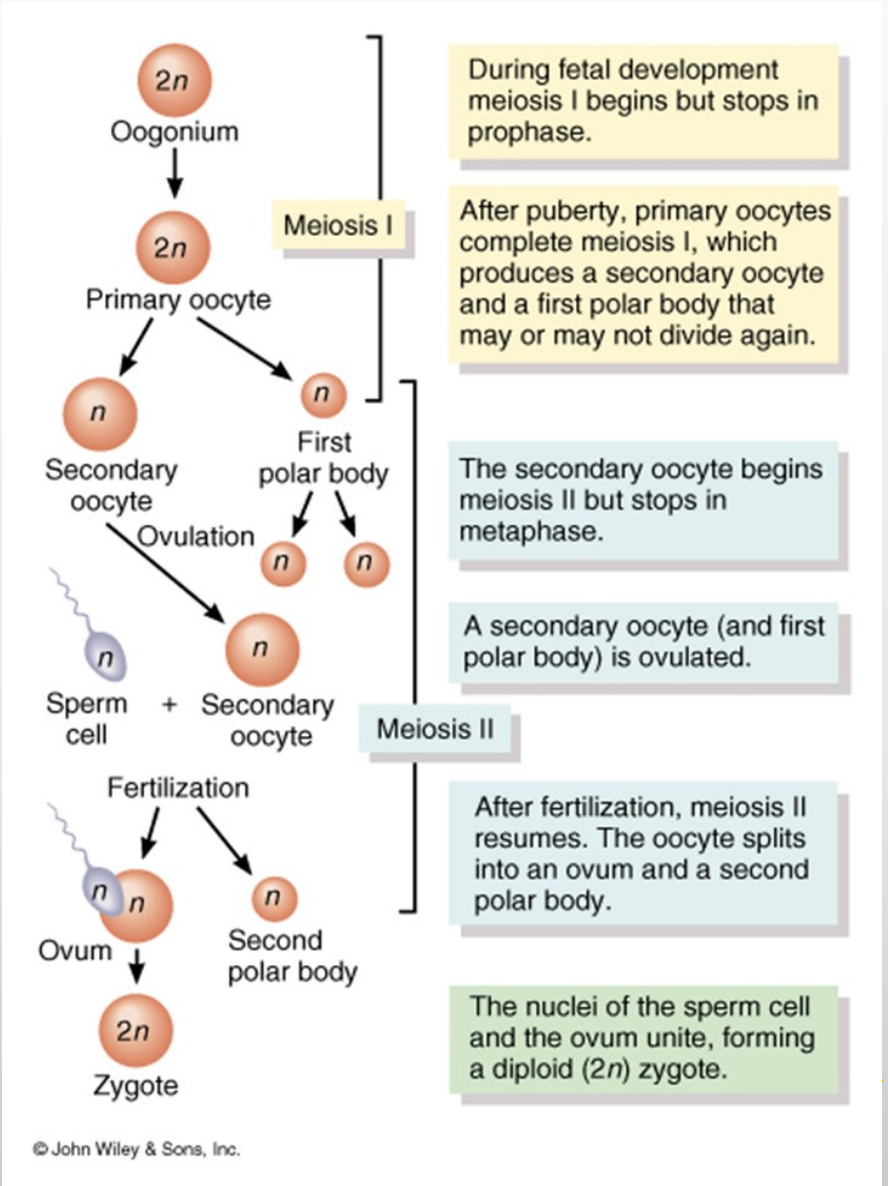

SEXUALLY INDIFFERENT
(Bipotential)
Gonads
Mesonephros
Ureter
Wolffian duct
Müllerian duct
Cloaca
Epididymis
Testes
Ureters
Degenerated Müllerian duct
Urinary bladder
Wolffian duct (vas deferens)
Urethra
MALE
Ovaries
Oviduct
Degenerated Wolffian duct
Urinary bladder
Müllerian duct (oviduct)
Urethra
Uterus
Vagina
FEMALE

Development of the male sexual organs



Influence of the sex glands on further sex differentiation

Development of the female sexual organs

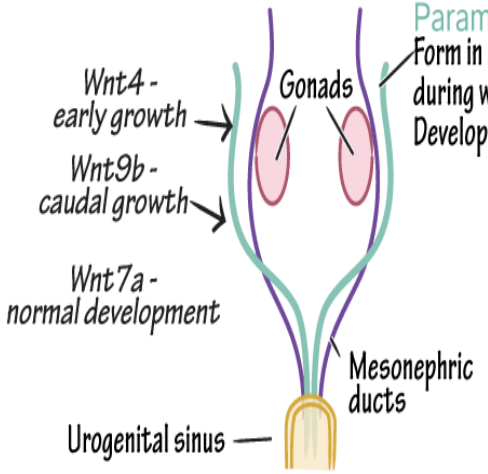


- In the primitive ovary granulosa cells, derived from the proliferating coelomic epithelium, surround the germ cells and form primordial follicles.
- Each primordial follicle consists of an oocyte within a single layer of granulosa cells. Theca cells develop from the proliferating coelomic epithelium and are separated from the granulosa cells by a basal lamina

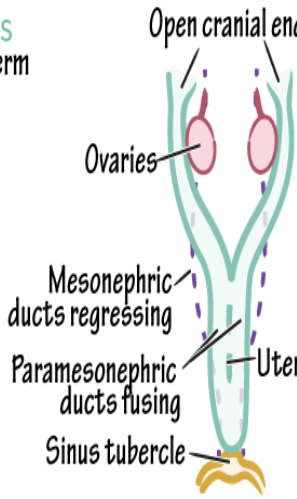
- The maximum number of primordial follicles is reached at 20 weeks' gestation when there are six to seven million primordial follicles present.
- The numbers of these reduce by atresia and at birth only 1–2 million remain.
- Atresia continues throughout life and by menarche only 300,000–400,000 are present, and by menopause none

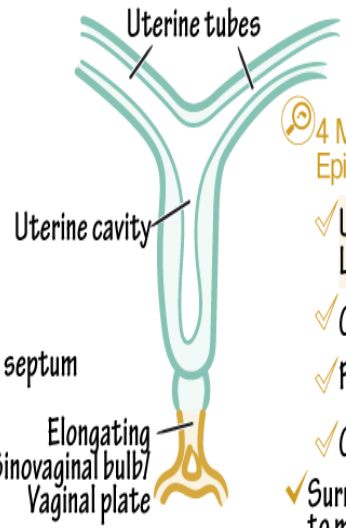
FEMALE REPRODUCTIVE TRACT DEVELOPMENT

~Week 7 — Undifferentiated gonad



~Week 10 — Parmesonephric ducts fuse

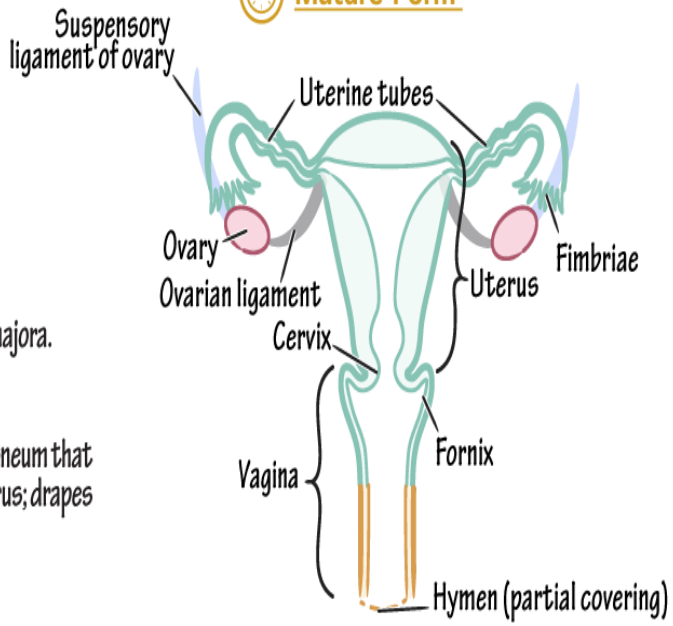




4 Models of Vaginal Epithelium Origins:

- ✓ Upper 2/3 = Paramesonephric; Lower 1/3 = Urogenital sinus
- ✓ Only Paramesonephric ducts
- ✓ Paramesonephric & Mesonephric
- ✓ Only Urogenital sinus
- ✓ Surrounding mesenchyme gives rise to musculature and peritoneal coverings of vagina and uterus.

Mature Form



Ovarian descent

- ✓ Migrate caudally & laterally, Stabilized by ligaments.

Uterine ligaments

- ✓ *Round ligament* — Extends from uterus to labia majora.
- ✓ *Broad ligament* — Double-layered sheet of peritoneum that extends laterally from the uterus; drapes over uterine tubes.

Embryological Origins

Paramesonephric ducts	Uterine tubes Uterus Vagina
Urogenital sinus	Vagina (lower*) Urinary bladder Urethra
Cranial genital ligament	Suspensory ligament of ovary
Caudal genital ligament	Ovarian ligament Round ligament of uterus
Mesonephros	Eoophoron Paraoophoron Gartner's duct

- The proximal 2/3 of the vagina develop from the paired Müllerian ducts, which grow in a caudal and medial direction and fuse in the midline.
- The midline fusion of these structures produces the uterus, cervix and upper vagina, and the unfused caudal segments form the Fallopian tubes .
- Cells proliferate from the upper portion of the urogenital sinus to form structures called the 'sinovaginal bulbs'.
- The caudal extension of the Müllerian ducts projects into the posterior wall of the urogenital sinus as the Müllerian tubercle.
- The Müllerian tubercles and the urogenital sinus fuse to form

the vaginal plate, which extends from the Müllerian ducts to the urogenital sinus.

- This plate begins to canalize, starting at the hymen and proceeding upwards to the cervix in the sixth embryonic month.

External female genitalia

- The external genitalia do not virilize in the absence of testosterone.
- Between the 5th and 7th weeks of life, the cloacal folds, which are a pair of swellings adjacent to the cloacal membrane, fuse anteriorly

to become the ge

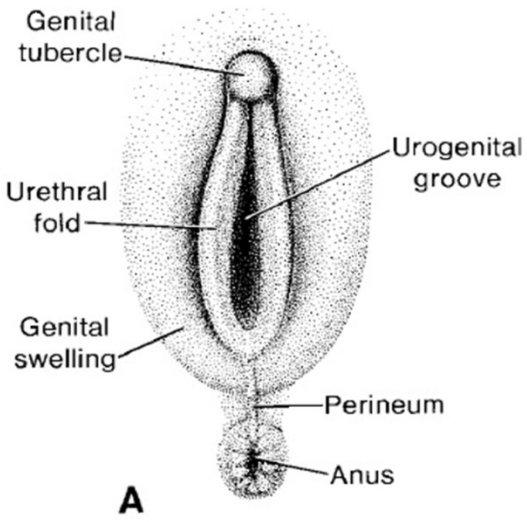
- The perineum
- anterior uroge
- The cloacal fol
- the labia minor
- Another pair o
- labioscrotal fol
- The urogenital
- The external g

twelfth embryoni

an

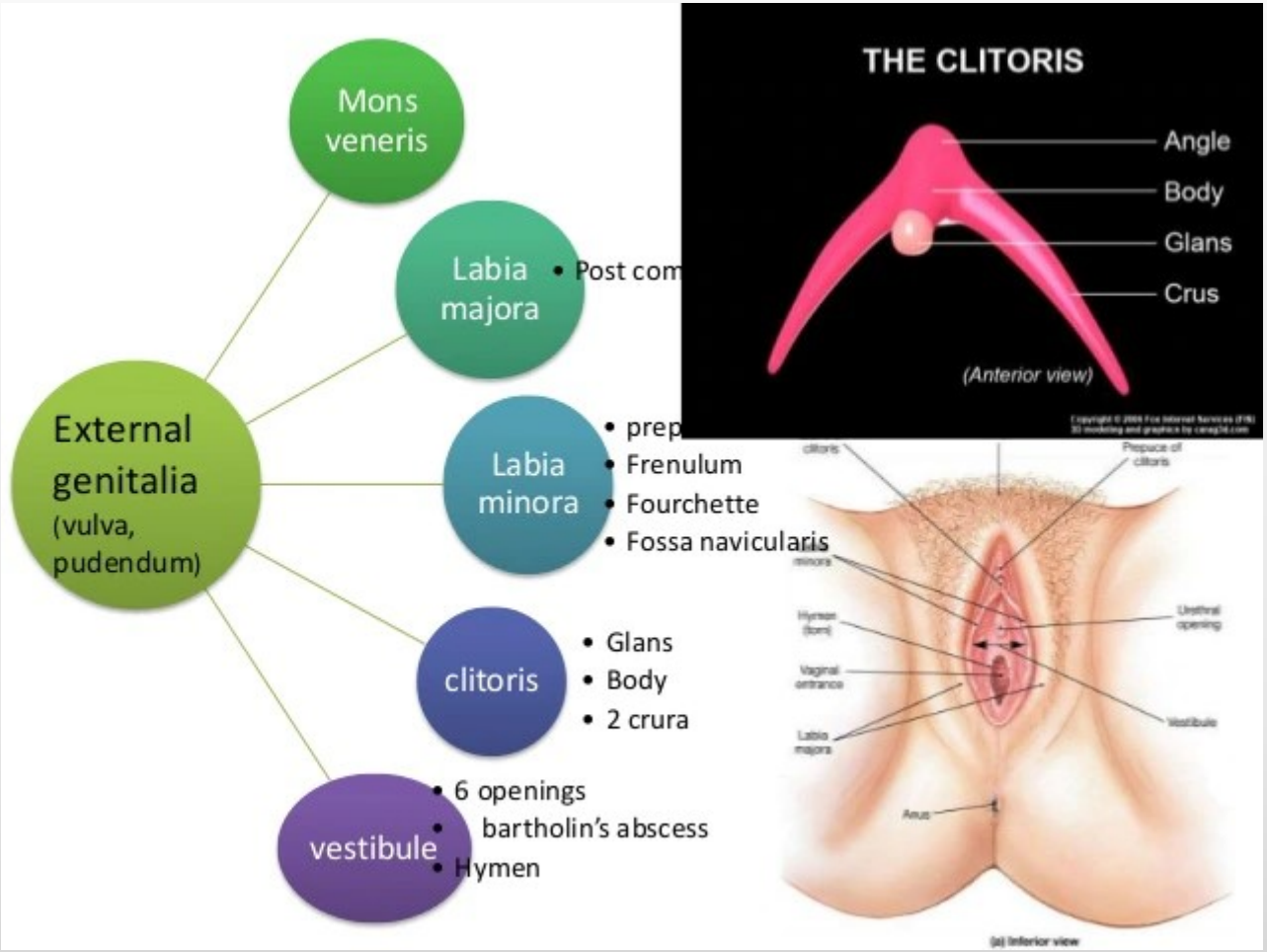
form

e

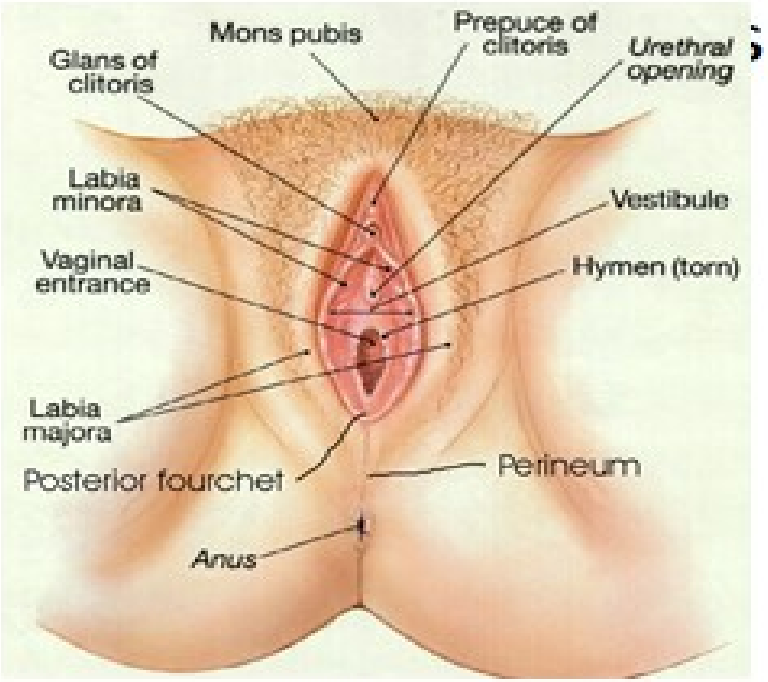


Development of the external genitalia in the female at 5 months **(A) and** in the newborn **(B).**

Female anatomy
External genitalia



the vulva means the external genitalia and is composed of the

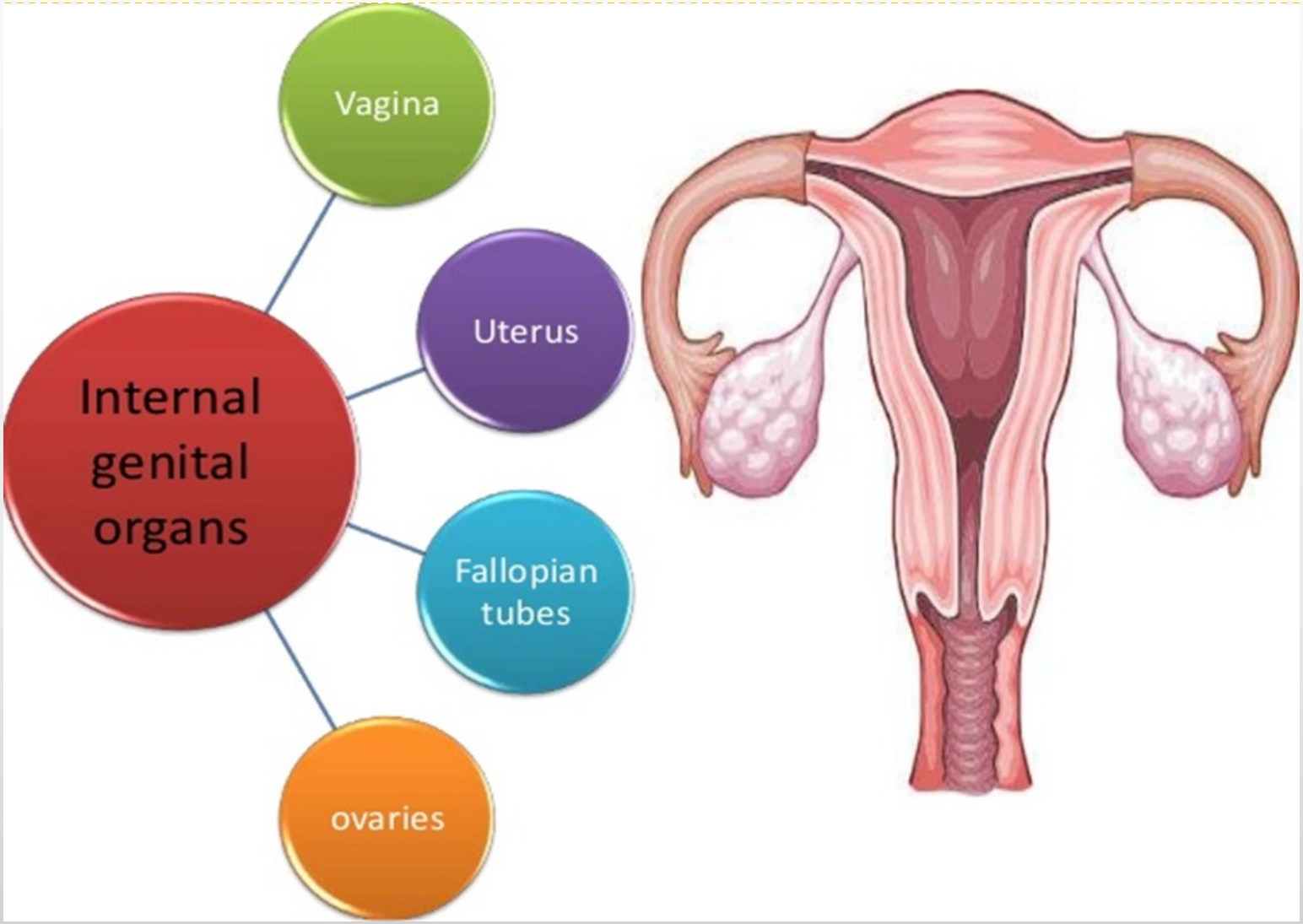


- The labia majora are two folds of skin with underlying adipose tissue lying either side of the vaginal opening. They contain sebaceous and sweat glands and a few specialized apocrine glands. In the deepest part of each labium is a core of fatty tissue continuous with that of the inguinal canal and the fibers of the round ligament, which terminate here.
- The labia minora are two thin folds of skin that lie between the labia majora. These vary in size and may protrude beyond the labia major where they are visible, but may also be concealed by the labia majora. Anteriorly, they divide in two to form the prepuce and frenulum of the clitoris (clitoral hood). Posteriorly, they divide to form a fold of skin called the fourchette at the back of the vagina introitus. They contain sebaceous glands, but have no adipose tissue. They are not well developed before puberty and atrophy after the menopause. Both the labia minora and labia majora become engorged during sexual arousal.

- The clitoris is an erectile structure measuring approximately 0.5–3.5 cm in length. The body of the clitoris is the main part of the visible clitoris and is made up of paired columns of erectile tissue and vascular tissue called the 'corpora cavernosa'. These become the crura at the bottom of the clitoris and run deeper and laterally.

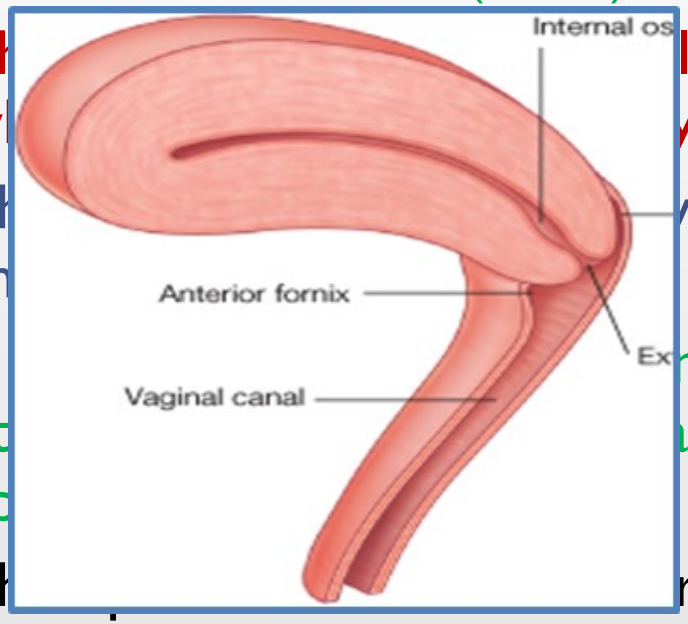
- The vestibule is the cleft between the labia minora. It contains openings of the urethra, the Bartholin's glands and the vagina. The vagina is surrounded by two bulbs of erectile and vascular tissue that are extensive and almost completely cover the distal vaginal wall. These have traditionally been named the bulb of the vaginal vestibule, although recent work on both dissection and magnetic resonance imaging (MRI) suggests that they may be part of the clitoris and should be renamed
- 'clitoral bulbs'. Their function is unknown but they probably add support to the distal vaginal wall to enhance its rigidity during penetration.

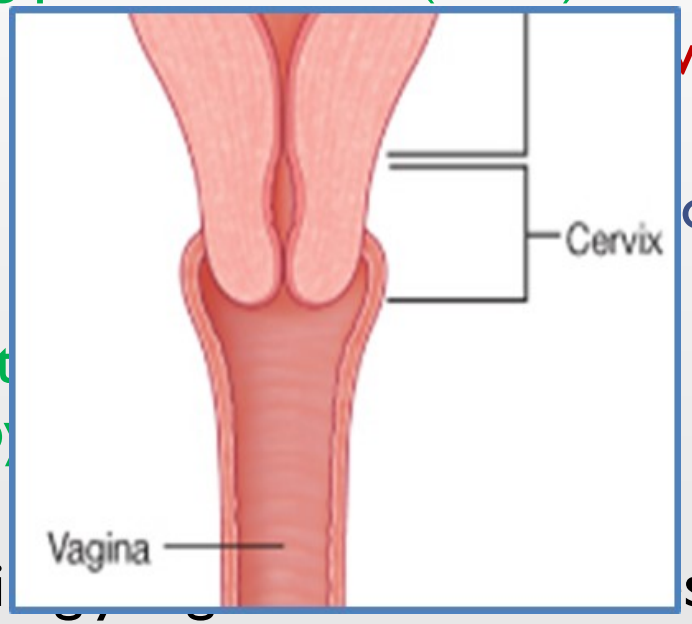
- The Bartholin's glands are bilateral and about the size of a pea. They open via a 2 cm duct into the vestibule below the hymen and contribute to lubrication during intercourse.
- The hymen is a thin covering of mucous membrane across the entrance to the vagina. It is usually perforated, which allows menstruation. The hymen is ruptured during intercourse and any remaining tags are called 'carunculae myrtiformes


Vagina
Uterus
Internal genital organs
Fallopian tubes
ovaries

Vagina

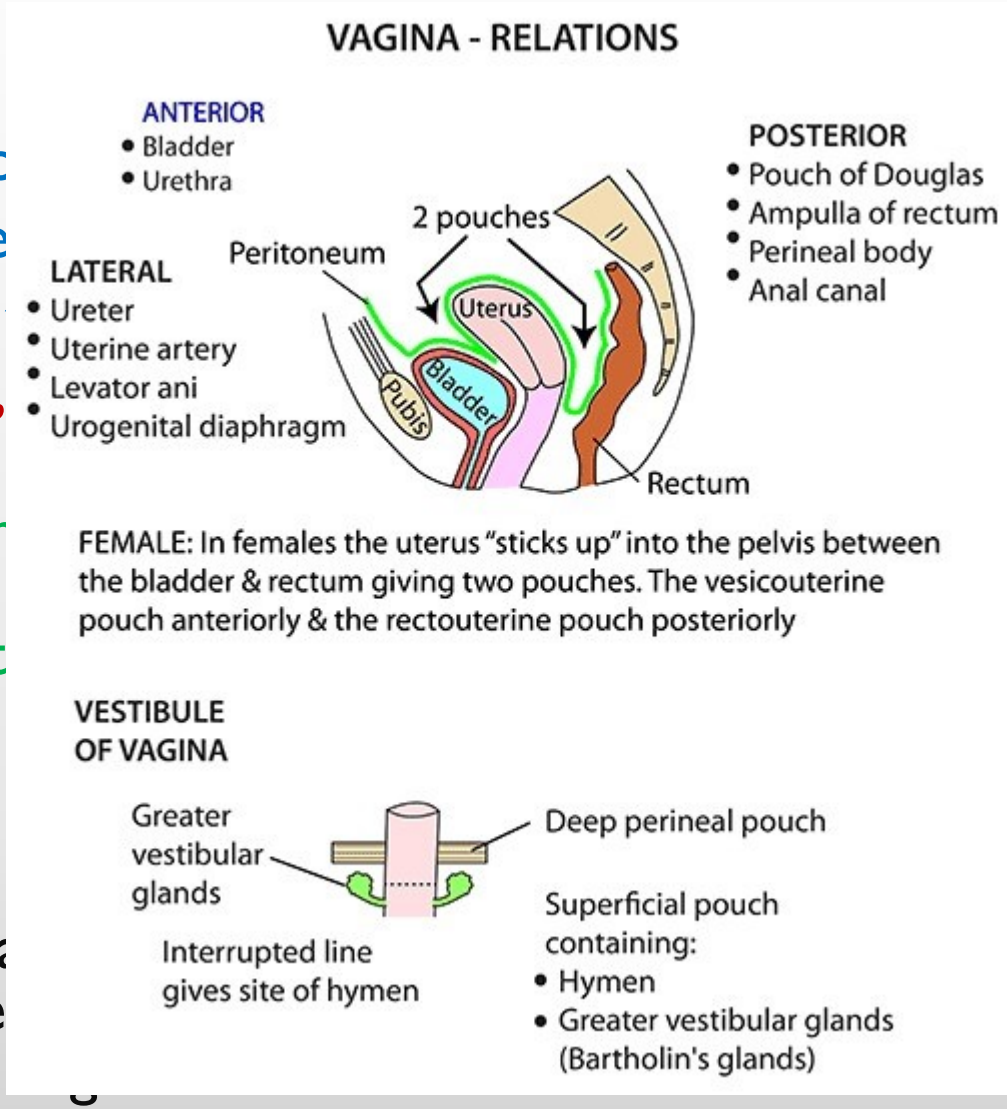
- canal lined with stratified squamous epithelium that leads from the uterus to the vulva.
- short anterior wall (7 cm) & long posterior wall (9 cm)
- Th lly in vault w y the
- Th vided or, an
- It moist ut nd b ep
- Th rich i s in the postovulatory phase of the cycle. However, before puberty and after the menopause, the vagina is devoid of glycogen due to the lack of oestrogen





Relations of vagina

- The upper … toneal reflection c…
- The middle … pelvic fascia
- The lower …
- Anteriorly, … base of the bladder.
- urethra run … open into the vestibu… gina wall. Laterally, at…
- The vagina …
- Below this … hiorectal fossae.
- The cardina… nts, which form poste… the upper part of the …



Blood supply

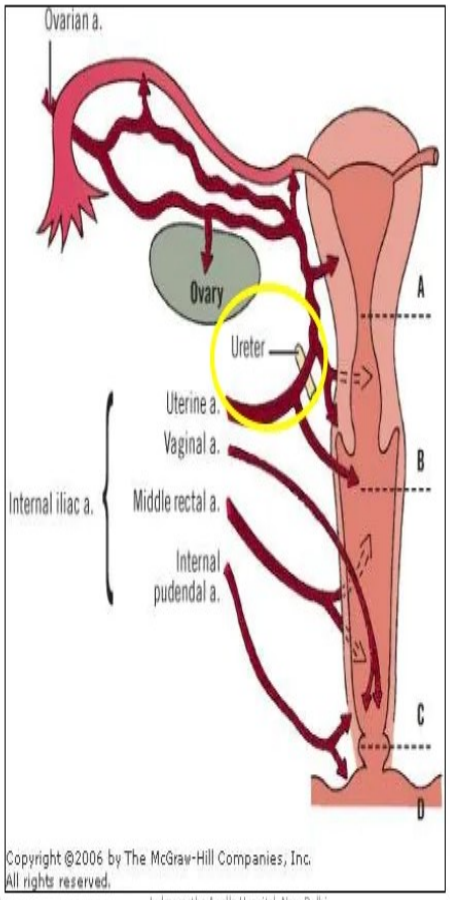
Vaginal artery and branches of uterine,internal pudendal,middle and inferior rectal arteries.

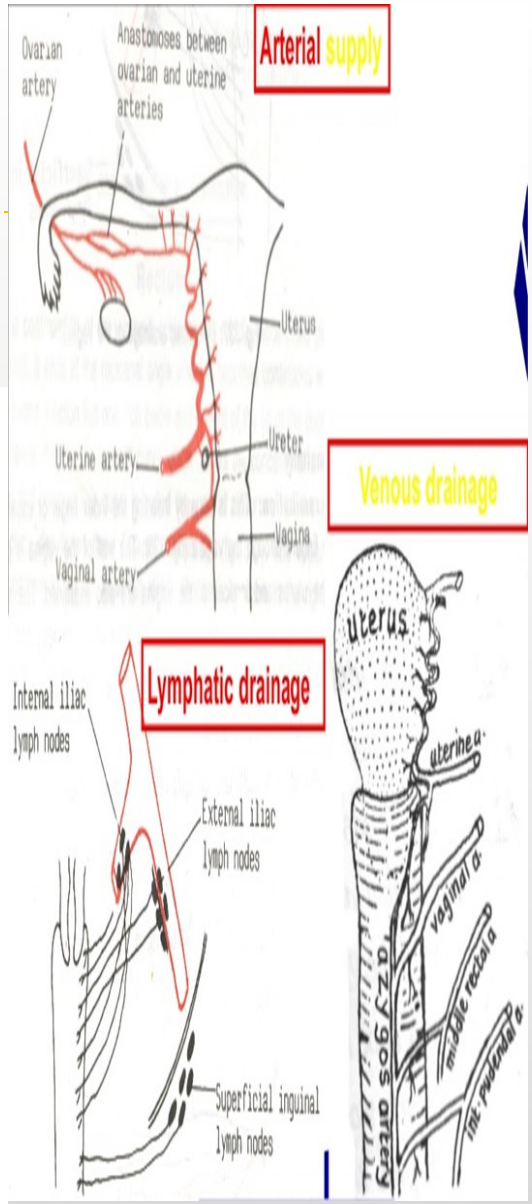
Lymphatic driange

the upper two-thirds of the vagina drain with the cervix and the lower third drains with the vulva

nerve supply:

upper two-thirds like the uterus and the lower third receives nerve supply from the pudendal nerve.



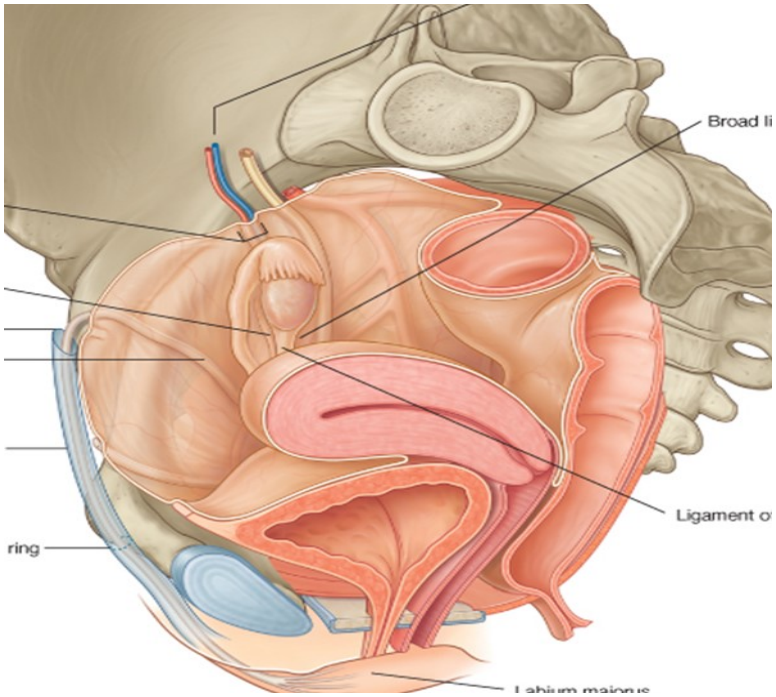


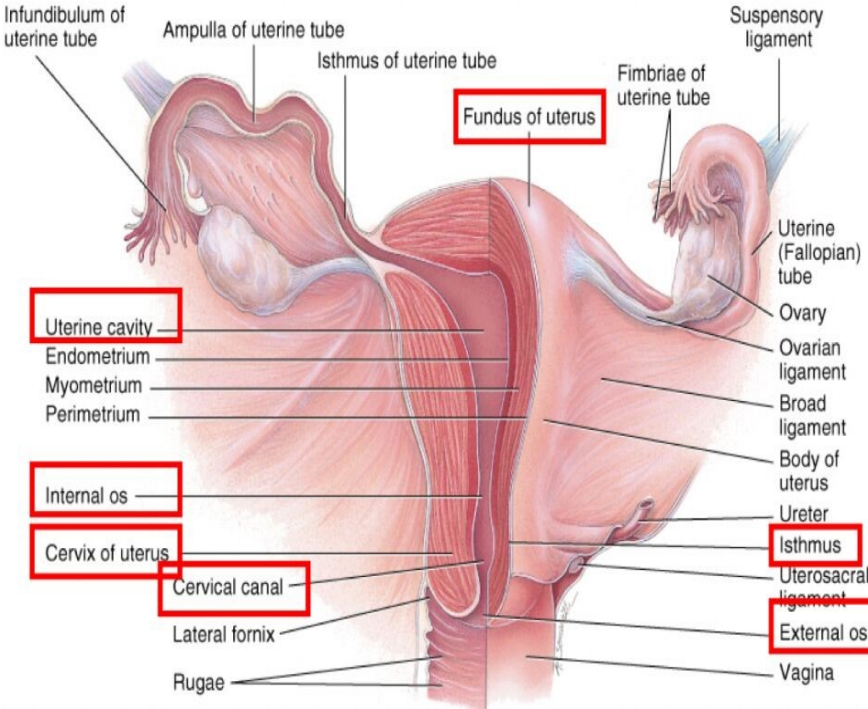
The uterus:

- Empty uterus measures 3cm thick, 5 cm width & 7.5 cm long
- Normal uterus is anteverted –anteflexed

Parts of the uterus:

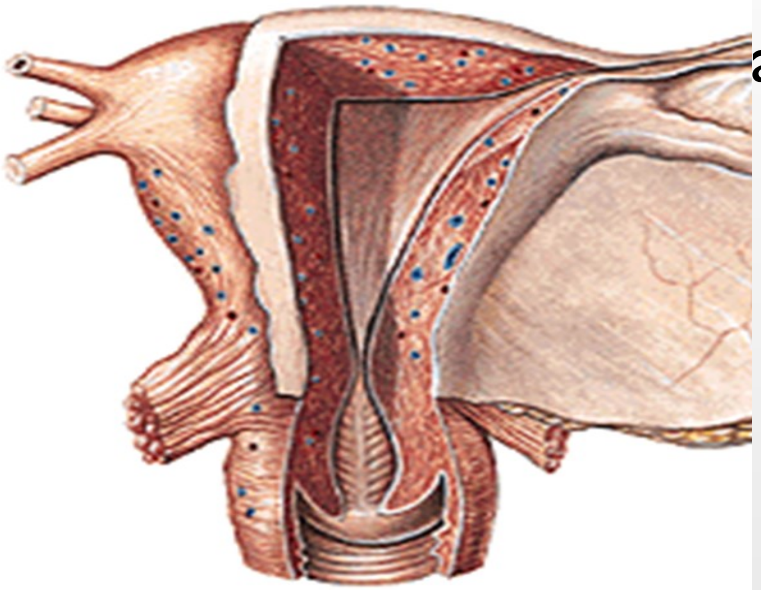
- The fundus
- The body
- The isthmus
- The cervix uteri
- The tapered lower 2 cm end of the organ
- Around the circumference of this part, the vagina is attached in oblique line, so it has a supravaginal & vaginal parts
- Has two Cervical openings internal os & external os





Cavity of the uterus:

- Is slit like in lateral view, tri
- The angles of the triangle a al canal

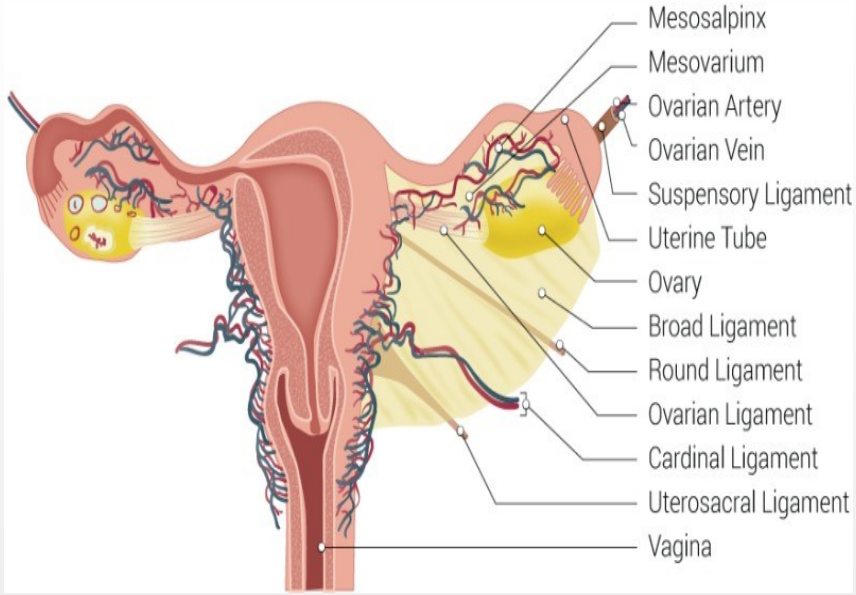


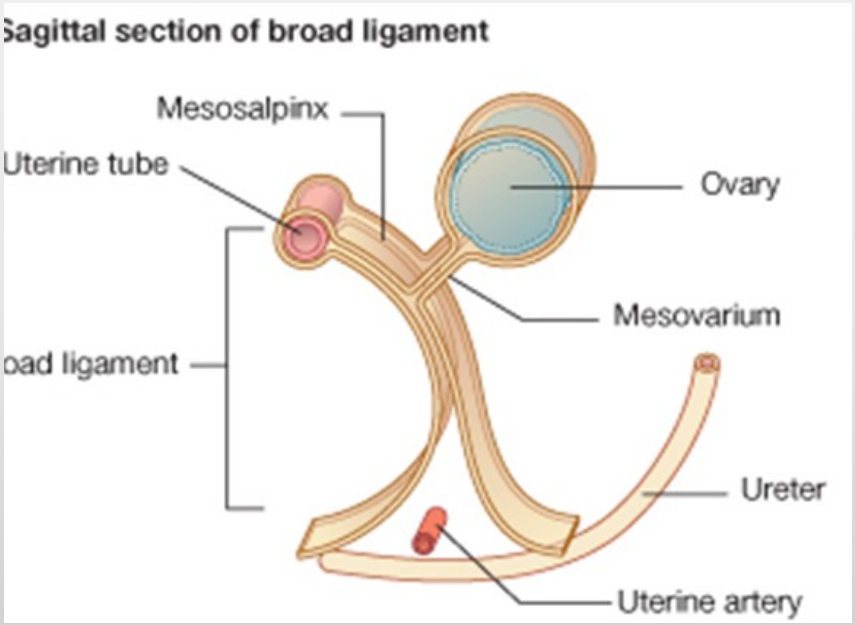
Stability of the uterus:

- Healthy pelvic floor & surr supportive structures for t
- Sound perineal body is imp floor
- Ligaments keep orientation of the organ but are insufficient to keep it in position

Uterine ligaments:
1- Broad ligament.

- A sheet-like double fold of peritoneum, oriented in the coronal plane
- It runs from the lateral pelvic wall to the uterus
- When reach the uterus, the two layers form the anterior & posterior peritoneal covering of the uterus (mesometrium)
- It encloses the uterine tube in its superior margin
- Mesovarium is derived from its posterior surface
- Mesosalpinx is the part of the broad ligament between the origin of the mesovarium and the uterine tube





2- Round ligament:

- Fibrous cord attached to the body antero-inferior to the entrance of the tubes
- Passing through the inguinal canal it is attached to the ipsilateral labium majus

3- Ovarian ligament:

- is attached to the body postero-inferior to tubal entrance

Blood supply

- 1- Uterine artery:
- At the isthmus the artery divides into larger ascending & smaller descending (vaginal) branch

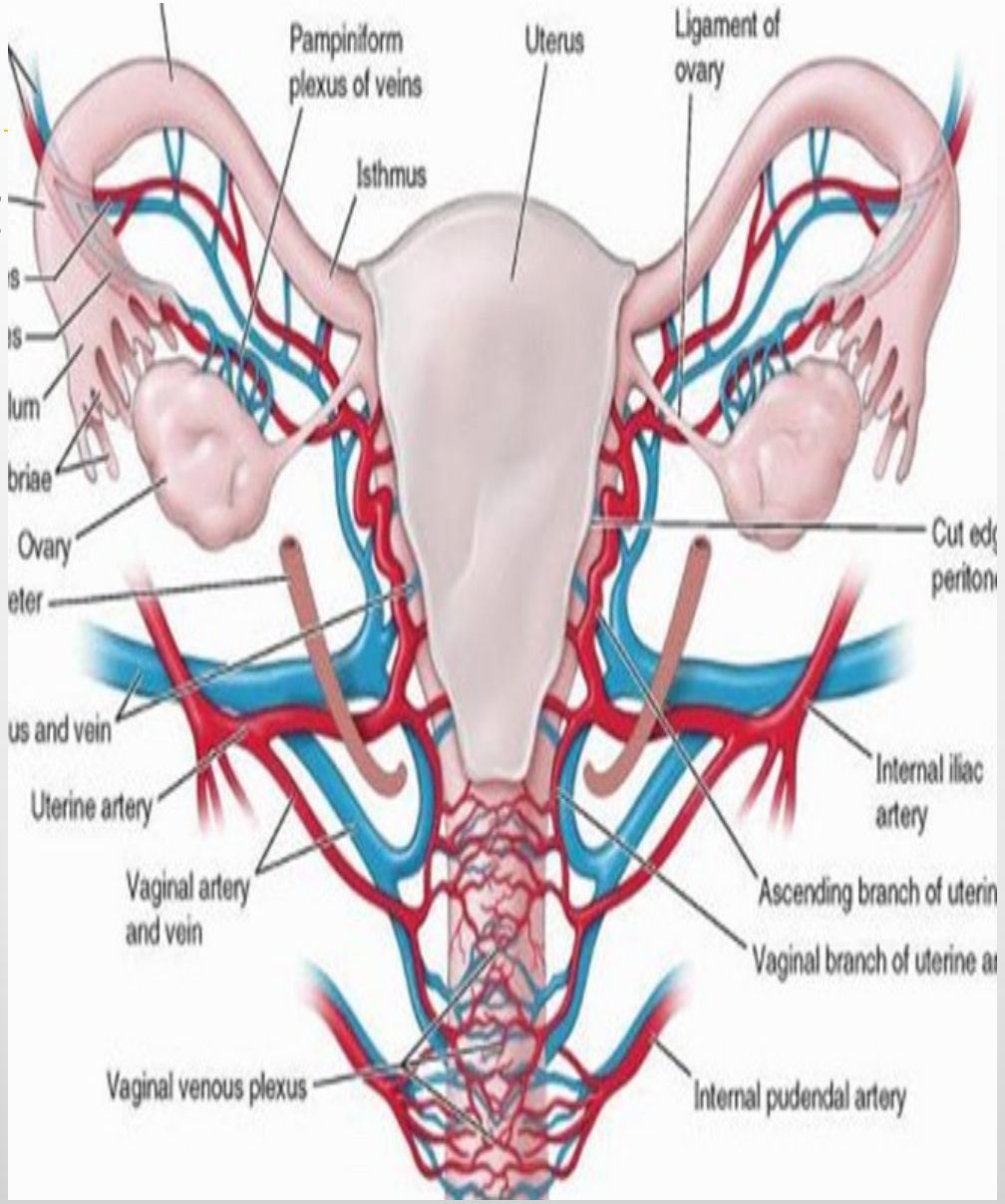
2- Ovarian artery:

Veins:

Veins accompany arteries

Form a plexus which is continuous with veins of adjacent organs

The pelvic venous plexus is continuous with internal vertebral plexus with spinal & cerebral veins

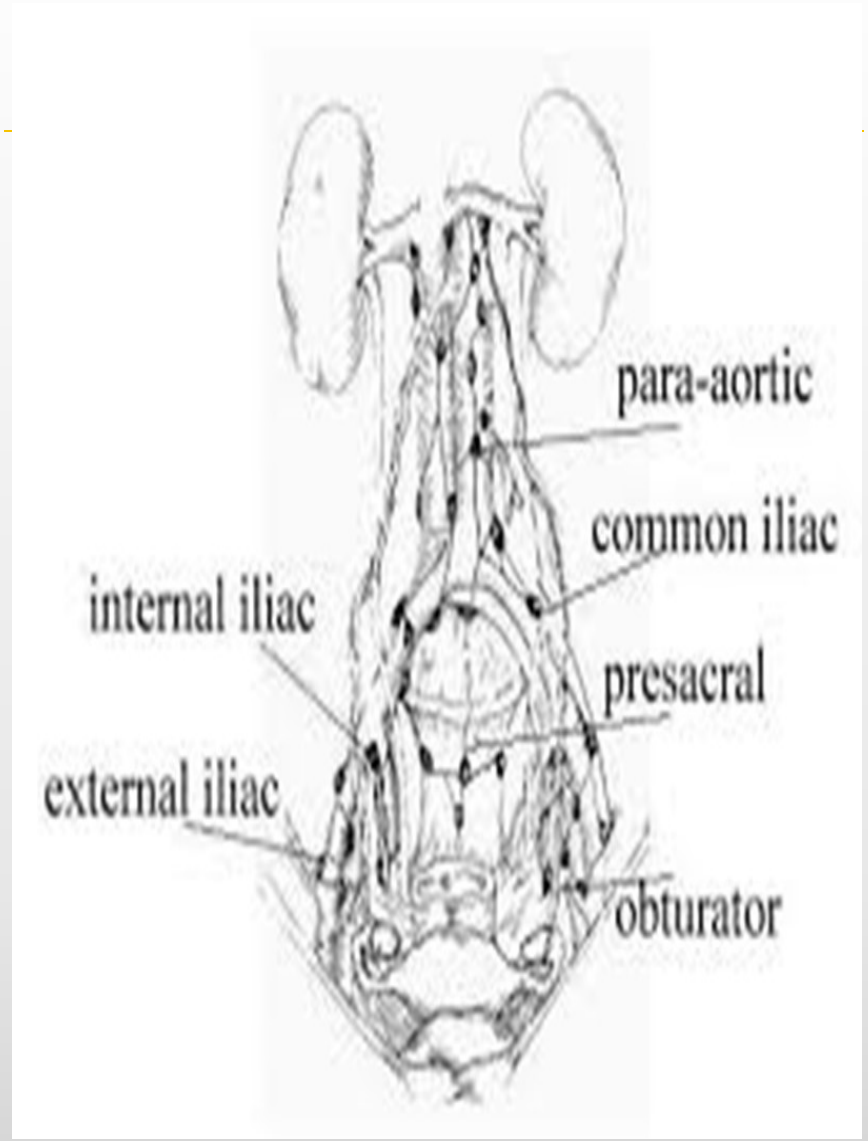


Lymph:

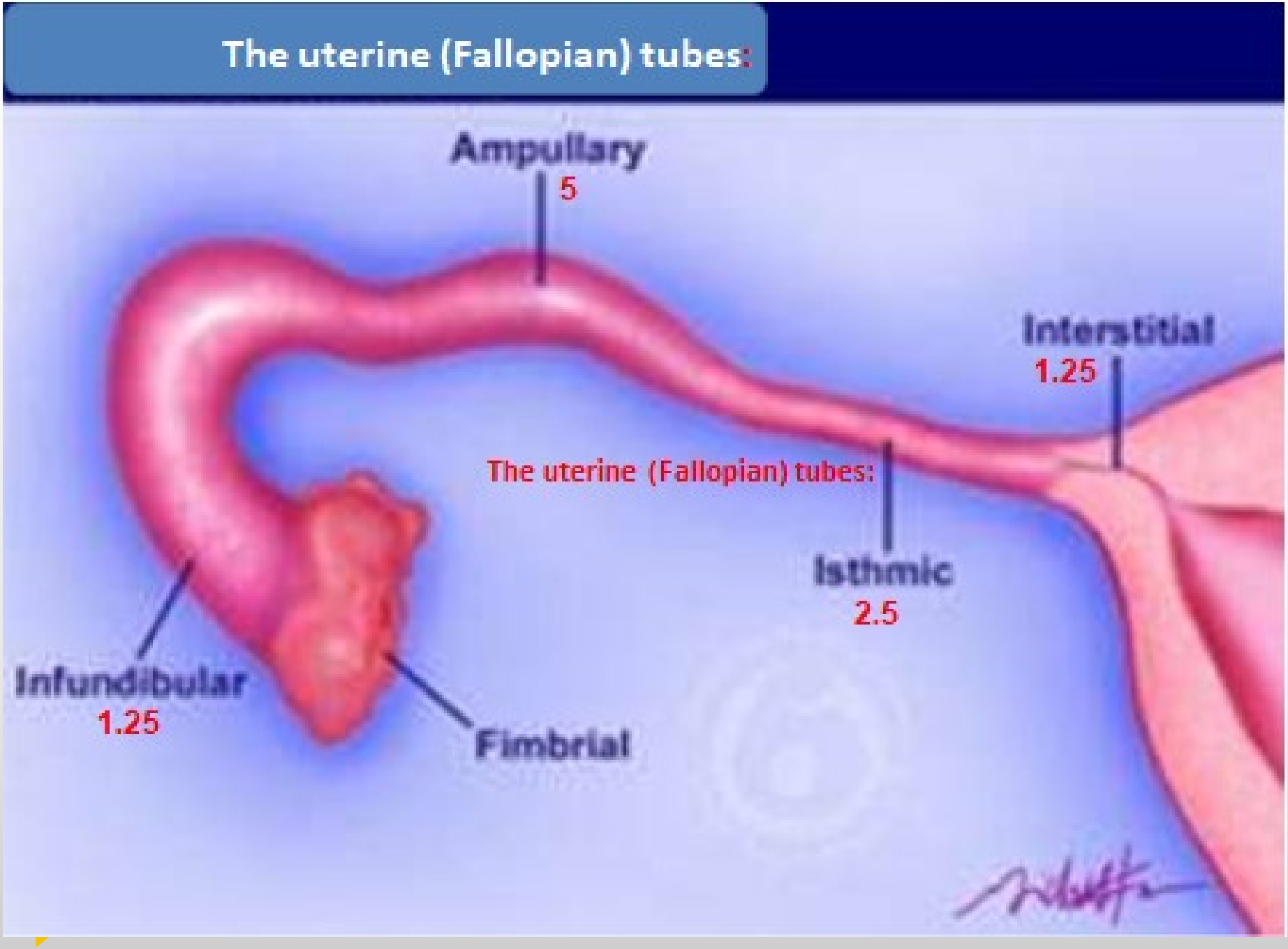
- From the fundus to para-aortic nodes along ovarian vessels
- From the body to external & internal iliac nodes
- From the cervix to the iliac & sacral nodes
- Few channels go with the round ligament to the superficial inguinal lymph nodes

Nerves:

- Uterovaginal plexus is extension of the hypogastric plexus
- Afferent fibers reach the cord by T11-L1 segments

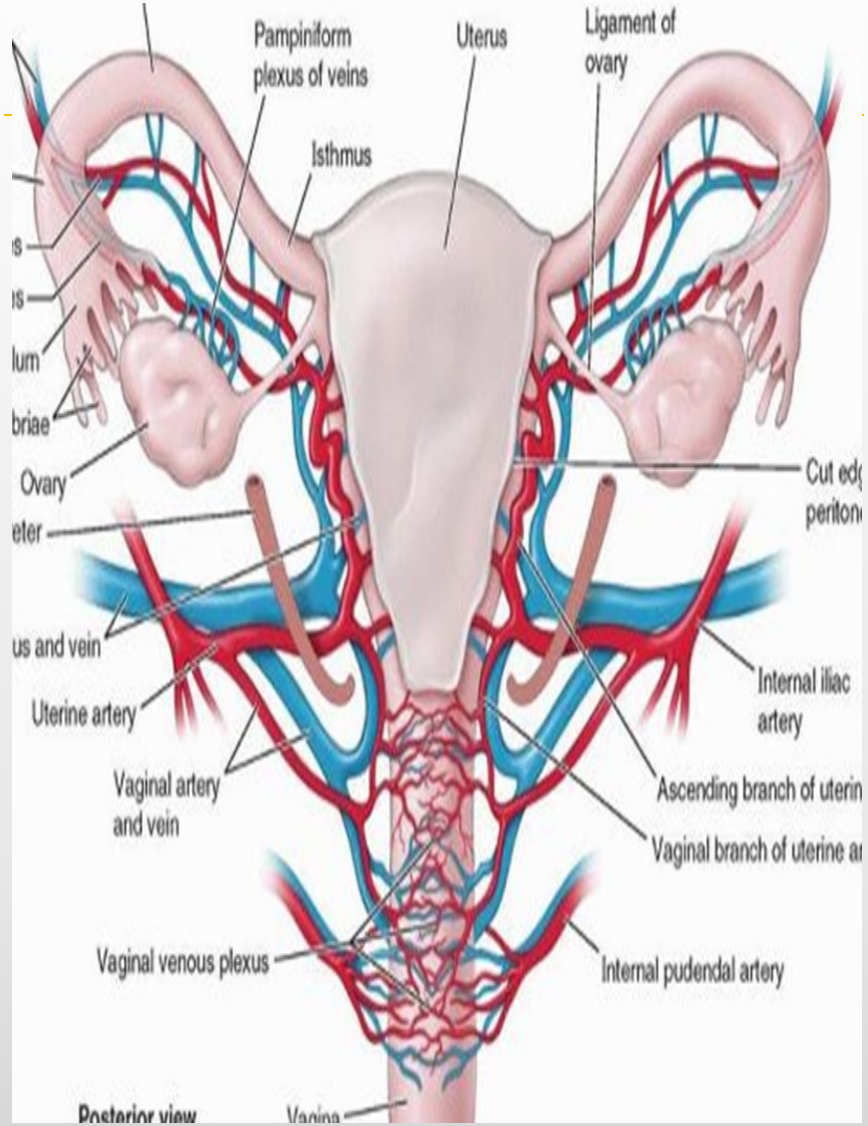


The uterine (Fallopian) tubes:



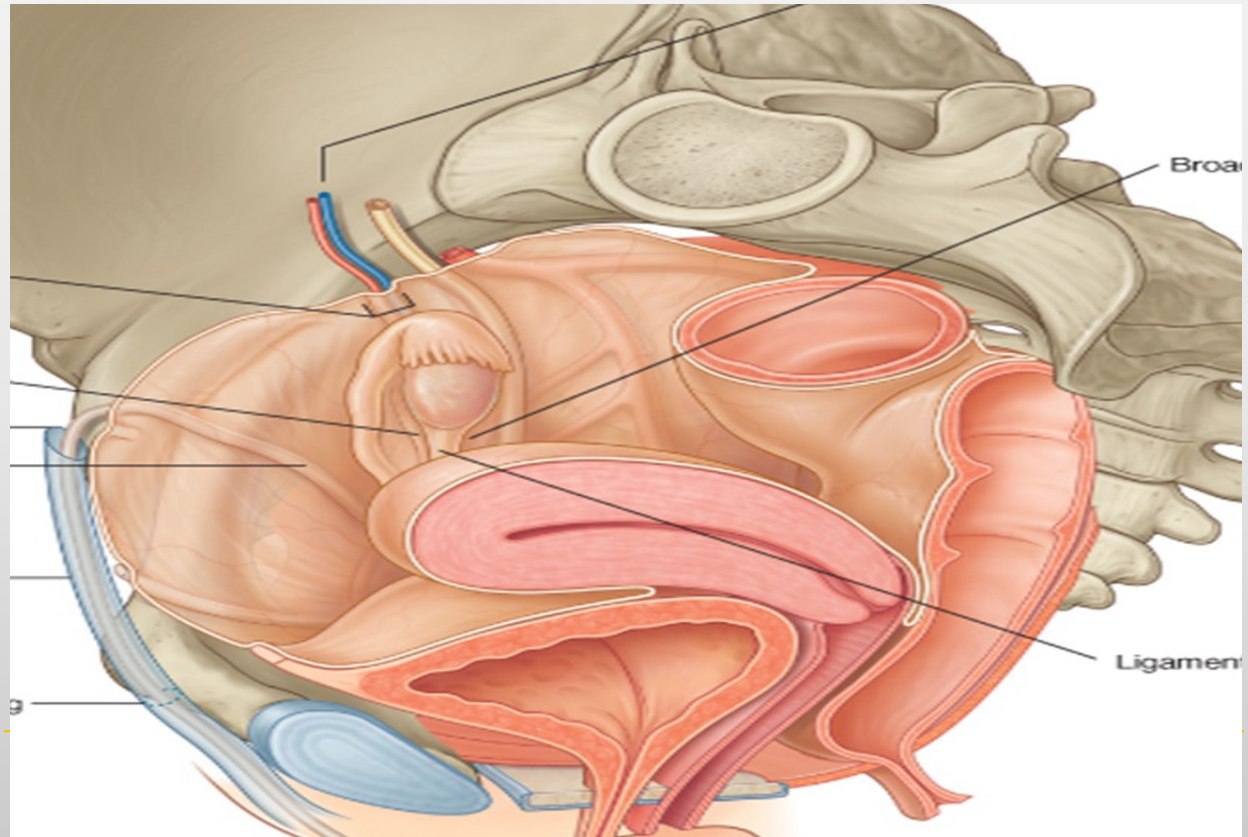
Vessels & nerves:

- Tubal branches of the ovarian & uterine arteries supply the tubes
- Tubal veins correspond to arteries
- Ovarian plexus of nerves is part of uterine plexus, its main afferent go to spinal segments T11, T12 & L1.

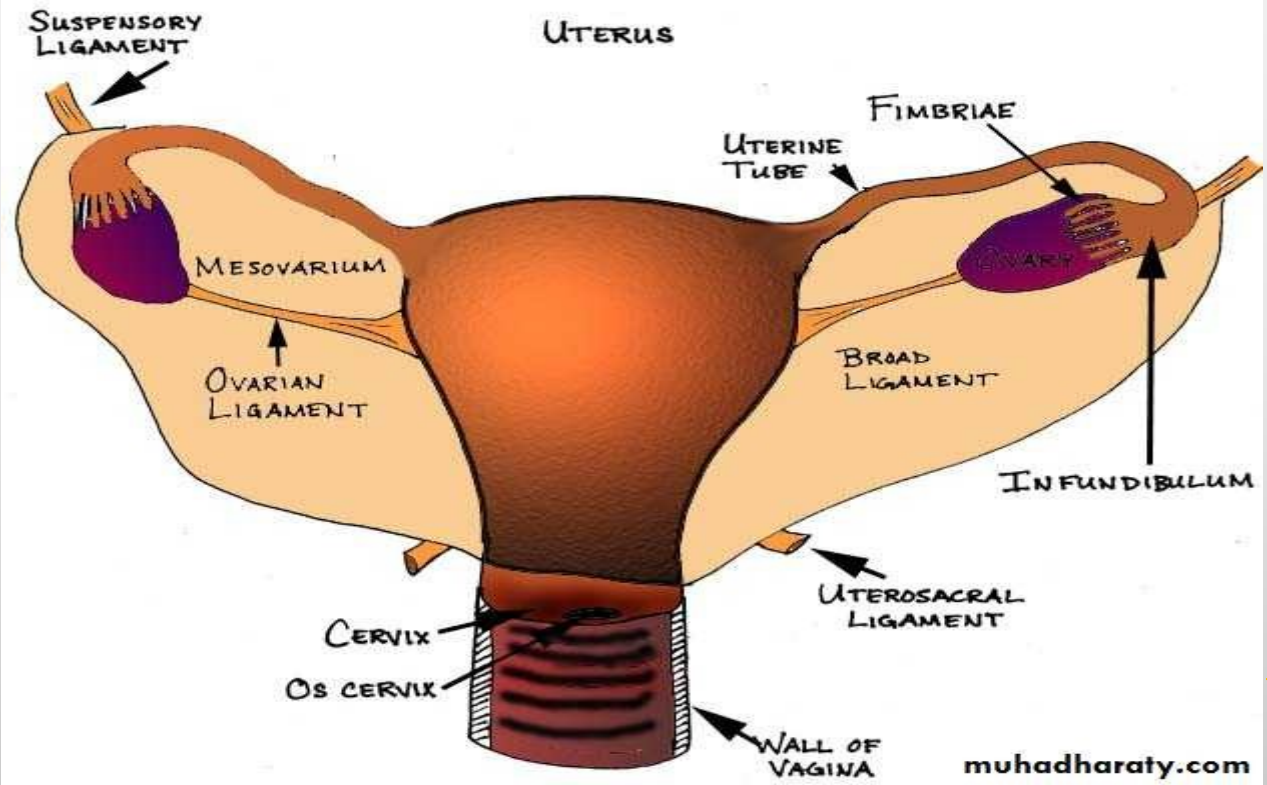


The ovaries:

- almond shape measures 1X2X3 cm
- In erect posture, the long axis of the ovary lies vertical, its upper pole approaches the uterine tubes & called tubal end while its lower end approaches the uterus & called uterine end



- The tubal end is connected by a peritoneal fold containing the ovarian vessels, nerves & lymphatics to the posterior abdominal wall, this fold is known as the suspensory (infundibulopelvic) ligament
- The uterine end is connected by a fibromuscular cord to the uterus, this is the ovarian ligament



- Ovaries lie between the uterus & lateral pelvic wall
- Ovarian fossa, in the bifurcation of the common iliac artery

Important close relations:

- Ureters
- Obturator nerve
- Obturator vessels

Big ovarian cysts may compress these structures

Ovarian artery:

- A branch of the abdominal aorta
- Reach
- Suppl
- Suppl rian
  ligam
- Ovar VC
  (right

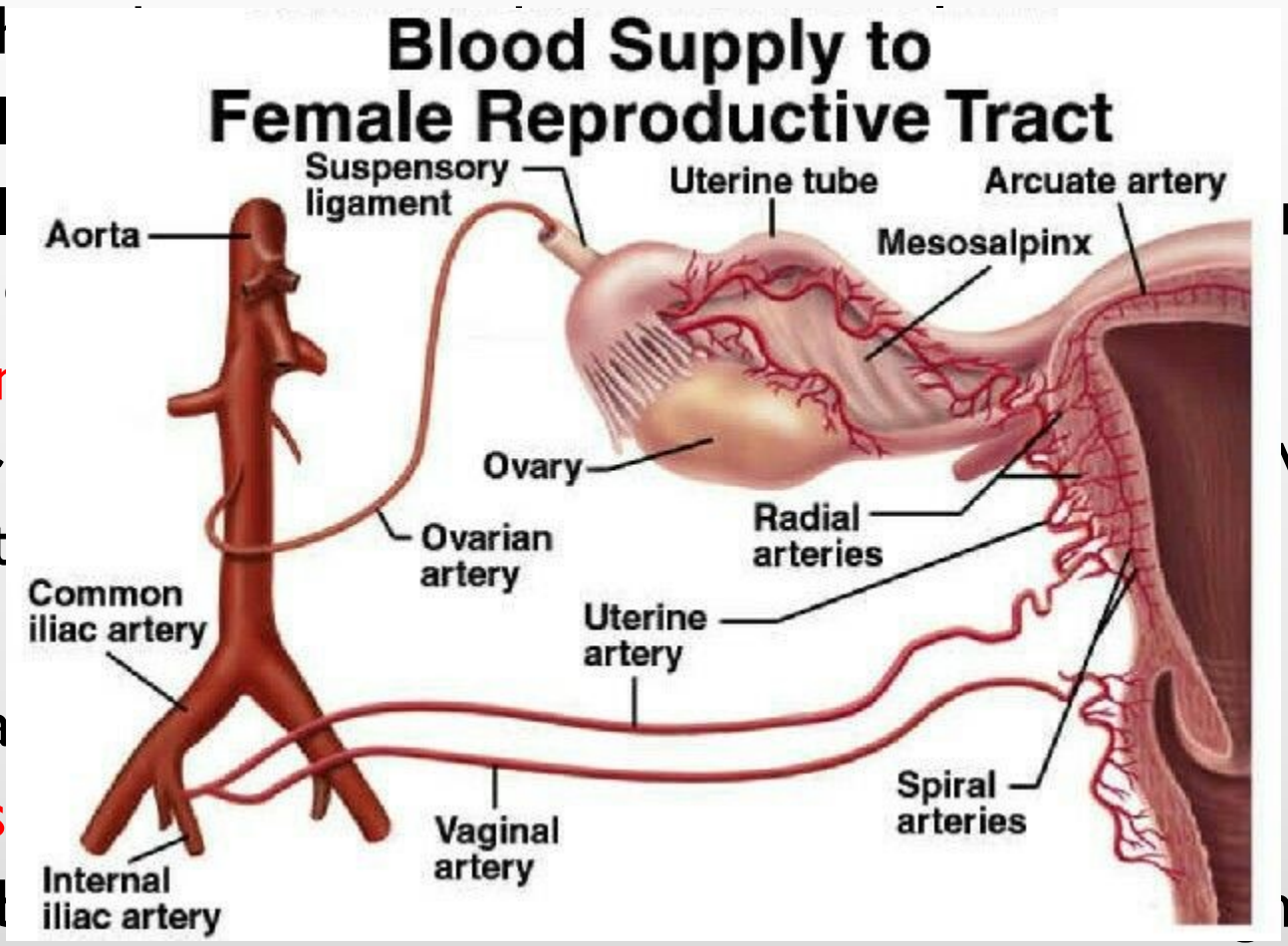
Ovarian

Lymph:

- To pa

Nerves

- Via al ment



The bladder, urethra and ureter

The bladder

- It is lined with transitional epithelium and has an average capacity of 400 ml.
- The base of the bladder is adjacent to the cervix, with only a thin layer of tissue intervening. It is separated from the anterior vaginal wall below by the pubocervical fascia that stretches from the pubis to the cervix.

The urethra

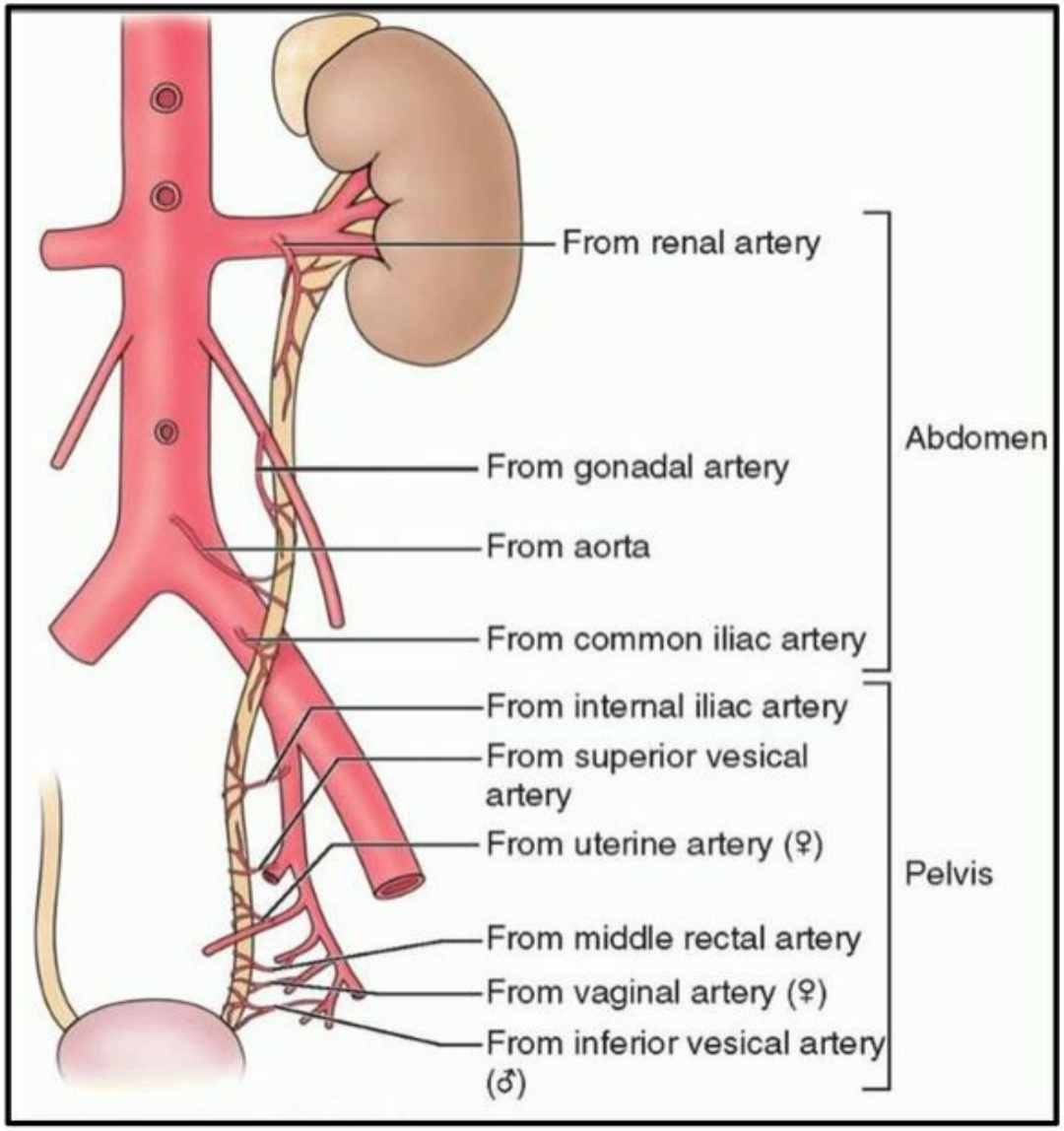
- The female urethra is about 3.5 cm long and is lined with transitional epithelium. It has a slight posterior angulation at the junction of its lower and middle thirds.

THE PELVIC URETER

Anatomy

- The pelvic portion of the ureter is 12-15 cm long .It is about the same length as the abdominal part.
- Diameter about 3 mm
- It enters the pelvis by crossing the end of the Common iliac artery and runs downwards into the pelvis anterior to the internal iliac artery and behind the ovarian fossa.
- When it reaches the ischial spine; it runs forwards and medially towards the bladder passing in the base of the-Broad ligament in the ureteric canal and below the uterine artery (water ' ·urine · flows under the bridge).
- In the later part of its course,the ureter lies2cm lateral to the cervix(supra vaginal part)and 2cm above the vaginal vault.

Blood supply of ureter



Dangerous Points of The Ureter

During gynaecological surgery the ureter is liable to be injured at the following sites:

- (I)at clamping the infundibulopelvic ligament;
- (2)at clamping of the uterosacral ligament:
- (3)When applying the clamp to the uterine artery during hysterectomy;
- (4)during separation of the bladder from the vagina:
- (5)during removal of abroad ligament tumour or cervical fibroid which displaces the ureter from its normal site;
- (6)while closing the peritoneum of the pelvic floor after hysterectomy;
- (7)in presacral sympathyectomy where the ureters are in relation to the common iliac arteries:
- (8)in vaginal operations for prolapse

Methods for Protection of Ureter During Pelvic Surgery

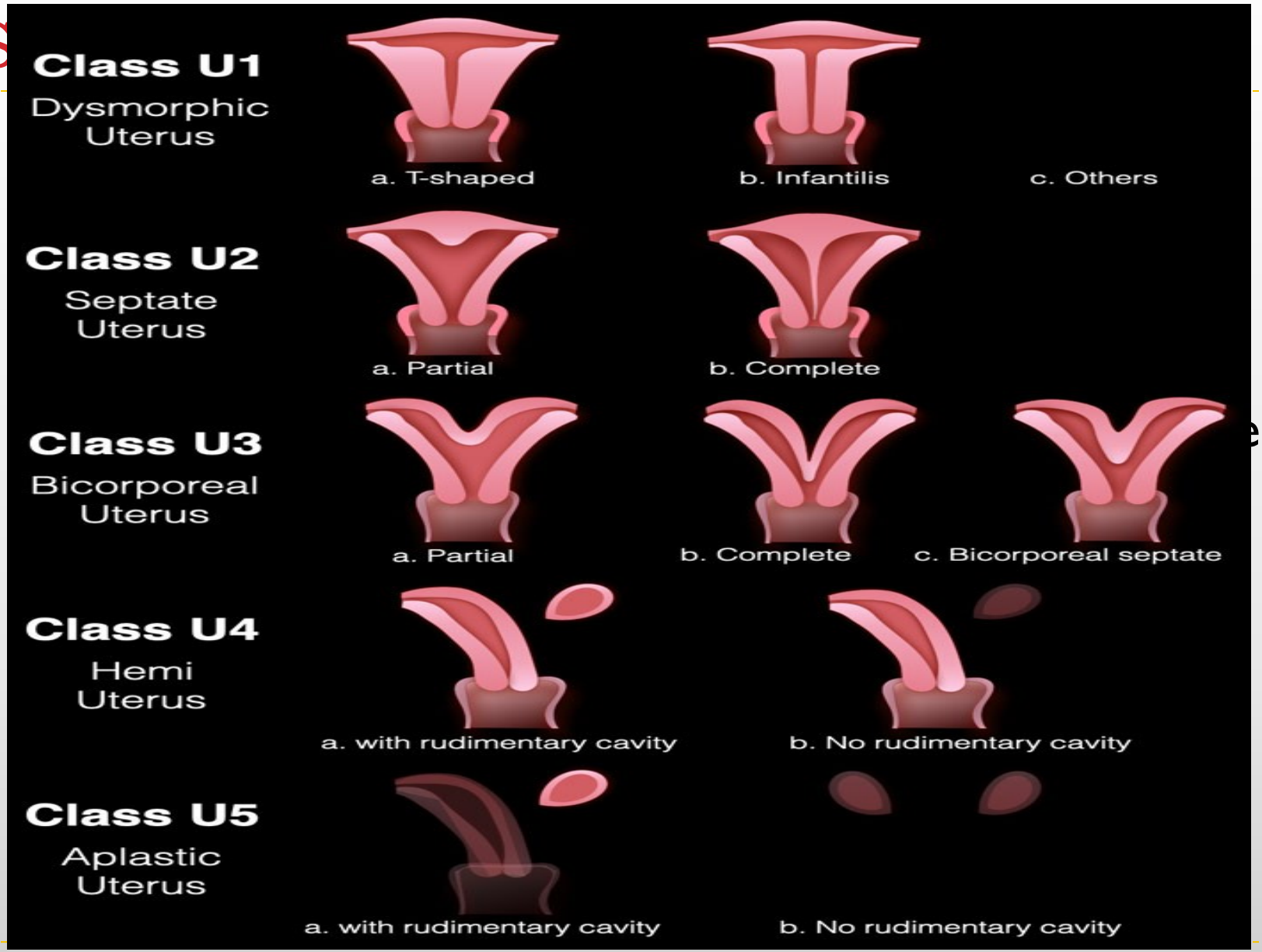
- 1-Intravenous pyelography is performed before operation when the ureter is liable to be displaced by the pelvic pathology as in case of a broad ligament tumour or cervical fibroid .This will show the site of the ureter;
- 2-A ureteric catheter is inserted immediately before operation to allow palpation of the ureter;
- 3-Exposure of the ureter at the pelvic brim and its course is followed downwards;
- 4-Pedicles and ligaments should be clamped under vision and not blindly;
- subcapsular removal of cervical fibroid as the ureter is outside the capsule.

Ectopic Ureter

- The ureter may open in the vestibule which is the commonest abnormal site. Other sites include the urethra,vagina,cervix and uterine body.

Causes of Compression of the Ureter

- (1)Pregnancy after the16thweek.The ureters are compressed against the pelvic brim;
- (2)pelvic tumour especially cervical and broad ligament fibroid;
- (3)cervical carcinoma infiltrating the parametrium;
- (4) parametric fibrosis following radiation used for the treatment of malignant lesions as cervical carcinoma;
- (5)second and third degrees of uterine prolapse.


Class U1
Dysmorphic Uterus
a. T-shaped
b. Infantilis
c. Others
Class U2
Septate Uterus
a. Partial
b. Complete
Class U3
Bicorporeal Uterus
a. Partial
b. Complete
c. Bicorporeal septate
Class U4
Hemi Uterus
a. with rudimentary cavity
b. No rudimentary cavity
Class U5
Aplastic Uterus
a. with rudimentary cavity
b. No rudimentary cavity

Müllerian obstruction

- Failure of complete canalization of the Müllerian structures can lead to menstrual obstruction.
- The obstruction most commonly occurs at the junction of the lower third of the vagina at the level of the hymen, although more proximal obstruction can occur.
- Presentation with an imperforate hymen

Imperforate hymen

Definition:

- One of the most common obstructive lesions of the female genital tract.

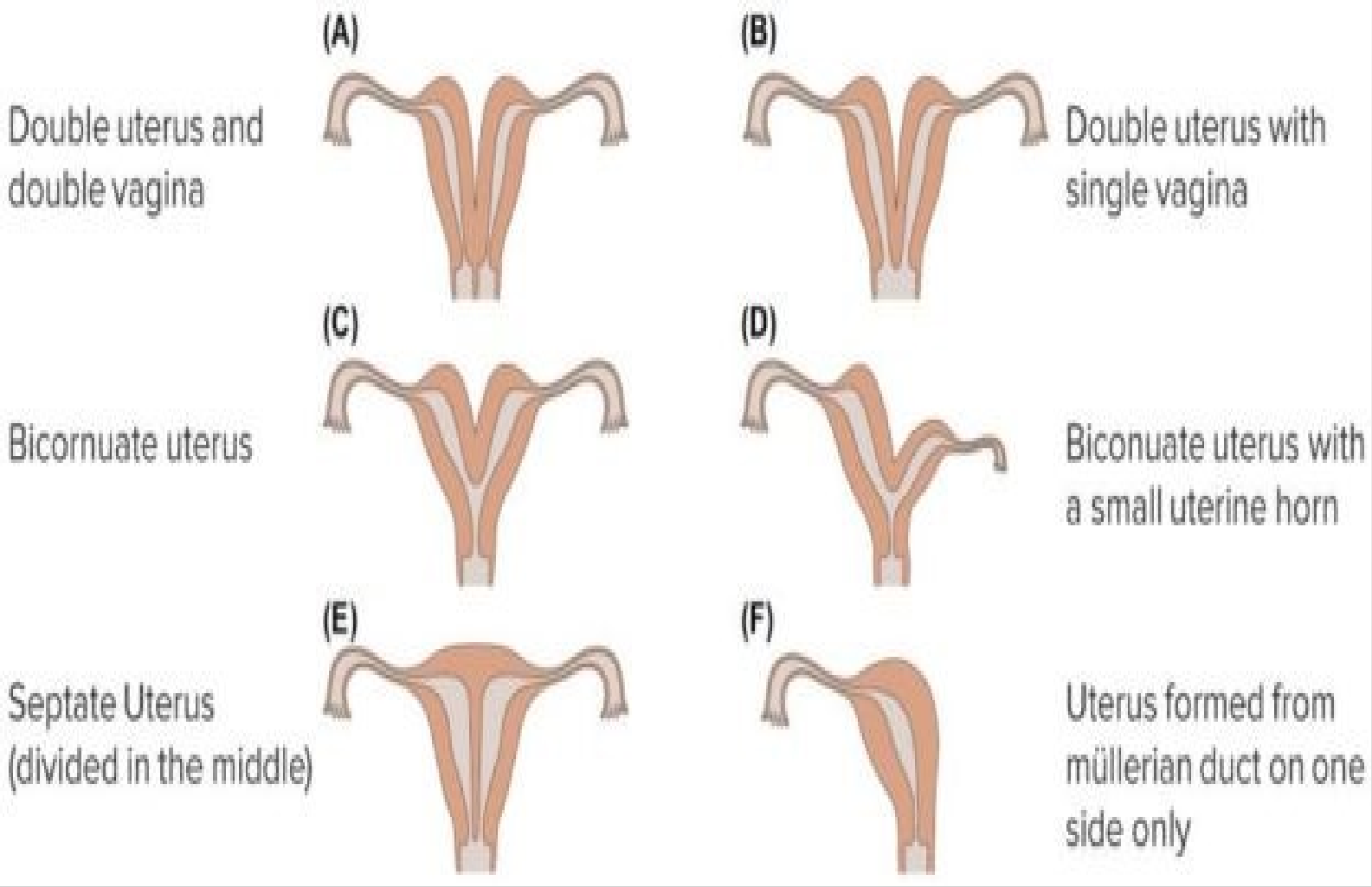
Clinical features:

- Periodic lower abdominal pain,
- Primary amenorrhea,
- Urinary symptoms,
- Abdominal swelling,
- Ultrasound findings

Treatment:

- Cruciate incision, use of antibiotics

Müllerian duplication



Müllerian agenesis

- In approximately 1 in 5,000 to 1 in 40,000 girls, the Müllerian system does not develop, resulting in an absent or rudimentary uterus and upper vagina.
- This condition is known as Rokitansky syndrome or

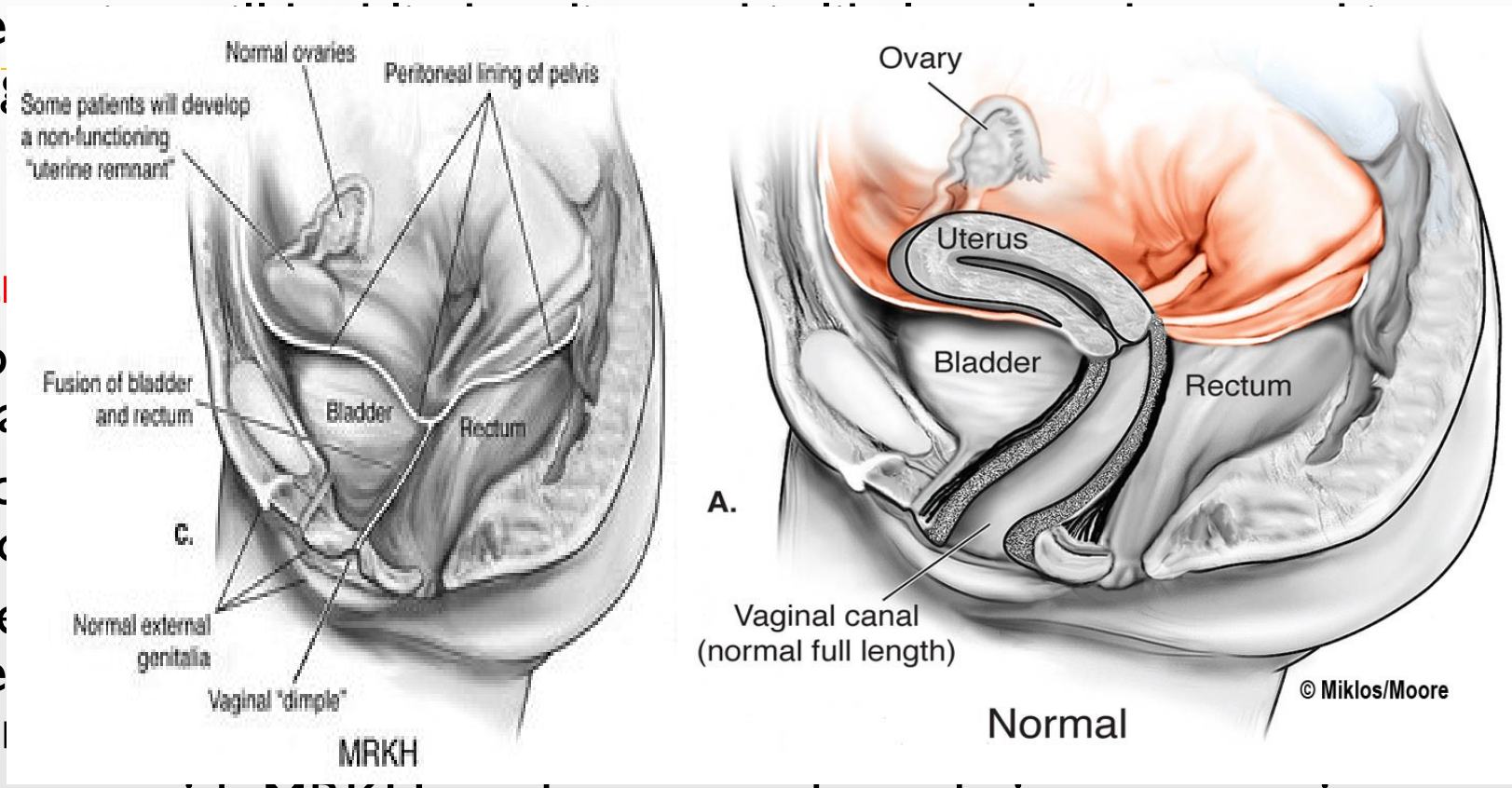
Mayer–Rokitansky–Kuster–Hauser syndrome (MRKH). The ovaries function normally and so the most common presentation is with primary amenorrhoea in the presence of otherwise normal pubertal development.

Aetiology

- Unknown
- environmental, genetic, hormonal or receptor factors.

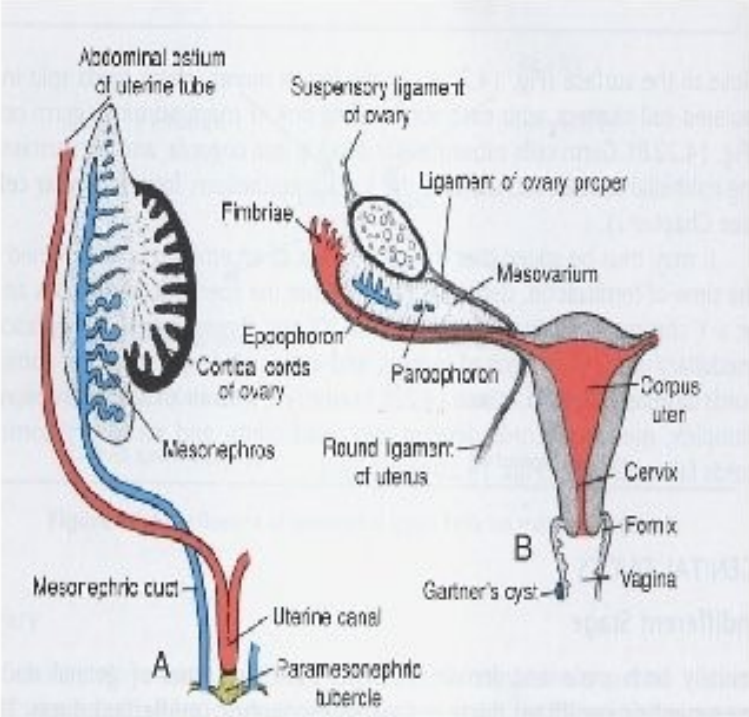
Examination

- the
- An
- Women with MRKH syndrome may have their own genetic children, using ovum retrieval and assisted conception techniques, and a surrogate mother.



Remnants of the ducts in female

- Remnants of the cranial and caudal excretory tubules in the mesovarium form the epoophoron and paroophoron respectively
- Mesonephric duct disappear except for a small cranial portion found in the epoophoron and a small caudal portion in the wall of uterus or vagina (Gartner's cyst)

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