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أستاذ المادة : م.د.آلاء شلال فرحان

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اسم المحاضرة الثامنة والعشرون باللغة الإنكليزية :Anatomy

محتوى المحاضرة الثامنة والعشرون

Anatomy

External genitalia

The external genitalia are commonly called the vulva and include the mons pubis, labia majora and minora, the vaginal vestibule, the clitoris and the greater vestibular glands. The mons pubis is a fibro-fatty pad covered by hair-bearing skin that covers the bony pubic ramus.

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. They contain sebaceous glands, but have no adipose tissue. They are not well developed before puberty and atrophy after the menopause.

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’. The vestibule is the cleft between the labia minora. It contains openings of the urethra, the Bartholin’s glands and the vagina.

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.

Internal reproductive organs

The vagina:

The vagina is a fibromuscular canal lined with stratified squamous epithelium that leads from the uterus to the vulva. It is longer in the posterior wall (approximately 9 cm) than in the anterior wall (approximately 7 cm). The vaginal walls are normally in apposition, except at the vault where they are separated by the cervix. The vault of the vagina is divided into four fornices: posterior, anterior and two lateral.

The midvagina is a transverse slit while the lower vagina is an H-shape in transverse section. The vaginal walls are lined with transverse folds. The vagina has no glands and is kept moist by secretions from the uterine and cervical glands and by transudation from its epithelial lining. The epithelium is thick and rich in glycogen, which increases 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. Doderlein's bacillus is a normal commensal of the vaginal flora and breaks down glycogen to form lactic acid, producing a pH of around 4.5. This has a protective role for the vagina in decreasing the growth of pathogenic bacteria.

The upper posterior wall forms the anterior peritoneal reflection of the pouch of Douglas. Anteriorly, the vagina is in direct contact with the base of the bladder, while the urethra runs down the lower half in the midline to open into the vestibule. Its muscles fuse with the anterior vagina wall. Laterally, at the fornices, the vagina is related to the cardinal ligaments. Below this are the levator ani muscles and the ischiorectal fossae. The cardinal ligaments and the uterosacral ligaments, which form posteriorly from the parametrium, support the upper part of the vagina. At birth, the vagina is under the influence of maternal oestrogens so the epithelium is well developed.

After a couple of weeks, the effects of the oestrogen disappear and the pH rises to 7 and the epithelium atrophies. At puberty, the reverse occurs and finally at the menopause the vagina tends to shrink and the epithelium atrophies once again.

The uterus

The uterus is shaped like an inverted pear tapering inferiorly to the cervix and in its non-pregnant state is situated entirely within the pelvis. It is hollow and has thick, muscular walls. Its maximum external dimensions are approximately 7.5 cm long, 5 cm wide and 3 cm thick. An adult uterus weighs approximately 70 g. In the upper part, the uterus is termed the body or ‘corpus’. The area of insertion of each Fallopian tube is termed the ‘cornu’ and that part of the body above the cornu is called the ‘fundus’.

The uterus tapers to a small constricted area, the isthmus, and below this is the cervix, which projects obliquely into the vagina. The longitudinal axis of the uterus is approximately at right angles to the vagina and normally tilts forward. This is called ‘anteversion’. In addition, the long axis of the cervix is rarely the same as the long axis of the uterus. The uterus is also usually flexed forward on itself at the isthmus – antiflexion. However, in around 20% of women, the uterus is tilted backwards – retroversion and retroflexion. This has no pathological significance in most women, although retroversion that is fixed and immobile may be associated with endometriosis.

The uterus consists of three layers: the outer serous layer (peritoneum), the middle muscular layer (myometrium) and the inner mucous layer (endometrium). The peritoneum covers the body of the uterus and posteriorly it covers the supravaginal part of the cervix. The peritoneum is intimately attached to a subserous fibrous layer, except laterally where it spreads out to form the leaves of the broad ligament.

The muscular myometrium forms the main bulk of the uterus and is made up of interlacing smooth muscle fibers intermingling with areolar tissue, blood vessels, nerves and lymphatics. The inner endometrial layer has tubular glands that dip into the myometrium. The endometrial layer is covered by a single layer of columnar epithelium. Ciliated prior to puberty, this epithelium is mostly lost due to the effects of pregnancy and menstruation.

The cervix

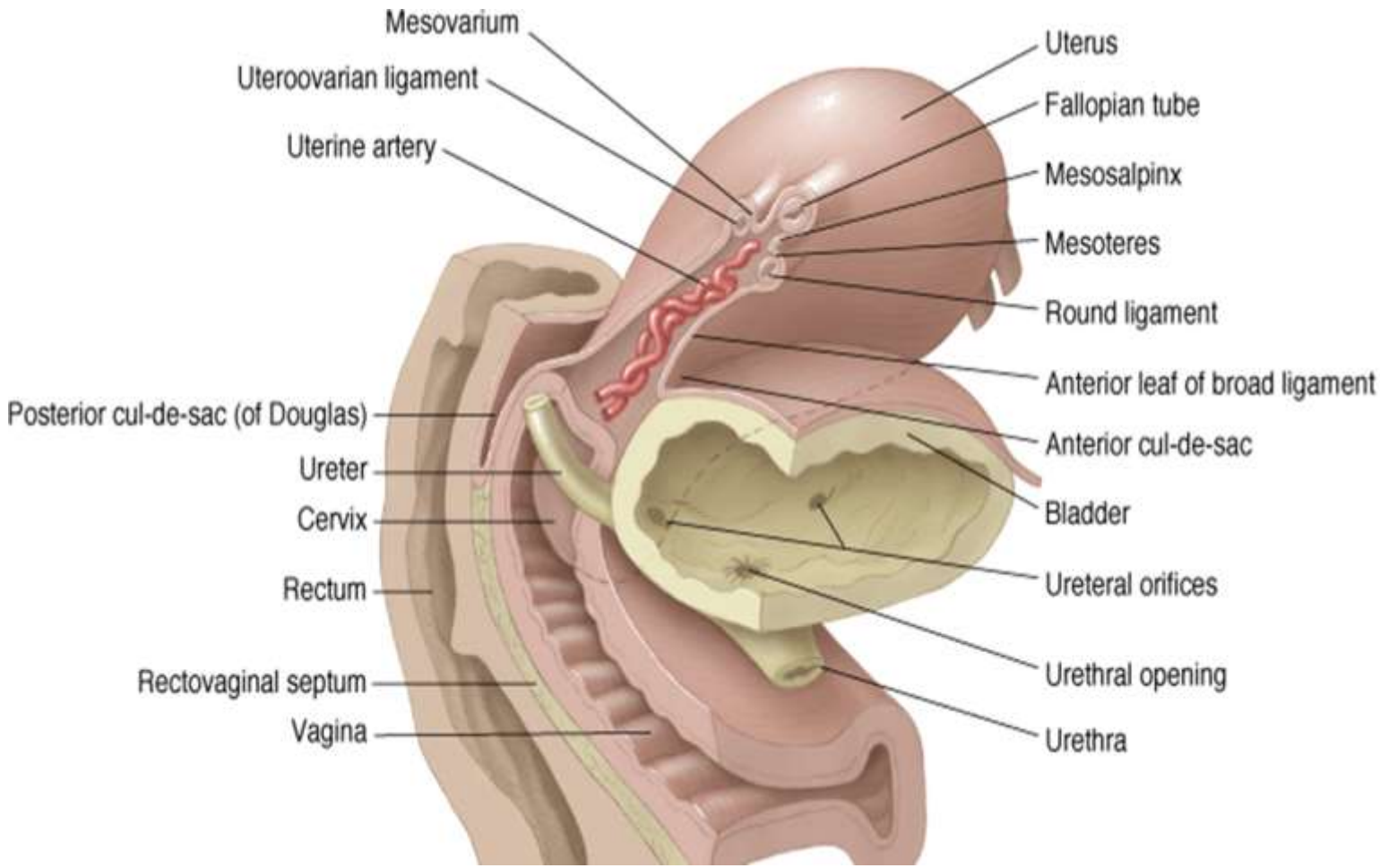
The cervix is narrower than the body of the uterus and is approximately 2.5 cm in length. Lateral to the cervix lies cellular connective tissue called the parametrium. The ureter runs about 1 cm laterally to the supravaginal cervix within the parametrium. The posterior aspect of the cervix is covered by the peritoneum of the pouch of Douglas.

The upper part of the cervix mostly consists of involuntary muscle, whereas the lower part is mainly fibrous connective tissue. The mucous membrane of the cervical canal (endocervix) has anterior and posterior columns from which folds radiate out. It has numerous deep glandular follicles that secrete clear alkaline mucus, the main component of physiological vaginal discharge. The epithelium of the endocervix is columnar and is also ciliated in its upper two-thirds. This changes to stratified squamous epithelium around the region of the external os and the junction of these two types of epithelium is called the ‘squamocolumnar junction’.

Age changes to anatomy

The disappearance of maternal oestrogens from the circulation after birth causes the uterus to decrease in length by around one-third and in weight by around one-half. The cervix is then twice the length of the uterus. During childhood, the uterus grows slowly in length, in parallel with height and age. The average longitudinal diameter ranges from 2.5 cm at the age of 2 years, to 3.5 cm at 10 years. After the onset of puberty, the anteroposterior and transverse diameters of the uterus start to increase, leading to a sharper rise in the volume of the uterus. The increase in uterine volume continues well after menarche and the uterus reaches its adult size and configuration by the late teenage years. After the menopause, the uterus atrophies, the mucosa becomes very thin, the glands almost disappear and the wall becomes relatively less muscular.

Vertical section through the uterine end of the right broad ligament



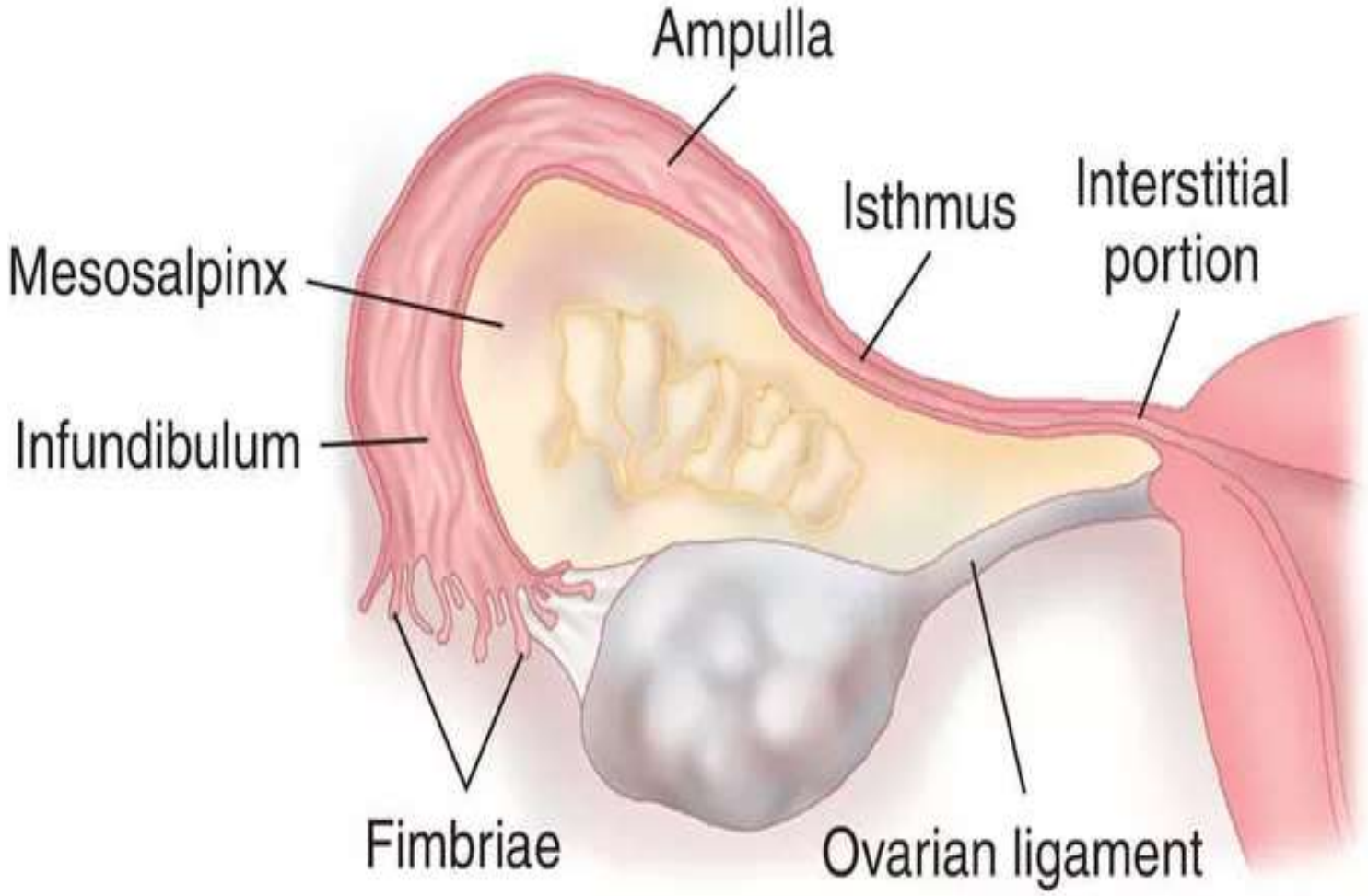
The Fallopian tube

The Fallopian tube extends outwards from the uterine cornu to end near the ovary. At the abdominal ostium, the tube opens into the peritoneal cavity, which is therefore in communication with the exterior of the body via the uterus and the vagina. This is essential to allow the sperm and egg to meet. The Fallopian tubes convey the ovum from the ovary towards the uterus and promote oxygenation and nutrition for sperm, ovum and zygote should fertilization occur.

The Fallopian tube runs in the upper margin of the broad ligament, known as the mesosalpinx, which encloses the tube so that it is completely covered with peritoneum, except for a narrow strip along this inferior aspect. Each tube is about 10 cm long and is described in four parts:

- The interstitial portion.
- The isthmus.
- The ampulla.
- The infundibulum or fimbrial portion.

Parts of The Fallopian tube

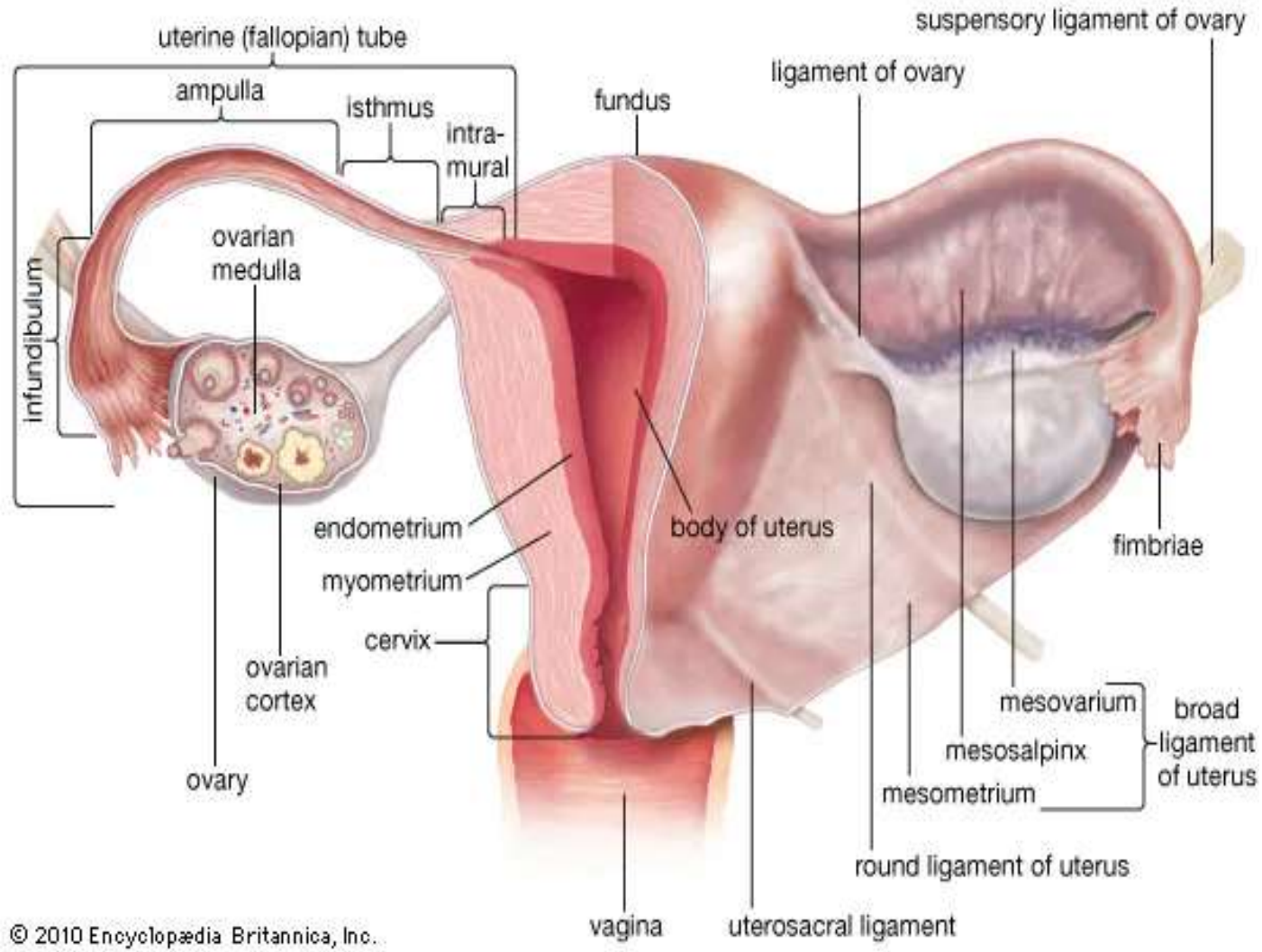


The ovaries

The size and appearance of the ovaries depends on both age and stage of the menstrual cycle. In a child, the ovaries are small structures approximately 1.5 cm long; however, they increase to adult size in puberty due to proliferation of stromal cells and commencing maturation of the ovarian follicles. In the young adult, they are almond-shaped and measure approximately 3 cm long, 1.5 cm wide and 1 cm thick. After the menopause, no active follicles are present and the ovary becomes smaller with a wrinkled surface.

The ovary is the only intra-abdominal structure not to be covered by peritoneum. Each ovary is attached to the cornu of the uterus by the ovarian ligament and at the hilum to the broad ligament by the mesovarium, which contains its supply of nerves and blood vessels. Laterally, each ovary is attached to the suspensory ligament of the ovary with folds of peritoneum that becomes continuous with that of the overlying psoas major.

Anterior to the ovaries lie the Fallopian tubes, the superior portion of the bladder and the uterovesical pouch. Posterior to the ovary lies the ureter where it runs downwards and forwards in front of the internal iliac artery.


uterine (fallopian) tube
ampulla
isthmus
intra-
mural
fundus
suspensory ligament of ovary
ligament of ovary
infundibulum
ovarian
medulla
endometrium
myometrium
cervix
body of uterus
fimbriae
ovarian
cortex
ovary
mesovarium
broad
ligament
of uterus
mesosalpinx
mesometrium
round ligament of uterus
vagina
uterosacral ligament
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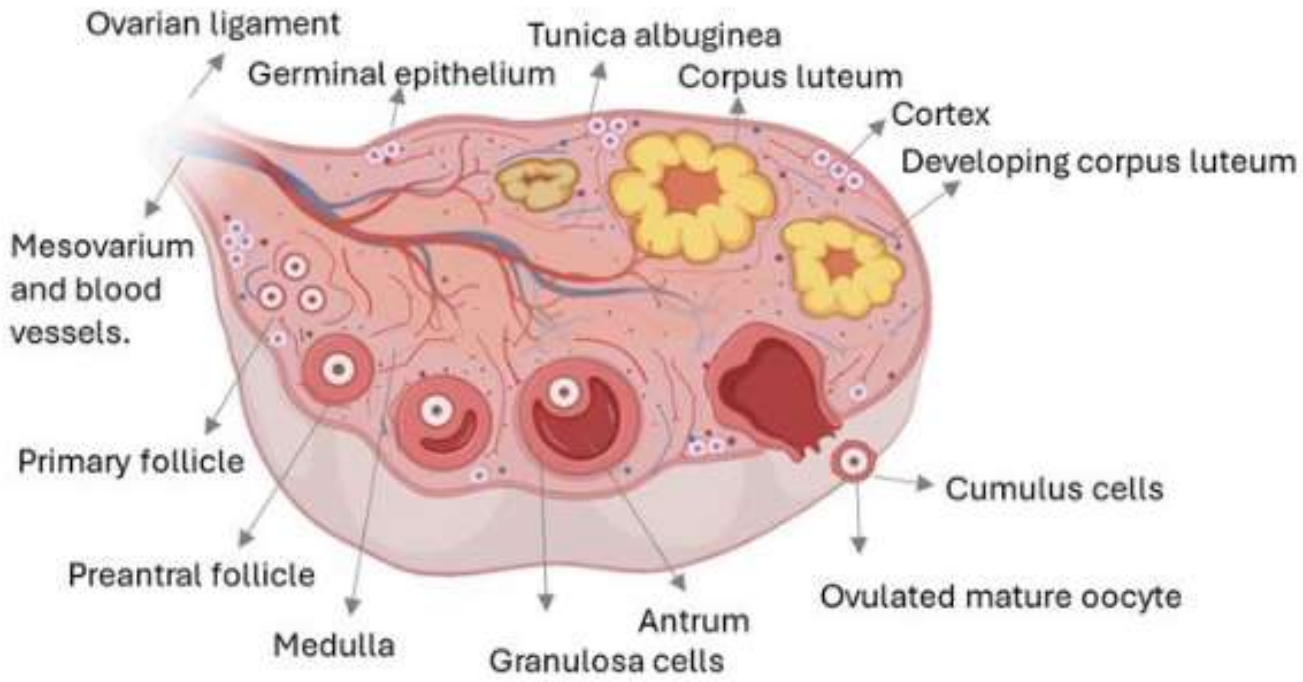
Structure of the ovary

The ovary has a central vascular medulla consisting of loose connective tissue containing many elastin fibers and non-striated muscle cells. It has an outer thicker cortex, denser than the medulla, consisting of networks of reticular fibers and fusiform cells, although there is no clear-cut demarcation between the two. The surface of the ovaries is covered by a single layer of cuboidal cells, the germinal epithelium. Beneath this is an ill-defined layer of condensed connective tissue called the ‘tunica albuginea’, which increases in density with age. At birth, numerous primordial follicles are found, mostly in the cortex, but some are found in the medulla. With puberty, some form each month into the graafian follicles under gonadotrophic control, to ovulate and subsequently form corpus lutea and ultimately the atretic follicles, the corpora albicans.

Structure of the ovary



The bladder, urethra and ureter

The bladder:

The vesicle or bladder wall is made of involuntary muscle arranged in an inner longitudinal layer, a middle circular layer and an outer longitudinal layer. It is lined with transitional epithelium and has an average capacity of 400 mL. The ureters open into the base of the bladder after running medially for about 1 cm through the vesical wall. The urethra leaves the bladder in front of the ureteric orifices. The triangular area lying between the ureteric orifices and the internal meatus of the ureter is known as the ‘trigone’.

The urethra

The female urethra is about 3.5 cm long and is lined with transitional epithelium. There are a number of tubular mucous glands and in the lower part a number of crypts which occasionally become infected. In its upper two thirds, the urethra is separated from the symphysis by loose connective tissue, but in its lower third it is attached to the pubic ramus on each side by strong bands of fibrous tissue called the ‘pubourethral tissue’. Posteriorly, it is firmly attached in its lower two thirds to the anterior vaginal wall. This means that the upper part of the urethra is mobile, but the lower part is relatively fixed. Medial fibers of the pubococcygeus of the levator ani muscles are inserted into the urethra and vaginal wall. On voluntary voiding of urine, the base of the bladder and the upper part of the urethra descend and the posterior angle disappears so that the base of the bladder and the posterior wall of the urethra come to lie in a straight line. It was formerly claimed that absence of this posterior angle was the cause of stress incontinence, but this is probably only one of a number of mechanisms responsible.

The ureter

As the ureter crosses the pelvic brim, it lies in front of the bifurcation of the common iliac artery. It runs downwards and forwards on the lateral wall of the pelvis to reach the pelvic floor and then passes inwards and forwards attached to the peritoneum of the back of the broad ligament to pass beneath the uterine artery. It next passes forward through a fibrous tunnel, the ureteric canal, in the upper part of the cardinal ligament. Finally, it runs close to the lateral vaginal fornix to enter the trigone of the bladder.

Its blood supply is derived from small branches of the ovarian artery, from a small vessel arising near the iliac bifurcation, from a branch of the uterine artery where it crosses beneath it and from small branches of the vesical artery.

Ureteric damage during hysterectomy

Because of its close relationship to the cervix, the vault of the vagina and the uterine artery, the ureter may be damaged during hysterectomy. Apart from being cut or tied, in radical procedures, the ureter may undergo necrosis because of interference with its blood supply. It may be displaced by scar tissue or by fibromyomata or cysts that are growing between the layers of the broad ligament and may suffer injury if its position is not noticed at surgery.

The pelvic diaphragm

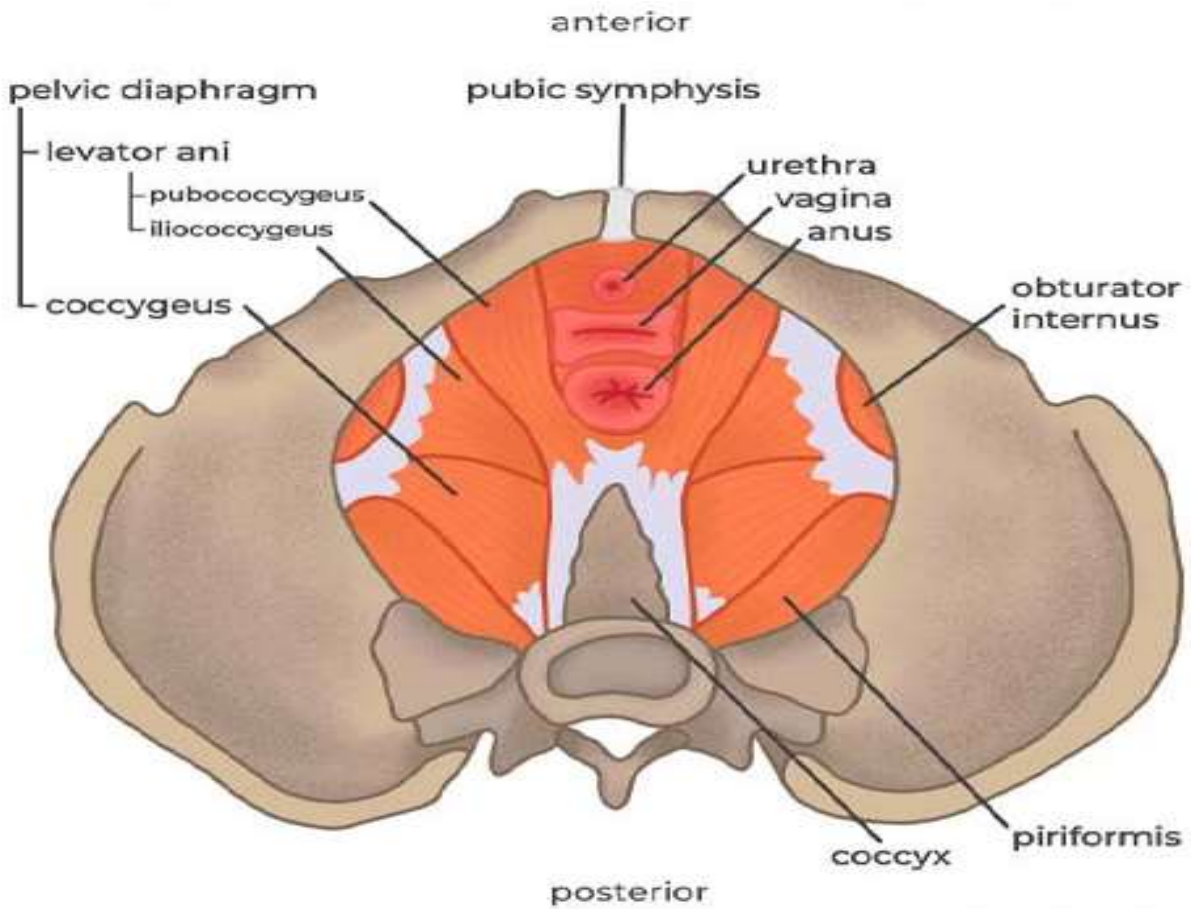
The pelvic diaphragm is formed by the levator ani muscles, which are broad, flat muscles the fibers of which pass downwards and inwards. The two muscles, one on either side, constitute the pelvic diaphragm. The muscles arise by linear origin from the following points:

- The lower part of the body of the os pubis.
- The internal surface of the parietal pelvic fascia along the white line.
- The pelvic surface of the ischial spine.

The levator ani muscles are inserted into the following points:

- The preanal raphe and the central point of the perineum, where one muscle meets the other on the opposite side.
- The wall of the anal canal, where the fibers blend with the deep external sphincter muscle.
- The postanal or anococcygeal raphe, where again one muscle meets the other on the opposite side.
- The lower part of the coccyx.
- The muscle is described in two parts:
- The pubococcygeus, which arises from the pubic bone and the anterior part of the tendinous arch of the pelvic fascia (the ‘white line’).
- The iliococcygeus, which arises from the posterior part of the tendinous arch and the ischial spine.

The pelvic diaphragm



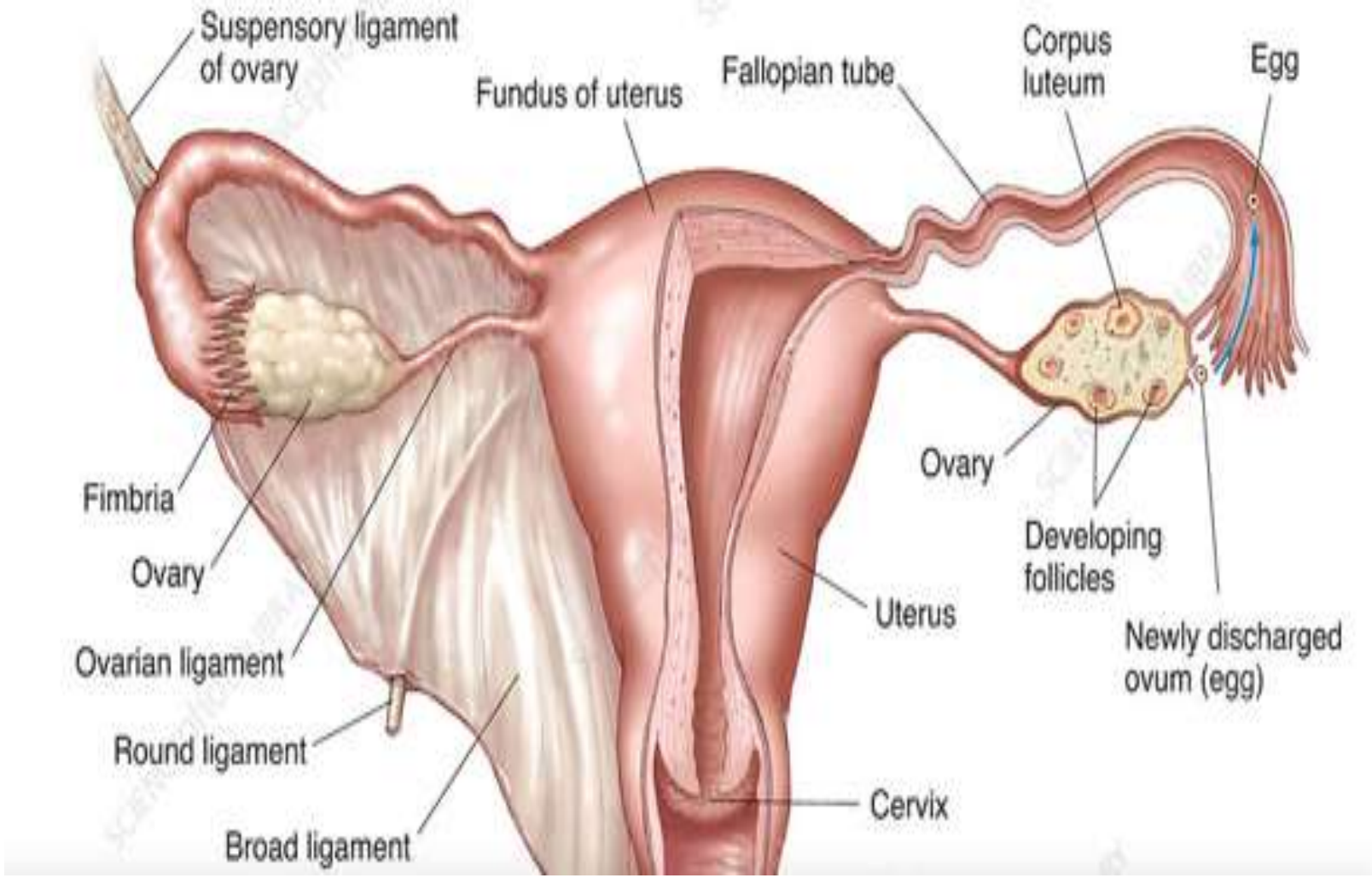
The pelvic peritoneum

The peritoneum is reflected from the lateral borders of the uterus to form, on either side, a double fold of peritoneum – the broad ligament. Despite the name, this is not a ligament but a peritoneal fold and it does not support the uterus. The Fallopian tube runs in the upper free edge of the broad ligament as far as the point at which the tube opens into the peritoneal cavity. The part of the broad ligament that is lateral to the opening is called the ‘infundibulopelvic fold’ and in it the ovarian vessels and nerves pass from the side wall of the pelvis to lie between the two layers of the broad ligament. The mesosalpinx, the portion of the broad ligament that lies above the ovary, is layered; between its layers are seen any Wolffian remnants that may remain. Below the ovary, the base of the broad ligament widens out and contains a considerable amount of loose connective tissue called the ‘parametrium’. The ureter is attached to the posterior leaf of the broad ligament at this point. The ovary is attached to the posterior layer of the broad ligament by a short mesentry (the mesovarium) through which the ovarian vessels and nerves enter the hilum.

The ovarian ligament and round ligament

The ovarian ligament lies beneath the posterior layer of the broad ligament and passes from the medial pole of the ovary to the uterus just below the point of entry of the Fallopian tube.

The round ligament is the continuation of the same structure and runs forwards under the anterior leaf of peritoneum to enter the inguinal canal, ending in the subcutaneous tissue of the labium major.


Suspensory ligament of ovary
Fundus of uterus
Fallopian tube
Corpus luteum
Egg
Fimbria
Ovary
Ovarian ligament
Round ligament
Broad ligament
Ovary
Developing follicles
Uterus
Newly discharged ovum (egg)
Cervix

The blood supply

Arteries supplying the pelvic organs:

Because the ovary develops on the posterior abdominal wall and later migrates down into the pelvis, it carries its blood supply with it directly from the abdominal aorta. The ovarian artery arises from the aorta just below the renal artery and runs downwards on the surface of the psoas muscle to the pelvic brim, where it crosses in front of the ureter and then passes into the infundibulopelvic fold of the broad ligament. The artery divides into branches that supply the ovary and tube and then run on to reach the uterus, where they anastomose with the terminal branches of the uterine artery.

The internal iliac (hypogastric) artery:

This vessel is about 4 cm in length and begins at the bifurcation of the common iliac artery in front of the sacroiliac joint. It soon divides into anterior and posterior branches; the branches that supply the pelvic organs are all from the anterior division and are as follows:

1.The uterine artery provides the main blood supply to the uterus. The artery first runs downwards on the lateral wall of the pelvis, in the same direction as the ureter. It then turns inward and forwards lying in the base of the broad ligament. On reaching the wall of the uterus, the artery turns upwards to run tortuously to the upper part of the uterus, where it anastomoses with the ovarian artery. In this part of its course, it sends many branches into the substance of the uterus. The uterine artery supplies a branch to the ureter as it crosses it and shortly afterwards another branch is given off to supply the cervix and upper vagina.

2.The vaginal artery runs at a lower level to supply the vagina.

3.The vesical arteries are variable in number and supply the bladder and terminal ureter. One usually runs in the roof of the ureteric canal.

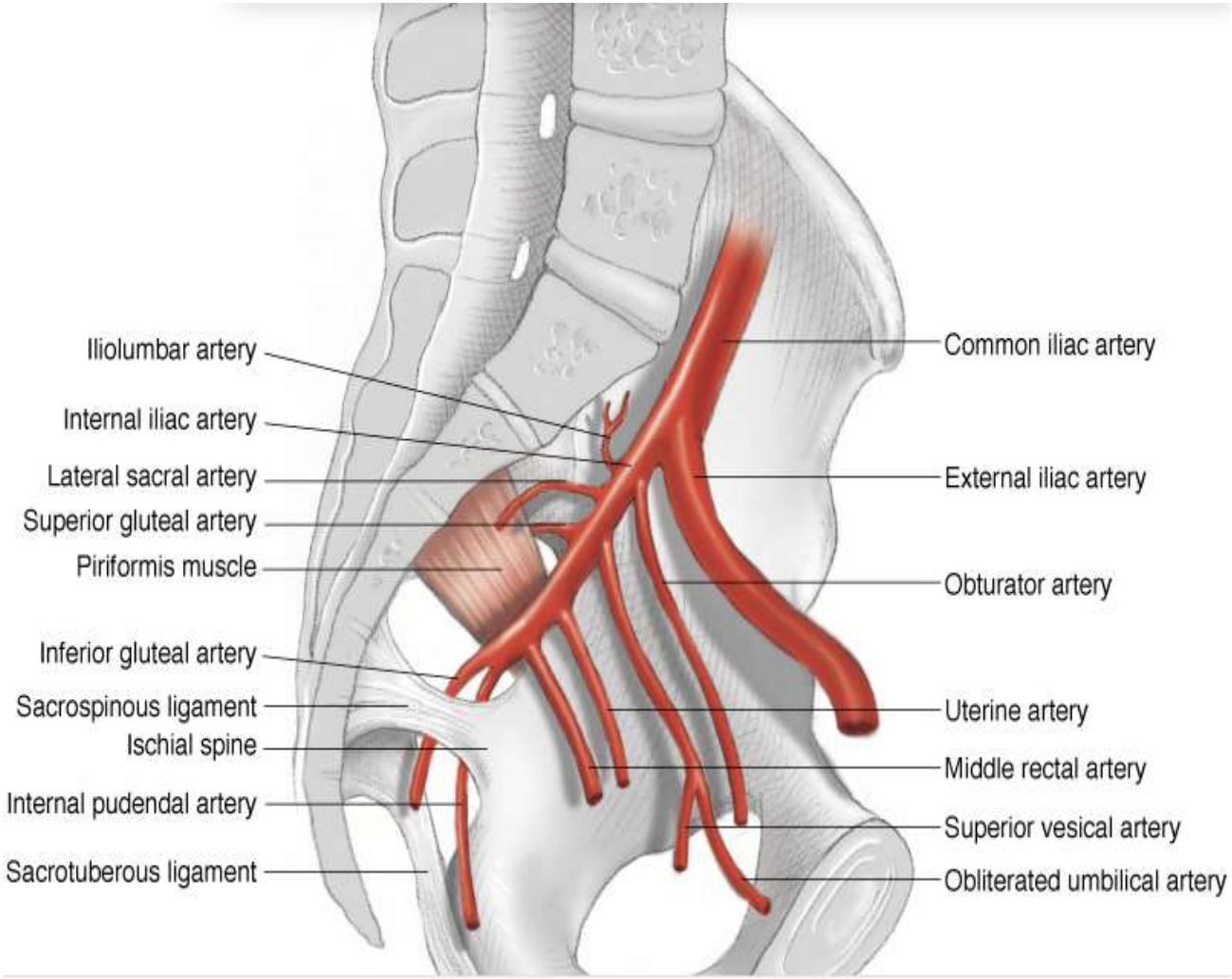
4.The middle rectal artery often arises in common with the lowest vesical artery.

5.The pudendal artery leaves the pelvic cavity through the sciatic foramen and, after winding round the ischial spine, enters the ischiorectal fossa where it gives off the inferior rectal artery. It terminates in the perineal and vulval arteries, supplying the erectile tissue of the vestibular bulbs and clitoris.

The superior rectal artery:

This artery is the continuation of the inferior mesenteric artery and descends in the base of the mesocolon. It divides into two branches that run on either side of the rectum and supply numerous branches to it.

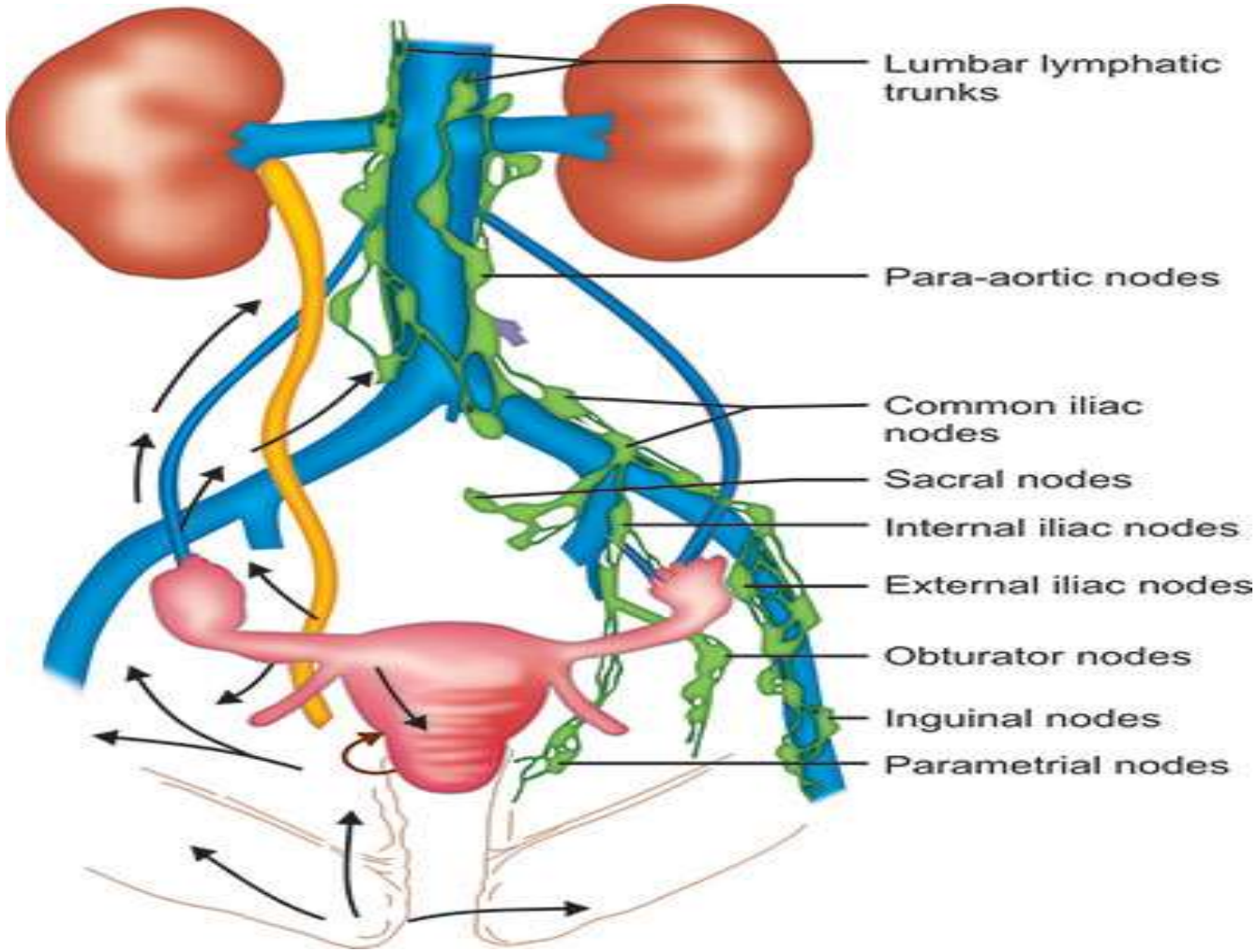
The blood supply



The pelvic lymphatics:

Lymph draining from all the lower extremities and the vulva and perineal regions is all filtered through the inguinal and superficial femoral nodes before continuing along the deep pathways on the side wall of the pelvis. One deep chain passes upwards lateral to the major blood vessels, forming in turn the external iliac, common iliac and para-aortic groups of nodes.

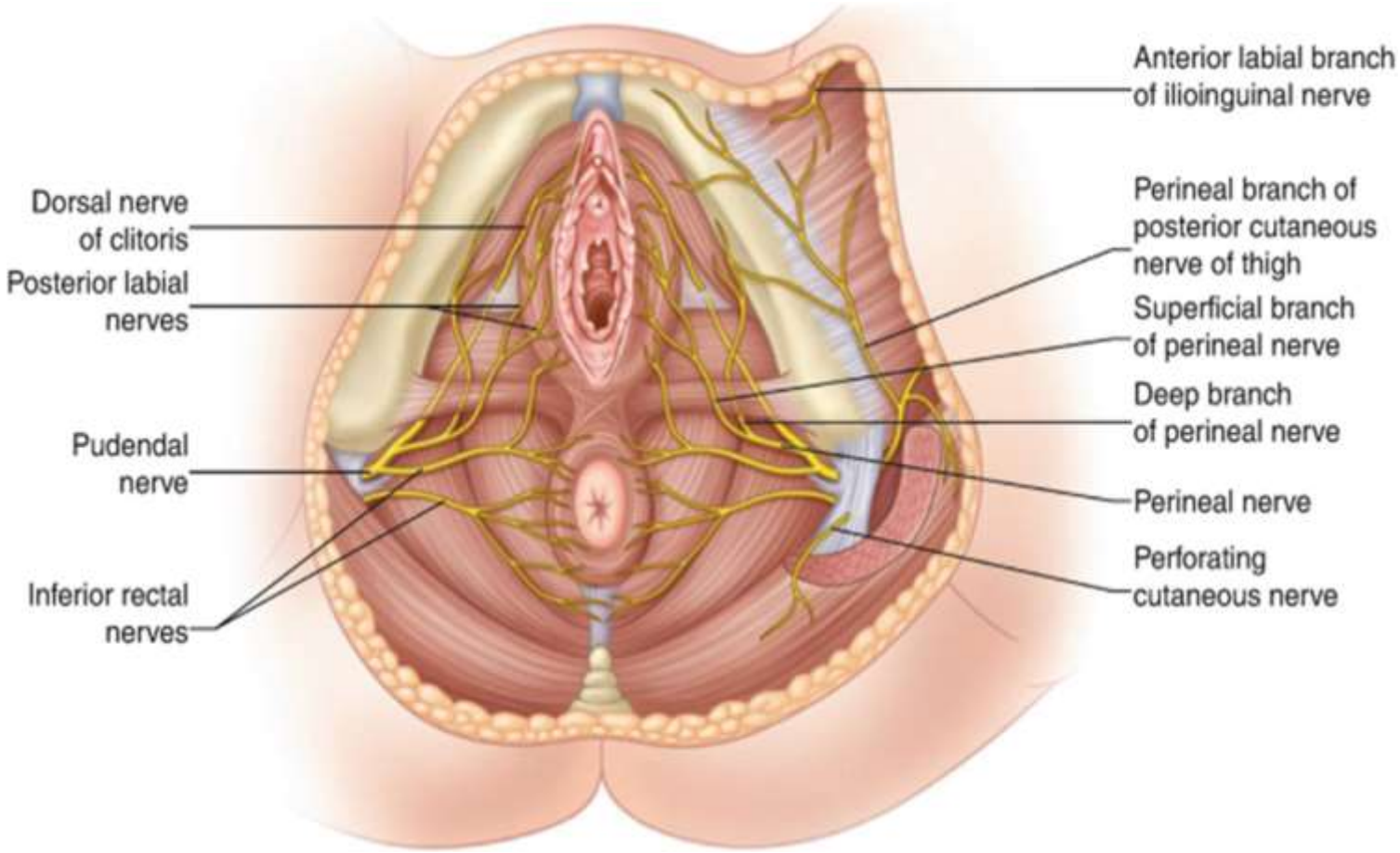
The pelvic lymphatics



Nerve supply of the vulva and perineum

The pudendal nerve arises from the second, third and fourth sacral nerves. As it passes along the outer wall of the ischiorectal fossa, it gives off an inferior rectal branch and divides into the perineal nerve and dorsal nerve of the clitoris. The perineal nerve gives the sensory supply to the vulva and also innervates the anterior part of the external anal canal and the levator ani and the superficial perineal muscles. The dorsal nerve of the clitoris is sensory. Sensory fibers from the mons and labia also pass in the ilioinguinal and genitofemoral nerves to the first lumbar root. The posterior femoral cutaneous nerve carries sensation from the perineum to the small sciatic nerve and thus to the first, second and third sacral nerves. The main nerve supply of the levator ani muscles comes from the third and fourth sacral nerves.

Nerve supply of the vulva and perineum



Nerve supply of the pelvic viscera

The innervation of the pelvic viscera is complex and not well understood. All pelvic viscera receive dual innervation (i.e both sympathetic and parasympathetic). Nerve fibers of the preaortic plexus of the sympathetic nervous system are continuous with those of the superior hypogastric plexus, which lies in front of the last lumber vertebra. Below this, the superior hypogastric plexus divides and on each side its fibers are continuous with fibers passing beside the rectum to join the uterovaginal plexus (inferior hypogastric plexus). This plexus lies in the loose cellular tissue posterolateral to the cervix, below the uterosacral folds of peritoneum.

Parasympathetic fibers from the second, third and fourth sacral nerves join the uterovaginal plexus. Fibers from (or to) the bladder, uterus, vagina and rectum join the plexus. The ovary is not innervated by the nerves already described, but from the ovarian plexus that surrounds the ovarian vessels and joins the preaortic plexus high up.

Thank you