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Applied Anatomy of the Female Genital Organs

SHORT ANSWER TYPE QUESTIONS

Q.1. Name the structures forming external genitalia of female.

The structures are collectively named the *vulva*. The vulva consists of mons pubis, labia minora and majora, hymen, clitoris, vestibule, urethra, Skene glands, greater vestibular (Bartholin) glands, and vestibular bulbs.

Q.2. What is the boundary of vulva?

Mons pubis anteriorly, the rectum posteriorly, and the genitocrural folds (thigh folds) laterally.

Q.3. What is the composition of labia majora?

The *labia majora* are two elongated, hair-covered, fatty skin folds that enclose and protect the other organs of the external female genitalia. They contain apocrine, sebaceous, and sweat gland.

Q.4. What is the composition of labia minora?

The *labia minora* are two thick skin folds that contain no fat or hair. The labia minora enclose the clitoris anteriorly.

Q.5. What is the composition of clitoris?

The *clitoris* is a short (2 cm) erectile organ at the top of the vestibule, which has a very rich nerve supply and blood vessels. The clitoris is made up of two crura, which attach to the periosteum of the ischiopubic rami.

Q.6. What are Bartholin's glands?

Bartholin's glands are small, similar to size of kidney beans, with openings just outside the hymen, bilaterally, at the posterior aspect of the vagina (5 and 7 o'clock position).

Q.7. What is the lymphatic drainage of vulva?

The main drainage site of the vulva is the superficial inguinal lymph nodes. The lymphatic drainage extends to the deep

inguinal lymph nodes, then to external iliac lymph nodes and the common iliac lymph nodes. There is a contralateral lymphatic drainage of the labia.

Q.8. What are the organs of female internal genitalia?

Internal genital organs are: (i) vagina, (ii) uterus, (iii) fallopian tubes, and (iv) ovaries.

Q.9. What is the relationship of uterus with other pelvic organs?

- Anteriorly, there is the uterovesical peritoneum and urinary bladder.
- Posteriorly, there is pouch of Douglas and coils of intestine.
- Laterally is the parametrium. Uterine artery crosses over the ureter (water under the bridge) 2 cm lateral to the cervix.
- Superiorly, there are coils of intestine and omentum.
- Inferiorly is the vagina.

Q.10. What are the parts of uterus?

The uterus can be divided into three parts:

1. *Body*: Body extends from the fundus to a constriction known as the isthmus which corresponds with internal os of cervical canal.
Fundus: The domed area at the top of the uterus, above the insertion of the two fallopian tubes. Fundus is the part of the body.
2. *Isthmus*: The region between the body and cervix is referred to as the isthmus, a short area of constriction.
3. *Cervix*: Cervix lies below the isthmus. The cervix may be subdivided in two parts: (1) a supravaginal portion superior to the limits of the vagina and (2) a vaginal portion, which projects into the cavity of the vagina.

Q.11. What is the uterine cervix?

The cervix connects the uterus and vagina, and projects into the upper vagina.

Q.12. What is the uterine corpus?

Corpus or body extends from the fundus to a constriction known as the isthmus.

Q.13. What are the ligaments of uterus and cervix?

Round ligaments, ovarian ligament, broad ligaments, Mackenrodt ligaments, uterosacral ligaments, and pubo-cervical ligaments.

Q.14. What are the uterosacral ligaments?

The uterosacral ligaments pass upward and backward from the posterior aspect of the cervix toward the lateral part of the second piece of the sacrum. In their lower part, they contain plain muscle along with fibrous tissue and autonomic nerve fibers.

Q.15. What are the cardinal ligaments?

The cardinal ligaments are dense condensations of connective tissue which extends from the pelvic side walls toward the genital tract. Medially, they are firmly fused with the fascia surrounding the cervix and upper part of the vagina. They pass upward and backward toward the root of the internal iliac vessel. These condensations of fibrous and elastic tissue, together with plain muscle fibers, are sometimes referred as parametrium.

Q.16. What is the blood supply of uterus?

The uterus gets its main blood supply from the uterine artery which is branch of anterior division of internal iliac artery. The ovarian artery which is a branch of the abdominal aorta also nourishes the uterus. The arteries anastomose along the fallopian tube.

Q.17. What is the blood supply of ovary?

The blood supply of ovary is through the ovarian artery—a branch of abdominal aorta and uterine artery and numerous anastomosis. The venous drainage is through the pampiniform plexus to the ovarian veins. The right ovarian vein drains into the inferior vena cava and left ovarian vein drains into the left renal vein.

Q.18. What is the lymphatic drainage of ovaries?

Primarily through the aortic nodes. Rarely they may drain through iliac lymph nodes.

SHORT NOTES

Supports of the Uterus

The main support of the uterus and cervix is provided by the interaction between the levator ani muscles and the connective tissue that attaches the walls of the cervix to

the pelvic walls which is known clinically as the *cardinal ligament* and *uterosacral ligament*.

Following are the uterine supports which prevent the uterus from prolapsing, are seen in pairs:

- *Cardinal ligaments (transverse cervical ligaments or Mackenrodt ligaments)*: These are strongest of all uterine supports. The cardinal ligaments are essentially dense condensations of connective tissue which extends from the pelvic side walls toward the genital tract. Medially, they are firmly fused with the fascia surrounding the cervix and upper part of the vagina. They pass upward and backward toward the root of the internal iliac vessel. These condensations of fibrous and elastic tissue, together with plain muscle fibers, are sometimes referred as parametrium. They support the upper vagina and cervix, helping to maintain ante flexion. Inferiorly, they are continuous with the fascia on the upper surface of the levator ani muscle.
- *Uterosacral ligaments*: The uterosacral ligaments pass upward and backward from the posterior aspect of the cervix toward the lateral part of the second piece of the sacrum. In their lower part, they contain plain muscle along with fibrous tissue and autonomic nerve fibers. In their upper part, they dwindle to shallow peritoneal folds. The ligaments divide the pouch of Douglas from the pararectal fossa from each side.
- *Pubocervical ligaments* are the weakest. These are the pair of thin fibrous bands which extend from the cervix to the pubic bones along the inferolateral surfaces of the bladder. The ligaments pull the cervix forward countering the pull of uterosacral ligament backward.
- *Round ligaments and broad ligaments*: Apart from the above mentioned ligaments, there are other ligaments, the round ligaments (prevent the uterus from axial rotation and maintain its ante flexion state) and the broad ligaments through which blood vessels nourishing the uterus and fallopian tubes pass.
- The *levator ani muscles* which act as pelvic floor support and prevent the uterus from prolapsing.

Clinical correlation: Weakening of the supports of uterus results in uterine prolapse.

Transformation Zone

Ectocervix is covered by a pink stratified squamous epithelium consisting of multiple layers of cells. Endocervix is lined by reddish columnar epithelium consisting of a single layer of cells. The columnar epithelium is characterized by infoldings or clefts and is commonly referred to as “glandular”.

The squamocolumnar junction commonly does not correspond to the anatomical os. *The location of squamocolumnar junction in relation to the external os varies depending upon age, menstrual status, and other factors such as pregnancy and oral contraceptive use.* It everts outward onto the ectocervix during adolescence, pregnancy, and with use of combined hormonal contraceptives. It regresses into the endocervical canal with menopause and other low-estrogen states such as prolonged lactation and use of progestin-only contraceptives. Thus, the original squamocolumnar junction is located on the ectocervix, far away from the external os. The metaplastic process mostly starts at the original squamocolumnar junction and proceeds centripetally toward the external os through the reproductive period to perimenopause. Thus, a new squamocolumnar junction is formed between the newly formed metaplastic squamous epithelium and the columnar epithelium remaining everted onto the ectocervix. As the woman passes from the reproductive to the perimenopausal age group, the location of the new squamocolumnar junction progressively moves on the ectocervix toward the external os.

The region of the cervix where squamous metaplasia occurs is referred to as the transformation zone (Fig. 1). It corresponds to the area of cervix bound by the original squamocolumnar junction at the distal end and proximally by the new squamocolumnar junction.

Colposcopic appearance: Colposcopically, the squamous epithelium of the cervix appears as a featureless, smooth, and pale pink surface. Blood vessels lie below this layer and therefore are not visible or are seen only as a fine capillary network. During colposcopy, the endocervix appears red and velvety due to the proximity of blood vessels beneath the one-cell-layer-thick epithelium.

Clinical correlation: Nearly all cervical neoplasia, both squamous and columnar, develops within the transformation zone, usually adjacent to the new

squamocolumnar junction. Thus, correct Pap smear preparation should sample cells from this junction. Identifying the transformation zone is of great importance in colposcopy.

Lymphatic Drainage of the Vulva (DNB 2017)

Vulval lymphatic drainage: The main drainage site of the vulva is the superficial inguinal lymph nodes, which are located below the inguinal ligament in the upper anterior and medial thigh. The lymphatic drainage extends to the deep inguinal lymph nodes, then to external iliac lymph nodes and the common iliac lymph nodes. There is a contralateral lymphatic drainage of the labia. However, the glans and corpora cavernosa of the clitoris may drain directly to the deep inguinal nodes.

Anatomy of inguinal lymph nodes: There are 10–20 inguinal nodes that are divided into a superficial and a deep group. *Superficial inguinal lymph nodes* are more numerous. They are found in the membranous layer of the subcutaneous tissue of the anterior thigh, just superficial to the fascia lata.

The *deep inguinal nodes* vary from one to three in number and are located deep to the fascia lata in the *femoral triangle*. This triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle, and medially by the medial border of the adductor longus muscle. The iliopsoas and pectineus muscles form its floor. Within this triangle, the deep nodes are in the *femoral canal*—the space that lies on the medial side of the femoral vein. This canal can communicate with the abdominal cavity through the *femoral ring*. Within the femoral triangle, lateral to medial, the structures found in this space are the femoral nerve, artery, vein, and deep inguinal lymphatics in the femoral canal.

The *fossa ovalis*, or saphenous opening, is an opening in the fascia lata and allows communication of superficial with deep inguinal nodes. When there are three deep inguinal

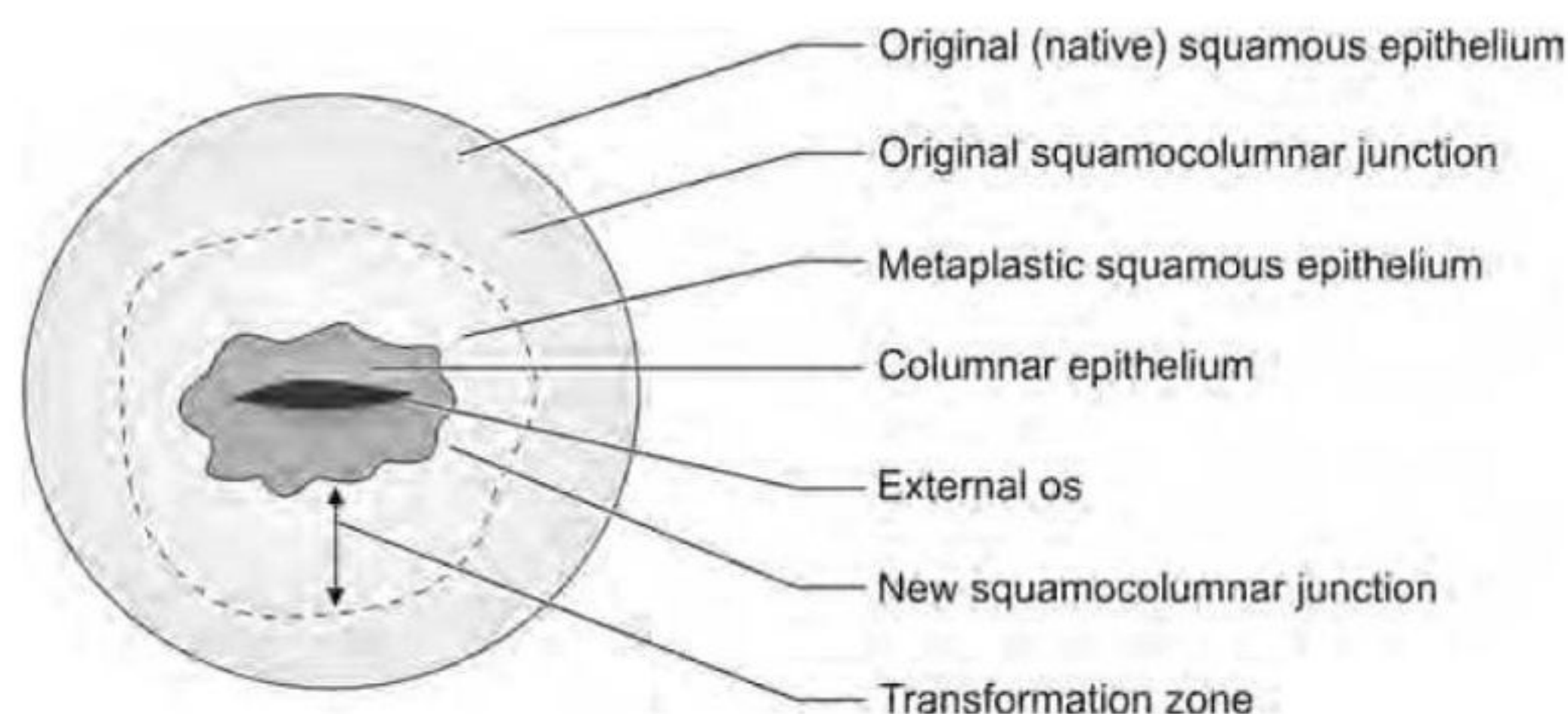


Fig. 1: A schematic diagram of the transformation zone.

Development of Female Genital Organs and its Congenital Anomalies

■ HYSTEROSALPINGOGRAM (FIG. 1)



Fig. 1

Q.1. Describe the X-ray plate.

This is a hysterosalpingogram (HSG) showing shadow of radiopaque dye delineating two separate uterine horns, fallopian tubes on both sides, and spillage of contrast on either sides.

Q.2. What is your diagnosis?

Suggestive of bicornuate uterus with patent fallopian tubes or completely septate uterus with a thick septum.

Q.3. How will you differentiate between the two?

It is not possible to differentiate septate uterus from bicornuate uterus accurately looking at hysterosalpingogram alone (accuracy only 55%). An angle between two uterine horns may help in differentiation between the two, an angle of $<75^\circ$ is suggestive of septate uterus and angle of $>105^\circ$ is consistent with bicornuate uterus. Unfortunately, in many cases the angle of divergence may fall between these ranges and there is considerable overlap between these two anomalies. Ultrasonography may also help in diagnosis. Laparoscopy

combined with hysteroscopy will confirm the diagnosis. Magnetic resonance imaging (MRI) can also help however, it is costly.

Q.4. How the patient presented to the hospital?

The patient may present with recurrent abortions or recurrent preterm birth.

Q.5. How she should be treated if bicornuate uterus is confirmed as a cause of recurrent abortion?

She can be treated by unification operation—Strassman metroplasty.

■ HYSTEROSALPINGOGRAM (FIG. 2)



Fig. 2

Q.1. Describe the HSG plate.

This is a HSG showing shadow of radiopaque dye delineating the uterine cavity and the fallopian tubes on both sides.

There is a triangular filling defect inside the endometrial cavity and dye has entered peritoneal cavity on either side. This is a HSG of septate uterus with bilateral spillage of dye through fallopian tubes.

Q.2. What other investigations can be done to confirm the diagnosis?

Ultrasonography, hysteroscopy, and laparoscopy, MRI.

Q.3. How this patient presented to the hospital?

Recurrent pregnancy loss.

Q.4. How this patient should be treated if the septum is confirmed?

Septum can be removed by hysteroscope.

■ **HYSTEROSALPINGOGRAM (FIG. 3)**



Fig. 3

Q.1. Describe the X-ray plate.

This is a hysterosalpingogram showing the shadow of radiopaque dye showing a banana shaped uterus with single fallopian tube with free spillage of dye in peritoneal cavity.

Q.2. What is your diagnosis?

Unicornuate uterus.

Q.3. How was the patient presented to the hospital?

May present with infertility, recurrent abortion, or preterm birth.

Q.4. Is there any rudimentary horn?

No rudimentary horn is visible on this HSG plate. So a communicating, rudimentary horn is absent. However, the

presence of a noncommunicating rudimentary horn or a rudimentary horn without an endometrial cavity cannot be diagnosed from HSG.

Q.5. What other investigations do you consider for her?

Two-dimensional (2D) or three-dimensional (3D) transvaginal ultrasonography, MRI, laparoscopy.

Q.6. Is there any role for intravenous pyelography?

Yes, intravenous pyelography should be done to detect renal anomalies.

Q.7. How will you treat the patient?

(i) Rudimentary horn, if present, can be removed before attempting pregnancy; (ii) Gestational surrogacy can be considered in cases of repeated pregnancy failure; (iii) The role of cervical cerclage operation during pregnancy is controversial.

■ **ULTRASONOGRAPHY (FIG. 4)**



Fig. 4

Q.1. Describe the ultrasonography (USG) plate.

This is a transabdominal ultrasonography of pelvis showing two uterine horns suggestive of bicornuate uterus or uterine didelphys.

Q.2. What are the criteria used for diagnosis of bicornuate uterus by ultrasonography?

Criteria for bicornuate uterus include:

- Intercornual angle $>105^\circ$
- Intercornual distance >4 cm
- Fundal depression depth >1 cm.

Q.3. What is the role of three-dimensional (3D) ultrasonography in diagnosis of uterine malformations?

In cases of suspected uterine malformations, a 3D ultrasound can be performed, in which the external and internal uterine