CONTENTS

SECTION 1 BASICS OF OBSTETRICS

SECTION 2 NORMAL PREGNANCY

SECTION 3 NORMAL LABOUR

SECTION 4 ABNORMAL PREGNANCY

SECTION 5 MEDICAL DISORDERS IN PREGNANCY

SECTION 6 SPECIAL SITUATIONS

SECTION 7 ABNORMAL LABOUR

SECTION 8 PUERPERIUM

SECTION 9 OPERATIVE OBSTETRICS

SECTION 10 SPECIAL INVESTIGATIONS

SECTION 11 NEONATOLOGY

SECTION 12 MISCELLANEOUS TOPICS

SECTION 13 SOCIAL OBSTETRICS

SECTION 14 MATERNAL MORTALITY

1 CHAPTER

Anatomy of the Female Reproductive Organs and Pelvis

A basic understanding of anatomy of the genital organs, pelvis, pelvic floor and perineum along with arterial and nerve supply is essential for performing gynaecological surgery and avoiding injury to vital structures.

FEMALE REPRODUCTIVE ORGANS

VULVA (Fig. 1.1)

The vulva lies on the pubic bones and extends caudally under the pubic arch. It consists of the following structures.

Labia Majora

Labia majora are two fibro-fatty folds of skin covered with hair and extending posteriorly from the mons and surrounding the pudendal cleft and are homologous with scrotum in the male. The round ligaments of uterus and the obliterated processus vaginalis (canal of Nuck) also terminate in the labia. Anteriorly they fuse over the symphysis pubis to form a fat-filled cushion called the *mons pubis or mons veneris* covered with a triangle of pubic hair. Posteriorly they merge into the perineum where they join medially to form the *posterior commissure*. The outer surfaces are pigmented and covered with hair; the inner surface is smooth containing many sebaceous glands. It is richly supplied with blood vessels, lymphatics and nerves.

Labia Minora

Labia minora are two delicate folds of skin on either side of the pudendal cleft. Anteriorly they split to enclose the clitoris; the upper pair merging to form the *prepuce* and the lower pair merging to form the *frenulum* of the clitoris. Posteriorly they fuse to form the *fourchette.* They are devoid of hair follicles but are richly supplied with sebaceous glands, blood vessels and nerves.

Clitoris

The clitoris is a small erectile structure situated anteriorly, enclosed within the anterior ends of the labia minora. It is homologous to penis in the male and is composed of a glans, a corpus and two crura. The *corpus* has 2 minute corpora cavernosa without any corpus spongiosum. The posterior extensions form the *crura,* which anchors the clitoris to the inferior rami of the pubic ischium. The clitoris rarely exceeds 1 cm in length. Its free end called the *glans*, is covered by the prepuce and is highly sensitive to sexual stimulation.

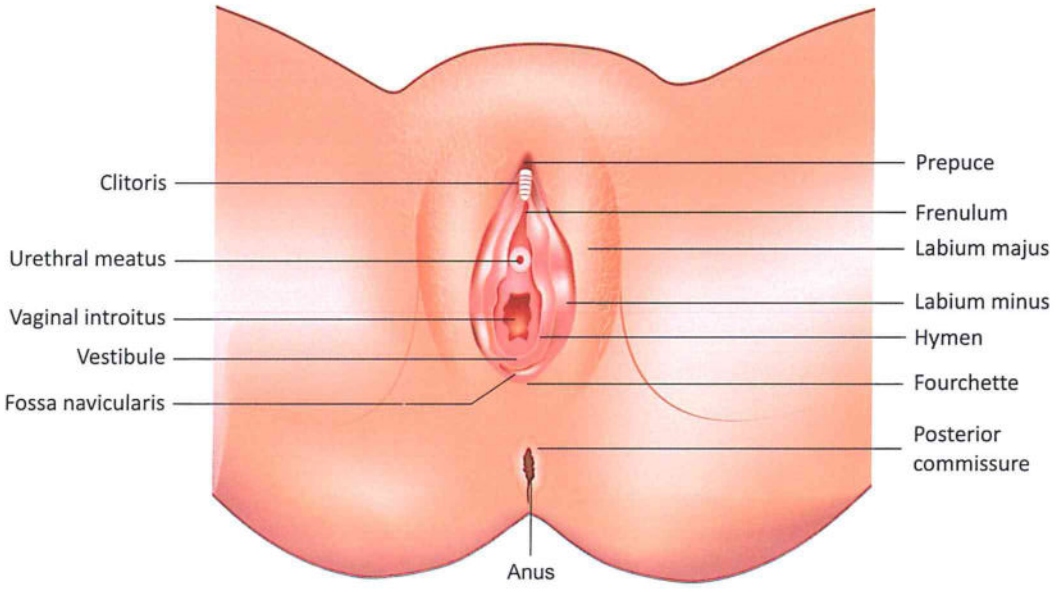

Fig. 1.1 The vulva

Vestibule of Vagina

This is the cleft between the labia minora and extends from the clitoris to the fourchette. It develops from the urogenital sinus and is usually perforated by six openings: the urethra, vagina, two Bartholin's ducts and at times the two ducts of the paraurethral glands also called Skene ducts. The posterior part of the vestibule between the fourchette and vaginal opening is called the *fossa navicularis* and is usually only seen in nullipara. The *vestibular bulbs* are two masses of erectile tissue on either side of the vaginal opening and contain a rich plexus of veins. They are covered by the bulbocavernosus muscles, which along with the ischiocavernosus muscles insert into the body of the clitoris and act to pull it downward.

Bartholin Glands

These glands are a pair of compound racemose glands situated at the base of the vestibular bulbs on either side of the vagina, in the superficial perineal pouch. They are also called the *major or greater vestibular glands* with ducts opening into the vestibule. They produce plenty of mucous and help in lubrication during sexual intercourse. The duct is lined by columnar epithelium, but near its opening, it is lined by stratified squamous epithelium. The gland lies on the perineal membrane and beneath the bulbocavernosus muscle.

Clinical Significance

These glands can be infected by *Neisseria gonorrhoea* or some other bacteria leading to a Bartholin abscess. The intimate relation between the excessively vascular erectile tissue of the vestibular bulb and Bartholin gland is responsible for the haemorrhage that can occur when removal of the gland is attempted.

Hymen

Hymen is the thin fold of mucous membrane attached to the vaginal orifice all around. Both the outer and inner surfaces are covered by stratified squamous epithelium and the hymen is mainly composed of elastic and collagenous connective tissue.

Clinical Significance

The hymen may be annular, cribriform, crescentic, septate or sometimes imperforate when it can lead to hidden menstruation or cryptomenorrhoea. The appearance of the hymen can help to determine whether a woman has begun sexual activity. Generally the hymen is torn at first intercourse.

Subcutaneous Tissue of Vulva

This is similar to that of the abdominal wall. The superficial fascia with predominance of fat is called *Camper's fascia* as it is on the abdomen and is continuous with the abdominal fat. The deep fascia is more fibrous and has less fat and is termed *Colle's fascia* and is similar to Scarpa's fascia on the abdomen. This fascia is attached laterally to the ischiopubic rami and fuses posteriorly with the posterior edge of the perineal membrane.

Development of Vulva

The clitoris develops from the genital tubercle, labia minora from the genital folds, labia majora from the labioscrotal (genital) swellings and vestibule from the urogenital sinus.

Blood Supply

Arterial supply is from the internal iliac artery with a significant contribution from the femoral artery.

1. The **internal pudendal artery** arises from the internal iliac artery and leaves the pelvis through the inferior aspect of the greater sciatic foramen below the pyriformis, crosses the ischial spine and enters the pelvis through the lesser sciatic foramen. It then runs in the pudendal canal along with the pudendal nerve to the labia majora. There it forms an anastomosis with the superficial and deep external pudendal vessels, which are branches of the femoral artery. The internal pudendal artery gives off the inferior rectal artery, which supplies the anal skin and musculature, the perineal artery which is the main supply to the skin, subcutaneous tissue and muscles of the vulva, the artery of the bulb of the vestibule and the deep and dorsal arteries of clitoris.
2. The **superficial and deep external pudendal arteries** which arise from the femoral artery also contribute to the arterial supply of the vulva and perineum. The superficial external pudendal artery arises from the medial side of the femoral artery, close to the superficial epigastric and superficial circumflex iliac artery. The deep external pudendal artery also arises from the femoral artery but is more deeply seated.

Venous drainage is a vast plexus that drains to the internal pudendal veins and thereby to the internal iliac veins. A small part of the anterior aspect drains through the external pudendal veins to the great saphenous vein.

Lymphatic Drainage

Inguinal nodes are divided into two groups; the superficial and deep inguinal nodes. Drainage is mainly into the medial group of the superficial inguinal lymph nodes, and from there they drain into the deep inguinal nodes in the femoral canal. The glans of the clitoris may drain directly into the deep nodes.

Superficial Nodes

The superficial nodes lie in a T-shaped pattern parallel to and 1 cm below the inguinal ligament, with the stem of the T extending down along the saphenous vein. These nodes are often divided into four quadrants. Drainage is primarily to the medial nodes of the upper quadrant. The saphenous vein joins the femoral vein through the saphenous opening, which is about 2 cm below the inguinal ligament. Three superficial vessels arise from the saphenous vein and the femoral artery.

These are the superficial epigastric vessels that supply the subcutaneous tissue of the lower abdomen, the superficial circumflex iliac that course laterally to the iliac crest and the superficial external pudendal that supply the vulva and clitoris. From the superficial nodes, the lymphatics enter the fossa ovalis (the saphenous opening) and drain into the deep inguinal nodes.

Deep Inguinal Nodes

The deep inguinal nodes are in the femoral canal of the femoral triangle. The femoral triangle is the subfascial space of the upper one-third of thigh bounded by the inguinal ligament, sartorius and adductor longus muscles. The floor is formed by the pectineal, adductor longus and iliopsoas muscles. The femoral artery is in the middle, with the femoral vein medial and the femoral nerve lateral to the artery. As the femoral vessels pass under the inguinal ligament, they carry with them an extension of the transversalis fascia called the femoral sheath, for about 2–3 cm below the inguinal ligament. Two parts of the sheath accompany the femoral vessels. A third part of the sheath is seen in the space medial to the vein and is called the ***femoral canal***. The abdominal opening of the femoral canal is the ***femoral ring***. The femoral canal contains the deep inguinal nodes. From here, lymphatics communicate with the external iliac nodes. In this region, the femoral vessels give rise to the deep external pudendal vessels.

Nerve Supply

Nerve supply is from the anterior divisions of the second, third and fourth sacral spinal nerves.

1. The main nerve is the ***pudendal nerve*** S234, which is a mixed nerve. It is the nerve of the pelvic floor and perineum. After leaving the pelvis, it curls around the ischial spine to enter the pudendal canal through the lesser sciatic foramen. Towards the end of the pudendal canal, it gives off the inferior rectal nerve which supplies the external anal sphincter, anal canal and perianal skin. Then it divides into the two terminal branches; dorsal nerve of the clitoris and the perineal nerve.
2. In addition, the anterior parts of vulva are supplied by the ***ilioinguinal*** and genital branch of the ***genitofemoral*** nerve.
3. The posterior parts are supplied by the perineal branch of the ***posterior cutaneous nerves of the thigh***.

VAGINA (Fig. 1.2)

The vagina is a distensible fibromuscular tube running from the vestibule to the cervix of the uterus. The anterior wall is about 7.5 cm and the posterior wall is 9 cm in length. The lumen is a transverse slit with the anterior and posterior walls in contact. The vagina is bent at an angle of 120° by the anterior pull of the levator ani at the junction of the lower one third and upper two thirds. The cervix protrudes into the vagina and thus the vault of the vagina is divided into four fornices, of which the posterior fornix is the deepest. The lumen is normally obliterated, as the anterior and posterior walls are in close apposition.

Clinical Significance

The importance of the fornices lies in the fact that the internal pelvic organs can be palpated through them. In addition, the posterior fornix provides surgical access to the peritoneal cavity through the pouch of Douglas. Aspiration of the pouch of Douglas through the posterior fornix is termed culdocentesis and is sometimes performed in cases of suspected ruptured ectopic gestation, when blood may be obtained.

Table 1.1 Blood supply of vulva

Artery	Origin	Branches
Internal pudendal artery	Internal iliac artery	Inferior rectal artery Perineal artery Artery of the bulb Deep artery of clitoris Dorsal artery of clitoris
Superficial external pudendal artery	Femoral artery	
Deep external pudendal artery	Femoral artery	

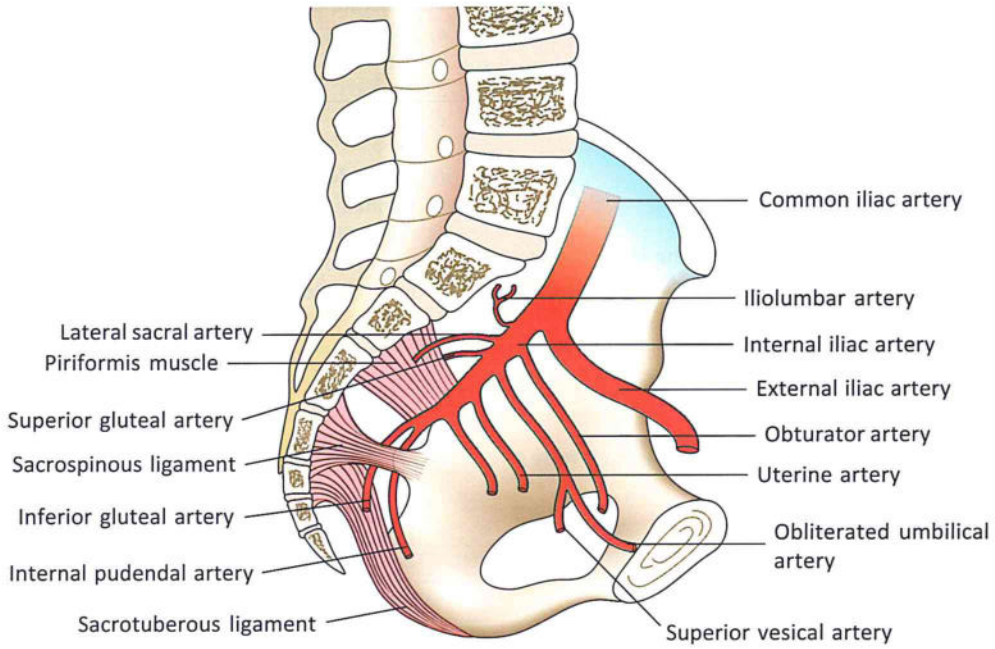

Fig. 1.12 Pelvic blood supply

The ureter is anterior and the internal iliac vein is posterior to the artery. It has an anterior and a posterior division. The division is usually about 3–4 cm after leaving the common iliac artery. The posterior division exits the pelvis and has only parietal branches. The anterior has both parietal and visceral branches; and supplies the internal and external genitalia. Trauma to the vessels of the posterior division should be avoided during internal iliac artery ligation. Ligation of the internal iliac artery has proven helpful in managing postpartum haemorrhage and haemorrhage during gynaecological surgery.

The first branch is usually the superior vesical. The superior vesical artery is the persistent proximal portion of the fetal umbilical artery. The distal part is obliterated and forms the medial umbilical ligament after birth. After giving off all the other parietal and visceral branches, the internal iliac artery continues as the internal pudendal artery. The internal pudendal artery hooks behind the ischial spines to enter the pudendal (Alcock's canal) in the ischiorectal fossa.

LYMPHATICS

The nodes of the pelvis are the external iliac, internal iliac, common iliac, obturator, sacral and pararectal nodes. The sacral nodes are few and follow the middle sacral artery. The sacral and pararectal are seldom involved in gynaecologic disease. The inguinal lymphatics are described in detail earlier in this chapter.

Table 1.12 Branches of the internal iliac artery

	Anterior division	Posterior division
Visceral branches	▪ Superior vesical (umbilical) ▪ Inferior vesical ▪ Middle rectal ▪ Uterine ▪ Vaginal	Nil
Parietal branches	▪ Obturator ▪ Inferior gluteal ▪ Internal pudendal	▪ Iliolumbar ▪ Sacral ▪ Superior gluteal

NERVES

The innervation of the reproductive organs and pelvis is from both the sympathetic and parasympathetic. Sensory fibres accompany these. The sympathetic innervation is through the hypogastric plexus. The parasympathetic is made up of the pelvic splanchnic nerves S234. The external genitalia are mainly supplied by the pudendal nerve (see section under vulva) S234 and branches. In addition, the ilioinguinal nerve L1, perineal branch of the posterior femoral cutaneous nerve S234 and genital branch of the genitofemoral nerve L12 contribute to the innervation of the perineal skin.

SUGGESTED READING

1. Delancey JOL. Surgical anatomy of the female pelvis. In: Rock JA, Jones HW, eds. Te Linde's Operative Gynecology, 10th ed., Philadelphia: Lippincott Williams and Wilkins; 2008:82–113.

MULTIPLE CHOICE QUESTIONS

1. **Which is the other name for Bartholin glands? (TN 1999)**
   a) Cervical glands
   b) Paraurethral glands
   c) Major vestibular glands
   d) Vaginal glands

2. **Which of the following is not a branch of the internal iliac artery?**
   a) Superior vesical
   b) External pudendal
   c) Uterine
   d) Vaginal

3. **Which of the following statements about the vagina is false?**
   a) Partly derived from the urogenital sinus
   b) Rich in glands
   c) Lined by stratified squamous epithelium
   d) Posterior fornix lengthier than anterior

4. **The uterine cervix ratio in childhood is (PGI 1981)**
   a) 3:2
   b) 2:1
   c) 2:3
   d) 1:2

5. **All of the following support the vagina except (AIIMS 2004)**
   a) Perineal body
   b) Pelvic diaphragm
   c) Levator ani
   d) Infundibulopelvic ligament

KEY to MCQs:
1–c; 2–b; 3–b; 4–d; 5–d