Anatomy and Physiology: The Female Reproductive System

CHAPTER 1

INCLUSIVITY

The overall goal of this chapter is to enhance healthcare for individuals seeking obstetric and gynaecological care. It is acknowledged that gynaecological care will be sought by women, individuals of diverse gender identities and those whose gender identity differs from the sex they were assigned at birth. This book and the chapters advocate for the provision of care that is consistently respectful, inclusive and attuned to the needs of all individuals. Acknowledging the crucial role of language in breaking down barriers to person-centred care, this chapter aims to enrich rather than diminish linguistic inclusivity. It recognises the significance of retaining language that is centred around women while also incorporating language for individuals who do not identify as such.

The female reproductive system (also referred to as the female reproductive tract) is a complex system responsible for producing female gametes (eggs or ova), the reception of sperm from the male reproductive system, fertilisation of the egg, and supporting the development of the embryo and fetus during pregnancy and the birthing process. It also plays a crucial role in hormone production and regulation.

Throughout the menstrual cycle, the female reproductive system undergoes various changes under the influence of hormones such as oestrogen and progesterone, preparing the body for the potential pregnancy. If fertilisation does not occur, the uterine lining is shed during menstruation and the cycle begins anew. If fertilisation does occur, then the fertilised egg implants in the uterus, leading to pregnancy and eventually childbirth.

This chapter delves into the intricacies of the female reproductive system. The female reproductive system includes both urinary and reproductive organs. Human reproduction is a multifaceted process that requires the synchronised interplay of anatomical and physiological events. While the anatomical and physiological dimensions primarily facilitate procreation, the psychological and social facets, along with the potential for pleasure derived from reproductive organs, also play crucial roles. Disorders affecting the reproductive tract can lead to various consequences, including loss of life to acute and chronic illnesses, as well as emotional and physical distress.

Individual expressions of reproductive health are heavily influenced by attitudes, both personal and those who provide healthcare. Social norms and cultural backgrounds further shape an individual's reproductive health, with sexuality closely intertwined with reproductive well-being. This chapter provides a comprehensive overview of the anatomy and physiology of the female reproductive system.

The female reproductive system is vital for reproduction and the continuation of the species, as well as for regulating hormonal balance and sexual health. The primary organs of the female reproductive system are collectively known as the vulva. The breasts also form part of the female reproductive organs.

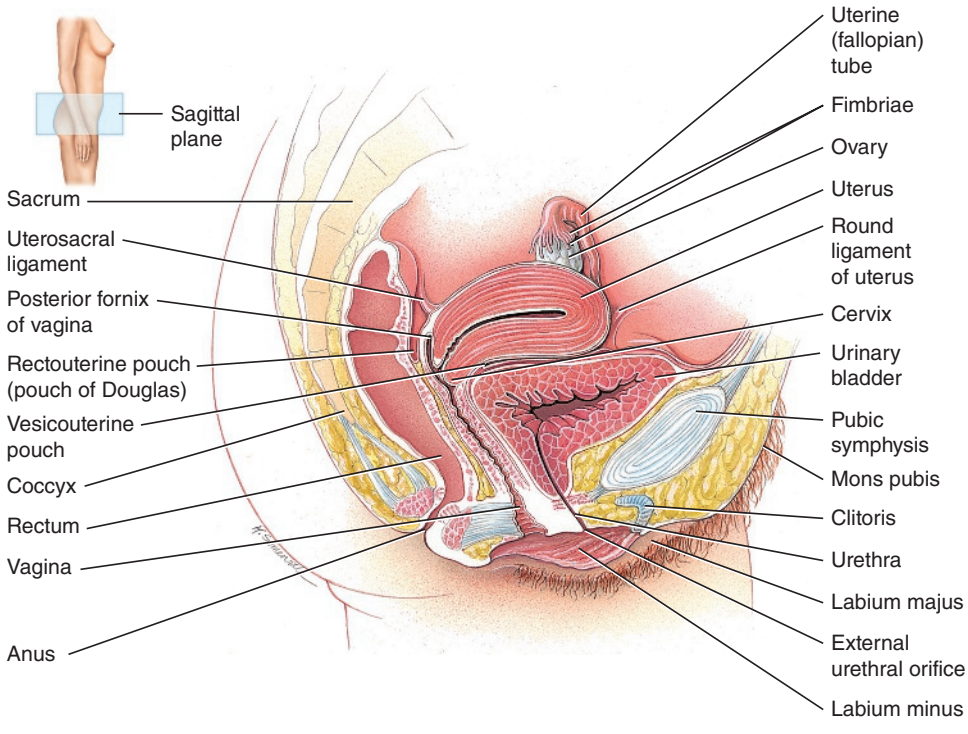

FIGURE 1.1 The female reproductive system

In contrast to men, the urethra and urinary meatus are not classified as reproductive organs in women. However, due to their close proximity, health issues affecting one can frequently impact the other. Figure 1.1 illustrates the location of the female reproductive organs.

THE OVARIES

The ovaries serve as the female gonads, appearing as paired almond-shaped glands positioned on either side of the uterus. A network of ligaments their position; the ovarian ligament links them to the uterus, while the suspensory ligament connects them to the pelvic wall. Aside from serving as storage for female germ cells, the ovaries produce the hormones oestrogen and progesterone. A woman's lifetime supply of ova is established at birth, with ovulation typically commencing monthly once puberty is reached.

Within the ovary are numerous small structures known as ovarian follicles, each housing an immature ovum known as an oocyte. Each month, these follicles undergo stimulation by follicle-stimulating hormone (FSH) and luteinising hormone (LH), which encourage their maturation, this typically leads to ovulation, the release of a mature ovum.

Ovarian follicles primarily reside in the outer region or cortex of the ovary, within dense irregular connective tissue. Meanwhile, the inner portion or medulla houses blood vessels, nerves and lymphatic tissues that are surrounded by loose connective tissue. There is an unclear border between the ovarian cortex and medulla.

OOGENESIS AND FOLLICULAR DEVELOPMENT

Oogenesis refers to the formation of the female gametes in the ovary. Oogonia are diploid ($2n$) stem cells (Mate 2020) that are formed during fetal development. These cells increase in size and develop into primary oocytes, which enter the first stage of meiosis before birth (see Figure 1.2). Women are therefore born with their entire lifetime supply of gametes, unlike males, who will continue to produce spermatozoa throughout their adult life. Primary oocytes remain in the first stage of meiosis until puberty, when the correct hormonal conditions are established for further development of the follicle and the ovum it contains. At this stage, the primary oocyte is surrounded by a single layer of follicle cells and the structure is known as a primordial follicle (see Figure 1.3).

Every month, from puberty and continuing until menopause, the anterior pituitary gland releases FSH and LH, which initiate the growth and maturation of follicles. In response to FSH and LH, a few primordial follicles begin to grow each month, progressing into secondary follicles with increased numbers of follicle cells. These cells secrete fluid, leading to the formation of a cavity within the follicle. These follicles, now called Graafian follicles, are at a stage just before ovulation, during which the diploid primary oocyte undergoes the

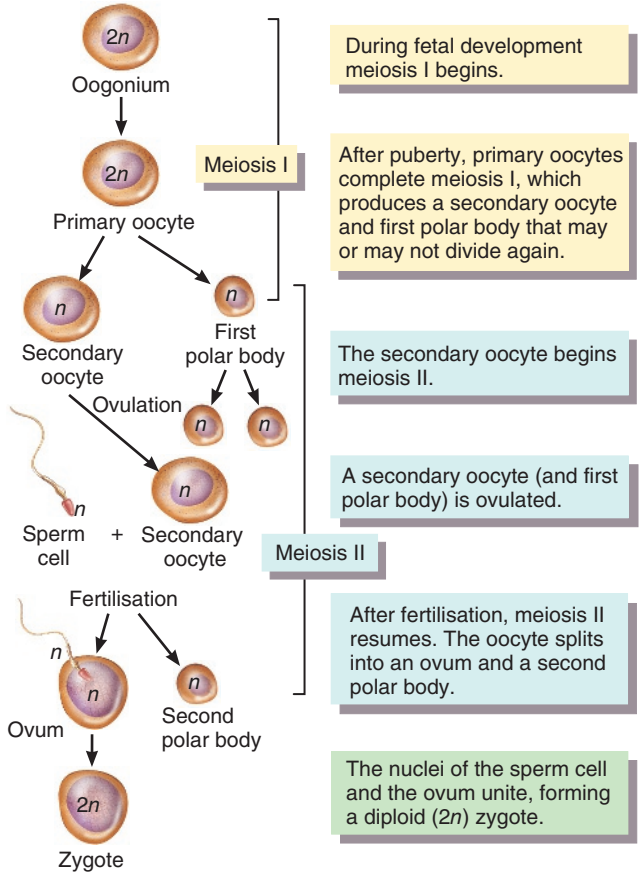

FIGURE 1.2 Oogenesis

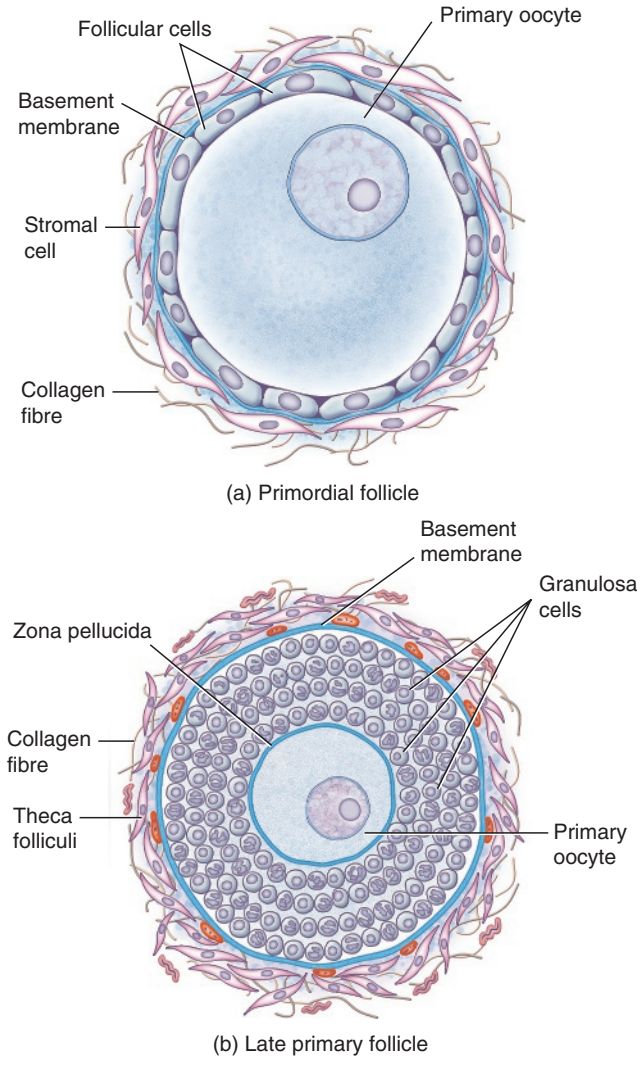

FIGURE 1.3 Developmental sequences associated with maturation of an ovum

first meiotic division to produce a haploid secondary oocyte and a polar body. The polar body, containing minimal cytoplasm, essentially serves as a repository for the unnecessary nuclear material that is discarded by the developing ovum. The secondary oocyte remains arrested during the second meiotic division, which only resumes if fertilisation occurs.

Additionally, the Graafian follicle synthesises oestrogen, which promotes the growth of the endometrium. Typically, only one Graafian follicle attains the maturity necessary to release an oocyte each month. This is known as ovulation.

CORPUS LUTEUM

The remnants of a large, ruptured follicle will become a new structure called the corpus luteum. It produces two hormones, oestrogen and progesterone, to support the endometrium

until conception has taken place or the menstrual cycle begins again. The corpus luteum will gradually disintegrate, and a scar is left on the outside of the ovary that is known as the corpus albicans.

THE FUNCTION OF FEMALE SEX HORMONES

The ovaries continuously produce the hormones oestrogen, progesterone and small amounts of androgens.Oestrogens are essential for the development and maintenance of secondary sex characteristics and perform various other functions. They prepare the female reproductive system for the potential pregnancy and also contribute to the typical structure of the skin and blood vessels. Oestrogens help reduce bone resorption, increase high-density lipoproteins, lower cholesterol levels and promote blood clotting.

Activity of the female reproductive system is controlled by hormones that are released by the brain and the ovaries. It is the combination of all these hormones that reproductive cycle (Peate 2019). The female sex hormones, play pivotal roles in regulating various aspects of reproductive function and overall health in women. Firstly, they regulate the menstrual cycle by coordinating the growth and shedding of the uterine lining. Oestrogen promotes the thickening of the endometrium during the follicular phase, while progesterone supports its maintenance during the luteal phase. Furthermore, these hormones are essential for ovulation, the process by which a mature egg is released from the ovary. Oestrogen stimulates the maturation of ovarian follicles, while progesterone helps prepare the uterine lining for the potential implantation of a fertilised egg.

During pregnancy, oestrogen and progesterone levels rise significantly to support the growth and development of the fetus. They help maintain the uterine lining and prevent contractions that could lead to premature labour.

Additionally, oestrogen plays a key role in maintaining bone health by regulating bone density and preventing bone loss. It contributes to the development of female reproductive organs during puberty, including breast growth and the maturation of the reproductive tract. These hormones also have a role to play in influencing sexual desire and arousal in women, although the exact mechanisms involved are complex and not fully understood.

THE INTERNAL ORGANS

The internal organs of the female reproductive system are the vagina and cervix, uterus, oviducts (also known as fallopian tubes or uterine tubes) and ovaries. The ovaries (discussed earlier) are the primary reproductive organs in women, as well as producing female sex hormones. The vagina, uterus and fallopian tubes act as accessory structures that support the ovaries and the growing fetus.

The internal components of the female reproductive system create a cohesive collection of interconnected structures, with each fulfilling a crucial function in the complex process of reproduction. From the ovaries' inception of egg production to the uterus's nurturing support of the developing fetus, every element works together seamlessly to sustain the marvel of life.

THE UTERUS

This is a hollow organ and is also known as the womb. It is a muscular organ that is located in the pelvic cavity posterior and superior to the urinary bladder; it lies anterior to the rectum. Figure 1.4 summarises the uterus and associated structures.

The uterus is approximately 7.5 cm long. There are three principal aspects that are associated with the uterus:

1. The fundus, a thick muscular region, is located above the fallopian tubes.
2. The body, the main portion of the uterus, is joined to the cervix by an isthmus.
3. The cervix, the narrowest part of the uterus opens into the vagina.

In addition to having three aspects or parts, the uterus is composed of three distinct layers. The outermost layer is known as the perimetrium; it is a serous layer that blends with the peritoneum. Occupying most of the uterine wall, the middle layer is called the myometrium. It contains numerous muscle fibres oriented in various directions, facilitating contractions during menstruation and childbirth, as well as accommodating the growing fetus. Finally, the innermost layer is the endometrium, which lines the uterus and is shed during menstruation. These three layers are summarised in Table 1.1.

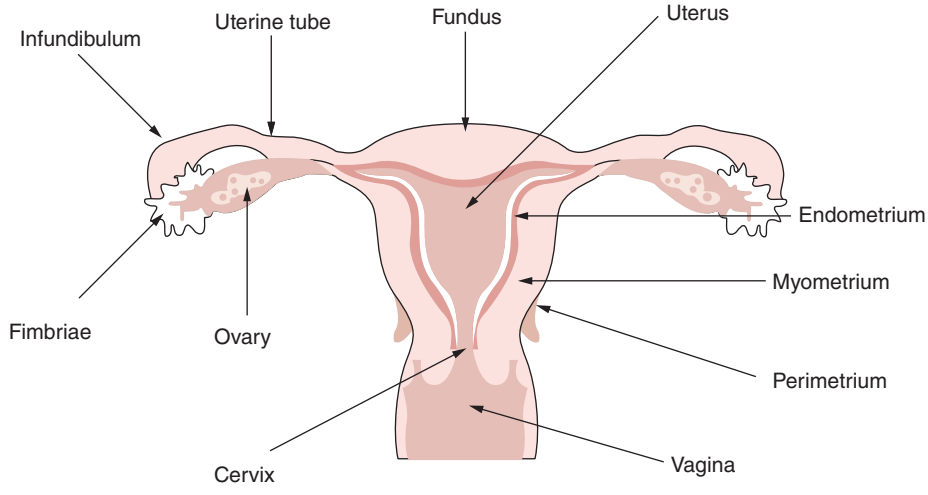

FIGURE 1.4 The uterus and associated structures

Table 1.1 Layers of the uterus

Layer	Description
Endometrium	The endometrium is the mucous membrane that lines the interior of the uterus. This lining undergoes alterations during the menstrual cycle, thickening and becoming well-supplied with blood vessels in anticipation of pregnancy. However, if conception does not occur, a portion of the endometrium is shed, leading to menstrual bleeding.
Myometrium	This layer constitutes the midsection and it consists of smooth muscle tissue. During pregnancy and delivery, the uterus must stretch, a task that is facilitated by this muscular layer. During labour, these muscles contract, aiding in childbirth, while after delivery, they contract vigorously to expel the placenta. Additionally, these contractions serve to regulate postpartum bleeding potential.
Perimetrium	A serous membrane that envelopes the uterus; this is the outer layer. It provides support to the uterus located within the pelvis. This may also be known as the parietal peritoneum.

THE FALLOPIAN TUBES

The paired fallopian tubes (also known as oviducts, salpinges or uterine tubes) are delicate, thin cylindrical structures approximately 8–14 cm long. They are affixed to the uterus at one end and are supported by broad ligaments. The lateral ends of the fallopian tubes are open and made of projections that are called fimbriae; these drape over the ovary. The fimbriae pick up the ovum after it has been discharged from the ovary.

The fallopian tubes have a layer of smooth muscle and are lined with ciliated, mucus-producing epithelial cells. The actions of the cilia and contractions of the smooth muscle transport the ovum along the tubes onwards to the uterus. It is at the end of the fallopian tube, closest to the ovary, where the fertilisation of the ovum by the sperm usually occurs.

The term adnexa is used collectively when discussing the fallopian tubes, ovaries and the supporting tissues.

THE VAGINA

The vaginal canal is a tubular fibromuscular structure that is approximately 8–10 cm in length, and it serves multiple purposes. It acts as the receptacle for the penis during sexual intercourse, facilitates sexual response, provides a passage for menstrual flow and serves as the birth canal. Positioned posterior to the urinary bladder and urethra and anterior to the rectum, the vagina houses the uterine cervix in its upper portion, which is known as the fornix. The vaginal walls are composed of membranous folds of tissue called rugae, which are made up of mucus-secreting stratified squamous epithelial cells.

Normally, the vaginal walls remain moist and maintain a pH level ranging from 3.8 to 4.2. This pH level inhibits bacterial growth (bacteriostatic) and is regulated by oestrogen and healthy vaginal microorganisms, collectively known as the normal vaginal flora. Oestrogen promotes the growth of vaginal mucosal cells, leading to thickening, development and increased glycogen content. The glycogen is then fermented into lactic acid by lactobacilli, organisms that typically reside in the vagina, resulting in a slight acidification of the vaginal fluid.

THE CERVIX

The cervix is a key anatomical structure that extends into the vagina, creating a pathway connecting the uterus to the vagina. It features two distinct openings: the uterine opening, known as the internal os, and the vaginal opening, called the external os. The space between these openings, referred to as the endocervical canal, serves as a conduit for various physiological processes, including the discharge of menstrual fluid, the passage of sperm during fertilisation and the delivery of the infant during childbirth.

Despite its seemingly rigid nature, the cervix is actually quite dynamic, undergoing significant changes in consistency and quantity of protective mucus throughout the uterine cycle and during pregnancy. These alterations in cervical mucus are influenced by hormonal fluctuations and serve to provide optimal conditions for fertility, facilitate sperm transport and protect the reproductive tract from pathogens.

During the menstrual cycle, the cervical mucus undergoes changes in response to fluctuations in oestrogen and progesterone levels. Under the influence of oestrogen, the mucus becomes thin, clear and stretchy, resembling the consistency of egg whites. This type of mucus promotes sperm survival and facilitates their journey through the reproductive tract. In contrast, during the luteal phase of the menstrual cycle, under the influence of progesterone, the cervical mucus becomes thicker and less hospitable to sperm, serving as a barrier to prevent the ascent of pathogens into the uterus.

During pregnancy, the cervix undergoes additional changes in preparation for childbirth. As the pregnancy progresses, the cervix gradually softens, thins and dilates in response to hormonal signals and uterine contractions, ultimately facilitating the passage of the baby through the birth canal during labour and delivery. Additionally, the cervix produces a thick plug of mucus, known as the mucus plug, which seals the cervical canal and provides a protective barrier against infection until labour begins.

The cervix has an important role to play in reproductive health and childbirth, undergoing dynamic changes in response to hormonal fluctuations and the various stages of the reproductive cycle.

THE EXTERNAL GENITALIA

The external genitalia, collectively referred to as the vulva, encompass several structures, including the mons pubis, labia, clitoris, vaginal and urethral openings and glands (see Figure 1.5).

The mons pubis, positioned anteriorly to the pubic symphysis, is a pad of elevated adipose tissue covered with skin to provide cushioning. Following puberty, it typically becomes covered with coarse pubic hair.

The labia consist of two distinct structures. The labia majora are outer folds of skin extending from the base of the mons pubis to the anus, containing an abundance of adipose tissue and pubic hair. Nestled within the labia majora, the labia minora are smaller, light pink folds of skin lacking pubic hair. Comprised of skin, adipose tissue and erectile tissue, the labia minora also house sebaceous glands.

The clitoris, which is a highly sensitive erectile structure, comprises two small erectile bodies called the corpora cavernosa, along with numerous nerves and blood vessels. Covered by a layer of skin known as the clitoral prepuce or hood, formed by the convergence of the labia minora, the exposed portion of the clitoris, called the glans clitoris, is akin to the glans penis in males. Capable of enlargement and important for sexual arousal, the glans clitoris plays a significant role in female sexual response.

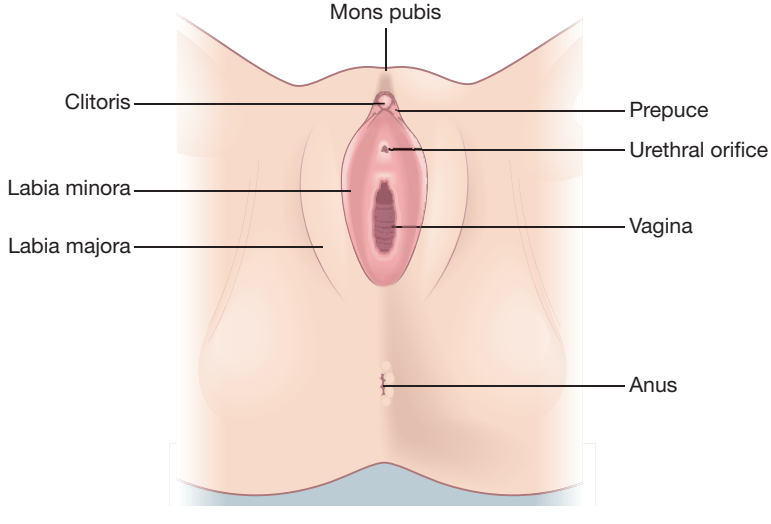

FIGURE 1.5 The external female genitalia

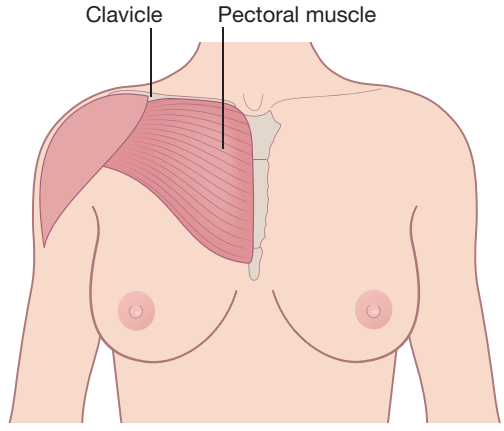

FIGURE 1.6 The breast and surrounding structures

THE BREASTS

The breasts are also known as mammary glands, they are dome-shaped protrusions that vary in size among individuals. Positioned between the third and seventh ribs on the anterior aspect of the chest wall, they are supported by the pectoral muscles and supplied with an extensive network of nerves, blood vessels and lymphatic vessels (see Figure 1.6).

A pigmented area known as the areola is situated a little below the centre of each breast and contains glands that secrete sebum – a thick substance that is composed of fat and cell debris (sebaceous glands) and a nipple. The nipple is usually protruding, becoming erect in response to cold and stimulation.

Comprising adipose (fat) tissue, fibrous connective tissue and milk-producing glandular tissue, the breasts also contain bands of fibrous tissue that provide structural support and extend from the outer breast tissue to the nipple, dividing the breast into 15–25 lobes. These lobes consist of alveolar glands connected by ducts that open onto the nipple. The production of milk is regulated by a hormone called prolactin.

THE MENSTRUAL CYCLE

The menstrual cycle is the series of changes a woman's body goes through to prepare for a pregnancy. The key participants in the female reproductive cycle are the pituitary gland, the ovaries and the uterus; the activities of each of these are very closely coordinated. The reproductive cycle encompasses a series of events that occur regularly every 26–30 days throughout the reproductive years. Each month, one of the ovaries releases a single egg (ovum). This is called ovulation and it occurs as a result of a complex set of interactions. There are three sets of hormones that control the menstrual cycle.

1. Gonadotrophin-releasing hormones: luteinising hormone-releasing hormone and follicle-stimulating hormone-releasing hormone.
2. Gonadotrophins: LH and FSH.
3. Ovarian hormones: oestrogen and progesterone.

Figure 1.7 provides an overview of the hormonal regulation of the changes in the ovary and uterus. Figure 1.8 describes the changes in the concentration of anterior pituitary and ovarian hormones.

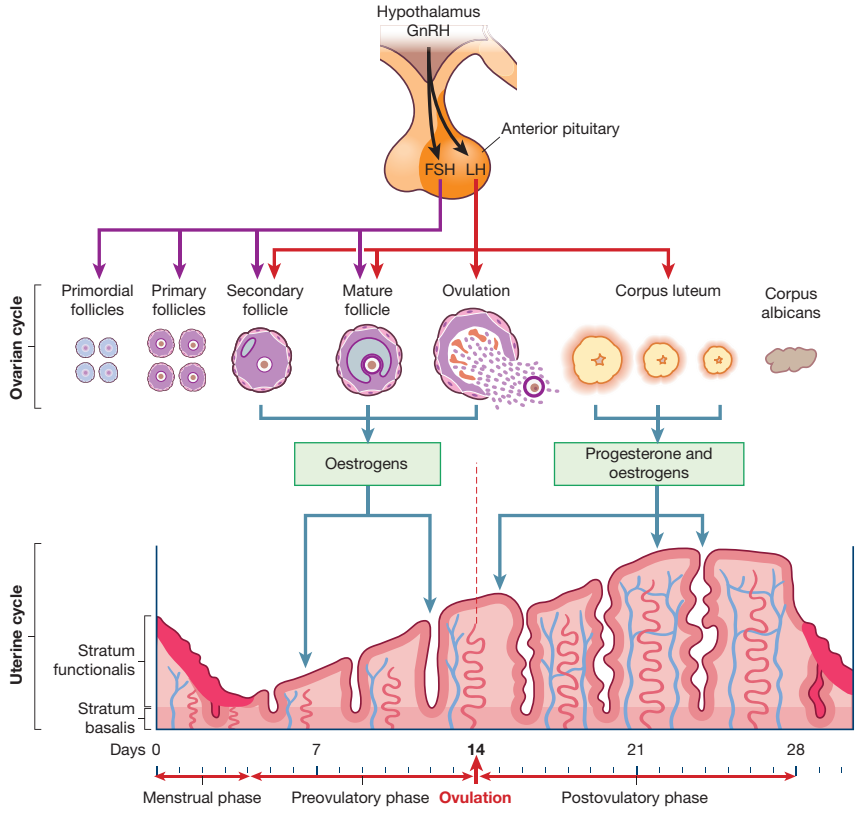

FIGURE 1.7 Hormonal regulation of the changes occurring in the ovary and uterus

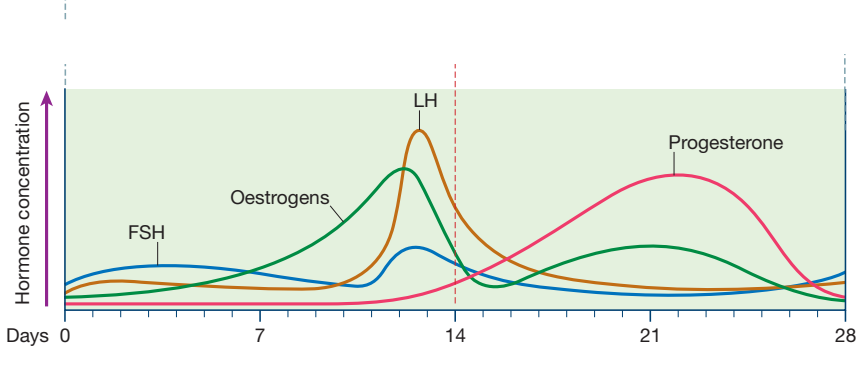

FIGURE 1.8 Changes in the concentration of anterior pituitary and ovarian hormones

THE PITUITARY GLAND

The hypothalamus regulates the functions of the pituitary gland, initiating the menstrual cycle by stimulating the secretion of FSH and LH through nerve cell activity. Hormone-releasing factors from the hypothalamus, known as gonadotropin-releasing hormones, govern the release of pituitary hormones, specifically, the gonadotropins FSH and LH. These

hormones, produced by the anterior pituitary gland, play a crucial role in regulating the ovarian hormones oestrogen and progesterone.

THE FOLLICULAR PHASE

Also referred to as the proliferative phase, this marks the initial stage of the menstrual cycle, paving the way for ovulation as the ovary prepares itself to release an egg. Typically spanning a 28-day cycle, the follicular phase encompasses the first 14 days. During this phase, FSH levels surge from the pituitary gland, prompting the development of multiple follicles on the ovarian surface, each housing an egg.

As FSH levels decrease, only one follicle persists in its development, simultaneously secreting oestrogen. This hormone plays a pivotal role in priming the endometrium for the potential egg implantation. During the early follicular phase, after the menstrual flow ends, the uterine lining is at its thinnest, with oestrogen and progesterone levels at their lowest.

Progressing through the follicular phase, the uterine lining undergoes proliferation or thickening, preparing to provide an optimal environment for embryo implantation.

THE OVULATORY PHASE

Ovulation is the key event of the menstrual cycle. Each cycle witnesses the release of a single egg from the dominant ovarian follicle in response to a surge in LH, with a narrow window for fertilisation lasting up to 48 hours.

This phase is characterised by a surge in pituitary LH secretion, culminating in the expulsion of the mature ovum through the ovarian capsule. The LH peak typically occurs mid-cycle, triggering ovulation approximately 16–32 hours after the onset of the LH surge. Following ovulation, LH levels decline within a couple of days.

Concurrently, oestrogen levels gradually rise from the ovaries towards ovulation, peaking during the LH surge – an essential aspect of the ovulatory process. Meanwhile, progesterone levels begin to elevate in anticipation of follicle release, priming the endometrial lining of the uterus for the potential implantation.

THE LUTEAL PHASE

During the post-ovulation phase, also known as the luteal or premenstrual phase, there is a decline in the levels of LH and FSH. Following the release of the ovum, the ruptured follicle undergoes closure and transforms into a corpus luteum, which generates substantial amounts of progesterone. This hormone serves to inhibit oestrogen from inducing another surge of LH from the pituitary gland.

If fertilisation occurs, the egg is fertilised by sperm and subsequently implants in the endometrium, leading to pregnancy. The onset of pregnancy is dated from day 1 of the menstrual cycle in which this occurs. However, if fertilisation fails to take place, the corpus luteum begins to degenerate, this causes a decline in progesterone and oestrogen levels.

Consequently, the blood vessels within the endometrium constrict, leading to breakdown and shedding of the endometrial lining.

THE MONTHLY CYCLE

The first day of the cycle is counted as the first day of the bleed – day 1. The cycle runs from the first day of menstruation to the next first day; 28 days is the average cycle length but, the cycle may be shorter or longer. A teenager's cycle may be long (up to 45 days), becoming

shorter over several years. Between 25 and 35 years, most women's cycles are regular and they generally last 21–35 days. At about 40–42 years, cycles tend to be the shortest and most regular. This is followed by 8–10 years of longer, less predictable cycles until the menopause occurs.

Menstruation primarily involves changes in the endometrium, this is triggered by the decrease in progesterone levels resulting from the degeneration of the corpus luteum in cycles where conception does not occur. Within the endometrium, significant structural alterations take place during menstruation. While some of these changes are well understood, others are not.

CONCLUSION

Understanding the intricacies of the female reproductive system is crucial for healthcare providers who offer people care that is safe, effective and patient centred. This chapter has explored the anatomical structures, physiological processes and essential functions of the female reproductive system.

From the ovaries, where ova are produced and hormones such as oestrogen and progesterone are synthesised, to the fallopian tubes, uterus and vagina, each component plays a vital role in the reproductive process. An overview of the menstrual cycle, ovulation and the hormonal regulations that govern these processes has been provided.

By applying understanding and knowledge to clinical this can help to make significant contributions to promoting the well-being and empowerment of individuals within their care.

GLOSSARY OF TERMS

Areola: The pigmented area surrounding the nipple of the breast, containing sebaceous glands and sweat glands.

Adnexa: The accessory structures adjacent to the uterus within the female reproductive system, including the ovaries, fallopian tubes and supporting ligaments.

Cervix: The cylindrical, fibrous portion of the uterus that projects into the vagina, serving as a passageway for menstrual blood and sperm.

Clitoris: A small, highly sensitive erectile organ located at the anterior junction of the labia minora, consisting of erectile tissue and nerve endings.

Endometrium: The inner mucous membrane lining of the uterus, composed of epithelial cells and glandular tissue, which thickens and sheds during the menstrual cycle in response to hormonal changes.

Fallopian tubes: Also called oviducts, these are paired tubes extending from the uterus to the ovaries, providing a pathway for the transport of eggs and the site of fertilisation.

Follicle: A fluid-filled structure within the ovary containing an immature egg (oocyte) surrounded by follicular cells, which undergoes maturation and ovulation under the influence of hormones.

Labia majora: The outermost pair of skin folds surrounding the vaginal opening, composed of adipose tissue, sebaceous glands and hair follicles.

Labia minora: The inner pair of skin folds within the labia majora, containing erectile tissue and serving to protect the vestibule of the vagina.

Menstruation: The cyclic shedding of the endometrial lining of the uterus, characterised by vaginal bleeding, which occurs in response to hormonal changes during the menstrual cycle.

Myometrium: The middle layer of the uterine wall, composed of smooth muscle tissue. It is the thickest layer of the uterus and is responsible for its contractile properties. During childbirth, the myometrium contracts rhythmically to facilitate the expulsion of the fetus from the uterus. Additionally, during menstruation, contractions of the myometrium help expel menstrual blood from the uterus.

Ovary: The paired female reproductive organs responsible for producing eggs (ova) and sex hormones, including oestrogen and progesterone.

Ovulation: The release of a mature egg (ovum) from a ruptured ovarian follicle into the fallopian tube, occurring midway through the menstrual cycle under the influence of luteinising hormone (LH).

Perimetrium: The outermost layer of the uterus, consisting of a thin serous membrane that covers the muscular walls of the organ.

Uterus: A hollow, muscular organ situated in the pelvis, where implantation of a fertilised egg occurs and embryonic/fetal development takes place during pregnancy.

Vagina: A muscular canal extending from the cervix to the external genitalia, serving as a passageway for menstrual flow, sexual intercourse and childbirth.

Vulva: The external female genitalia, consisting of the labia majora, labia minora, clitoris, vaginal opening and vestibule.

MULTIPLE CHOICE QUESTIONS

1. What is the primary function of the ovaries?
   a) Production of eggs
   b) Secretion of oestrogen and progesterone
   c) Both a and b
   d) Regulation of menstrual cycle

2. Which structure connects the ovaries to the uterus?
   a) Fallopian tubes
   b) Uterine ligaments
   c) Ovarian ligaments
   d) Broad ligament

3. The inner lining of the uterus that thickens and sheds during the menstrual cycle is called:
   a) Myometrium
   b) Endometrium
   c) Perimetrium
   d) Myoendometrium

4. What is the name of the small, highly sensitive organ located at the anterior junction of the labia minora?
   a) Clitoris
   b) Cervix
   c) Bartholin's gland
   d) Perineum

5. During which phase of the menstrual cycle does ovulation occur?
   a) Menstrual phase
   b) Follicular phase
   c) Luteal phase
   d) Proliferative phase

6. What is the main hormone responsible for thickening the endometrium during the menstrual cycle?
   a) Oestrogen
   b) Progesterone
   c) Follicle-stimulating hormone
   d) Luteinising hormone

7. The finger-like projections at the end of the fallopian tubes that capture the released egg are called:
   a) Cilia
   b) Fimbriae
   c) Villi
   d) Microvilli

8. What is the function of the corpus luteum?
   a) Production of oestrogen
   b) Production of progesterone
   c) Production of eggs
   d) Both a and b

9. The menstrual cycle is controlled by hormones released from which gland?
   a) Ovaries
   b) Hypothalamus
   c) Pituitary gland
   d) Thyroid gland

10. What is the main function of the fallopian tubes?
    a) Production of eggs
    b) Fertilisation of the egg
    c) Secretion of hormones
    d) Menstrual flow

REFERENCES

Mate, K. (2020). The reproductive systems (Chapter 13). In: *Fundamentals of Anatomy and Physiology*, 3e (eds. I. Peate and S. Evans). Oxford: Wiley.

Peate, I. (2019). Reproductive Disorders (Chapter 34). In: *Learning to Care* (ed. I. Peate). London: Elsevier.