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Reproductive System

Anatomy & Physiology

Male and female reproductive organs

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Reproductive System - B.Sc. Nursing Applied Anatomy Notes

1. Introduction

The reproductive system is responsible for the production of sex cells (gametes), secretion of sex hormones, fertilisation and reproduction.

It is divided into two main parts:

1. Male reproductive system
2. Female reproductive system

Main functions:

- Production of sperm and ova.
- Secretion of sex hormones.
- Transport of reproductive cells.
- Fertilisation.
- Support of pregnancy and childbirth in females.
- Development of secondary sexual characteristics.

2. Male Reproductive System

Definition

The male reproductive system consists of organs responsible for producing, storing and transporting sperm and secreting male sex hormones, mainly testosterone.

Parts of Male Reproductive System

1. Testes
2. Scrotum
3. Epididymis
4. Vas deferens
5. Ejaculatory ducts
6. Urethra
7. Penis
8. Accessory reproductive glands

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A. Testes

Definition

The testes are a pair of oval-shaped male reproductive glands that produce sperm and testosterone.

Location

- Located inside the scrotum.
- Usually the left testis hangs slightly lower than the right.
- Each testis is covered by a fibrous capsule called the tunica albuginea.

Structure

Each testis contains approximately 200-300 lobules.

Each lobule contains seminiferous tubules, where sperm production occurs.

Important cells:

- Sertoli cells: Support and nourish developing sperm cells and form the blood-testis barrier.
- Leydig cells: Located between seminiferous tubules and produce testosterone.

Functions

- Produces sperm through spermatogenesis.
- Secretes testosterone.
- Supports the development of male secondary sexual characteristics.

B. Scrotum

Definition

The scrotum is a skin-covered muscular sac that contains the testes.

Structure

- Divided into two compartments by a septum.
- Contains the testes, epididymides and lower parts of the spermatic cords.
- Contains dartos muscle and cremaster muscle.

Functions

- Protects the testes.
- Maintains testicular temperature approximately 2-3 C below core body temperature.
- Helps regulate testicular temperature through muscular contraction and relaxation.

C. Epididymis

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Definition

The epididymis is a long, highly coiled tube attached to the posterior surface of each testis.

Parts

1. Head
2. Body
3. Tail

Functions

- Allows sperm maturation.
- Stores sperm.
- Transports sperm toward the vas deferens.

D. Vas Deferens (Ductus Deferens)

Definition

The vas deferens is a muscular tube that carries sperm from the epididymis toward the ejaculatory duct.

Structure

- Begins at the tail of the epididymis.
- Passes through the spermatic cord and inguinal canal.
- Enters the pelvis.
- Joins the duct of the seminal vesicle to form the ejaculatory duct.

Function

Transports sperm during ejaculation through muscular contractions.

E. Ejaculatory Ducts

- Two ejaculatory ducts are present.
- Each is formed by the union of the vas deferens and the duct of a seminal vesicle.
- They pass through the prostate gland.
- They open into the prostatic urethra.

Function: Carry sperm and seminal vesicle secretions into the urethra.

F. Urethra

The male urethra is a tube that carries urine and semen out of the body at different times.

Parts

1. Pre-prostatic (intramural) urethra
2. Prostatic urethra

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3. Membranous urethra
4. Spongy (penile) urethra

Length: Approximately 18-20 cm.

G. Penis

Definition

The penis is the external male reproductive organ and also serves as the passage for urine.

Parts

1. Root
2. Body or shaft
3. Glans penis

Internal Structure

The penis contains three columns of erectile tissue:

- Two corpora cavernosa.
- One corpus spongiosum, which surrounds the spongy urethra.

The glans is the expanded distal end of the corpus spongiosum.

Functions

- Deposits semen into the female reproductive tract during sexual intercourse.
- Allows the passage of urine.
- Contains erectile tissue that produces erection.

H. Accessory Reproductive Glands

The male reproductive system contains three major accessory gland groups.

1. Seminal Vesicles

- Two glands located behind the urinary bladder.
- Produce a fructose-rich fluid.
- Contribute a major portion of semen volume.
- Provide energy to sperm.
- Their secretion contains substances such as prostaglandins.

2. Prostate Gland

- Located below the urinary bladder.
- Surrounds the prostatic urethra.
- Produces a thin fluid containing enzymes and other substances.
- Contributes to semen formation and sperm function.

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3. Bulbourethral (Cowper's) Glands

- Two small glands located below the prostate.
- Secrete mucus-like pre-ejaculatory fluid.
- Help lubricate the urethra.

Functions of Male Reproductive System

- Produces sperm.
- Produces testosterone.
- Transports and stores sperm.
- Produces seminal fluid.
- Deposits semen into the female reproductive tract.

3. Spermatogenesis

Definition

Spermatogenesis is the process of formation of mature sperm cells from spermatogonial cells in the seminiferous tubules of the testes.

Stages of Spermatogenesis

1. Multiplication phase: Spermatogonia divide by mitosis.
2. Growth phase: Some spermatogonia grow into primary spermatocytes.
3. Maturation phase: Primary spermatocytes undergo meiosis I to form secondary spermatocytes; meiosis II produces spermatids.
4. Spermiogenesis: Spermatids develop into spermatozoa.

Structure of Sperm

A mature sperm consists of:

1. Head: Contains the haploid nucleus and acrosome.
2. Neck: Connects the head to the middle piece.
3. Middle piece: Contains mitochondria that provide energy.
4. Tail: Helps sperm move.

Normal chromosome number: 23 chromosomes (haploid).

4. Female Reproductive System

Definition

The female reproductive system consists of organs responsible for producing ova, secreting female sex hormones, receiving sperm, supporting fertilisation, pregnancy, childbirth and lactation.

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Parts of Female Reproductive System

Internal Organs

1. Ovaries
2. Fallopian tubes (uterine tubes)
3. Uterus
4. Vagina

External Organs

Collectively called the vulva:

- Mons pubis
- Labia majora
- Labia minora
- Clitoris
- Vestibule
- Greater vestibular glands

Accessory Organ

- Mammary glands (breasts)

A. Ovaries

Definition

The ovaries are a pair of female reproductive glands that produce ova and secrete oestrogen and progesterone.

Location

- Located on either side of the uterus.
- Situated in the pelvic cavity.
- Attached to the uterus and pelvic wall by supporting ligaments.

Structure

Each ovary has two main regions:

1. Cortex: Outer region containing ovarian follicles at different stages of development.
2. Medulla: Inner region containing blood vessels, nerves and connective tissue.

Functions

- Produces ova.
- Secretes oestrogen.
- Secretes progesterone, particularly from the corpus luteum after ovulation.

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- Helps regulate the menstrual cycle.
- Supports female secondary sexual characteristics.

B. Fallopian Tubes (Uterine Tubes)

Definition

The fallopian tubes are two muscular tubes that transport the ovum from the ovary toward the uterus.

Length

Approximately 10-12 cm each.

Parts

1. Infundibulum: Funnel-shaped lateral end with finger-like projections called fimbriae.
2. Ampulla: Widest and longest part; the usual site of fertilisation.
3. Isthmus: Narrow medial portion.
4. Intramural (interstitial) part: Passes through the uterine wall.

Functions

- Receives the ovulated oocyte.
- Transports the oocyte toward the uterus.
- Provides the usual site for fertilisation.
- Supports early movement of the fertilised egg toward the uterus.

C. Uterus

Definition

The uterus is a hollow, muscular, pear-shaped organ in which implantation and development of the embryo and fetus normally occur.

Location

- Situated in the pelvic cavity.
- Lies between the urinary bladder and rectum.
- Normally anteverted and anteflexed, although position varies.

Size

In a non-pregnant adult, approximately:

- Length: 7-8 cm.
- Width: 4-5 cm.
- Thickness: 2-3 cm.

These measurements vary with age, parity and hormonal status.

Parts of Uterus

1. Fundus: Upper rounded portion above the openings of the uterine tubes.
2. Body: Main central part.
3. Isthmus: Narrow region between the body and cervix.
4. Cervix: Lower narrow portion that opens into the vagina.

Layers of Uterine Wall

1. Perimetrium: Outer serous covering.
2. Myometrium: Thick middle muscular layer responsible for uterine contractions.
3. Endometrium: Inner mucosal lining that undergoes cyclic changes during menstruation and supports implantation.

Functions

- Receives the fertilised ovum for implantation.
- Supports development of the embryo and fetus.
- Provides muscular contractions during childbirth.
- Participates in menstruation when pregnancy does not occur.

D. Vagina

Definition

The vagina is a muscular, elastic canal connecting the cervix of the uterus to the exterior.

Length

Approximately 7-10 cm in an adult, with variation.

Location

- Extends from the cervix to the vaginal opening.
- Lies behind the urinary bladder and urethra.
- Lies in front of the rectum.

Structure

- Fibromuscular wall.
- Lined by non-keratinised stratified squamous epithelium.
- Normally has an acidic environment in reproductive-age individuals due largely to lactobacilli and lactic acid.

Functions

- Receives the penis and semen during sexual intercourse.
- Provides passage for menstrual flow.
- Forms the birth canal during vaginal delivery.

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5. External Female Reproductive Organs (Vulva)

The vulva refers to the external genital structures of the female reproductive system.

Parts

1. Mons Pubis

- Rounded fatty area over the pubic symphysis.
- Usually develops pubic hair after puberty.
- Provides cushioning.

2. Labia Majora

- Two outer folds of skin.
- Contain connective tissue and fatty tissue.
- Help protect the external genital structures.

3. Labia Minora

- Two inner folds located inside the labia majora.
- Surround the vestibule.
- Contain no significant fat.

4. Clitoris

- Small, highly sensitive erectile organ.
- Contains erectile tissue.
- Important in sexual sensation.

5. Vestibule

The area between the labia minora containing:

- External urethral opening.
- Vaginal opening.
- Openings of the greater vestibular glands.

6. Greater Vestibular (Bartholin's) Glands

- Located on either side of the vaginal opening.
- Secrete mucus that helps lubricate the vestibule.

6. Mammary Glands (Breasts)

Definition

Mammary glands are modified sweat glands that produce milk to nourish an infant.

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Location

- Present in the breasts on the anterior chest wall.
- Extend approximately from the second to sixth ribs.
- Extend from the lateral border of the sternum toward the midaxillary region.

Structure

Each breast contains:

1. Glandular tissue: Consists of lobes and lobules containing milk-producing alveoli.
2. Lactiferous ducts: Carry milk toward the nipple.
3. Nipple: Contains openings of lactiferous ducts.
4. Areola: Pigmented area surrounding the nipple.
5. Adipose tissue: Provides much of the breast's size and shape.
6. Suspensory ligaments of Cooper: Support the breast.

Functions

- Produces milk after childbirth.
- Provides nutrition and immune protection to the infant.
- Supports breastfeeding.

7. Oogenesis

Definition

Oogenesis is the process of formation and development of the female gamete (ovum) in the ovaries.

Stages of Oogenesis

1. Multiplication: Oogonia multiply by mitosis during fetal development.
2. Growth: Primary oocytes develop and begin meiosis I.
3. First meiotic division: Usually completed shortly before ovulation, producing a secondary oocyte and first polar body.
4. Second meiotic division: The secondary oocyte begins meiosis II and is arrested at metaphase II. It completes meiosis II only if fertilisation occurs.

Important: The cell released at ovulation is usually a secondary oocyte, not a fully mature ovum.

8. Menstrual Cycle

Definition

The menstrual cycle is a series of cyclic changes in the ovaries and uterus that prepares the female reproductive system for possible pregnancy.

Average cycle length: Approximately 28 days, although normal cycles vary.

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Phases of Menstrual Cycle

1. Menstrual Phase (Approximately Days 1-5)

- The functional layer of the endometrium is shed.
- Menstrual bleeding occurs.
- Oestrogen and progesterone levels are low.

2. Follicular or Proliferative Phase (Approximately Days 1-13)

- FSH stimulates ovarian follicle development.
- Developing follicles produce oestrogen.
- The endometrium repairs and thickens.

3. Ovulation (Around Day 14 in a 28-Day Cycle)

- A surge in LH triggers ovulation.
- The secondary oocyte is released from the mature follicle.
- The oocyte enters the fallopian tube.

4. Luteal or Secretory Phase (Approximately Days 15-28)

- The ruptured follicle develops into the corpus luteum.
- The corpus luteum secretes progesterone and some oestrogen.
- The endometrium becomes suitable for implantation.
- If pregnancy does not occur, the corpus luteum regresses and hormone levels fall, initiating menstruation.

Note: Ovulation does not always occur on day 14. Its timing depends on the length of the menstrual cycle.

9. Female Reproductive Hormones

Hormone

Main source

Main function

FSH

Anterior pituitary

Stimulates ovarian follicle development

LH

Anterior pituitary

Triggers ovulation and corpus luteum formation

Oestrogen

Mainly developing ovarian follicles

Develops female secondary sexual characteristics and supports endometrial growth

Progesterone

Mainly corpus luteum; placenta during pregnancy

Maintains the endometrium and supports pregnancy

Inhibin

Ovaries

Inhibits FSH secretion

hCG

Placenta (developing trophoblast)

Maintains the corpus luteum in early pregnancy

Prolactin

Anterior pituitary

Stimulates milk production

Oxytocin

Synthesised in hypothalamus; released by posterior pituitary

Stimulates uterine contractions and milk ejection

10. Fertilisation and Implantation

Fertilisation

Fertilisation is the union of a sperm and a secondary oocyte to form a diploid zygote.

- Usually occurs in the ampulla of the fallopian tube.
- The sperm penetrates the oocyte.
- The male and female genetic material combines.
- A diploid zygote is formed with 46 chromosomes.

Implantation

Implantation is the attachment and embedding of the developing blastocyst into the endometrium.

- Usually begins approximately 6-7 days after fertilisation.
- Occurs in the uterine lining.
- Establishes the early connection between the developing embryo and maternal tissues.

11. Differences Between Male and Female Reproductive Systems

Feature

Male

Female

Main gonads

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Testes

Ovaries

Gametes

Sperm

Oocytes/ova

Main sex hormones

Testosterone

Oestrogen and progesterone

Gamete production

Begins at puberty and continues throughout adult life

Oocytes mature cyclically after puberty until menopause

Main reproductive role

Produces and delivers sperm

Produces oocytes and supports pregnancy

External organs

Penis and scrotum

Vulva

Internal organs

Epididymis, vas deferens, ejaculatory ducts and accessory glands

Uterine tubes, uterus and vagina

12. Common Reproductive System Disorders

Male Reproductive Disorders

Disorder

Description

Benign prostatic hyperplasia (BPH)

Non-cancerous enlargement of the prostate

Prostatitis

Inflammation of the prostate gland

Prostate cancer

Malignant growth in the prostate

Testicular torsion

Twisting of the spermatic cord, compromising blood supply

Epididymitis

Inflammation of the epididymis

Orchitis

Inflammation of the testis

Varicocele

Dilatation of veins in the pampiniform plexus

Hydrocele

Collection of fluid around the testis

Erectile dysfunction

Difficulty achieving or maintaining an erection

Male infertility

Inability to achieve pregnancy due to male reproductive factors

Female Reproductive Disorders

Disorder

Description

Polycystic ovary syndrome (PCOS)

Hormonal and metabolic disorder affecting ovarian function

Endometriosis

Endometrial-like tissue grows outside the uterus

Uterine fibroids

Benign tumours arising from uterine smooth muscle

Pelvic inflammatory disease (PID)

Infection involving the upper female reproductive tract

Cervicitis

Inflammation of the cervix

Ovarian cyst

Fluid-filled or other cystic structure in the ovary

Cervical cancer

Malignant growth of the cervix

Ovarian cancer

Malignant growth of the ovary

Uterine prolapse

Descent of the uterus into the vagina

Infertility

Inability to achieve pregnancy after a specified period of regular unprotected intercourse

13. Nursing Importance of the Reproductive System

Knowledge of reproductive anatomy is essential for reproductive health assessment, patient education, maternal care and prevention of reproductive disorders.

Nursing Assessment

- Obtain relevant menstrual and reproductive history.
- Assess menstrual cycle pattern, duration and associated symptoms.
- Assess for pelvic pain, abnormal bleeding and abnormal discharge.
- Observe for urinary or reproductive symptoms.
- Assess pregnancy history when relevant.
- Maintain privacy, dignity and informed consent during examinations.

Nursing Responsibilities

- Provide education about menstrual hygiene.
- Explain reproductive anatomy and physiology.
- Promote awareness of contraception and family planning.
- Educate about sexually transmitted infections (STIs) and prevention.
- Encourage appropriate cervical cancer screening and HPV vaccination according to guidelines.
- Support breastfeeding and provide lactation education.
- Identify warning signs such as severe pelvic pain, abnormal bleeding and testicular pain.
- Provide non-judgmental counselling about sexual and reproductive health.
- Maintain confidentiality and respect patient autonomy.

Important Emergency Signs

- Sudden severe testicular pain may indicate testicular torsion and requires emergency assessment.
- Severe pelvic pain with possible pregnancy may indicate ectopic pregnancy.
- Heavy vaginal bleeding with dizziness or fainting requires urgent assessment.
- Fever with pelvic pain may indicate serious infection.

14. Important Questions for Nursing Examinations

Long Answer Questions

1. Describe the anatomy of the male reproductive system with a labelled diagram.
2. Explain the anatomy of the female reproductive system with a labelled diagram.
3. Describe the structure and functions of the uterus.
4. Explain spermatogenesis and the structure of sperm.

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5. Describe the menstrual cycle and its hormonal regulation.
6. Explain oogenesis and fertilisation.

Short Answer Questions

1. Write the functions of the testes.
2. Explain the structure of the epididymis.
3. Write the functions of the prostate gland.
4. Describe the parts of the male urethra.
5. Explain the structure of the ovary.
6. Write the parts of the fallopian tube.
7. Describe the three layers of the uterus.
8. Explain the functions of the vagina.
9. Define ovulation.
10. Write the functions of mammary glands.

Very Short Answer Questions

1. What is the male gamete? Answer: Sperm.
2. What is the female gamete? Answer: Oocyte.
3. Which hormone is secreted by Leydig cells? Answer: Testosterone.
4. Where does sperm production occur? Answer: Seminiferous tubules.
5. Where does fertilisation usually occur? Answer: Ampulla of the fallopian tube.
6. What is the functional unit of the testis for sperm production? Answer: Seminiferous tubule.
7. Which hormone triggers ovulation? Answer: Luteinising hormone (LH).
8. Which layer of the uterus is shed during menstruation? Answer: Functional layer of the endometrium.
9. What is the average menstrual cycle length? Answer: Approximately 28 days.
10. Which hormone stimulates milk production? Answer: Prolactin.
11. Which hormone causes milk ejection? Answer: Oxytocin.
12. What is the main male sex hormone? Answer: Testosterone.

15. Quick Revision

- The reproductive system is divided into male and female systems.
- Testes produce sperm and testosterone.
- Seminiferous tubules are the sites of sperm production.
- Sertoli cells support developing sperm.
- Leydig cells produce testosterone.
- Epididymis is responsible for sperm maturation and storage.

- Vas deferens transports sperm.
- Seminal vesicles, prostate and bulbourethral glands contribute to seminal fluid.
- The penis is the male external reproductive organ.
- Ovaries produce oocytes, oestrogen and progesterone.
- Fallopian tubes transport the oocyte.
- The ampulla is the usual site of fertilisation.
- The uterus supports implantation and fetal development.
- The endometrium is the inner uterine layer.
- The myometrium is the muscular uterine layer.
- The vagina serves as the birth canal.
- The menstrual cycle involves ovarian and uterine changes.
- LH surge triggers ovulation.
- Progesterone supports the endometrium.
- Prolactin stimulates milk production.
- Oxytocin stimulates milk ejection.

Conclusion

The reproductive system plays an essential role in human reproduction, hormone secretion and sexual development. The male system produces and transports sperm, while the female system produces oocytes and supports fertilisation, pregnancy, childbirth and lactation. Understanding reproductive anatomy and physiology is important for nursing examinations, reproductive health education and clinical practice.

Quick Revision

- Male organs & sperm pathway: The testes lie in the scrotum; seminiferous tubules contain developing sperm and Sertoli cells. Interstitial Leydig cells produce testosterone. Sperm travel through straight tubules -> rete testis -> efferent ductules -> epididymis -> ductus deferens -> ejaculatory duct -> urethra.

- Female organs: Ovaries lie in the pelvis and contain follicles. Uterine tube regions are infundibulum with fimbriae, ampulla, isthmus and uterine part. Fertilization most commonly occurs in the ampulla.

- Uterine wall & support: Pelvic floor muscles and connective-tissue supports help maintain organ position. Broad ligaments are peritoneal folds; they are not the sole support of the uterus.

- Mammary glands: Mammary glands occupy the superficial tissue of the anterior chest. Lobes contain lobules and alveoli, with ducts opening at the nipple. Fibrous suspensory ligaments support the breast; much lymph drains to axillary nodes.

Examination questions

1. Trace sperm from testis to urethra.
2. Name uterine tube parts.
3. Compare the three uterine wall layers.

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Practice questions

Choose one best answer. The answer key and explanations follow the questions.

1. The thick muscular uterine layer is the:

A. Endometrium

B. Myometrium

C. Perimetrium

D. Mesometrium

2. Where does sperm mature and acquire motility?

A. Epididymis

B. Prostate

C. Bladder

D. Seminal vesicle

3. Which tube region commonly hosts fertilization?

A. Isthmus

B. Uterine part

C. Ampulla

D. Cervix

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Answer key and explanations

1. B - Myometrium

The myometrium consists mainly of smooth muscle.

2. A - Epididymis

The epididymis is a site of sperm maturation and storage.

3. C - Ampulla

The ampulla is the usual site.

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