An Overview of the Female Reproductive System: A Narrative Literature Review

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A B S T R A C T

The female reproductive system is a biological system that is responsible for producing, transporting, and storing eggs and facilitating the meeting between eggs and sperm for fertilization. The female reproductive system consists of internal and external organs. This literature review aimed to describe the female reproductive system. Internal organs include the ovaries (ovaries), fallopian tubes (oviducts), uterus (womb), cervix (cervix), and vagina. The ovary is the main female reproductive organ. The two main functions of the ovaries are the secretion of female sex hormones and the development and release of female gametes, or ova. The almond-shaped ovaries are located on either side of the uterus and are supported and supported by the halves mesovarium of the broad, ovarian, and suspensory ligaments. The female reproductive system is also influenced by reproductive hormones such as estrogen, progesterone, and gonadotropins which are produced by the pituitary gland and ovaries.

1. Introduction

The female reproductive system is a biological system that is responsible for producing, transporting, and storing eggs and facilitating the meeting between eggs and sperm for fertilization. The female reproductive system consists of internal and external organs. Internal organs include the ovaries (ovaries), fallopian tubes (oviducts), uterus (womb), cervix, and vagina. The ovaries are organs that produce egg cells and female reproductive hormones, namely estrogen, and progesterone. The fallopian tube is a tube that connects the ovary and uterus and is the meeting place for the egg and sperm. The uterus is the organ where the fetus develops during pregnancy. The cervix is the cervix that connects the uterus to the vagina. The vagina is an external organ that is the outlet for menstruation and also a place for sexual intercourse. The female reproductive system is also influenced by reproductive hormones such as estrogen, progesterone, and gonadotropins which are produced by the pituitary gland and ovaries. This hormonal balance is important for maintaining the menstrual cycle and female fertility.[1-3] This literature review aimed to describe the female reproductive system.

External genitalia anatomy

The main structures of the external genitalia consist of the mons pubis, labia majora, labia minora, clitoris, vestibule and perineum. The mons pubis or mons veneris is a layer of fatty tissue above the symphysis pubis (a joint formed by the union of the pubic bones). During puberty, the mons pubis is covered by pubic hair, and the sebaceous and sweat glands become more active. Estrogen causes fat to be

stored under the skin, giving the mons pubis a mound-like shape. This cushion of tissue protects the symphysis pubis during sexual intercourse.[4,5]

The labia majora (singular, labium majus) are two folds of skin appearing at the mons pubis and extending backward into the fourchette, forming a cleft. During puberty, the amount of adipose tissue increases, pubic hair grows on its lateral surface, and sebaceous glands on the hairless medial surface secrete lubricant. This structure is very sensitive to temperature, touch, pressure, and pain. This organ is homologous to the male scrotum and protects the inner structures of the vulva.

The labia minora (singular, labium minus) are two smaller, thinner, asymmetrical folds of skin within the labia majora that form the clitoral hood (prepuce) and frenulum and then divide to close the vestibule and meet near the anus to form the fourchette, The labia minora are hairless, pink, and moist and are equipped with nerves, blood vessels, and sebaceous glands which secrete a bactericidal fluid that has a characteristic odor and lubricates and waterproofs the vulvar skin. Labia swell with blood during orgasm.[4]

The clitoris is an organ rich in innervation and an erectile organ that is located between the labia minora. The clitoris is a small cylindrical structure that has visible glands and a shaft that lies under the skin. The clitoris is homologous to the male penis. The clitoris secretes smegma, which has a unique odor that can arouse male orgasms. Like the penis, the clitoris is the main site of sexual arousal and orgasm. With an orgasm, the erectile tissue in the clitoris fills with blood, causing it to enlarge slightly.

The vestibule is the area covered by the labia minora and contains the external vaginal opening, which is called the introitus or vaginal opening. A thin, perforated membrane called the hymen may cover the introitus. The vestibule also contains the urethral opening or urinary meatus (opening). These structures are lubricated by two pairs of glands, namely Skene's glands and Bartholin's glands. The ducts of Skene's glands (also called the lesser vestibular or paraurethral glands) open on either side of the urinary meatus. The ducts of the Bartholin's glands (great vestibular or vulvovaginal glands) open on either side of the introitus. Bartholin's glands secrete mucus which lubricates the inner labial surface during sexual

stimulation and increases sperm viability and motility. Skene's glands help lubricate the urinary meatus and vestibule. Secretions from both sets of glands facilitate coitus. In response to sexual stimulation, the highly vascular tissue just below the vestibule fills with blood and becomes enlarged.

The perineum is the area with little hair, skin, and subcutaneous tissue that lies between the vaginal and anal openings. Unlike the rest of the vulva, this area has less subcutaneous fat, so the skin is close to the muscles beneath. The perineum covers the muscular perineal body, a fibrous structure composed of elastic fibers and connective tissue, and serves as the attachment site for the bulbocavernosus, external anal sphincter, and levator ani muscles. The perineum varies in length from 2 to 5 cm or more and is very stretched. The length and elasticity of the perineum affect tissue resistance and injury during delivery.

Internal genitalia anatomy
Vagina

The vagina is an elastic fibromuscular canal, 9 to 10 cm long in women of reproductive age. The vagina extends up and back from the introitus to the bottom of the uterus. The vagina is located between the urethra (and part of the bladder) and the rectum. Mucous secretions from the upper genital organs, menstrual fluid, and products of conception leave the body through the vagina, which also receives the penis during coitus. During orgasm, the vagina lengthens and widens, and the lower third fills with blood.[6]

The vaginal wall consists of 4 layers, namely the mucous membrane layer, fibrous connective tissue, smooth muscle, and rich connective tissue vascularization. The mucous membrane layer of squamous epithelial cells will thicken and thin in response to hormones, especially estrogen. The squamous epithelial membrane is continuous, with the membrane covering the bottom of the uterus. In women of reproductive age, the mucous lining is arranged in transverse wrinkles, or folds, called rugae (singular, ruga) that allow stretching during coitus and childbirth.

The upper part of the vagina surrounds the cervix, the lower end of the uterus. The hidden space around the cervix is called the vaginal fornix. The posterior fornix is deeper than the anterior fornix because of the

angle at which the cervix meets the vaginal canal. In most women, this angle is around 90 degrees. A so-called pocket cul-de-sac separates the posterior fornix and rectum.

It is elasticity, and relatively sparse nerve supply enhance the function of the vagina as a birth canal. During orgasm, the walls of the vagina become filled with blood, as do the labia minora and clitoris. Vaginal swelling will push some of the fluid onto the mucosal surface, increasing lubrication. The vaginal wall does not contain mucus-secreting glands; instead, secretions flow into the vagina from the endocervical glands or enter from the vestibule, from the Bartholin's and Skene's glands.

There are two factors that will help maintain the self-cleaning action of the vagina and defend it from infection, especially during the reproductive years. It is their acid-base balance that inhibits the proliferation of most pathogenic bacteria and the thickness of the vaginal epithelium. Before puberty, the vaginal pH is around 7 (neutral), and the vaginal epithelium is thin. At puberty, the pH becomes more acidic (4 to 5), and the squamous epithelium thickens. These changes are maintained until menopause (cessation of menstruation) when the pH again rises to a more alkaline level and the epithelium thins. Therefore, protection from infection is greatest during the years when a woman is most likely to be sexually active.

Between puberty and menopause, susceptibility to infection varies slightly with changes in pH cycles and epithelial thickness. Both defenses are strongest when estrogen levels are high, and the vagina contains a normal population of Lactobacillus acidophilus, a harmless commensal bacteria that helps maintain pH at an acidic level. Any condition that causes the vaginal pH to increase, such as douching or using vaginal sprays or deodorants, having low estrogen levels, or crushing *L. acidophilus* by antibiotics, lowers the vaginal defense against infection.[6]

Uterus

The uterus is a hollow, pear-shaped organ that opens into the vagina at the lower end. The uterus acts as the anchorage and protection of the fertilized egg, provides the optimal environment for the egg to develop, and expels the fetus at birth. In addition, the uterus plays an important role in sexual response and conception. During an orgasm, the opening of the uterus (cervix) dilates slightly. At the same time, the uterus increases in size and moves up and back, creating a tenting effect in the midvagina, which causes the cervix to sit in a pool of sperm. During orgasm, the rhythmic contractions facilitate the movement of sperm through the cervical ostium while increasing physical pleasure.[7-8]

At puberty, the uterus reaches its adult size and proportions and descends from the abdomen into the pelvis below, between the bladder and rectum. The uterus of an adult non-pregnant woman is about 7 to 9 cm long and 6.5 cm wide, with a muscular wall 3.5 cm thick. To maintain its position, the uterus is assisted by ligaments, folds of peritoneal tissue, and pressure on adjacent organs, especially the bladder, sigmoid colon, and rectum. In most women, the uterus is in the anteverted position, that is, tilted forward so that it rests on the bladder. However, it may be reversed or flipped backward. Various types of flexion are normal.

The uterus has two main parts, namely the corpus (body) and the cervix. The top of the body, above the insertion of the fallopian tube, is called the fundus. The diameter of the uterine cavity is widest at the fundus and narrowest at the isthmus, just above the cervix. The cervix, or "cervical," extends from the isthmus to the vagina. The canal between the upper opening of the cervix (internal os) and its lower opening (external os) is called the endocervical canal. The entire uterus, like the upper vagina, is innervated exclusively by motor and sensory fibers from the autonomic nervous system.
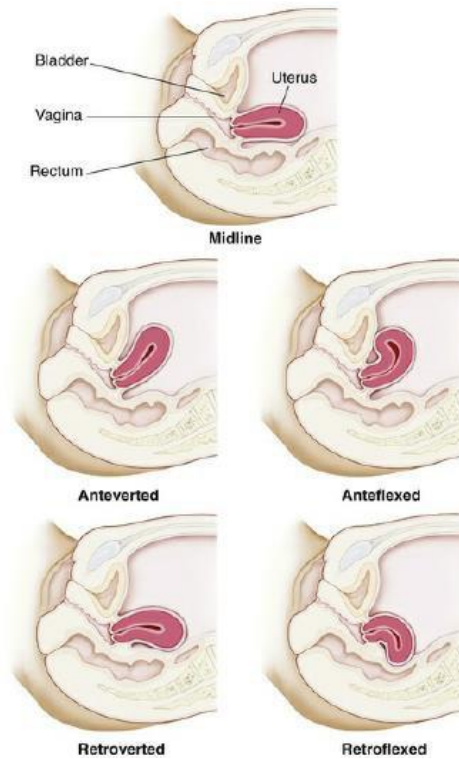
Figure 1. Variations in uterine position.[7]

The uterine wall consists of three layers. The perimetrium (parietal peritoneum) is the outer serous membrane that covers the uterus. The myometrium is the thick middle layer of muscle. Thickest on the fundus, apparently to facilitate birth. The endometrium, or lining of the uterus, is composed of a functional layer (a superficial compact layer and a middle, spongy layer) and a basal layer. The functional lining of the endometrium is responsive to the sex hormones estrogen and progesterone. This layer multiplies and sloughs off every month between puberty and menopause. The basal layer, which is attached to the myometrium, regenerates the functional layer after decay (menstruation).

The endocervical canal is devoid of an endometrial lining but is lined with columnar epithelial cells. It continues with the lining of the outer cervix and vagina, which are lined with squamous epithelial cells. The point where the two cell types meet is called the transformation zone or squamous-columnar junction. The transformation zone is susceptible to human papillomavirus (HPV), especially HPV types 16 and 18, which can cause cervical dysplasia or carcinoma in situ. Cells from the transformation zone are removed for examination during the Papanicolaou smear (Pap test), which can be combined with the HPV DNA test.[8,9]

The cervix acts as a mechanical barrier against infectious microorganisms from the vagina. The external cervical Os is a tiny opening filled with thick, sticky mucus (mucous plug) during the luteal phase of the menstrual cycle and throughout pregnancy. During ovulation, the mucus changes under the influence of estrogen and forms watery strands, or spinnbarkeit mucus, to facilitate the transport of sperm into the uterus. In addition, the downward flow of cervical secretions moves microorganisms away from the cervix and uterus. In women of reproductive age, the pH of these secretions is not suitable for most bacteria. Furthermore, the mucosal secretions contain enzymes and antibodies (mostly immunoglobulin A [IgA]) of the secretory (humoral) immune system. Pathophysiological disorders of the uterus include infection, displacement of the uterus into the pelvis, benign growths (fibroids) of the uterine wall, endometrial hyperplasia, endometriosis, and cancer.

Fallopian tube

Both fallopian tubes (oviducts, uterine tubes) enter the uterus bilaterally just below the fundus. Their

function is to carry the egg from the space around the ovary to the uterus. From the uterus, the fallopian tubes curve up and over the two ovaries. Each tube is 8 to 12 cm long and about 1 cm in diameter, except at the tip of the ovary, where it expands like a trumpet bell. This widened end, called the infundibulum, is fringed or fimbriae. The fimbriae (singular, fimbriae) (fringes) move, creating currents that pull the ovum into the infundibulum. After the ovum enters the fallopian tube, cilia and peristalsis (muscle contractions) keep it moving toward the uterus.

The ampulla, or distal third, of the fallopian tube, is the usual site of fertilization. Sperm released into the vagina travel upwards through the endocervical canal and uterine cavity and enter the fallopian tubes. If an egg is present in either tube, fertilization can occur. Whether the ovum meets sperm or not, it continues to travel through the fallopian tube to the uterus. If fertilized, the ovum (later called a blastocyst) embeds itself in the endometrial lining of the uterine wall. If not fertilized, the egg breaks down within 12 to 24 hours. Disorders affecting the fallopian tubes (e.g., congenital malformations, infections, and inflammation) can block the passage of sperm and ova and cause infertility or ectopic (tubal) pregnancy.[10]

Ovary

The ovary, the female gonad, is the main female reproductive organ. The two main functions of the ovaries are the secretion of female sex hormones and the development and release of female gametes, or ova. The almond-shaped ovaries lie on either side of the uterus and are supported and supported by the mesovarium portions of the broad, ovarian, and suspensory ligaments. The ovaries are smaller than the male homologues, the testes. In women of childbearing age, each ovary is 3 to 5 cm long, 2.5 cm wide, and 2 cm thick and weighs 4 to 8 g. Size and weight vary somewhat from phase to phase of the menstrual cycle.

The middle portion of the ovary, or medulla, is composed of connective tissue and contains many small arteries, veins, and lymphatics that enter at the hilum. Around the medulla is the cortex. At birth, the cortex of each ovary contains about 2 million ova within primordial (immature) ovarian follicles. The follicle grows and undergoes continuous and irrevocable atresia throughout a woman's life. At puberty, the number ranges between 300,000 and 500,000 ova. Between puberty and menopause, the ovarian cortex constantly contains follicles and ova in various stages of development, including primary and secondary follicles. Once every menstrual cycle (about every 28 days), usually only one follicle reaches maturity and releases its ovum through the outer layer of the ovary, the germinal epithelium. During the reproductive years, 400 to 500 ovarian follicles fully mature and release an ovum (ovulation). The remaining follicle either fails to develop at all or degenerates without fully maturing and is known as an atretic follicle.

After the release of the mature ovum (ovulation), the follicle develops into another structure, the corpus luteum. The immediate fate of the corpus luteum depends on whether the released ovum is fertilized. If fertilization occurs, the corpus luteum enlarges and begins to secrete hormones that maintain and support pregnancy. If fertilization does not occur, the corpus luteum secretes this hormone for approximately 14 days and then degenerates, triggering the maturation of another follicle. The ovarian cycle—the processes of follicular maturation, ovulation, development of the corpus luteum, and degeneration of the corpus luteum—continues from puberty to menopause, except during pregnancy or the use of hormonal contraceptives. At menopause, this process stops, and the ovaries atrophy to the point that they cannot be felt during a pelvic exam.

Sex hormones are secreted by cells present in the ovarian cortex, including two types of cells in ovarian follicles (theca cells [produce androgens that migrate to granulosa cells] and granulosa cells [convert androgens to estradiol]) and corpus luteum cells which primarily secrete progesterone, estrogen, and inhibin.[11,12]

Female sex hormones

All sex hormones are steroid hormones and are synthesized from cholesterol. Male and female sex hormones are present in all adults. However, the female body contains low levels of testosterone and other androgens, and the male body contains low levels of estrogen. The individual effect of sex

hormones depends on their amount and concentration in the blood.[13]

The predominant female sex hormones, estrogen, and progesterone, are produced primarily by the ovaries. During fetal development, infancy, and childhood, sex hormone production is low. At puberty, hormone production spikes, triggering sexual maturation and the development of secondary sex characteristics. From puberty to menopause, sex hormones control the menstrual cycle and are produced cyclically; that is, production spikes and wanes each month, creating the ovarian and uterine changes associated with the menstrual cycle. These hormones are also produced at higher levels during pregnancy by the placenta, thereby inhibiting ovulation. Androgens are produced in small amounts by the ovaries and adrenals and have important functions in women.[14]

Estrogens and androgens

Estrogen is an umbrella term for three similar hormones, namely estradiol, estrone, and estriol. Estradiol (E_2) is the most potent and abundant of the three and is mainly produced (95%) by the ovary (ovarian follicle and corpus luteum). Secreted by the cortex of the adrenal glands and the placenta in limited quantities during pregnancy. Androgens are converted to estrone in the ovaries and peripheral adipose tissue. Estriol is a peripheral metabolite of estrone and estradiol.

Estrogen has many biological effects, many of which involve interactions with other hormones, and is required for the maturation of the reproductive organs, the development of secondary sex characteristics (distinguishing male and female physical characteristics that are not directly related to reproduction), growth, and maintenance of the reproductive system pregnancy. Effect On-reproductive Estrogens include the closure of long bones after the pubertal growth spurt (in both males and females), maintenance of bone and skin, and function of systemic organs. After menopause, the ovaries dramatically reduce estradiol production and estrone secretion. Currently, most of the estradiol is derived from the intracellular synthesis in peripheral tissues. Estradiol acts locally to meet physiological requirements according to the cell type and is then inactivated without systemic effects.

Like other steroid hormones, estrogen is derived from cholesterol after a series of complex enzyme-mediated reactions. The hypothalamus secretes GnRH regularly, which stimulates the release of gonadotropins (LH and FSH) from the anterior pituitary. Gonadotropins trigger ovarian estrogen production. The main function of LH is to stimulate ovarian follicular theca cells to produce androgens, especially androstenedione. Some of these androgens are converted to estrogens by the theca cells themselves, and others diffuse into the granulosa cells. Within the granulosa layer, FSH induces the conversion (aromatization) of androgens to estrogens. Estrogen is then released into the bloodstream. Estrogen and FSH together increase FSH receptors in the follicle, stimulating additional granulosa cells until a dominant follicle is determined.[14,15]

Although androgens are the main male sex hormones produced by the testes, small amounts are produced in the adrenal cortex in both men and women and in the ovaries in women. Some androgens (dehydroepiandrosterone and its metabolite androstenedione) are precursors of estrogens (estrone, estradiol). At puberty, androgens contribute to accelerated bone growth and cause pubic and axillary hair growth. Androgens also activate the sebaceous glands, which cause some cases of acne during puberty, and play a role in libido.[15]

Progesterone

Luteinizing hormone (LH) from the anterior pituitary stimulates the corpus luteum to secrete progesterone, the second major female sex hormone. With estrogen, progesterone controls the ovarian menstrual cycle. The LH surge occurs when there are peak levels of estrogen around 24-36 hours before ovulation. LH increases granulosa luteinization in the dominant follicle and results in the production of progesterone and the development of blood vessels and connective tissue. During phase follicular, the ovaries and adrenal glands each contribute about 50% of progesterone production. Instead, a large amount is secreted from the ovary while the corpus luteum is active for about 9 to 13 days after ovulation.[16]

Progesterone secreted by the corpus luteum stimulates the thickened endometrium to become more complex in preparation for blastocyst implantation. If conception and implantation do occur, the corpus luteum persists and secretes progesterone (and estrogen) until the placenta is properly formed at around 8 to 10 weeks gestation and begins producing progesterone. Progesterone is sometimes called the pregnancy hormone. The effects of progesterone on pregnancy include maintaining endometrial thickening; relaxing the smooth muscle in the myometrium, which prevents premature contractions and helps the uterus expand; thickening (hypertrophy) of the myometrium, which prepares it for labor muscle action; promoting the growth of lobules and alveoli in the breast in preparation for lactation but prevents lactation until the fetus is born and then promotes lactation in cooperation with prolactin after birth; preventing additional egg maturation by suppressing FSH and LH, thus stopping the menstrual cycle; provide immune modulation, enabling tolerance to fetal antigens (the mother's immune system does not attack the fetus); and prevent birth premature. [17]

2. Conclusion

The female reproductive system is a biological system that is responsible for producing, transporting, and storing eggs and facilitating the meeting between eggs and sperm for fertilization.

3. References

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