Human Physiology
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Hello everyone, welcome to another new class on human physiology. In the last class, we discussed male reproductive organs and saw how spermatogenesis occurs. In this current class, we will discuss female reproductive organs and we will see the different functions of different parts of female reproductive organs. So, let us stick with it. So, what are the different concepts that will be covered in this class? So, first we will look at the anatomy of the female reproductive system. We will also see different internal organs of the female reproductive system and discuss their functions.

We will also see the different external organs of the female reproductive system along with their functions. So, let us see all these things one by one. So, in general, what is the female reproductive system? It is like a natural marvel of biological engineering, and the main process of this group of organs, or combination of organs, is to create the reproductive system. So, by processing the birth of a new baby, the reproductive system creates another new life; however, beyond creating a new life, it also plays a vital role in the production and regulation of different hormones.

In terms of hormonal regulation, we will have a completely separate class. There we will see how various female hormones play a crucial role in terms of reproduction and other functions. But in this class, we will try to just touch base on the female reproductive organs and their functions. So, this intricate network of different female organs, both internal and external, works highly in coordination because there are many cases like this where the reproductive system functions step by step, and without skipping a certain step or without an abnormality in a certain situation, it can completely stop the whole process. So, all these organs mostly function in a coordinated manner.

There are different organs that are part of the female reproductive system. Some of the important ones are, for example, the ovaries, which are also called female gonads, the uterus, the fallopian tubes, the cervix, and the mammary glands. So, all of these are some of the female reproductive organs that are highly important and need to be discussed. So, as you can see, there is some general female reproductive system anatomy; apart from, of course, the mammary gland, here we do not have the mammary gland, but most of them are here, as you can see. Here are some of the important ones; for example, the ovary.

So, the ovary is one of the most crucial parts of the female reproductive system. Why? Because the ovary generally stores the female eggs. So, as you can see, in the ovary, it basically acts to store female eggs. Along with that, the ovary is also the house where the ovulation process happens. So, basically, the immature eggs are used to produce the mature eggs.

The process of formation and eventual release of the mature eggs occurs in this ovary. So, the ovary is a very important and crucial organ and one of the primary female reproductive organs. Then there are also fallopian tubes; you can see that this is like the fallopian tubes, and at the top of the fallopian tubes, you can see these tentacle-shaped threads or membranes called

fimbriae. So, as a whole, what is the role of the fallopian tubes whenever an egg is released near them? These cells basically generate, these cells basically the fimbria cells generate electrical pulses. So, what do they generate? They generate electrical pulses, and due to this generation of electrical pulses, they act as a kind of suction pump.

So, whenever the mature egg is released, it acts as a suction pump, and eventually, the eggs will be sucked inside this fallopian tube. And also fallopian tubes sometimes, like this, are also the house where fertilization happens. So, basically, whenever the sperm enters during the process of sexual intercourse, at that time, sperm goes into the fallopian tube where the sperm meets the mature egg and fertilization occurs. So, inside the fallopian tube, there is another important role: fertilization, which occurs when mature eggs meet the sperm. So, in the case of fertilization, mature eggs mix with the male sperm, and it causes fertilization.

So, the fallopian tube has a very important role to play, and even after fertilization, what happens is that the fertilized embryo gets transported to the uterus. So, the uterus is one of the most important components of the female reproductive system because it is the house where the embryo gets implanted. So, eventually after fertilization, the embryo gets implanted in the uterine wall, mostly in the endometrium. The uterus is also highly vascular. So, it has a lot of dense blood vessels that continuously supply nourishment, such as oxygen and nutrients, to the embryo and to the baby.

So, that is why the uterus is highly important and one of the crucial female reproductive organs. Then, as you can see, the female reproductive organ also has a cervix. The cervix is very important in controlling the supply of fluids from outside to inside or from inside to outside. During birth, the cervix, although very narrow, will contract, causing dilation, and once the cervix is dilated, there will be enough space for the baby to come out. Apart from that, the cervix also controls the entry of sperm; it also regulates the excretion of various types of female fluids during the menstruation period.

Also, another important reproductive organ is the vagina. which is like a muscular type of organ and is essentially the house for sexual intercourse, as it accepts the male penis. So, as you can see, these are some of the very general and primary female reproductive organs, but one by one, we will discuss them further in detail. So, as I said, the ovary is the most important and primary female reproductive organ because it is the storehouse for the female egg. So, initially I will discuss in the next few classes, but just briefly, when a female child is born, there are only a few thousand or a few million female eggs that are actually present in the female body.

So, it is not like in the male body where sperm can be produced in unlimited amounts throughout their human life, but for females, the number of eggs is fixed. So, we will discuss all this again in the next class, but just think of it this way because there is only a limited number of eggs present in each female. There needs to be a storehouse where the eggs can be stored very safely in the right conditions. So, the ovary is like that type of house where the female eggs can be stored, and in each cycle of the female, some of these eggs, like a few of these eggs, actually start their maturation process. And as you can see, the ovary is mostly almond-shaped, like an organ.

There are two ovaries on either side, and these ovaries are placed very close to the fallopian tubes. And as we said, once the mature egg is released from the ovary near the fallopian tube, the fallopian tube eventually acts as a suction machine to draw those female eggs for future

fertilization. So, mainly there are two functions of the ovary; the first one is, of course, oogenesis, which is a remarkable process to produce mature eggs from initial primordial follicles. And also, ovaries have a very important role in the synthesis and secretion of essential reproductive hormones. So, both of these roles actually have an important function.

And then, the ovaries are also a primary source for the secretion of different steroid hormones, for example, estrogen and progesterone. We will discuss the detailed role of estrogen and progesterone again in the next class. But just try to remember that the ovary has a very important and crucial role to play, not only in storing the eggs. Then, also through the oogenesis process, it helps in terms of the maturation of those eggs. And finally, it is the house where several important hormones get produced and secreted.

And these hormones are very important because they play a crucial role in the development and maintenance of female secondary sexual characteristics, contributing to various physical attributes of women. As you can see, the ovary is one of the highly important primary reproductive organs. And if you can see the ovary anatomy, it has specifically different parts, including the outer layer, which is also called the cortex. And in the cortex layer, you will see that all these oogenesis steps happen. And the oogenesis step, as I said, is basically like the maturation of an egg.

And in this step, there are a few kinds of stages that one goes through. We will see those stages again in very much detail and about their critical structure in the next class. But just to start with, I'll give you a brief overview. There are certain stages of maturation where each of the components of the female egg forms one by one. So, you can see in the early stage, like the primordial follicles, these are some dormant types of eggs that were initially present in the female body.

As I said, right when a female is born, a certain number of fixed female eggs are present in the body. So, these are some of those initial dormant kinds of eggs, or they are also called primary oocytes. Basically, it is surrounded by a single layer of flattened granulosa cells. And then after the next stage, where the primary follicles get a little bit matured and become from the primordial follicles to the primary follicle. So, from the primordial follicle, it becomes a primary follicle where the granulosa cells slowly become much thicker and cuboidal in nature, and it starts to proliferate.

And from the primary follicle, the secondary follicles eventually develop. And in the case of the secondary follicle, it is mostly characterized by further granulosa cell proliferation. So, you can see how the cells are becoming thick and this outer layer of granulosa cells is eventually proliferating and growing further. So, from the secondary follicle, it forms the antral follicle. So, you can see from the secondary follicle that it forms like a central follicle or a tertiary follicle, and in this case of the follicle, there is a fluid sac that gets generated.

So, like a fluid-filled cavity which can kind of slowly develop, this is called the antral type of follicles, and to form the antral follicle, it further gets matured. Eventually, in the final stages of the oogenesis process or ovarian cycle, it forms a mature Graafian follicle. And it is mostly the finally largest matured follicles that are almost ready for the step of ovulation. And it contains a fully grown oocyte and a large, well-developed antrum. So, this is like the final stage of the matured egg, which is ready to kind of eject, and in the next step, as you can see, the female matured egg is ejected.

This whole step of oogenesis mostly happens in the outer layer of the ovary, which is also called the cortex. And then, the ovary also has a medullary part, which is the inner region of the ovary, and it contains mostly loose connective tissue, blood vessels, lymphatic vessels, and nerves. But it does not contain any follicles. The ovary also has a component of stroma and corpus luteum. The corpus luteum is very important because, as you see, after the oogenesis step, this yellow body, or the corpus luteum, eventually forms, which is a temporary endocrine gland because it secretes some of the very crucial hormones that occur only during this oogenesis step.

But it is temporary, as I said, because if fertilization does not occur, eventually the corpus luteum breaks down to a white body; as you see here, it is yellow in color. So, it can also be called the yellow body, but if fertilization does not occur, the corpus luteum eventually gets degenerated and becomes the white body, which is further degraded. So, we will discuss in detail what type of specific role the corpus luteum plays and what hormones it secretes, all in detail in the next few classes. Then another important component of the female reproductive system, as I was saying, was the fallopian tube. Why? Because here, fertilization happens.

So, after sexual intercourse when the sperm enters, this is the place where the female egg and sperm can actually fertilize and start to create the embryonic development process. Apart from that, you can see that fallopian tubes also have these thin, tentacle-like cells, which are also called fimbriae. So, these are like finger-like projections, and what they do is basically that they have a lot of specialized types of cells; for example, ciliated cells. So, these cells create an electrical pulse. And it kind of beats in a rhythmic way.

So, once those rhythmic beats initially create inside the ciliated cells, what they can do is like this: the fallopian tube sucks those female eggs, sucking those matured female eggs inside of it, okay. So, this is highly specific in terms of its function. By a specific rhythmic nature, the fallopian tubes and the fimbriae type of cells help the matured egg to be sucked inside the fallopian tube, where, once the sperm enters during sexual intercourse, it can facilitate the fertilization process. So, as you can see, the fallopian tubes, or oviducts, are highly important female reproductive organs in the female body. And eventually, once the fertilization happens, the fallopian tubes also help to propel the released egg towards the uterus.

So, the eventual goal is that if fertilization happens, this fertilized egg eventually gets propelled and ejected into the uterus or uterine membrane where the implantation of the baby can occur. So, the fallopian tube is very crucial, as you can see. Next one is the uterus, as we said, that the uterus is the house or the place where implantation of the embryo happens. So, it is situated in the pelvic cavity and it is a pear-shaped muscular organ which has different layers of membranes. Mostly, it is known for receiving the fertilized ovum that eventually passes through the uterotubal junctions of the fallopian tube.

So, from the uterotubal junctions of the fallopian tube, the fertilized ovum eventually comes inside, and once the fertilized ovum is inside, it is implanted in the endometrium. So, once the fertilized egg arrives, it gets implanted in the endometrium, which is the innermost layer of the uterus. The endometrium has a lot of blood vessels, including surrounding blood vessels and mature blood vessels. Hence, inside the baby can get a proper supply of oxygen and nutrients. So, the uterus has a very important role because it mainly protects the implanted baby for about 38 to 42 weeks, and eventually it helps to remove the fully developed baby during childbirth.

So, as I said, the uterus has different types of membranes, the most inner of which is called the endometrium. As I said, this is highly vascular in nature, so it has a lot of dense mature blood vessels, and it helps to supply nutrients and oxygen to the growing fetus and the growing baby. And inside the endometrial wall or the endometrium membrane, there is another membrane called the myometrium. This is also a thick and muscular layer or lining that helps with the contraction process during labor and delivery. And in the outermost layer, which is also called perimetrium or serosa, this is mostly a structural type of membrane layer that provides support, structural support, and also helps reduce friction.

It is important to know that even if pregnancy does not occur, the uterus has a crucial role in the menstruation cycle because it sheds the inner lining to prepare for the next potential fertilization. So, we will discuss these cycles in our next class, but just try to remember that if I consider this endometrial lining, which is highly dense in blood vessels, after fertilization, this lining becomes more mature and thicker with further branching of the blood vessels. So, initially the endometrium lining is not as thick, but once fertilization happens and even after the implantation of the embryo, it gets much thicker, much thicker in nature. So, if the implantation does not occur, the goal of the endometrium is to basically shed this layer. So, it basically shades this layer or degrades this layer, and eventually all these blood vessels will come out in terms of bleeding or menstruation, and it basically prepares the female body, or the endometrium, or the uterus for the next cycle or the next step of fertilization, if it happens.

As you can see, the cervix is also a very important component. So, just near the uterus, you can see there is a narrow opening. So, this opening is about 2 to 3 centimeters long, and you can see that this basically controls the internalization or even removal of certain components. For example, it allows sperm to enter. It also allows for the female period, or the bleeding, or the female eggs to come out from inside, and it is also important to provide structural support to the growing embryo or baby.

Because if it has a very big opening, there might be a chance of the inside implantable baby coming out from that space. So, it is initially narrowed during the early stages of pregnancy, and just during delivery, due to the uterine contractions, it generally kind of opens up. So, once it opens up due to dilation, it has an enough opening. From where the baby can be delivered. So, in this way, the cervix maintains structural integrity and also allows for the exchange of fluid.

Finally, the vagina, as you can see, is like the fibromuscular component, and it receives the penis during sexual intercourse. It also kind of serves like a birth canal or the birth channel during childbirth. It also kind of facilitates a passage for the menstruation flow. And, very importantly, the vagina has different microbes or bacteria. So, the vagina is like high in bacteria, and these bacteria basically produce glycogen into lactic acid.

So, what this bacteria does is that it converts glycogen; it metabolizes glycogen to make lactic acid, and as you know, lactic acid is acidic in nature. So, overall, the vagina is generally acidic in nature, and this acidic environment generally prevents different pathogenic microbes from growing inside. So, in this way, the vagina is also kind of a cell that protects itself. Finally, the vulva, which is an external female reproductive organ, is located near the openings of the urethra and vagina. And these structures collectively serve several important functions.

This includes protection from the external environment and sensation. It also supports the vaginal openings and secretion of various lubricating fluids. The vulva has different

components or structures, as you can see, such as the mons pubis, labia majora, labia minora, clitoris, and vestibule. Finally, in terms of external organs or reproductive organs, the mammary gland is highly important. These are like modified sweat glands that are located in the chest, and they are structurally modified into apocrine sweat glands.

And it kind of looks like a lobar type of structure composed of around 15 to 25 lobes radiating around each nipple. So, this is like in general mammary structure where you will see that there is a nipple. and there are about 15 to 20 to 25 lobes around the nipple. These lobes contain clusters of milk-secreting alveoli. So, this contains a lot of milk-secreting alveoli-type cells.

And even the memory has duct channels or duct systems. So, as the alveoli secrete the milk into the intralobular ducts, then into the intralobular ducts, and finally into the lactiferous ducts that open at the nipple with the lactiferous sinuses for storage. So, the nipple and areola are another important component of the mammary gland. So, the nipple is important for releasing milk, and it is also surrounded by a pigmented areola with lubricating glands. And eventually, there is like a sucking feedback that is highly important. So, let us discuss how the sucking feedback or the sucking positive loop happens when an infant starts sucking the breast.

So, let us slowly see how the sucking feedback happens. So, if I consider this to be the mother and this to be the baby. So, when the baby sucks the nipple or the breast, what it does is create a stimulation. So, basically, after the sucking of the breast, it creates an afferent type of impulses, afferent impulses that eventually stimulate the hypothalamus. So, what are we saying? That as the baby sucks the breast or the nipple, it sends afferent impulses to the hypothalamus.

So, basically, it stimulates the hypothalamus. And now in the hypothalamus it gets stimulated and it releases prolactin-releasing factor. So, what does it secrete? It stimulates the hypothalamus, which gets secreted, and it secretes prolactin-releasing factor. Prolactin-releasing factor eventually further stimulates the anterior pituitary. So, what does it stimulate? It stimulates the anterior pituitary for the secretion of prolactin. So, what does the anterior pituitary do? It secretes the hormone prolactin, which eventually stimulates the mammary glands or the cells associated with the mammary glands for the secretion of milk or the production of milk.

For the production of milk, okay. So, what we just said is that when the baby sucks the nipple, it sends afferent impulses, and these impulses eventually go and stimulate the hypothalamus. The hypothalamus then secretes prolactin-releasing factor, which eventually goes to the anterior part of the pituitary to secrete the hormone called prolactin. This prolactin eventually enters the blood circulation and stimulates the cells of the mammary glands for the production of milk. This hypothalamus, once stimulated by afferent impulses from sucking, does one more thing: it produces the secretion of oxytocin. So, what does it do? The hypothalamus also secretes another hormone called oxytocin.

Now, this oxytocin, with the help of afferent fibers, stimulates the posterior pituitary. So, the posterior pituitary. So, basically, once the hypothalamus secretes oxytocin, it eventually comes to the posterior pituitary for secretion. So, from the posterior pituitary, oxytocin is eventually released.

Oxytocin is released into the bloodstream. So, oxytocin is released in the blood, right? And now this oxytocin eventually goes to the mammary gland, and it kind of stimulates those

mammary cells, and eventually it helps in the secretion of milk, okay. So, basically, it stimulates the release of the milk from the breast. So, this is basically, you can see this is like a positive feedback loop. So, this whole thing is a positive feedback loop. So, as the baby sucks the nipple, eventually it sends the signal to the hypothalamus.

The hypothalamus produces oxytocin; the oxytocin eventually gets released by the posterior part of the pituitary. And this oxytocin, when released into the bloodstream, eventually activates the mammary cells for the release of milk. In the same way, the hypothalamus is also important for secreting various prolactin-releasing factors that eventually positively stimulate the anterior part of the pituitary to secrete prolactin, which then enters the bloodstream. It goes to the mammary gland; it stimulates the mammary gland cells for the production of milk. So, this is the positive feedback loop of how milk is produced when the baby sucks on the nipples.

So, do you know that unlike males who continuously produce sperm, females are born with only a specific and definitive number of immature eggs? And every month only a few eggs are released for potential oogenesis or the maturation process. A woman typically releases only one to a few mature eggs, generally one mature egg, during the menstrual cycle, even though multiple follicles start to develop in the ovaries. So, it rarely secretes multiple ova; the majority of the time, it does not. The female body only secretes one mature egg even though there are multiple primary or primordial follicles that initially start the maturation process. In a rare case, a female body can develop two different mature eggs, but that is uncommon.

So, I hope that you enjoyed the female reproductive organ class, and we thoroughly discussed different components of female reproductive organs; we discussed their functions, and we also saw how the initial steps of oogenesis and maturation happen. In the next class, we will discuss specific details of the oogenesis process. So, please stay with us, and hopefully you are enjoying the class. So, some activity question: if the fallopian tubes were completely blocked, what would be the implication for natural conception? So, please let us know if you have any questions during the live sessions; you can also drop us an email. Furthermore, you can contact us via email, and during the live sessions, we will try to clear your doubts.

Hope you are enjoying the class. Thank you again for another class on human physiology. We will come very soon with another new class of human physiology. Thank you.