

Human Physiology
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Lecture - 01

Welcome to another new class on physiology. In this week's lecture, we will discuss the reproductive glands and their functions. So, for this class, we will discuss Male Reproductive Organs and we will see how different parts of the male reproductive organs perform different functions. So, let us stay with it. So, what would the different contents be for today's class? We will discuss the male reproductive system, different internal organs, and their functions. Also, we will discuss different reproductive male external organs and their functions.

So, the male reproductive system is a network of internal and external organs that function together to produce, support, transport, and deliver viable sperm for reproduction. So, the key goal is to develop the sperm and eventually to deliver the mature sperm for the possible fertilization process. What are the different key functions important for spermatogenesis? This important process of sperm cell development is called spermatogenesis. This we will discuss in detail in the next class.

Then other functions, such as hormonal production, synthesis, and regulation of androgens and testosterone, are very important hormones that play crucial roles in the male reproductive system. And also, sperm delivery is the coordinated transport and delivery of the sperm during fertilization. What is the anatomy of the male reproductive system? We already said that the male reproductive system is a combination of external and internal organs. So, in terms of external organs, you see mostly the part of our penis and the scrotum; these are the important components of the external organs. organs or the external reproductive organs, okay.

And all those internal organs, for example, like testes, then epididymis, right? Testes, epididymis, and then the vas deferens, then seminal vesicles, prostate glands, and then bulbourethral gland. So, all of these are part of the internal reproductive organs, okay. So, the penis and scrotum are part of the external organs, and the rest are part of the internal organs. As a whole, all these parts combine, maintain, and function properly towards our male reproductive system. So, let us start with one by one; slowly we will try to discuss the testis structure, and we will try to see what their different functions are.

So, in the testis, as you see, the first is like the tunica albuginea. So, this is like a tough fibrous capsule that surrounds the testis and also provides structural support. So, you can see in the image that this is a fibrous type of capsule which mainly provides structural support for the testis, called the tunica albuginea. And then exactly outside of that tunica albuginea, you see another part of the tunica vaginalis. Which is like a serous membrane, it is a rough membrane, but also pay attention that this part of the membrane does not totally cover the whole testis; it leaves a little bit of empty area.

Most importantly, this also functions to provide structural support for the testis. This consists mainly of two layers; one is the parietal layer and the second is the visceral layer. This reduces the friction and allows for a free movement of the testes within the scrotum. Then the next is the seminiferous tubule, okay. So, inside the testes, you can see a tubule-like structure.

These tubules are collectively called seminiferous tubules. These are like highly coiled tubules where the sperm cells are produced. This contains a specific type of cells called Sertoli cells and germ cells, and at various stages of the development of sperm, they play an important role. So, what is the different function of the testes? As we said, the testes are the primary site of spermatogenesis, which should be covered in our next class. This is the process by which mature sperm cells are produced.

This process occurs within the seminiferous tubule, which comprises the majority of the testicular volume. The testes are also the primary site of testosterone production, and as you know, testosterone has different applications, including the development and maintenance of the male reproductive organs, developing the primary and secondary sexual characteristics, stimulation of spermatogenesis, and influences on bone density and red blood cell production. So, you can see testosterone has various diverse types of applications. Apart from that, Leydig cells, which are also located in the interstitial tissues between the seminiferous tubules, also play an important role in testosterone synthesis. Then the next part, which is very important, is the epididymis.

So, you can see that this part after the test is called the epididymis area. Right, it has a distinct three-part structure, which includes the head area, the body area, and finally the tail area. The primary function of the epididymis is sperm maturation, allowing sperm to gain the capacity for motility and fertilization. This maturation occurs inside the epididymis. Epithelial cells present in the epididymis secrete different substances that are very crucial for sperm maturation and protection.

It also involves alterations in the membrane proteins, lipids, and other intercellular components. Also, the epididymis plays an important role in sperm storage, mainly in the tail area. Basically, sperm storage happens in the tail area. Sperm can also be stored for a significant period of time. It is important that the epididymis can store sperm for a longer time if needed.

Then finally, the sperm is transported; so basically, once the sperm is produced from the seminiferous tubule in the duct area, it goes to the epididymis zone, where it can be stored in the tail area for some time, and slowly after that, the matured sperm cells can mostly be transported back using the contraction of smooth muscle cells. Then the vas deferens, you remember we said that after the epididymis, we can see a tube-like structure which is called the vas deferens. So, it is mostly a long muscular tube that connects the epididymis to the urethra. It is also known as the ductus deferens. It ascends from the epididymis through the spermatic cord.

And the main function of this is similar to sperm transport. So, the primary function is the rapid transport of sperm from the epididymis to the urethra during the ejaculation process. Mainly, peristaltic contractions of the muscle propel the sperm movement. It also plays a role in sperm storage. It can store sperm for some time, but of course, you have to remember that this storage in the vase is not for a longer time.

For a longer storage time, the epididymis is the main compartment area. The next are the seminal vesicles you can see. These two vesicles are seminal vesicles. These are paired, highly convoluted, pouch-like glands. These are located posterior to the urinary bladder and anterior to the rectum.

So, you can see two almost similar glands that are near the urinary bladder. And what are the different functions of the seminal vesicle? Mainly seminal fluid production. So, the seminal vesicles produce almost 70 percent of the seminal fluid that makes up the semen. And what is the composition? Semen contains fructose, which provides energy to the sperm cells. Semen also produces seminal vesicles, which also produce prostaglandins, hormone-like substances that stimulate smooth muscle cell contraction in the female reproductive tract, aiding in sperm movement and transport.

Then it also produces different clotting factor-like proteins to cause coagulation after ejaculation. It also helps to secrete alkaline pH for neutralizing the acidic environment of the female reproductive tract because sperm cells can get destroyed in the acidic female reproductive environment. So, it also helps to maintain a neutral pH by secreting an alkaline type of solution. Apart from all these important ones like amino acids, certain enzymes and nutrients can also be secreted. So, as a whole, as you remember, about 70 percent of the total semen volume is generated inside the seminal vesicles.

Then, after the seminal vesicles, you can see that there are two prostate glands, right? So, if the prostate gland surrounds the proximal portion of the urethra, it is kind of like the size of a walnut. with a consistent granular and fibromuscular type of tissue. And prostates also secrete different types of fluid, mostly like the rest of the 20 to 30 percent of the semen fluid that is produced inside the prostate. These are slightly acidic types of fluid. It contains different important kinds of enzymes; for example, prostate-specific antigen or PSA.

This is like a serine type of protease enzyme, as well as prostatic acid phosphatase, or PAP. Then it also secretes some citrate-type molecules. It also contributes to the secretion of zinc that contributes to the stability of the sperm. So, what is the function of the prostate gland? Of course, the prostate glands help in the secretion of all these important components and enzymes, and basically, they contribute to the rest of the semen volume, which is about 20 to 30 percent. It also provides important nutrients and enzymes for ensuring important and necessary sperm function.

Like PSA or the prostate-specific antigen, they help to liquefy the semen, improving sperm motility. PAP, or prostatic acid phosphatase, is a type of enzyme that produces choline, which also helps in sperm motility. So, you can see different ways this type of enzyme helps in sperm motility and movement, which is very important before entering the female reproductive organ so that sperm can reach the egg at the right time without getting destroyed. And zinc is also very important for the stability of the sperm. Then, you can see the bulbourethral glands, which are two glands just after the prostate.

These pea-shaped glands are also impaired, and they secrete certain fluids that are mostly clear, viscous, and alkaline. These fluids are also very rich in mucoproteins. So, what are the functions of the bulbourethral glands, also known as Cowper's glands? This fluid that is getting secreted from the Cowper's gland generally helps in the lubrication of the urethra prior to the ejaculation process. It also helps because, as you see, it secretes some alkaline fluid; by secreting the alkaline fluid, it helps to neutralize the acidic urine residues in the urethra. So that the sperm does not get destroyed by the acidic environment during ejaculation.

It importantly provides lubrication even during sexual intercourse. So, you can see there are a lot of important functions of the Cowper's gland. What is the basic timing of secretion? It can be secreted during sexual arousal prior to ejaculation. It helps to prepare the urethra for the

passage of semen. So, you can see all three of these glands, including the seminal vesicle, prostate gland, and Cowper's gland.

All three of these glands function as a pair, and they play many important roles, especially in making up the total semen volume. Creating the neutralizing conditions for the sperm to survive in harsh acidic environments, especially near the urethra and inside the female reproductive system. Also, it improves sperm stability and motility. So, these are the crucial functions of this gland that help the sperm stay alive and function. Then finally, after all these internal male reproductive organs, we should also discuss the external organ.

So, the foremost part of the external reproductive system is the penis. The structure of the penis will have a root and a shaft area. Of course, the shaft area will have various parts like the corpora cavernosa and the corpus spongiosum. And then, of course, the foreskin will also be present. The function of the penis is like the erectile tissues that facilitate sexual intercourse, and the urethra enables urination and semen delivery.

So, the penis is important not only during ejaculation and the delivery of sperm, but also on a regular basis during frequent urination. Erection depends on the neuronal and vascular mechanisms that include the release of nitric oxide and the relaxation of smooth muscle cells. So, apart from the penis, we have another external male reproductive organ, which is the scrotum, okay. And in the scrotum, you can see the structure that has layers of skin, dartos muscle, and cremaster muscle. And what is the important function? The main important function of the scrotum is temperature regulation during spermatogenesis.

Because internally our body's temperature, if you remember, is about 37 degrees Celsius, sperm cells are generally not that healthy under these temperature conditions. Sperm cells for optimized sperm cell development, maturation, and stability need to maintain a temperature condition of about 34 to 35 degrees Celsius. And that is almost impossible to attain inside our body; hence, the production and storage of sperm, which occurs in the testes, are placed inside the scrotum. It is positioned externally to our body, where the temperature can be easily regulated to achieve the optimum temperature of 34 degrees Celsius. So, do you know that, as we said, some of the glands can secrete fructose, and this is a sugar that gets produced in high concentration in the seminal vesicles? It can be a very important forensic marker in cases of sexual assault.

Doctors and police can verify whether the fluid contains fructose in the female reproductive system because fructose is generally not present in the female reproductive system; it only comes from semen. So, by using it as a biomarker, the condition of sexual assault can be easily predicted and proven. And also, as we said, sperm production is most effective in temperature conditions of about 34 to 35 degrees centigrade. So, that is why the scrotum and the testes are located outside of our body; there, the sperm can stay easily healthy and optimum condition near a temperature of about 35 degrees.

The scrotum achieves this through several mechanisms, mainly using various muscular movements and blood circulation. So, lastly, a very important activity questions why it is important that sperm are produced in the testis, which is located outside the main body cavity in the scrotum. So, please try to understand and answer this question and also what will happen if the sperm is produced at normal or elevated body temperature. So, if you have further questions regarding the male reproductive system, please drop us the questions, and we can thoroughly discuss them during the live interactive sessions.

Hopefully, you enjoyed the primary class on the male reproductive system. In the next class, we will discuss the process of spermatogenesis, and in the consecutive class, we will discuss the female reproductive system and the process of fertilization. Hopefully, you enjoyed another new class of human physiology. Please stick with us, and thank you for attending. Thank you.