

Human Physiology
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Welcome to another new class on human physiology. In today's class, we will discuss the endocrine systems, and we will also learn about our various endocrine glands, the different types of molecules they secrete, and their functions. Hopefully, you will enjoy it. So, what contents will be covered? Overall, we will see what the endocrine system is, and then we will discuss different types of endocrine organs in our body, such as the hypothalamus, pituitary, pineal glands, parathyroid, thyroid, thymus, adrenal glands, pancreas, liver, kidneys, and gonads. Let's see one by one how all of them function. So, first, to start with, what is the endocrine system? The endocrine system in our body consists of a lot of different glands that produce the hormones.

So, what these hormones do is create, in the majority of cases, some irreversible reactions, and once these hormones enter the bloodstream, they regulate various types of physiological processes in our body. So, these hormones are very important. They are secreted from the endocrine glands and eventually, once they are distributed to the body, they control various types of physiological processes. So endocrine glands secrete hormones, and the process of hormonal activities is generally very slow; also, these processes are mostly long-term.

The majority of the time, they can be irreversible. For example, growth and reproduction. Let's see one by one how different types of endocrine glands we have and what their functions are. So, to start with, we'll begin with the most important endocrine gland in our body, which is the pituitary gland. It is also called the master gland or the mother of all glands, and it is situated at the base of our brain.

So, this is situated at the base of our brain, and it looks like a small, almost pea-shaped gland. Okay, it is divided into two parts: the anterior lobe and the posterior lobe. Basically, it is divided if you think of one as the anterior side and the back side as the posterior side. This is called the master gland just because the pituitary controls various hormone secretions, and using those hormones, many activities are controlled in our body. That is why, because it is so important, the pituitary endocrine gland is also termed the master gland.

So, what are the different functions of the pituitary gland and their associated hormones? Let us see, for example, that the pituitary secretes growth hormone, which can promote tissue growth and metabolism. So, the pituitary controls the regulation of growth and development of our body. The pituitary also secretes a very important hormone, the thyroid-stimulating hormone, that influences metabolism. So, the pituitary also controls the metabolism of our body. The pituitary secretes the adrenocorticotropic hormone.

This also regulates cortisol production and manages stress. Therefore, the pituitary is important for managing our stress as well. Pituitary secretes hormones such as follicle-stimulating hormone and luteinizing hormone to control various processes related to our reproductive system, including the menstrual cycle, ovulation, and even testosterone production. The prolactin that is secreted by the pituitary can influence the lactation of a pregnant woman, and

once milk production is initiated, it also secretes antidiuretic hormones that help maintain water balance in the body. The pituitary also secretes oxytocin, a type of hormone that increases labor pain and contractions during the delivery of the baby.

So, you can see that starting from growth regulation to metabolism to stress management, and even reproduction, there are so many kinds of physiological functions of the pituitary, and for that reason, the pituitary is one of the master glands. The hypothalamus is another important endocrine gland in our body, and very importantly, it is located almost close to the pituitary at the base of the brain. The hypothalamus is also called a precursor gland of the pituitary, which means that whatever hormones are secreted from the hypothalamus are the precursor hormones of the pituitary. So, for example, you remember how the pituitary secretes growth hormone, thyroid-stimulating hormone, follicle-stimulating hormone, all those hormones, right? So, the hypothalamus needs to first secrete a precursor hormone to stimulate the action of the pituitary. So, you can also say that without the function of the hypothalamus, the pituitary will not get activated to secrete important hormones.

And that is why the hypothalamus is very, very important. So, you can see that the hypothalamus secretes thyrotropin-releasing hormone (TRH) that stimulates the release of TSH and prolactin. See how the hypothalamus can secrete the precursor hormones of TSH and prolactin. Then you can see that the hypothalamus also secretes gonadotropin-releasing hormone, or GnRH. This gonadotropic-secreting hormone, or GnRH, can stimulate the release of LH and FSH, which are the luteinizing hormone and the follicle-stimulating hormone.

So, some of these examples you can see, like this precursor hormone that is secreted by the hypothalamus, are very important to eventually stimulate the pituitary and the secretion of the main hormones that actually control various physiological processes. It can also inhibit some hormones or suppress pituitary hormone release. For example, the hypothalamus inhibits prolactin release through the process of dopamine secretion. The somatostatin, a type of activity or the hormone it secretes, can inhibit the growth hormone and the thyroid-stimulating hormone. So, not only can it stimulate certain activity of the pituitary in a few cases by somatostatin and dopamine, it can also inhibit certain pituitary actions.

The pineal gland, which is located between the hypothalamus and the pituitary gland, is a small, circular, spherical-shaped gland. This gland secretes a very important hormone called melatonin, and do you know what the function of melatonin is? Melatonin maintains the regulation of sleep in our body. It also maintains the circadian rhythm or the sleep-wake cycle. There are other properties, such as antioxidant and neuroprotective functions of this melatonin hormone, but the primary function is maintaining sleep and wake regulation or the circadian cycles. Then next is the parathyroid gland; you can see that there are four small glands in between the thyroid.

These four small glands are present inside the thyroid; they are called parathyroid glands, and they secrete a very important hormone, PTH or parathyroid hormone, that maintains the blood calcium levels in our body. Let's see how PTH maintains the blood calcium level. So, what happens is basically whenever the calcium level goes down in the body, the parathyroid glands, the four parathyroid glands, stimulate the secretion of PTH, the parathyroid hormone. This PTH, when it comes to the blood and eventually goes to the bone, increases the osteoclast cells in the bone. And what does the osteoclast cell do? It breaks down the bone because this is basically a destructive type of cell that degrades or destroys bone cells.

So, basically it will degenerate and destroy the bone cells through osteoclastic activity, which will release calcium into the blood. So, in this way, if there is a negative imbalance of calcium, parathyroid hormone secretes parathyroid hormone. The parathyroid gland secretes parathyroid hormone, and through osteoclastic activity and bone degradation, calcium is released into the blood to maintain homeostasis; on the other hand, if the calcium ion concentration increases in the blood, then the parathyroid hormone level will decrease. Right, and that will influence the calcium deposition in the bone, and if the calcium gets deposited in the bone, the calcium level inside the blood will be reduced. Okay, so in this way, again, calcium homeostasis will be maintained.

So you can see how parathyroid is so important by influencing the upregulation or downregulation of parathyroid hormone to control the calcium level in our blood. Also importantly, for example, vitamin D levels also have an important influence on this parathyroid activity and on maintaining calcium levels and calcium absorption. So, these are very important. The thyroid gland, you remember, secretes various types of hormones, mostly T3 and T4, right? Triiodothyronine and thyroxine, and what these hormones do, they have a very important role in our metabolic regulation. In our next few classes, we will see how the thyroid hormone plays an important role in our body's metabolism.

But at this point, just try to remember that the thyroid gland is very important for maintaining the metabolic activity of our body. So, what are the defined functions that T3 and T4 can do? It regulates the metabolism; it has a very important role in overall growth and development. The thyroid gland and the thyroid hormone also maintain our body's temperature; they play a very important role in the regulation of cardiovascular function and nervous system function. So, T3 and T4 that get released from the thyroid gland have many important functions for our body; you can see, then thymus, thymus you can see is just below the thyroid gland, we have this thymus that secretes various hormones like thymosin, thymulin, thymopoietin, and you know why they are so important because they play a very important role in the development and maturation of T cells. These are a form of immune cell.

If you remember, we discussed in detail what T cells do and how T cells play a very important role in maintaining our body's immunity. So, for the development of the maturation of T cells, the thymus gland plays a very important role. So, it also has a very important role for our overall immune function. In the adrenal glands, do you remember what the adrenal gland does? Adrenal glands secrete various glucocorticoids. So, in the adrenal cortex, you can see the outer layer, which produces a lot of steroid hormones like glucocorticoids, such as aldosterone, and what they do is maintain blood pressure.

And the medulla, or the inner layer, also produces a lot of stress hormones like epinephrine and norepinephrine. So, they also play an important role in terms of stress regulation in our body. So, maintaining blood pressure and the stress response, the adrenal gland has a very important role. See, this is kind of the overall function of the adrenal gland. You can see that the adrenal gland can secrete androgens, which have a very important role in influencing sexual development and the functions of our body.

In the same way, adrenaline can secrete like different glucocorticoids or steroids. They control the metabolism inside our liver. In the kidney, aldosterone maintains the blood pressure and the electrolytic balance. Also, in muscle cells such as those in the heart or smooth muscle, epinephrine and norepinephrine activity can control muscle stress during the regulation of the stress response. So, you can see the adrenal gland has so many important activities in

maintaining metabolism, stress, blood pressure, and also helping in sexual development and function.

Then the very important pancreas, you know, has different types of cells, like alpha cells and beta cells; these are some primary cells, as well as acinar cells. What does the pancreas do? There are so many activities of the pancreas. For example, beta islet cells of the pancreas secrete insulin, and you know why insulin is so important. Insulin increases the glucose distribution from the blood to various cells and tissues. Also, insulin can lower the glucose by converting it to glycogen and storing it in the liver.

And that's why insulin and pancreatic cells are so important, especially beta islet cells. Alpha cells in turn produce glucagon. Whenever there is a fasting condition, glucagon is secreted by the alpha cells and converts glycogen back to glucose. So, in this way, the pancreas maintains the glucose homeostasis of our body by the secretion of insulin and glucagon hormones. Also, if you remember, there are other inhibitors of excessive hormone secretion, like somatostatin, which can prevent excessive insulin and glucagon release, maintaining a good sensing application that, whenever it detects high glucose in the body, insulin is only secreted by the beta islet cells; otherwise, somatostatin is released.

can prevent excessive insulin release because excessive insulin release can cause conditions such as hypoglycemia or brain coma. This is the diagram of the same thing as I said: whenever there is high blood glucose, pancreatic beta islet cells will secrete insulin, which will distribute the glucose to various tissue cells, and excess glucose will be converted to glycogen by the same function of insulin in the liver. However, whenever there is a fasting condition and the glucose level goes down, Then what will happen? The glucagon secreted by the alpha cells of the pancreas converts glycogen back to glucose through alpha cell activity, and then this glucose is further distributed to the body. So, this is the overall glucose homeostasis. By this, our body continuously maintains the glucose condition, and in case of any irregularity, if possibly the beta islet cells get destroyed or if they become resistant, then a condition occurs in our body with persistent high blood glucose, which we call diabetes.

In our next few classes, we'll see how diabetes occurs and how we can have various types of therapies that can control our blood glucose levels or hyperglycemic levels in our body, but just try to remember in this class that the pancreas is a very important gland, a very important gland that maintains the secretion of different hormones like insulin and glucagon, by which glucose homeostasis is maintained. So, we discussed a lot of different endocrine glands. Finally, we will try to wrap up with some more examples, such as liver. The liver has a lot of different secretions of hormones that maintain the regulation of growth and development, blood pressure, iron and mineral absorption, blood clotting regulation, especially by thrombopoietin, and metabolic homeostasis by IGF-1, angiotensinogen, and hepcidin. Then the kidney, you remember, secretes renin, which plays an important role in the rash system for blood pressure maintenance.

The kidney also has an important role in calcium and bone metabolism because it converts vitamin D to its active form, calcitriol, allowing proper calcium absorption and bone maintenance. And lastly, but not least, our gonads, or reproduction-related endocrine glands, for example, ovaries, secrete estrogen and progesterone; they maintain the menstruation cycle, reproductive health, and the progression of a baby. So, there are a lot of important functions for our ovaries and even the testes because, you know, like testes also secrete testosterone that is very important for the development of the male embryo or like sperm, the quality of and the

healthiness of the sperm. So all these endocrine glands play a very important role in various functions and different types of physiological conditions and balances of our body. So think about how the endocrine glands maintain homeostasis in the body.

Then can you tell me which hormone regulates the calcium level in the blood? Also, try to find out which hormone is called the stress hormone and what type of endocrine glands produce the stress hormone. So hopefully you enjoyed the endocrine glands class. We have discussed the function of endocrine glands through the secretion of hormones, starting from our master gland, the pituitary, to the pancreas, thyroid, thymus, and various other reproductive endocrine glands. The endocrine system as a whole has such a significant role to play in our normal physiological function and overall balance. So, this is a very important chapter, and in the next few classes, we'll thoroughly discuss some aspects of the endocrine system.

We'll see if certain imbalances happen in the endocrine system, what types of diseases can form, and then what the therapeutic or intervention strategies would be. Hopefully, you liked today's class. Let's meet with another class of human physiology very soon. Thank you.