Human Physiology
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Hello everyone, welcome to another new class on human physiology. In the last few classes, we have been discussing different endocrine glands; we are also discussing what different types of hormones are produced by those endocrine glands and their roles. In this class, we will discuss different endocrine diseases and disorders. Whenever there is a dysregulation or any disease affecting the endocrine glands, there are abnormalities. So, we will see what types of diseases can form and some intervention strategies and therapies. So, let us stay with it.

So, what different content will be covered for this class? So, we will discuss what an endocrine disorder is, and we will discuss different endocrine disorders like hypothalamus disorders. Pituitary disorder; then we will discuss thyroid disorder, parathyroid disorder, and adrenal and pancreatic disorders. Lastly, we will discuss gonadal disorders and some very preliminary diagnostic tests that are needed for the detection of endocrine disorders. So, in general, what is an endocrine disorder? Endocrine disorder results from the dysfunction of hormone-producing glands, which can affect metabolism, growth, various sexual characteristics, insulin production, steroid hormone production, etc.

All these hormones, what they do, is basically maintain physiological homeostasis. So, whenever there is a dysfunction due to improper hormone production from the endocrine glands, our physiological homeostasis completely breaks down. And there might be abnormal hormone production; those conditions are called hyperstate or hyperfunction state. There can be an abnormally low amount of production as well; it can be called hypofunction state or hypo state. So, in case the enzymes are produced in an excessive manner or in a higher manner, it can be called hyperfunction or a hyperactivity condition.

If the production of the hormone is very low compared to the general standard level, it can be called hypo function or a hypoactive state. Let us see with a different disorder. This would be a very straightforward, direct class. If you have any further questions, please ask us during the live session. Also, you can drop your question via email.

So, what is a hypothalamic disorder? Hypothalamic disorder is also termed hypothalamic dysfunction. It can be caused by different reasons; for example, it can be caused by tumor formation or by different types of trauma, including head trauma, because, as you remember, the hypothalamus is present in our brain. It can also be caused by different genetic defects. And what type of symptoms will you observe, such as irregular temperature control of the body? So, sometimes our body may have a temperature that is too high, and all of a sudden, within maybe half an hour to one hour, the body experiences a severe cold condition or temperature. Because you remember that the hypothalamus has a very specific role in temperature regulation, in the case of a hypothalamic disorder or dysfunction, we may observe irregularities in temperature control.

Apart from that, there can be appetite loss, and along with that, sleep disturbances can also be observed. Then the next one is a pituitary disorder. So, what can happen in the case of a pituitary disorder? Either, as we said, there can be two distinct conditions: either it can be hyperfunction,

which is called hyperpituitarism, or overactive pituitary. What happens in the case of hyperpituitarism? This can basically lead to conditions like acromegaly, which is characterized by excess growth due to the secretion of excess growth hormone from the pituitary. Gigantism can also occur due to excess growth hormone during childhood, and Cushing's syndrome or excess cortisol can also be observed.

In case of abnormally low activity, hypopituitarism or underactive pituitarism can be observed. This happens whenever the pituitary gland does not generate too much hormone. This can lead to severe dysfunction, for example, such as growth deficiency and hormonal deficiency. It can also affect thyroid functions, adrenal functions, and various primary and secondary sexual characteristics and development. So, the pituitary, as we said, is one of the most important glands or the master gland.

In case of any disorder associated with the pituitary, our physiological homeostasis is completely disturbed, and that can affect us in different ways. Then in the last class, as you remember, we discussed the thyroid hormones T3 and T4 and how they are synthesized. We also discussed, once the thyroid hormone enters the blood, what its primary role is, and we said that the primary role of thyroid hormone is in terms of metabolism. There are also different roles of thyroid, but what happens in the case of a thyroid disorder? So, the first thyroid disorder can be associated with different conditions; the first one would be hyperthyroidism or the overactive thyroid. So, basically, hyper means, as you know, abnormal or a higher level or excess level, and we know that thyroid refers to our thyroid gland, and it signifies a medical condition, disease, or process.

So, hyperthyroidism means the presence of abnormally high thyroid hormones that are secreted from the thyroid gland, causing a medical condition or disease. Basically, it is an overproduction of the thyroxine hormone, or T4, and the triiodothyronine hormone, which is the T3 hormone. So, what will happen if the thyroid disorder occurs, we will discuss, but before that, let us see what the different types of medication are that can be given. So, basically, antithyroid drugs can be given; for example, this kind of reduces the production of the thyroid hormone, and beta blocker drugs can be given; these medications can help to manage symptoms like rapid heart rate. Then radioactive iodine treatment can be given to destroy some of the thyroid cells to reduce the synthesis of the thyroid hormone.

Apart from that, surgery may also be needed sometime to remove the thyroid gland to stop or reduce thyroid hormone synthesis. Then there is hypothyroidism or an underactive thyroid. So, what basically happens in hypothyroidism? So, this is hyper; this would be like hypothyroidism. In the case of hypothyroidism, what happens is that there are low levels of hormones. So, in the case of hypothyroidism, a low level of production of T3 and T4 hormones occurs, which creates a condition or medical disease.

So, what happens exactly in the case of hypothyroidism? We will discuss how that affects our body, but generally, in terms of therapy, this levothyroxine can be used. The levothyroxine hormone can eventually stimulate the underactive thyroid to produce more thyroid hormone. Basically, it is kind of hormone replacement therapy. So, after the hyperthyroidism, we will discuss hypothyroidism. So, what happens in the case of hypothyroidism? As we said, in the case of hyperthyroidism, an excess amount of T3 and T4 production occurs, causing different abnormalities, which we will discuss; however, the challenge with hypothyroidism is that when there is a very low amount of T3 and T4 production, it causes a medical condition.

Levothyroxine or a thyroxine or thyroid hormone type of replacement therapy can be given. This levothyroxine basically replaces the thyroxine hormone that the thyroid is not able to make enough of. So, this type of thyroid, like thyroxine or thyroid replacement therapy, can be used for hypothyroidism. Now, let's see what specific situations or conditions happen in the body in the case of both hypothyroidism and hyperthyroidism. So, let's see; in the case of hypothyroidism, the body can experience weight gain, decreased appetite, cold intolerance, constipation, fatigue, hair loss, dry skin, etc.

In cases of hyperthyroidism, there can be weight loss, increased appetite, heat intolerance, diarrhea, anxiety, increased hair and nail growth, and increased sweating. So, all these physiological changes can be observed during hypo- and hyperthyroidism, and as we mentioned, different therapeutic interventions and drugs can be prescribed to the body, along with options such as surgery. Now, let us see the thyroid level chart. You can see that in the case of normal conditions, the TSH level is about 1.

9 or around 2. In the male, in the female, it is also almost the same: 1.9 plus or minus 1.2. The T3 level, in the case of normal, is about 1.58 for both males and females.

In cases of T4 in the normal range, the level is about 97 to around 86 for males and females. Now what happens basically in the case of hypo condition, as you can see, is that the level of TCH, along with the levels of T3 and T4, goes down from the normal level in both males and females. In case of hyper condition, the levels of TSH, T3, and T4 all go high. So, these are like a clinical chart where all the data points and all the standard values for normal levels and hypo and hyper levels are given. If you are interested, please read more about the thyroid hormone and diseases related to the thyroid.

The next thyroid disorder we will discuss is the goiter, which is basically a condition where the enlargement of the thyroid gland happens. So, you see an enlargement of the thyroid gland happen, which is also called a goiter. Why does it happen? Basically, iodine deficiency can cause goiter formation. Apart from that thyroid inflammation, different types of hormonal changes can also cause issues. Basically, the symptoms may include pain and swelling in the neck, and you may have difficulty swallowing different foods and water.

Termesis can be done by blood test, for example, by measuring the T3, T4, and TSH levels. Apart from that, physical examination and ultrasound-based imaging can also be done. If goiter and thyroid disorders are identified, then there can be different types of treatment options that can be obtained. If it is iodine deficiency-related goiter, iodine can be prescribed as a supplement. Apart from that, if the thyroid is too high or too enlarged, surgical intervention might be needed to remove it.

Apart from that, radioactive iodine therapy can also be used. Lastly, the thyroid gland can also experience tumorigenic formation or cancer formation, which can manifest as tumors forming inside or outside of the thyroid gland, such as thyroid cancer, where malignant cells uncontrollably proliferate and produce, and eventually, in a later stage, it can metastasize and affect other organs as well. There can be different causes including genetic mutations, radiation, and other chemical toxin exposures such as environmental pollution. The symptoms can include having a lump in the neck, rapid voice changes, and swelling; these can all signal thyroid cancer. There can be radiation therapy and chemotherapy, right? So, the therapy can include radioactive iodine therapy, and a surgical procedure to remove the thyroid gland can also be an option.

Then a different type of chemotherapy or drug-based therapy can also be given. And sometimes hormonal replacement therapy, or very recently immunotherapy, or even gene therapies and cell therapies, can be prescribed. So, these are some of the modern therapies, including immunotherapies, gene therapies, and cell therapies; these can also be given to thyroid cancer patients. Then, after the thyroid, as you remember, there are about four parathyroid glands, and these parathyroid glands secrete a hormone called PTH, or parathyroid hormone, which has a very significant role in regulating the calcium concentration in the blood. So, in the case of a parathyroid disorder like hyperparathyroidism, an excess amount of PTH or parathyroid hormone activity or production can cause a significantly high level of calcium.

So, you remember what PTH does: it basically breaks down the bone through osteoclastic activity and eventually increases the calcium concentration in the blood. So, in cases of a high amount of PTH in the condition called hyperparathyroidism, calcium concentration can increase, which can lead to kidney disease or even kidney stones, and muscle weakness can also be observed, right? The treatment can generally be described in terms of the removal of the parathyroid glands by surgical procedure. So, in cases of hypoparathyroidism or low PTH levels, it is a very rare endocrine disorder where the parathyroid gland does not produce enough PTH hormone. This results in a very low level of calcium in the blood, right? So, the blood calcium level goes down. In this case, the blood calcium level goes up, but the bone calcium level goes down.

So, in the case of hyperparathyroidism, the bone calcium level goes down; right, that can also cause osteoporosis. But in the case of hypoparathyroidism, blood calcium levels go down. Right, and it can also increase, like the phosphorus level in the blood. So, basically, it is a very rare condition; sometimes it can be related to autoimmune disorders as well. What can be observed because blood calcium levels go down is that there can be occurrences of muscle cramps or seizures, and tingling in the hands and feet can also be observed.

In terms of treatment, calcium and vitamin D supplements can be given to the patient, or PTH, or parathyroid hormone replacement can also be suggested. After the parathyroid disorder, another important disorder that is commonly observed is similar to the adrenal type of disorder. In adrenal disorders, as you can see, there can be different conditions. The first one is Addison's disease or adrenal insufficiency, where adrenal glands don't produce enough cortisol or aldosterone. As you know, aldosterone and cortisol control our blood pressure.

So, if they don't produce enough aldosterone, the patient may suffer from low blood pressure along with fatigue and weight loss. Apart from that, Cushing's syndrome with excess cortisol can also be observed in the case of an adrenal disorder. Here, too much cortisol produced by the adrenal gland can result in increased blood pressure or weight gain. Apart from that, congenital adrenal hyperplasia can also be observed, which is basically a genetic condition or genetic disorder where the adrenal glands don't produce enough cortisol and aldosterone, leading to ambiguous genitalia in newborns. As you can see, apart from those, hyperaldosteronism can also be observed in Kohn's syndrome, where the adrenal gland produces too much aldosterone, causing high blood pressure or low potassium levels.

Apart from that, adrenal gland tumors can also be observed, which is, of course, a little bit rare, but still observed. The tumor can be, of course, either benign or cancerous, and if the tumors are not detected in the early stages, there is a significantly high risk of mortality. After the adrenal, you remember we thoroughly discussed the pancreatic disorders. We will not

discuss too much, just to touch base a little bit briefly. The pancreas is responsible for maintaining glucose regulation in our body, as you remember.

And in case of any disorder related to the pancreas, what basically happens is that the high level of glucose that persists in our body is called hyperglycemia, right? So, high blood glucose due to the irregularity or disorder of the pancreas can be called hyperglycemia, and a persistent hyperglycemic condition can lead to a disease known as diabetes. Diabetes, or diabetes mellitus, can be of two types, as you know: type 1 diabetes, where an autoimmune disorder occurs and all the beta cells are destroyed pretty early in life, mainly in the case of children. Type 2 diabetes also occurs when insulin resistance happens, and due to insulin not binding properly to the insulin receptor, it cannot stimulate or induce the blood receptors for the uptake of glucose. So, in this way, diabetes can happen, and we thoroughly discuss what the various types of therapy are. So, you remember that there can be insulin therapy, organ donation, and most importantly, cell-based therapy, right? So, in one or two classes before, we discussed the beta islet cell-based therapy and how immuno-isolation can be developed, right? We discussed how immuno-isolation can be developed using polymeric capsules that are conjugated with chemical molecules and, inside this immuno-isolated polymer, how beta islet cells can be transplanted in diabetic patients, which will basically maintain normal glycemic conditions for a longer time.

Apart from that, the pancreas can also observe tumor formation, which is called insulinoma, a rare condition that can still occur and cause a lack of insulin production; it may also lead to an increased amount of insulin production. So, insulinoma, if the insulin-secreting tumors are rapidly synthesized, too many insulin-producing cells will develop, causing a higher amount of insulin production in the body, which can eventually lead to a hypoglycemic situation that can cause brain coma, fainting, and can also increase the risk of mortality. So, after the pancreatic disorder, there can also be gonadal disorders. For example, those are mostly related to the female and male reproductive organs. So, in the case of females, they are very highly prone to conditions like PCOS or polycystic ovary syndrome.

This is a very common hormonal disorder that mostly affects women of reproductive age, and because of the polycystic ovary formation, which is basically cyst formation inside the ovary, females can experience irregularities in their periods, excess hormonal levels, and the formation of many small or large cysts. Right in terms of picos treatment, the cyst can eventually be removed, or it can be treated with hormonal control therapy. Also, treatment can be given mostly because the cause has been a hormonal imbalance apart from insulin resistance. Treatment can be given in terms of regular weight management, a healthy diet, or regular exercise. Apart from that, there are different medications; for example, hormonal birth control can be given, anti-androgen medication can be given, and insulin-sensitizing medication can be given.

Then, ovulation induction medications can be given, and apart from that, different other medications to treat or cure the pain and other conditions related to PCOS can be given to the female patient. So, this is mostly related to the female reproductive system. Apart from that, hypogonadism or low sex hormone levels can also be a condition that develops in both males and females. In cases of hypogonadism, it can affect males in the testes and also the ovaries in females. This can happen due to genetic causes or also with aging and pituitary dysfunction.

And if it happens, it can delay puberty; it can also cause low libido and fatigue. In case of treatment, testosterone can be prescribed for the male patient, and for the females, estrogen or

progesterone replacement therapies can be prescribed. So, lastly, what are the different types of diagnostic tests for endocrine disorders? Of course, the primary one is like the hormonal test because endocrine glands secrete different hormones to maintain physiological homeostasis. So, the hormonal test can be easily done for example, TSH, ACTH, cortisol, GH, prolactin, etc.

, and insulin. To measure their right level and determine if there is any condition or any abnormal level, either high (hyper) or low (hypo), the doctor can easily understand the condition and prescribe the medication accordingly. Apart from that, MRI, CT scans, and ultrasound imaging can also be done. MRI and CT scans are mostly done for the pituitary and adrenal glands, sometimes even for the pancreas. Ultrasounds can be done for the thyroid, pancreas, etc. The glucose tolerance test can be done; the dexamethasone suppression test to detect Cushing's syndrome can also be done.

So, there are different kinds of ways to detect various sorts of endocrine disorders, and if they are detected under the right conditions, a doctor may prescribe the proper medication to the patient. So, think about what the major differences are between the endocrine and exocrine glands in disease pathology, how feedback mechanisms regulate hormonal levels, and how disruption can lead to disease. You may also refer to different types of textbooks, including Tortora items. If you have any further questions, please discuss them with us during the live sessions; you can also drop us your questions via email. So, in the last few classes, we thoroughly covered the endocrine glands.

We saw how glucose homeostasis happened. We saw, in the case of dysregulation of glucose homeostasis, how type 1 and type 2 diabetes occurred. We discussed various therapies for diabetes, including modern approaches such as cell-based therapies and the artificial pancreas. Lastly, we also saw thyroid hormone synthesis and its functions. Finally, today we are ending with the endocrine glands with different types of endocrine disorders.

Hopefully, you are enjoying the human physiology class. Let's meet with another new class very soon. Thank you.