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This is the first of two presentations on the ENDOCRINE SYSTEM. The endocrine system is made up by a series of glands that all have in common the job of secreting hormones into the bloodstream. The prefix “Endo” means “internal”. On the other hand, we have the exocrine glands which have a different job. The prefix “exo” means “external” and this tells us that they DO NOT secrete their products into the bloodstream (a sweat gland, which is an example of an exocrine gland secreting sweat onto the skin).

The HORMONES secreted by the endocrine glands travel through the circulation and produce certain effects when they reach organs whose cells have receptors that recognize these hormones. The hormone tells the organ what to do. It's like an email with specific instructions for the organ's cells.

The glands that make up the endocrine system are the following:

1) The PITUITARY GLAND aka HYPOPHYSIS
2) The PINEAL GLAND
3) The PARATHYROID GLAND
4) The THYROID GLAND
5) The PANCREAS
6) The ADRENAL GLANDS aka SUPRARENAL GLANDS
7) The OVARIES
8) The TESTICLES

In this First Presentation on the Endocrine System we will be talking about:

The PANCREAS
The PITUITARY GLAND
The PINEAL GLAND

Now back in the fourth presentation on the Digestive System we had said that the pancreas had 2 jobs. One was to secrete digestive juices into the duodenum to facilitate digestion which is it's job as an exocrine gland but it also has a second job as an endocrine gland – that's the part we're going to cover now-. So, having said that, let's start by talking about the:

PANCREAS

The pancreas produces a couple of important hormones: one is

1) GLUCAGON: is a sweet hormone because it INCREASES BLOOD SUGAR by telling the liver to release sugar into the bloodstream. When we say “blood sugar” we are referring to the level of glucose in blood. Doctor's call it: GLYCEMIA. Glucose is a carbohydrate and is the basic fuel for cells. Glucagon is secreted in response to low blood sugar: HYPOGLYCEMIA.
The other important hormone is:

2) **INSULIN**: which is secreted by the pancreatic beta cells and **LOWERS BLOOD SUGAR** by telling the body's cells to take in the glucose from the blood. Insulin binds to a cell's **insulin receptor**. A receptor is like a keyhole. The insulin acting as a key, binds to that receptor and opens the door for the glucose to enter the cell and **this lowers the blood sugar level**. **Insulin is secreted AFTER A MEAL** when a lot of glucose is absorbed into the bloodstream from the intestines. **These mechanisms are altered in diabetes**.

When the endocrine function of the pancreas is affected a well-known disease appears and that is:

**DIABETES MELLITUS (DM)**: this disease is the star of our presentation as it is a **very frequent disease**. It is classified as:

**TYPE 1**: where the pancreatic **BETA CELLS** are being **DESTROYED** and so there's not enough **insulin**. Reason why type 1 diabetes requires treatment with **insulin injections**. Seen more frequently in children and adolescents.

**TYPE 2**: has more to do with **INSULIN RESISTANCE**. That means there is insulin but it's not working. Reason why it is generally treated with **oral medications**. It has a strong **hereditary** component. The amount of fat in the body is related to insulin resistance, so make no mistake, **the fatter you are, the better your chances of developing TYPE 2 DM**.

Both types are characterized **HIGH BLOOD SUGAR** aka **HYPERGLYCEMIA**

**DM SYMPTOMS**: excessive **THIRST**
- excessive **URINATION**
- excessive **HUNGER**

**DIAGNOSIS**: **FASTING BLOOD SUGAR** tests show high blood sugar. An **OGTT** (oral glucose tolerance test) may also be done: blood is drawn to get a baseline blood sample then patient drinks a sweet solution and then gets blood drawn several times at different intervals.

**COMPLICATIONS**: over time diabetes affects many areas of the body (what's known as a **SYSTEMIC DISEASE**) like:

- **CIRCULATION** Diabetes clogs arteriess, especially affects the circulation through the lower extremities which can result in:
  - ULCERS
  - GANGRENE
  - AMPUTATION of toes and foot.

  When it affects the circulation in:
  - the heart: can lead to: **HEART ATTACK**
  - the brain: can lead to: **STROKE**

It also affects:

- **NERVOUS SYSTEM** what’s known as:
  - **DIABETIC NEUROPATHY**: with symptoms like: **TINGLING** and **BURNING FEET**
• **EYES** what's known as:
  - **DIABETIC RETINOPATHY**: with symptoms like: **BLURRED VISION**, **BLINDNESS**

• **KIDNEYS** what's known as:
  - **DIABETIC NEPHROPATHY**: which can lead to **KIDNEY FAILURE**

A patient can monitor his blood sugar at home by purchasing a **GLUCOMETER**. The patient pricks a finger with a **LANCET** to obtain a drop of blood which will be placed on a **REACTIVE STRIP** and the **glucometer** will measure the patient's **glycemia**.

If a patient's **diabetes gets out of control** either because he doesn't take his medicines, doesn't stick to a diet or gets an infection (and diabetics are prone to infections) one can find very high blood sugar levels of **250 or higher**. When the blood sugar is that high the **glucose starts leaking into urine causing excessive urination**. This leads to **DEHYDRATION**. There is also transformation of that **excess glucose into acid** (known as **KETONE BODIES**). When this happens the patient can develop a condition called **KETOACIDOSIS**. Patients with ketoacidosis come to the ER **breathing fast** aka **HYPERVENTILATION** as the body tries to “breathe the acid out”. They also have **vomiting**. These patients go to the **ICU** (intensive care unit). Untreated this can lead to **COMA**.

**DM TREATMENT**
- **Type 1** is treated by injecting **INSULIN**. There are different types of insulin like **REGULAR** and **NPH**.
- **Type 2** is generally treated by oral medications called **ORAL HYPOGLYCEMICS** like **METFORMIN** and **GLYBURIDE** but sometimes also requires insulin.

**DIABETIC HYPOGLYCEMIA aka INSULIN SHOCK**: **Hypoglycemia** is the medical term for **very low blood sugar**. That may happen sometimes if a diabetic exercises too much, or doesn't eat well, or uses too much insulin. This **low blood sugar** can cause:
  - **TREMBLING**
  - **LIGHT-HEADEDNESS**
  - **SWEATING**
  - **HEADACHE**
  - **CONFUSION** and
  - **LOSS OF CONSCIOUSNESS**. Remember glucose is the brain's main food if it's not getting any it will complain and shut down. **There will most certainly be material related to diabetes on your exams so study the terminology well.**

Our next stop in our presentation is “**THE BOSS**” is of all glands which is the:

**PITUITARY GLAND aka HYPOPHYSIS**

It is aka “the master gland” since it **secretes hormones that regulate all other glands**. The pituitary gland is located at the **base of the brain**. It is tiny, the size of a pea, deep behind your nose. I think Mike Tyson really hated it because I once heard him say in a documentary that when he was in the ring he focused on hitting his opponent's nose so hard so as to smash it up into his brain! Yikes! The pituitary gland would not survive a blow like that!
Now, if we remember that mythical Greek creature: the centaur we find that the pituitary gland has something in common with the centaur because just like the centaur is...part man...part horse. The pituitary is ...part gland...part nervous tissue.

-The part that is gland is called **ADENOHYPOPHYSIS**. 
   Adeno = Gland

-The part that is nervous tissue is called **NEUROHYPOPHYSIS**.

The neurohypophysis is basically a part of the **HYPOTHALAMUS** which is a part of the brain.

Now the **ADENOHYPOPHYSIS** is the part of the pituitary gland that does most of the work here. It secretes:

1) **(TSH) Thyroid-Stimulating Hormone**: tells the thyroid to secrete its hormones.
2) **(GH) Growth Hormone**: Regulates growth of bone, muscle and other tissues and is getting all the Hollywood hype about the actors who are getting themselves injected with it to stay young.
3) **Prolactin**: stimulates breast development during pregnancy (women's breasts grow during pregnancy for those who hadn't noticed it). It also has a role in human sexuality.
4) **(LH) Luteinizing Hormone**: stimulates ovulation in women and production of sperm in men
5) **(ACTH) or Adrenocorticotropic Hormone**: maintains the adrenal gland and tells it to secrete corticosteroids
6) **(FSH) Follicle-Stimulating Hormone**: stimulates the secretion of estrogen and production of ova (eggs) in women. Also stimulates production of sperm in men
7) **(MSH) Melanocyte Stimulating Hormone**: promotes pigmentation of the skin.

The **NEUROHYPOPHYSIS** on the other hand, functions as the “shipping department” for the hypothalamus. Two hormones made in the hypothalamus are sent down to the neurohypophysis to be stored and later released into the circulation. They are:

1) **OXYTOCIN**: comes from “oxys”= quick and “tocos”=birth. From which we understand that this hormone stimulates the contractions of the uterus during childbirth. We mentioned this hormone back in the first part of obstetrics where we said it was used to induce labor. Remember? Oxytocin also stimulates release of milk from the breasts during the act of breastfeeding.

2) **ANTIDIURETIC HORMONE (ADH)**: first let’s make it clear that diuretics make a person urinate. Coffee is a diuretic for example. Ever notice how after a couple of cups you are looking for a restroom? Well this hormone does the opposite. If diuretics make a person urinate, this hormone tells the kidney to save water.

**ADH--> CONCENTRATES URINE**
When the Pituitary gland gets sick SOME DISEASES can occur like:

1) **ACROMEGALY**: caused by a tumor (adenoma) of the pituitary gland which makes too much GH. This causes growth of the jaw, face and extremities.

   - An adult person with this condition “thickens out” because they cannot grow.
   - When this condition affects a child it does cause them to get taller (because the growth plates in their bones are still open) and is called GIGANTISM. Some of the tallest human beings on earth actually had this.

**SYMPTOMS:**
- Appearance of COARSE FACIAL FEATURES (pretty much like Shrek's face… Maybe Shrek had acromegaly...who knows???)

**DIAGNOSIS:** BRAIN MRI

**TREATMENT:**
- SURGERY or RADIATION to shrink tumor.
- A medicine called: OCTREOTIDE is also useful since it blocks effect of GH.

2) **DWARFISM**: when we say dwarfism we are referring to growth retardation due to lack of GH. Therefore it is treated with: (GH) INJECTIONS.

3) **PROLACTINOMA**: another tumor of the hypophysis which secretes excess PROLACTIN. Giving way to:

**SYMPTOMS:** IRREGULAR MENSES
- INFERTILITY
- MILKY DISCHARGE FROM BREASTS in women and
- DECREASED VISION & HEADACHES in both sexes

**DIAGNOSIS:** BRAIN MRI

**TREATMENT:**
- surgical removal of the tumor and
- there is a drug called BROMOCRIPTINE which blocks prolactin.

4) **DIABETES INSIPIDUS**: Now if we look again, we see that instead of diabetes “mellitus” it says “insipidus”. Mellitus is Latin for “honey” meaning “sweet” because of the increased blood sugar in diabetes mellitus. However in diabetes “insipidus” there is no sweetness...in other words no elevated blood sugar so “insipidus” which is Latin for “tasteless” tells us just that. So if there is no elevated blood sugar then *why do they call it “diabetes”??*

**SYMPTOMS:** that's because there is EXCESSIVE URINATION AND THIRST like in DM BUT no problem with insulin here. Problem is due to deficient ADH secretion or ADH resistance (so patients pee a lot because they can't concentrate their urine and that makes them thirsty). Diabetes Insipidus can be caused by a pituitary tumor, a blow to the head or sick kidneys.
DIAGNOSIS:

- BRAIN MRI.
- Blood tests: BMP which stands for BASIC METABOLIC PANEL
- URINALYSIS, a WATER DEPRIVATION TEST and other tests which I will not go into further details here because it goes past the scope of this training

TREATMENT: will depend on the cause:

- If it is a tumor: surgery.
- If not, the synthetic form of ADH called DESMOPRESSIN may be used.
- If sick kidneys are the cause then HYDROCHLOROTHIAZIDE may be useful.

Our last stop in this first presentation on the endocrine system is the:

**PINEAL GLAND**

Named that way due to its **pine-cone shape**. This small gland located deep in the brain secretes a hormone called MELATONIN which is thought to regulate sleep. When your eyes open, the light creates electrical impulses that reach the pineal and the secretion of melatonin is reduced. When in the dark (bed time!), secretion increases. There has been some speculation about giving melatonin supplements to soccer teams when they fly to other countries to help reduce jet-lag! There is not much more to say about this little gland which is really a part of the nervous system except to just mention a rare tumor called a PINEALOMA that may affect it.

This concludes our first presentation on the Endocrine System. Please know that you will not be tested on what each individual hormone does (with the possible exception on insulin because diabetes is such a frequent disease). You were provided with that information for your general knowledge and so you can better understand the diseases.

In this presentation we have gone over many terms related to **ENDOCRINOLOGY** while we discussed the signs and symptoms of sickness and diseases. We also discussed some of the diagnostic procedures and treatments used. I hope you’ve enjoyed this lesson and come away with a better understanding of **ENDOCRINOLOGY** and the terms related to this field of medicine.

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