The lecture started with talking about eicosanoids but, unfortunately I couldn't hear it well enough due to noise and the doctor's voice wasn't loud enough. Excuse me for that. But this is what's written in previous year's slides:

Eicosanoids:

Animals fed a fat-free diet fail to grow, develop skin and kidney lesions and become infertile. Adding linolenic, linoleic and arachidonic acids to the diet cures all the deficiency symptoms. These three acids are polyunsaturated fatty acids and because of their action are called **essential fatty acids**. One of the reasons and possibly the only reason, that essential fatty acids are necessary for health is that they are the precursors of prostaglandins, prostacyclin, thromboxanes, lipoxins, leukotrienes and related compounds. These substances are called eicosanoids. The leukotrienes, thromboxanes, lipoxins and prostaglandins have been called **local hormones**. They undoubtedly act mainly in the tissues at sites in which they are produced.

The doctor answered the question that was assigned for one of the students.
Why adrenaline (aka; epinephrine), which is an amino acid derivative, cannot diffuse into cells ?
Because it's polar, hydrophilic and there are no specific channels to pass through.
Another important point about this, adrenaline produces **fast action**, therefore the receptors of the adrenaline are in the cell membrane.

Down-regulation:

There are some cells that have low number of receptors because they are exposed to high concentration of hormones. For instance, insulin's high concentration doesn't function properly leading to hyperglycemia (high concentration of glucose in plasma) because of **low number of receptors** as well as **decreased affinity** to insulin. These patients have Diabetes Mellitus II and they compose two-thirds of the obese individuals -BMI more than 27- in the US (we took the US as a standard due to similar life habits in all states).

*BMI = Body Mass Index, if calculated and appeared to be more than 27 then the individual is considered overweight or about obese.

Up-regulation:

These diabetic patients are advised to have exercise as well as controlling the diet and at the end they will reduce their weight because the number of the receptors for insulin will increase and the affinity will do so, too.

Desensitization:

*2 types of desensitization mentioned in the previous lecture; homologous and heterologous desensitization.

Example on desensitization:
Chemical castration or chemical therapy for prostate cancer (Homologous desensitization), which is the continuous administration or injection of Gonadotropin-Releasing hormone (GRH), thus the cells in the anterior pituitary gland become less responsive. FSH and LH will decrease, consequently testosterone decreases and then dihyrdotestosterone decreases.

*High concentration of dihydrotestosterone (DHT) causes prostate cancer.

Hormonal interactions:

Hormones don't function separately, there's interaction between hormones, and they show: Permissive, synergistic and antagonistic effects.

Permissive effect:
Sometimes, for a hormone to function properly, it needs the first action of another hormone, for example: Adrenaline to function properly on fat cells, it needs the additional action of thyroxin.

Synergistic effect/ Synergism:
When many hormones work together in order to produce the best results as if they complete each other. For example, not only the Growth Hormone (GH) causes the body to grow, many other hormones participate in the growth action of human beings and mammals.

Antagonistic effect/Antagonism:
Sometimes, two hormones function against each other on the same target cells. For example, insulin lowers blood glucose level while glucagon raises it.

The mechanisms of hormones:
First, hormones need receptors, and then they need to produce second messengers.

Protein hormones:
We will classify the protein hormones according to number of second messengers produced:

- Some of them produce one second messenger which is the **cAMP**.
  (Enzyme is adenylyl cyclase)
- Some produce two second messengers; (**DAG**) for the activation of the enzymes and the other (**IP_3**) increases the calcium level inside the cell. This means that for these hormones

to function properly, they need high concentration of Ca^{+2} inside the cells. (enzyme is phospholipase C)

Amino acid derivatives:
They are small molecules that can diffuse inside the cells as well as inside the nuclei. They bind to receptors either inside the cells or inside the nuclei, affecting DNA, producing mRNA then physiological responses, except adrenaline which cannot diffuse and need cell membrane receptors.

Steroid hormones:
Some of them, as to function properly, they have receptors in the cell membrane such as estrogen, progesterone.

There are always some exceptions; insulin (protein hormone) has a receptor and a second messenger that are entirely different, it has an enzyme-linked hormone receptor (Tyrosine Kinase). Also, Nitric Oxide (NO), its second messenger is guanosine monophosphate (GMP).

Pituitary gland physiology:

Small gland, less than 1 gram, lies in cavity at base of the brain called sella turcica. The pituitary gland is also called the **hypophysis** and is composed of 2 parts; the anterior (**adenohypophysis**) and the posterior (**neurohypophysis**). These two parts are entirely different in their embryology, histology and physiology. They are both connected to the hypothalamus directly or indirectly.

- The posterior pituitary is connected **directly** to the hypothalamus, since neurons extend directly from the hypothalamus to the neurohypophysis and its hormones originally come from the hypothalamus and are transferred down, that's why they are called **neurohormones** (Oxytocin and ADH). The function of the posterior pituitary is just a **storage** function. Two nuclei produce the posterior pituitary hormones which are the paraventricular nucleus produces oxytocin and a little bit ADH (vasopressin) and the supraoptic nucleus produces ADH and a little bit of oxytocin.

**The two nuclei produce little bit of the other hormone due to similarity of structure (difference in two amino acids) and also there's very little similarity in function (similarity in structure is more than in function).

Function similarity:
For oxytocin: Milk ejection to ADH potency is 100:1
For ADH: ADH potency to milk ejection is 200:1

The ADH (Antidiuretic Hormone) has two main functions:

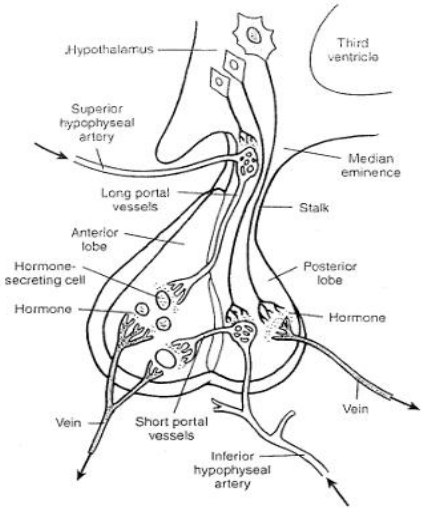
1. Increasing the reabsorption of water from renal tubules.
2. Vasoconstriction of blood vessels.

There are stimuli and inhibitors for the release of ADH:

- Major and minor stimuli:
  The two major stimuli are osmolarity and the volume of the blood/body fluid.
  - This is also applied on the inhibitors.

There are 2 types of ADH: AVP (Arginine Vasopressin) and LVP (Lysine Vasopressin). They have the same function. In some other mammals, there's just LVP such as pigs and marsupials (kangaroo).

- The anterior pituitary is connected indirectly to the hypothalamus. The hormones are first produced by the hypothalamus and released into the capillary bed at the median eminence, then move to the anterior pituitary. There are 2 types of stimulation of anterior pituitary hormones, through short portal vessels and long portal vessels;
  Short portal vessels: neurons from the hypothalamus extend around the posterior pituitary location, and then from there, the short portal vessels affect the anterior pituitary hormones.
  Long portal vessels: The hormones from the hypothalamus are released in the median eminence capillary bed then into the long portal vessels to affect the anterior pituitary.



In the anterior pituitary gland, there are five types of cells: somatotropes 30%-40%, corticotropes 20%, gonadotropes, thyrotropes and lactotropes (the last three are 3%-5%).

Each cell type usually produces one hormone:
Somatotropes: growth hormone.
Corticotropes: ACTH.
Thyrotropes: TSH.
Gonadotropes: FSH and LH.
Lactotropes: prolactin (PRL).

The hypothalamic hormones affect the anterior pituitary hormones:

Corticotropin Releasing hormone (**CRH**) affects the **ACTH**.
Thyrotropin Releasing hormone (**TRH**) affects the **TSH**.
Growth Hormone Releasing hormone (**GHRH**) affects the **GH**.
Gonadotropin Releasing hormone (**GRH**) affects FSH and **LH**.
Dopamine affects **prolactin.**

Notes:

- Even though gonadotropes produce FSH and LH, there are some other cells produce only FSH and others produce only LH whether in normal or abnormal conditions. This also goes to lactotropes and somatotropes which are separate, but sometimes one of them produces the two hormones (Growth hormone and prolactin) because of the similarity in the hormonal structure and little bit in function.
- For most pituitary hormones, the hypothalamic releasing hormones exert more control, as for prolactin, **the hypothalamic inhibitory hormone** probably exert more control because prolactin isn't needed in both sexes, even in females it's not always needed.
- Oxytocin isn't that important in the delivery, but females are given a material to induce contraction.
- The hypothalamus receives signals from all centers of the CNS.