Intro to THE ENDOCRINE SYSTEM (handout)

GENERAL OVERVIEW (see fig. 16.1)

- The second organ system dedicated to **control and integration** of the activities of various tissues and organs. 1st was the Nervous Sys.
- Consists of various **glands** which communicate with each other and with target tissues by way of chemical ligands called **hormones**.
- Endocrine literally means "**to secrete within**." The hormones are usually secreted into surrounding tissue fluids and transported throughout the body by blood.
- The nervous system communicated by way of nerve impulses and neurotransmitters (NTs.) Here we're doing it with chemicals called **Hormones** (Hs).
- Hs are similar to NTs in their action. It's just that the distance between the source of release and the target tissue is much greater. Just think of Hs as "long distance" NTs.
- Hs are chemical substances (ligands) released by one tissue and then transported in ECFs to act upon another target tissues.
    1. Most Hs are AA based (proteins).
    2. A few are steroids derived from cholesterol... e.g. estrogen, progesterone, testosterone, aldosterone, and cortisol.

MECHANISMS OF HORMONE ACTION

- Hs are often referred to as "messengers" but they *carry no information*.
- Instead, they simply either "turn on" or "turn off" a genetically preprogrammed function of the cell. A hormone simply triggers the cell to do what the cell is already programmed to do. It would be better to call them chemical "triggers" rather than messengers.
  e.g. FSH triggers an ovarian follicle to begin to grow but not *how* to grow.
- The effects of Hs may be visible in a matter of seconds, minutes, hours or even days.
- Steroid Hs tend to be slower acting... AA based Hs tend to be fast acting
- The body's response to Hs is generally slower than to NTs but their effects are usually longer lasting

SEVERAL GENERIC EFFECTS OF Hs

When Hs bind to receptors on target cells they typically produce a response by one of the following:

1. alter membrane permeability and therefore RMP
2. alter synthesis of protein and/or regulatory enzymes
3. alter activity of existing enzymes
4. alter secretory activity
5. stimulate (increase the rate of) cell division by **mitosis**

TARGET CELL SPECIFICITY

- Hs are receptor specific. They circulate to almost all body cells but bind with and affect only those with the appropriately shaped receptors. We call these cells the target tissue of that hormone.

MAGNITUDE OF RESPONSE

How large of a response you get from the release of a hormone is influenced by:

1. Concentration of the H in the blood
2. # of receptor sites present on target cells.
3. Affinity of the H for the receptor.

All 3 of these variables can and do change:

1.) The conc. of an H in the blood directly influences the conc. of the H in the ISF. The more H in the ISF the more **hormone-receptor complexes** that are formed and the greater the magnitude of the response.

2.) Protein receptors in membranes are relatively short-lived so the # present fluctuates.

UP REGULATION - # of receptors for hormone "X" increases in response to an increase in hormone "Y"
(e.g. FSH increases the # of LH receptors on ovarian follicles)

DOWN REGULATION - # of receptors declines after binding with the H. to reduce subsequent response.
(e.g. GnRH from hypothalamus binds to receptors at the anterior pituitary triggering the release of FSH and LH to start the monthly ovarian cycle. Within hours the # of GnRH receptors in the anterior pituitary dramatically ↓ making the anterior pituitary much less responsive to additional GnRH.

3) Affinity is how "attracted" the H is to its receptor or another way to think of it is "how strongly the H binds to its receptor." Changes in nutrient levels may affect affinity. And, changes in the concentration of hormone 'X' may cause changes in the affinity of hormone 'Y' for its receptors.