endocrine system general concepts

homeostatic control

- local response
    - occurs at target cells
        * paracrine/autocrine not considered hormones
        * hormone is considered when is released into the blood
- reflexes
    - response made is distant from target cell
    - low concentration / high affinity
    - in contrast, the nervous system, works with high concentration. Receptor with low affinity
    - high concentration / low affinity

endocrine glands

- ductless glands
- specific homeostatic mission:
    - sodium/water
    - calcium
    - energy
    - cope with stress
    - growth
    - reproduction

concentration of hormone in blood

- rate of production
    - most regulated
    - mediated by + and - feedback
- rate of delivery
    - dependent on perfusion and blood flow
    - follow mass action laws (carriers)
        * lipids and steroid bind to protein carrier, carriers have low affinity
            · H * C -> H + C -> H * R
- rate of degradation and/or excretion

peptide protein hormones

- peptide 3+ aminos
    - made in rough endoplasmic reticulum
        * preprohormone
            · inactive
            · packaged and moved to the golgi
            · cleaved to prohormone

* prohormone
  · almost always inactive
  · secretory vesicle
* hormone
  · active
  · happens within the secretory vesicle
  · delivered via +calcium Ca or cyclic AMP (adenosin monophosphate) signal
  · prepackaged, released as needed
  · once they are in the blood, the half life is short
  · do not require carriers, because they are soluble
- steroid hormones
  - adrenal, gonads, placenta
  - not soluble in plasma, lipid plasma
  - use carriers, because they are soluble in lipid
  - synthesized on demand
  - concerted to active in target tissues
  - testosterone -> DHT ; testosterone -> estrogen, depending upon the target
- amino acid derivatives
  - insoluble in plasma
  - transported via carrier
  - long half life
  - conversion in target tissues

transport carriers

- extend live of the hormone
- sequester the hormone from its target cell receptor

receptor types

- soluble in plasma:: hydrophilic, receptor in the cell surface
  - integral membrane proteins
    * tyrosine kinase (puts phosphate) <- growth hormone -> when binded, then second msgr start the chain
    * inherent tyrosine kinase <- insulin -> phosphorilation
    * g protein coupled <- glucagon
    * steroid & thyroid hormone, can cross plasma membrane -> nuclear receptor -> changes to DNA

target cell sensitivity

- affinity
- receptor number
- competition

- saturation

types of stimuli

- Stimuli -> neuron (sense sodium concentration) -> secrete hormone -> anti diuretic hormone -> kidney -> dilutes sodium concentration :: neural control
- hormonal control
- low blood calcium -> paratyroid -> paratyroid hormone -> bone -> release calcium :: substrate control

inactivation of hormone signaling

- receptor desensitization ex: type II diabetes
  - sequestration
    * remove the receptor from the surface
  - degradation
    * destroy receptor
- negative feedback
  - removes initial stimulus

general concepts

- peptide hormones are soluble in plasma, bind cell surface receptor, are fast-acting and are short-lived
- thyroid hormones and steroid hormones are insoluble in plasma, act via intracellular receptor to change transcription, are slow acting and long lived
- binding proteins (carriers) regulate hormone availability, physiologic function, and half lives
- hormone release is under neural, hormonal, nutrient and ion regulation
- signaling is regulated by changing plasma hormone concentration and by changing target cell receptor sensitivity

Endocrine system assessment & pathology

assessment of function

- too much -> hyper secretion, hormone excess
- too little -> hypo-secretion, hormone insufficiency
- target cell resistance -> unresponsive
- just right -> normal or eu-secretion, works fine

competitive binding assay

- high sensitivity and high specificity

- specific antibody -> marks the hormone -> labeled hormone
  - unlabeled hormone competes, then via subtraction we find how much unlabeled hormone there was, because we know the initial labeled hormone concentration

bioassay = function?

- low plasma glucose -> hypothalamus -> CRH (cortico trophin) -> anterior pituitary -> ACTH (adreno cortico throphin) -> adrenal cortex -> cortisol -> negative feedback anterior pituitary + hypothalamus
- if high cortisol -> high plasma glucose -> give dexamethasone to inhibit ACTH -> ACTH lvl should fall -> - cortisol; if not -> problem with the adrenal gland
- low plasma + low cortisol -> give ACTH -> cortisol should rise -> problem was with hypothalamus or anterior pituitary

general concepts

- pathology happens when theres too much or too little hormone or resistance to the hormone due to receptor dysfunction
- interpretation of hormone levels requires consideration of either the trophic hormone or of the ios/nutrient controlled by the hormone