Adrenal & Gonadal Hormones

Topics for today:

• Adrenal cortex hormone
• Adrenal medulla hormones
• Hormone control of organs
• Steroid hormone synthesis
• Vitamin D3
• Estrogens and Progesterone

Layers of adrenal cortex

[Diagram showing layers of adrenal cortex: zona glomerulosa, zona fasciculata, zona reticularis]
Hormones of adrenal cortex

- **Androgens** = dehydroepiandrosterone
  - increased protein synthesis
  - masculinizing effects in female (hypersecretion)

Dehydroepiandrosterone (DHEA) is a weak androgen with almost no effect in males but has masculinizing effects in females.

Adrenal medulla (interior)

- Composed of modified post-synaptic sympathetic neurons
- Releases mostly epinephrine.
- Has effects similar to those triggered by sympathetic nervous system

Adrenal medulla hormones

\[
\text{epinephrine}
\]

**Effects of epinephrine:**
- causes elevated blood glucose level
- stimulates glycolysis & fatty acid use
- increases cardiac output & blood pressure
- shifts blood flow to skeletal muscle
- increases rate and depth of respiration
Organ responses to Epinephrine

- Causes glycogen degradation in muscle
- Causes fatty acid release from adipose tissue
- Causes release of glucose from liver

Hormone action time

<table>
<thead>
<tr>
<th>Fast-acting Hormones</th>
<th>Slow-acting Hormones</th>
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<tbody>
<tr>
<td>• Norepinephrine</td>
<td>• Throxine</td>
</tr>
<tr>
<td>• Epinephrine</td>
<td>• Cortisol</td>
</tr>
<tr>
<td>• Insulin</td>
<td>• Growth hormone</td>
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<tr>
<td>• glucagon</td>
<td>• Estrogens</td>
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<tr>
<td>• Androgens</td>
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Epinephrine is in group of fast-acting hormones

Hormone control of metabolism (Pathway/metabolic effects)

- Insulin
  - ↓ Glycogenesis
  - ↓ Glycolysis
  - ↓ Lipid synth
  - ↓ Protein synth

- Glucagon
  - ↑ Gluconeogenesis
  - ↑ Glycogen degrad (effect in liver)

- Epinephrine
  - ↑ Glycogen degrad
  - ↑ Glycogen degrad (effect in liver)
  - ↑ Glycolysis
  - ↑ Lipid degrad (effect in muscle)
  - ↑ Protein synth

- Cortisol
  - ↑ Protein degradation (effect in muscle)
  - ↑ Gluconeogenesis (effect in liver)
Endocrine disfunctions

**Cushing’s syndrome** – excessive cortisol resulting in loss of muscle protein

**Addison’s disease** – insufficient aldosterone causing cardiac disturbance due to high K⁺

**Adrenogenital syndrome** – excessive androgen causing virilization in female

Steroid synthesis

- cholesterol
- pregnenolone
- progesterone
- 17α-H progesterone
- testosterone
- 19-Nor-testosterone
- 17β-estradiol
- desoxycorticosterone
- cortisol

Vitamin D3 synthesis

- cholesterol
- 1,25-dihydroxy Vit D3
Hormone control of Calcium levels

<table>
<thead>
<tr>
<th>Parathormone</th>
<th>Calcitonin</th>
<th>Vitamin D</th>
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<tbody>
<tr>
<td>Renal reabsorption of Ca</td>
<td>↑</td>
<td>-</td>
</tr>
<tr>
<td>Intestinal absorption of Ca</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ca mobilization from bone</td>
<td>*</td>
<td>↑</td>
</tr>
<tr>
<td>Serum Ca level</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

* Ca mobilization results from action on hydroxyapatite (the mineral matrix of bone) by acid phosphatase released from osteoclasts.

Ovarian follicles & corpus luteum

Hormones of the ovaries

Hormones of the ‘Follicular’ phase:

Hormones of the ‘Luteal’ phase:

progesterone
Hormonal effects of estrogens

General effects:
• stimulates bone elongation and then closure of the epiphyseal plates
• produce a general ‘anabolic’ effect
• stimulates “female” pattern of fat distribution
• stimulates mammary gland growth

Reproductive system effects:
• stimulates growth of uterus & fallopian tubes
• stimulates growth of external genitalia

Synthetic estrogen

Diethylstilbestrol (DES) and 17-ß-estradiol

Diethylstilbestrol (DES) is a synthetic nonsteroidal estrogen that binds estrogen receptors. It was formerly used to prevent premature labor and also used as a feed additive to promote growth of livestock and poultry. It has been linked to increased risk of vaginal or cervical carcinoma.

Effects of progesterone

• maturation of uterine mucous glands
• stimulates uterine glands to secrete mucus
• blocks androgen effects (competes for binding)