Pharmacology

Drugs that Affect the Endocrine System
Topics

- Pituitary Drugs
- Parathyroid/Thyroid Drugs
- Adrenal Drugs
- Pancreatic Drugs
- Reproductive Drugs
- Sexual Behavior Drugs
Functions

- Regulation
- Control
Glands

Exocrine
- Secrete enzymes
- Close to organs

Endocrine
- Secrete hormones
- Transport via bloodstream
- Require receptors
Nervous

- Wired
- Neurotransmitters
- Short Distance
- Closeness
- Rapid Onset
- Short Duration
- Rapid Response

Endocrine

- Wireless
- Hormones
- Long Distance
- Receptor Specificity
- Delayed Onset
- Prolonged Duration
- Regulation
Mechanism of Action

- A cell producing protein hormones
- Blood vessels
- Protein hormone
- Target cells
- Receptor site
- Unmatched hormone and receptor site: No effect

- A cell producing steroid hormones
- Steroid hormone
- Receptor site
- Effect
Hypothalamus
<table>
<thead>
<tr>
<th>Posterior Pituitary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target</strong></td>
</tr>
<tr>
<td>Oxytocin</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ADH</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
## Anterior Pituitary

<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>GH</td>
<td>Most tissue $\uparrow$ Growth</td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid $\uparrow$ TH secretion</td>
</tr>
<tr>
<td>ACTH</td>
<td>Adrenal Cortex $\uparrow$ Cortisol secretion</td>
</tr>
</tbody>
</table>
### Anterior Pituitary

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSH</td>
<td>Ovaries Testes</td>
<td>Follicles Estrogen Sperm</td>
</tr>
<tr>
<td>LH</td>
<td>Ovaries Testes</td>
<td>Ovulation Progesterone Testosterone</td>
</tr>
</tbody>
</table>
Anterior Pituitary

<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolactin</td>
<td>Mammary Gland</td>
</tr>
<tr>
<td></td>
<td>Milk production</td>
</tr>
</tbody>
</table>
Pituitary Hormones
Thyroid
Thyroid

<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroxine</td>
<td>Most cells</td>
</tr>
<tr>
<td>Triiodothyronine</td>
<td>Mostly bone</td>
</tr>
</tbody>
</table>
Hypothyroidism
Hyperthyroidism
Parathyroid
Parathyroid

<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parathyroid (PTH)</td>
<td>Bone</td>
</tr>
<tr>
<td></td>
<td>Kidney</td>
</tr>
<tr>
<td></td>
<td>GI Tract</td>
</tr>
<tr>
<td></td>
<td>↑ Calcium</td>
</tr>
</tbody>
</table>
Calcium Regulation

- High blood calcium stimulates calcitonin release, which inhibits blood calcium reduction.
- Low blood calcium stimulates parathyroid hormone release, which stimulates blood calcium increase.
- Parathyroid hormone stimulates release of calcium from bone, absorption of calcium in intestines, and reabsorption of calcium in kidneys.

Thyroid and parathyroid glands are involved in this regulation process.
Pancreas

Hormones (insulin, glucagon)

Blood

Endocrine portion of pancreas (Islets of Langerhans)

Duct cells secrete aqueous NaHCO₃ solution

Acinar cells secrete digestive enzymes
Pancreas

- Alpha cells: glucagon
- Beta cells: insulin
Pancreas

Target | Action
---|---
Glucagon | Liver | ↑ Glucose
Insulin | General | ↓ Glucose
Glucose Regulation

- Increased blood glucose (i.e., after eating) stimulates the islets of Langerhans to increase insulin production.
- Decreased blood glucose (i.e., skipping a meal) decreases insulin production.
- Normal blood glucose levels decrease insulin production and stimulate the release of glucose.
- Increased insulin causes glucose to be stored in liver and other tissues.
- Decreased insulin stimulates the release of glucose.

The cycle maintains stable blood glucose levels.
Stress
physical activity
low blood glucose

Hypothalamus

Nerve impulses from hypothalamus to the spinal cord

Epinephrine

- Diverts blood to skeletal muscles
- Increases cardiac muscle contraction
- Increases heart rate
- Increases blood glucose
- Increases metabolic rate
- Increases breathing rate
- Increases tissue flow
- Decreases function of digestive organs
- Dilates bronchioles

Sympathetic nerves carry impulses to adrenal medulla
<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norepi Epi</td>
<td>Heart, Blood vessels, Liver</td>
</tr>
<tr>
<td></td>
<td>Prolongs SNS Effects</td>
</tr>
<tr>
<td>Target</td>
<td>Action</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>↑ Na reabsorption</td>
</tr>
<tr>
<td>Kidney</td>
<td>↑ Water retention</td>
</tr>
<tr>
<td>Cortisol</td>
<td>↑ Glucose</td>
</tr>
<tr>
<td></td>
<td>↓ inflammation</td>
</tr>
</tbody>
</table>
## Anterior Pituitary Drugs

<table>
<thead>
<tr>
<th>Inadequate Growth Hormone</th>
<th>Excessive Growth Hormone</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dwarfism</td>
<td>• Acromegaly</td>
</tr>
<tr>
<td>• somatrem (Protropin®)</td>
<td>• Gigantism</td>
</tr>
<tr>
<td>• homatropin (Humatrope®)</td>
<td>• Surgical removal 1º</td>
</tr>
<tr>
<td></td>
<td>• octreotide (Sandostatin®)</td>
</tr>
</tbody>
</table>
Posterior Pituitary Drugs

- Oxytocin
- ADH
  - Diabetes insipidus
  - Nocturnal enuresis
- vasopressin (Pitressin®)
- desmopressin (Stimate®)
- lypressin (Diapid®)
Parathyroid Diseases

• Hypoparathyroidism
  – Inadequate calcium levels
    • TX: increased dietary calcium

• Hyperparathyroidism
  – Excessive calcium levels
    • TX: surgical removal
Thyroid Disease

- Hypothyroidism
  - Hormone replacement
  - levothyroxine (Synthroid®)
- Hyperthyroidism
  - Thyrotoxicosis
  - Surgical removal
  - propylthiouracil (PTU)
Adrenal Cortex

ACTH Hypersecretion
Cushing’s Disease
• Surgical removal
• Inhibit adrenal secretion
  – ketoconazol (Nizoral®)
• Symptomatic tx:
  – Antihypertensives

ACTH Hyposecretion
Addison’s Disease
• Replacement therapy
• Cortisone (Cortistan®)
• Hydrocortisone (SoluCortef®)
• Fludrocortisone (Florinef Acetate®)
Pancreas

**Blood Glucose**

- **Insulin**
- **Glucagon**

**Beta Blockers**

Blood Potassium
Insulin Preparations

- Regular Insulin
  - Natural insulin

- Modified Insulin
  - Increased duration of action
  - NPH (neutral protamin Hagedorn)
    - Natural plus protamin
  - Lente
    - Attached to zinc to prolong absorption
Oral Hypoglycemic Agents

**Sulfonylureas**
- ↑ insulin secretion
- tolbutamide (Orinase®)
- chlorpropamide (Diabinese®)
- glipizide (Glucotrol®)
- glyburide (Micronase®)

**Alpha-glucosidase inhibitors**
- Delay carbohydrate metabolism
  - acarbose (Precose®)
  - miglitol (Glyset®)

**Biguanides**
- metformin (Glucophage®)
- ↓ Glucose synthesis
- ↑ Glucose uptake

**Thiazolidinediones**
- ↑ Insulin effectiveness
- troglitazone (Rezulin®)
Hyperglycemic Agents

- Glucagon
  - ↑ gluconeogenesis

- D$_{50}$W

- diazoxide (Proglycem®)
  - Inhibits insulin release
Estrogens & Progestins

- Estrogens used for post-menopausal hormone replacement therapy.
  - estradiol (Estrace®)
  - conjugated estrogens (Premarin®)
  - estropipate (Ogen®)

- Progestin
  - Diminish side effects of estrogen therapy
  - Nausea, fluid retention, breast tenderness
  - medroxyprogesterone acetate (Provera®)
  - norethindrone acetate (Aygestin®)
Oral Contraceptives

• Combination of estrogen and progestin
  – Loestrin®, Levora®, Nordette®, Ovocon®, Norinyl® plus many others

• Minipill: progestin only
  – Micronor®, Nor-Q.D.®, Orvette®

• Prime side effect: ↑ risk of thromboembolism
Uterine Stimulants & Relaxants

- **Stimulants (Oxytocics)**
  - \( \uparrow \) uterine contraction
  - Indication:
    - Induce labor
    - Postpartum hemorrhage
  - oxytocin (Pitocin®)
  - ergonovine (Ergotrate®)

- **Relaxants (tocolytics)**
  - Relax uterine smooth muscle
  - Beta₂ agonists
    - terbutaline (Brethine®)
    - ritodrine (Yuptopar®)
Infertility Agents

- Promote maturation of ovarian follicles
- clomiphene (Clomid®)
- urofollitropin (Metrodin®)
Male Reproductive Agents

- Testosterone Replacement
  - methyltestosterone (Metandren®)
  - fluoxymesterone (Halotestin®)
- Benign Prostatic Hypertrophy
  - Surgery
  - finasteride (Proscar®)
Sexual Behavior

- Most are side effects from other medications
  - Antihypertensives & psychoactive drugs
- sildenafil (Viagra®)
Thank You!

- To Temple College EMS Professions for permission to use their materials