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

Effect

Unmatched hormone and receptor site
No effect

A cell producing steroid hormones

Steroid hormone

Receptor site

Effect
Hypothalamus
Hypothalamic Control Pituitary
<table>
<thead>
<tr>
<th>Oxytocin</th>
<th>Uterus</th>
<th>↑ Contraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammary</td>
<td></td>
<td>↑ Milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑ Milk let-down</td>
</tr>
<tr>
<td>ADH</td>
<td>Kidneys</td>
<td>↑ Water reabsorption</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 ↑ Growth</td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid ↑ TH secretion</td>
</tr>
<tr>
<td>ACTH</td>
<td>Adrenal Cortex ↑ Cortisol secretion</td>
</tr>
<tr>
<td>Hormone</td>
<td>Target</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>FSH</td>
<td>Ovaries</td>
</tr>
<tr>
<td></td>
<td>Testes</td>
</tr>
<tr>
<td>LH</td>
<td>Ovaries</td>
</tr>
<tr>
<td></td>
<td>Testes</td>
</tr>
<tr>
<td></td>
<td></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

- GH (Growth Hormone)
- TSH (Thyroid-Stimulating Hormone)
- ACTH (Adrenocorticotropic Hormone)
- FSH (Follicle-Stimulating Hormone)
- LH (Luteinizing Hormone)
- ADH (Antidiuretic Hormone)
- PRL (Prolactin)
- Oxytocin

Tissues and Hormones:
- Thyroid: Thyroid hormones
- Adrenal gland: Cortical hormones
- Testis: Testosterone
- Sperm
- Ovary: Estrogen, Progesterone
- Ova
- Breast glandular tissue
- Kidney: Kidney water reabsorption
- Lactation
- Uterine contraction

Functions:
- Tissue growth
- Thyroid hormones
- Adrenocorticotropic hormone
- Follicle-stimulating hormone
- Luteinizing hormone
- Antidiuretic hormone
- Prolactin
- Oxytocin

Related organs and functions:
- Kidney
- Lactation
- Uterine contraction

Diagram showing the interaction and function of these hormones and their effects on various organs and tissues.
Thyroid
<table>
<thead>
<tr>
<th>Thyroid Hormones</th>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroxine</td>
<td>Most cells</td>
<td>↑ BMR</td>
</tr>
<tr>
<td>Triiodothyronine</td>
<td>Mostly bone</td>
<td>↓ Calcium</td>
</tr>
<tr>
<td>Calcitonin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothyroidism
Hyperthyroidism

[Images of two individuals with symptoms of hyperthyroidism]
Parathyroid
Parathyroid (PTH)

Target: Bone, Kidney, GI Tract

Action: ↑ Calcium
Calcium Regulation

High blood calcium
Stimulates
Thyroid
Calcitonin released
Inhibits
Blood calcium reduced

Low blood calcium
Stimulates
Parathyroid
Parathyroid hormone released
Stimulates.
Release of calcium from bone
Absorption of calcium in intestines
Reabsorption of calcium in kidneys
Blood calcium increased
Pancreas

- Duct cells secrete aqueous NaHCO₃ solution
- Acinar cells secrete digestive enzymes
- Endocrine portion of pancreas (Islets of Langerhans)
- Hormones (insulin, glucagon)
- Blood
Pancreas

- Alpha cells: glucagon
- Beta cells: insulin
<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucagon</td>
<td>Liver</td>
</tr>
<tr>
<td>Insulin</td>
<td>General</td>
</tr>
</tbody>
</table>
Glucose Regulation

- Increased blood glucose (i.e., after eating)
- Decreased blood glucose (i.e., skipping a meal)
- Normal blood glucose
- Increased insulin causes glucose to be stored in liver and other tissues
- Decreased insulin stimulates release of glucose
- Inhibits insulin production
- Stimulates islets of Langerhans to increase insulin production
Adrenal
<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norepi</td>
<td>Heart</td>
</tr>
<tr>
<td>Epi</td>
<td>Blood vessels</td>
</tr>
<tr>
<td></td>
<td>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>Most Tissue</td>
<td>↓ inflammation</td>
</tr>
</tbody>
</table>
Anterior Pituitary Drugs

Inadequate Growth Hormone
- Dwarfism
- somatrem (Protropin®)
- homatropin (Humatrope®)

Excessive Growth Hormone
- Acromegaly
- Gigantism
- Surgical removal 1º
- octreotide (Sandostatin®)
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 Hyopsecretion
Addison’s Disease
- Replacement therapy
- Cortisone (Cortistan®)
- Hydrocortisone (SoluCortef®)
- Fludrocortisone (Florinef Acetate®)
Pancreas

Insulin

Beta Blockers

Glucagon

Blood Glucose

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
  - Beta$_2$ 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