Dysfunctions of Posterior Pituitary (cont)

- SIADH - Too much ADH in the blood.

- Diabetes Insipidus (urine without taste)

Results from insufficient secretion of ADH

3 forms:

Neurogenic diabetes insipidus
results from lesion of the post. pit. caused by tumor, infection, or disruption of normal blood flow to post. pit.
results in no secretion of ADH

Nephrogenic diabetes insipidus
caused by inadequate response of the collecting ducts in the kidneys to ADH
Psychogenic diabetes insipidus
caused by drinking large
amounts of fluid in
response to psychological
disruption (e.g., stress)

Whatever the form D.I.E. is characterized by:

1. Hypotonic polyuria - production
   of large volumes
   of dilute urine

2. Increased conc. of body fluids
due to dehydration

3. Polydipsia - drinking of large volumes
   of fluid.

Treatment for D.I.E. depends on cause

Neurogenic - Replacement of
ADH with synthetic
ADH generally administered as nasal spray or orally.

Nephrogenic - use of this side drugs to increase reabsorption of from the proximal tubules of the kidneys, low Na+ diet to decrease concentration of the body fluids.

Psychogenic - Psychotherapy to address psychologic disturbance, stress reduction.
Disfunctions of the Anterior Pituitary

Hypopituitarisms + Hyperpituitarisms

Hypopituitarisms - decreased or absent Anterior pituitary hormone secretion

Variety of causes:
- Head trauma that damages the pituitary gland
- Infection of pituitary gland
- Blockage of blood flow to Anterior pituitary. Can occur during pregnancy due to enlargement of the anterior pituitary pinching off blood vessels
- Genetic malformation of the anterior pituitary
- Surgical removal of the anterior pituitary

Panhypopituitarism - All pituitary hormones are absent

has wide effects on the body:

- Thyroid deficiency due to lack of TSH

- Cortisol deficiency due to lack of ACTH

- Gonadal failure due to lack of LH and FSH.
    Includes gonadal atrophy, loss of body hair, sex drive, amenorrhea in women

- Inability of women to lactate after giving
Birth due to loss of prolactin

- Loss of growth hormone, which affects the normal growth and development if it occurs during childhood.

Loss or decreased secretion of growth hormone in children results in "pituitary dwarfism" - person has normal body proportions, but they are short in stature (≤4½ ft)

"Achondroplastic dwarfism" genetic condition in which the epiphyseal plates in the bones close early in development
Results in the person's limbs being disproportionately short compared to the rest of their body. (This is a genetic disorder, not an endocrine disorder!)

Treatment of hypopituitarism depends on underlying cause:

If the normal function of the pituitary can't be restored, then hormone replacement therapy is used to bring pituitary hormone levels back up to normal.
Hyperpituitarism - Hyper secretion of one or more anterior pituitary hormones

most caused by pituitary adenomas (benign hyperplasia of endocrine cells of anterior pituitary)

Ex. Hyperplasia of the Growth Hormone secreting cells of the anterior pituitary → hypersecretion of Growth hormone

In adults the hypersecretion of growth hormone results in Acromegaly - characterized by thickening of the bones of the chin, nose, forehead, and hands + feet.
Figure 19.17

The progression of acromegaly in one individual. The coarsening of features and disfigurement are evident by age 33 and severe at age 52.

- Nerve damage
- Cardiovascular disease
  - Most die of heart damage
Fig. 18-4 Giantism. A pituitary giant and dwarf contrasted with normal-size men. Excessive secretion of growth hormone has characteristically led to disintegration of bones in these individuals.
Hypersecretion of growth hormone during childhood results in "pituitary gigantism," in which the person grows to be 8-9 ft tall.

If hypersecretion of growth hormone continues into adulthood, the person will develop acromegaly.

Treatment of hyperpituitaryism involves reducing secretion of the hormone(s) to normal levels. Because hyperpituitaryism generally involves a pituitary adenoma, surgical removal of the tumor is necessary followed by hormone replacement therapy.
Thyroid Gland

Thyroid gland secretes thyroid hormone in two forms:
- Triiodothyronine (T₃)
- Tetraiodothyronine (T₄)

T₃ is the active form of the hormone (Target cells convert T₄ into T₃)

Thyroid stimulating hormone (TSH) from the anterior pituitary regulates the synthesis and secretion of T₃+T₄

T₃ + T₄ act on most tissues and have two affects
- Increases the rate of metabolic reactions in target cells resulting in setting the
basal metabolic rate for the body (BMR) and normal body temperature

- interact permissively with other hormones (like growth hormone) allowing these other hormones to achieve their full effects.

Hyperthyroid diseases:

All involve hypersecretion of T3 and T4

- Grave's Disease
  - Thyroid Cancer
  - Hypersecretion of TSH by the anterior pituitary

Grave's Disease
Most common type of hyperthyroid disease.

Antibodies are produced against the TSH receptors on the follicular cells of the thyroid gland.

Binding of antibody stimulates the follicular cells to synthesize and secrete T₃ + T₄.

Get oversecretion of T₃ + T₄ and hypertrophy of the follicular cells.

Hypertrophy of the follicular cells causes enlargement of the thyroid gland referred to as goiter.
Figure 76-7. Patient with exophthalmic hyperthyroidism. Note protrusion of the eyes and retraction of the superior eyelids. The basal metabolic rate was +40. (Courtesy of Dr. Leonard Posey.)
Oversecretion of T3 + T4 causes:

- ↑ BMR > above normal
  - ↑ Body Temp
  - Weight loss

- ↑ HR > ↑ BP

- Neurologic disorder
  - Hyperactivity
  - Hand tremors
  - Nervousness
  - Irritability

Exophthalmos — protrusion of the eyes

Results from swelling of the tissues around the eyes and eye muscles. Can result in optic nerve damage causing visual impairment including blindness.
Swelling may be due to inflammatory processes related to antibodies produced against TSH receptors.

Treatment of Grave's disease is aimed at reducing the levels of T3 + T4 down to normal.

Drugs can be used to reduce thyroid hormone synthesis. If these don't work, then the thyroid gland can be ablated using radioactive iodine. Followed by thyroid hormone replacement therapy.
Hypothyroid diseases involve decreased or absent secretion of the thyroid hormones.

Two classes:

- Primary hypothyroidisms result from diseases of the thyroid gland

Include:

- Congenital defects of the thyroid gland
- Defective thyroid hormone synthesis most commonly caused by iodine deficiency in the diet
- Destruction of the thyroid gland due to autoimmune disease or surgery
Secondary Hypothyroidisms caused by diseases occurring outside of the thyroid gland that affect the thyroid.

Include:
- Insufficient TSH secretion due to lesion of the anterior pituitary
- Resistance of target tissues to thyroid hormones

All hypothyroidisms are characterized by:
- $\downarrow$ BMR $\rightarrow$ weight gain $\downarrow$ normal body temp.
  Expressed as "cold intolerance"
- Lethargy (chronic fatigue)
- $\downarrow$ HR $\rightarrow$ $\downarrow$ BP
Treatment for hypothyroidism is directed at bringing thyroid hormone levels in the blood back up to normal. Usually involves hormone replacement therapy by oral Thyro tablets.

Congenital hypothyroidism can lead to “cretinism”

- Characteristic symptoms of hypothyroidism
- Short stature (≤ 4 ft tall)
- Mental retardation

Results from failure of growth hormone to exert its full effects on targets due to lack of thyroid hormone
If congenital hypothyroidism is detected within the first 6 weeks after birth, it can be treated with oral administration of Ty and can result in completely normal development of the individual.

**Parathyroid Glands**

Synthesize and secrete parathyroid hormone (PTH), which regulates calcium levels in the body.

PTH secretion is stimulated when Ca++ levels fall below a certain level in the blood.
PTH acts primarily on the bones and kidneys:

- Stimulates osteoclasts in the bones that breakdown bone matrix resulting in release of Ca++ from the bones

- Increases reabsorption of Ca++ from the filtrate in the kidneys

- Stimulates the kidneys to synthesize calcitriol from Vitamin D3

Calcitriol

- Increases Ca++ absorption from the small intestine
- Increases Ca++ reabsorption
from the filtrate in the kidneys

All serve to increase Ca++ levels in the blood.

Increased Ca++ levels feedback on the parathyroid glands to inhibit synthesis and secretion of PTH.

Hyperparathyroidism

most cases result from benign tumors of the parathyroid glands that cause hypersecretion of PTH.

Results in:

- Excessive bone reabsorption due to overstimulation of the osteoclasts.
— Increased synthesis of Calcitrol by the kidneys.
— Increased Catt reabsorption from the filtrate in the kidneys, and increased absorption of Catt from the small intestine.

Together these result in hypercalcemia - elevated levels of Catt in the blood can lead to formation of kidney stones.

Release of Catt from the bones weakens the bones predisposing the person to bone fractures.
Treatment is directed at lowering blood Ca++ levels using diuretic drugs to increase Ca++ excretion in the urine.

If these fail, then surgical removal of the parathyroid glands can be done to bring down PTH levels. Followed by dietary regime to insure proper Ca++ levels + vitamin D3 levels are maintained.

Hypoparathyroidism - decreased or absent PTH secretion

↓ PTH → hypocalcemic - low Ca++ levels in the blood.
Results from:

- Decreased bone reabsorption

- Decreased calcium reabsorption from the filtrate in the kidneys

- Decreased calcium absorption from the small intestine due to decreased calcitriol levels

Hypocalcemia results in increased excitation of neurons and muscle tissues. This occurs because

↓ Calcium levels in ECF

↓ Decrease in positive charge in the ECF
Causes the membrane potential of neurons + muscle fibers to depolarize.

This depolarization brings the membrane potential of these cells closer to threshold.

Making the neurons + muscle fibers more easily excited.

Results in:

- muscle spasms
- hyperreflexia
- neurologic disorders (confusion, depression, and hallucinations)
- convulsions
- cardiac arrhythmias
Asphyxiation due laryngeal spasms

Treatment is directed at raising Catt levels in the body fluids.

IV Catt salt solution can be administered to bring Catt levels up quickly in emergency situations.

Long term treatment involves increasing Catt + Vitamin D₃ in the diet to try to maintain normal Catt levels, and Calcitrol can be taken orally to increase Catt absorption from the small intestine.
Pancreatic Distorctions

Clusters of endocrine cells called islets of Langerhans.

Two primary endocrine cells:
- α cells - synthesize and secrete a hormone called glucagon
- β cells - synthesize and secrete a hormone called insulin

These two hormones are responsible for regulating the blood levels of glucose. Most cells are targets of insulin.
Insulin:
- ↑ the uptake + use of glucose in glycolysis
- stimulates protein synthesis
- In muscle fibers + liver it stimulates the conversion of glucose → glycogen by glycogenesis. The glycogen is stored in the muscle fibers + liver as "glucose reserve"

Insulin synthesis + secretion is normally stimulated when blood glucose levels rise above 100mg/dL. The actions of insulin on its targets serves to decrease blood glucose levels,