Pathology of the endocrine system

Endocrine system

Structure and function [Figs. 17-1, 17-2]
- The endocrine system consists of cells that secrete hormones
- Endocrine cells are organized as:
  - Glands [e.g. pituitary, thyroid, adrenal, parathyroid glands]
  - Major component of another organ [e.g. testicle]
  - Scattered cells within other organs [e.g. pancreas, intestine]
- Hormones are substances made by endocrine cells and released into the blood to act on distant targets
- Release of hormones by endocrine cells is controlled by various feedback mechanisms

Overview of pathology

Clinical presentation
- Symptoms of endocrine gland disorders are usually due to increased hormone production, decreased hormone production or mass lesions
- Hypofunctioning of endocrine cells results in decreased hormone levels
- Hyperfunctioning of endocrine cells results in increased hormone levels
- Mass lesions are usually due to neoplasia or hyperplasia

Multiple endocrine neoplasia syndromes (MEN)
- Certain syndromes are characterized by multiple endocrine neoplasms
  - MEN I (pituitary, parathyroid, pancreatic islet cell neoplasia)
  - MEN IIa (medullary thyroid carcinoma, pheochromocytoma, parathyroid)
  - MEN IIb (IIa + skin and mucosal nerve tumors)

Pituitary gland

Structure
- Single endocrine gland located in base of the cranium
- Two parts, anterior and posterior
  - Posterior pituitary (extension of the hypothalamus)
    - Secretes the hormones ADH, and oxytocin
  - Anterior pituitary
    - Secretes growth hormone, thyroid stimulating hormone, adrenocorticotropin hormone, gonadotrophin hormones
    - Release of hormones controlled by other hormones released by hypothalamus and various feedback loops

Pituitary gland pathology

Pituitary adenoma
- Benign neoplasm of endocrine cells in the anterior pituitary
- Symptoms due to release of excess hormones or pressure effects of mass (compression of pituitary stalk and/or optic chiasm)
- Endocrine effects depend on what hormone produced by the adenoma
- 80% of pituitary adenomas produce hormones

Prolactinoma (LH)
- Most common pituitary adenoma produces prolactin
- Identified earlier in young reproductive female because present with amenorrhea, galactorrhea, infertility (microadenoma)
- Surgery or medical therapy (bromocryptine) to remove
Pathology of the endocrine system

Pituitary gland pathology

Pituitary adenoma

Somatotropic adenomas
- neoplastic cells produce growth hormone
- gigantism results from excess growth hormone before growth plates close
  - generalized increase in body size with disproportionately long legs, arms
- acromegaly results from excess growth hormone after puberty
  - enlargement of hands, feet, jaw, tongue, and soft tissue

Corticotropic adenoma
- neoplastic cells produce adrenocorticotropic hormone
- Cushing’s disease refers to the syndrome resulting from excess glucocorticoid release by the adrenal cortex
due to excess ACTH

Pituitary hypofunction
- causes of pituitary hypofunction include
  - congenital defect of pituitary gland (primary dwarfism)
  - destructive tumor (pituitary adenoma)
  - ischemia of the pituitary gland (Sheehan’s syndrome)

symptoms
- weakness, ↓ appetite, ↓ weight, hypotension, amenorrhea
- secondary hypofunction of target organs

Diabetes insipidus
- lack of ADH
- usually due to destructive lesion in hypothalamus, pituitary
- unable to resorb water, large amounts of hypotonic urine

Thyroid gland

Structure and function
- located in anterior neck, right and left lobes joined by isthmus
- follicular cells produce thyroid hormones (T4, T3)
- release of thyroid hormones controlled by TSH (from pituitary)
- C cells produce calcitonin

Pathology of the thyroid gland

Thyroid hyperfunction (hyperthyroidism) [Figs. 17-5, 17-6]
- major causes are Grave’s disease, some multinodular goiters, tumors

symptoms of hyperthyroidism
- restless, nervous, emotional lability, sweating, tachycardia, diarrhea, weight loss with increased appetite

Hyperthyroidism

Grave’s disease
- autoimmune disease due to antibodies targeting the TSH receptor on thyroid follicular cells
- AB binds to TSH receptor causing release of thyroid hormones
- more common in females
- associated with other autoimmune diseases
- exophthalmos occurs in Grave’s disease

Multinodular goiter
- enlarged, nodular thyroid may produce increased amounts of thyroid hormone (some may be euthyroid or hypofunctioning)
Pathology of the endocrine system

Pathology of the thyroid gland

Thyroid hypofunction (hypothyroidism) [Fig. 17-6]

- major causes are agenesis, surgery, thyroiditis, iodine deficiency
- Symptoms of hypothyroidism
- cretinism and dwarfism if occurs in perinatal period or infant
- myxedema if occurs in older child or adult
  - sleepy, tire easily, cold intolerance, constipation, weak
- treat with thyroid hormone replacement

Nodular goiter
- goiter is general term for enlarged thyroid gland (many causes)
- nodular goiter is a form of goiter characterized by multiple nodules
- goiters are usually euthyroid (normal thyroid hormone levels)
- may cause mass effects (surgery if problematic)

Thyroid neoplasms

Adenomas
- benign neoplasms of thyroid follicular cells
- may produce symptoms due to mass effect
- treated by surgery (microscopic examination required to rule out cancer)

Carcinoma
- malignant neoplasm of thyroid follicular cells
- two major types:
  - papillary carcinoma (80%)- good prognosis
  - follicular carcinoma (15%)- relatively good prognosis

Parathyroid glands

Structure and function
- usually 4 glands, located in the anterior neck
- produce parathyroid hormone (PTH), involved in calcium homeostasis

Pathology of the parathyroid glands

Hyperparathyroidism [Figs. 17-8, 17-10]
- major causes are parathyroid adenoma and parathyroid hyperplasia
- symptoms of hyperparathyroidism (hypercalcemia)
- bones, stones, moans, abdominal groans

Hypoparathyroidism
- causes of include surgery, congenital hypoplasia
- symptoms of hypoparathyroidism (hypocalcemia)
- muscle spasms, irregular heart beat, cardiac arrest (if severe)

Adrenal glands

Structure and function
- right and left glands, located retroperitoneal
- adrenal cortex
  - zona glomerulosa (aldosterone)
  - zona fasciculata (cortisol)
  - zona reticularis (secondary sex steroids)
- adrenal medulla
  - secrete epinephrine, norepinephrine
Pathology of the endocrine system

Pathology of the adrenal gland

Adrenocortical hyperfunction [Figs. 17-11, 17-13]

Hypercortisolism (Cushing’s syndrome)
- syndrome due to excess glucocorticoid hormones (cortisol)
- most common cause is exogenous steroids, other causes include
  - adrenal hyperplasia or neoplasia
  - hypersecretion of ACTH by pituitary gland (Cushing’s disease)
  - ectopic ACTH (paraneoplastic syndrome)
- dramatic appearance: central obesity, buffalo hump, moon face, striae

Hyperaldosteronism (Conn’s syndrome)
- syndrome due to excess mineralocorticoid hormone (aldosterone)
- causes include adrenocortical adenoma and adrenal hyperplasia
- present with hypertension and hypokalemia

Adrenocortical hypofunction
- usually autoimmune destruction of adrenals, also due Tb, malignancy
  - Addison’s disease
- autoimmune destruction of adrenal gland
- fatigue, weight loss, nausea, increased infections, low Na, high K

Diseases of Adrenal Medulla
Neuroblastoma
- malignant neoplasm of neuroblasts (primitive cells) in neonates, infant
- treatment with chemotherapy, surgery, radiation (90 % cure)
Pheochromocytoma
- a neoplasm (usually benign) derived from adrenal medulla cells
- diagnosed on basis of dramatic clinical picture, metabolites in urine
- treated by surgery

Endocrine pancreas

Structure
- cells located in islets within the pancreas
- several different types of cells (B cells produce insulin)

Pathology of the endocrine pancreas

Diabetes mellitus
- heterogeneous group of diseases due to inadequate insulin activity
- present with polyuria, polydypsia, weight loss
classification of primary diabetes
- type 1 diabetes (insulin dependent, juvenile onset)
- type 2 diabetes (non-insulin dependent, adult onset)
  - most common, relative lack of insulin
- impaired glucose tolerance
pathogenesis
- insulin released in response to increased blood sugar
  - insulin required by certain cells for entry of glucose into the cell
- insulin decreases blood glucose levels
- lack of insulin causes hyperglycemia
  - present with polyuria (osmotic diuresis) and resulting polydypsia
  - also fatigue due to inability of glucose to enter certain cells
- striated muscle cells must use anaerobic glycolysis
  - increased lactic acid
  - decreased use of fats result in increased free fatty acids
    - free fatty acids oxidized into ketones (acidosis)
Pathology of the endocrine system
Pathology of the endocrine pancreas
Diabetes mellitus

- genetic predisposition
  - type 2 > type 1
- environmental factors

Complications (due to long term uncontrolled hyperglycemia)
- Cardiovascular [increased atherosclerosis (CAD, CVD, distal gangrene)]
- Renal [glomerulosclerosis, pyelonephritis, papillary necrosis]
- Eyes [diabetic microangiopathy of retinal vessels, glaucoma, cataracts]
- Nervous system

Treatment (depends on type)
- type 1 requires insulin
- type 2 diet, oral hypoglycemics, insulin if unable to control
Skin
Structure [Fig. 18-1]
- Epidermis (keratinocytes, melanocytes)
- Dermis (connective tissue, adnexal structures)
- Subcutis (adipose tissue)
Functions
- protection; regulation of body temperature
Basic skin pathology
Congenital diseases
- nevus (mole)
- albinism
External injury
mechanical trauma
thermal injury
- burns
  - first degree (erythema and swelling)
  - second degree (blisters)
  - third degree (dermis involved)
  - total surface area of burn is important
cold injuries
  - frostbite
electrical injury
radiation injury
  - sunburn, increased neoplasms
Infectious diseases
- bacterial, fungal, viral
- insect infestations and bites
- acne
Idiopathic and immune diseases
- eczema
- seborrheic dermatitis
- psoriasis
Neoplasms
- Basal cell carcinoma
  - common malignant epithelial neoplasm, excellent prognosis
- Squamous cell carcinoma
  - common malignant epithelial neoplasm, good prognosis
Melanoma [Figs. 18-9]
- malignant neoplasm originating from melanocytes
- different types
  - lentigo maligna
  - superficial spreading
  - nodular
  - acral-lentiginous
- depth of invasion important prognostic factor
- clinical features worrisome for melanoma
  - A - asymmetry
  - B - border irregularity
  - C - color irregularity
  - D - diameter > 6 mm