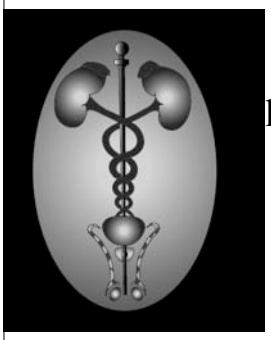


he Adrenal Glands

Thomas Jacobs, M.D.
Diane Hamele-Bena, M.D.

I. Normal adrenal gland
   A. Gross & microscopic
   B. Hormone synthesis, regulation & measurement

II. Hypoadrenalism

III. Hyperadrenalism; Adrenal cortical neoplasms

IV. Adrenal medulla

Normal Adrenal Gland

- Normal adult adrenal gland: 3.5 - 4.5 grams

Adrenal Cortex Morphology

- Cortex: 3 zones:
  - Glomerulosa
  - Fasciculata
  - Reticularis

Hypoadrenalism

Hypoadrenalism

- Primary Adrenocortical Insufficiency
- Secondary Adrenocortical Insufficiency

Hypoadrenalism
Clinical Manifestations

Hypoadrenalism
Clinical Manifestations

Hypoadrenalism
Clinical Manifestations

Pathology of Hypoadrenalism

- Primary Adrenocortical Insufficiency
  - Acute
  - Chronic = Addison Disease
- Secondary Adrenocortical Insufficiency

Pathology of Hypoadrenalism

- Primary Adrenocortical Insufficiency
  - Acute
  - Chronic = Addison Disease

Addison Disease
Clinical findings

Autoimmune Adrenalitis

Pathologic Changes in Autoimmune Adrenalitis

•Gross:
- –Very small glands (1 - 1.5 grams)
- –Cortices markedly thinned

•Micro:
- –Diffuse atrophy of *all* cortical zones
- –Lymphoplasmacytic infiltrate
- –Medulla is unaffected

Pathology of Hypoadrenalism

- Primary Adrenocortical Insufficiency
  - – Acute
    - Waterhouse -Friderichsen Syndrome
  - – Chronic = Addison Disease
- Secondary Adrenocortical Insufficiency

Hyperadrenalism

Hyperadrenalism

Hyperadrenalism

"Endogenous" Cushing Syndrome

Etiology	Pathology
I. ACTH-dependent:	
•Cushing *Disease*	Pituitary adenoma or hyperplasia ↓ Adrenal cortical hyperplasia
•Ectopic ACTH production	Extra-adrenal ACTH-producing tumor ↓ Adrenal cortical hyperplasia
II. ACTH-independent: •Hypersecretion of cortisol by adrenal neoplasm or autonomous adrenal cortical hyperplasia	Adrenal neoplasm or cortical hyperplasia

Cushing Syndrome

Hydrocortisone Excess
- Abnormal fat distribution
  - –Moon face
  - –Central obesity
- Increased protein catabolism
  - –Thin skin
  - –Easy bruisability
  - –Striae
  - –Osteoporosis with vertebral fractures
  - –Impaired healing
  - –Muscle wasting
  - –Suppressed response to infection
- Diabetes
- Psychiatric symptoms

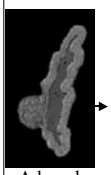
Adrenal Androgen Excess
- Hirsutism
- Deepened voice in women
- Acne
- Abnormal menses

Mineralocorticoid Excess
- Hypokalemia with alkalosis
- Usually occurs in cases of ectopic ACTH production

Pathology of Primary Hyperaldosteronism

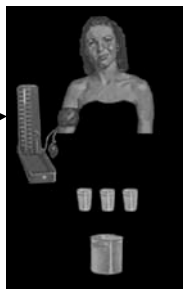
- Aldosterone-secreting adenoma
  - – *Conn Syndrome*
- Bilateral idiopathic cortical hyperplasia
- Adrenal cortical carcinoma
  - – Uncommon cause of hyperaldosteronism

Conn Syndrome



Adrenal adenoma

→ Aldosterone →



- Hypertension
- Polydipsia
- Polyuria
- Hypernatremia
- Hypokalemia

Adapted from Netter

Cortical Neoplasms

Adenomas and Carcinomas → Functioning
Adenomas and Carcinomas → Non-functioning

Cortical Neoplasms

- Adenomas
  - Gross:
    - Discrete, but often unencapsulated
    - Small (up to 2.5 cm)
    - Most <30 grams
    - Yellow-orange, usually without necrosis or hemorrhage
  - Micro:
    - Lipid-rich & lipid-poor cells with little size variation
- Carcinomas
  - Gross:
    - Usually unencapsulated
    - Large (many >20 cm)
    - Frequently > 200-300 grams
    - Yellow, with hemorrhagic, cystic, & necrotic areas
  - Micro:
    - Ranges from mild atypia to wildly anaplastic

Adrenal Medulla

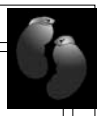
Adrenal Medulla

- Specialized neural crest (neuroendocrine) cells
- Part of the chromaffin system
- Major source of catecholamines

Tumors of the Adrenal Medulla

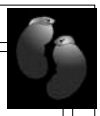
- Neuroblastoma
- Ganglioneuroblastoma
- Ganglioneuroma
- Pheochromocytoma

Neuroblastoma



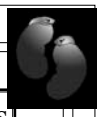
- *Poorly differentiated* malignant neoplasm derived from neural crest cells
- Usually occurs in infants & small children
- "Small round blue cell tumor" of childhood

Neuroblastoma: Pathology



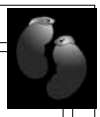
- Gross:
  - Large tumor with hemorrhage, necrosis, & calcification
- Micro:
  - Undifferentiated small cells resembling lymphocytes
  - May show areas of *differentiation*

Neuroblastoma: Prognostic Factors



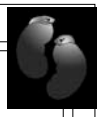
- Patient age
- Stage
- Site of 1^0 involvement
- Histologic grade
- DNA ploidy
- N-myc oncogene amplification

Ganglioneuroma



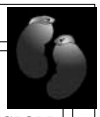
- *Differentiated* neoplasm of neural crest origin
- Benign
- Occurs in older age group
- Pathology:
  - Gross: Encapsulated, white, firm
  - Micro: Ganglion cells & Schwann cells

Ganglioneuroblastoma



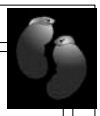
- Composed of malignant neuroblastic elements & ganglioneuromatous elements
- Prognosis depends on % of neuroblasts

Pheochromocytoma



- Catecholamine-secreting neoplasm: HYPERTENSION
- Rare, but important: surgically curable form of hypertension
- May arise in association with familial syndromes, e.g., MEN2, von Hippel-Lindau, von Recklinghausen (NF1)
- May be "sporadic"
- Extra-adrenal tumors (e.g., carotid body) are called "paragangliomas"

Pheochromocytoma: Pathology



- Gross:
  - 1 - 4000 grams (average = 100 grams)
  - Areas of hemorrhage, necrosis, & cystic degeneration
- Micro:
  - Balls of cells resembling cells of medulla, with bizarre, hyperchromatic nuclei; richly vascular stroma
- Benign & malignant tumors are histologically identical; the only absolute criterion for malignancy is *metastasis*.