



The Adrenal Glands

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Adrenal Cortex Morphology

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




- 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



Hypoadrenalism

Hypoadrenalism

- Primary Adrenocortical Insufficiency
- Secondary Adrenocortical Insufficiency



Hypoadrenalism Clinical Manifestations



Hypoadrenalism Clinical Manifestations



Pathology of Hypoadrenalism

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



Hypoadrenalism Clinical Manifestations



Pathology of Hypoadrenalism

- Primary Adrenocortical Insufficiency
 - Acute
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Addison Disease Clinical findings



Pathology of Hypoadrenalism

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



Autoimmune Adrenatitis




Pathologic Changes in Autoimmune Adrenatitis

- Gross:
 - Very small glands (1 - 1.5 grams)
 - Cortices markedly thinned
- Micro:
 - Diffuse atrophy of *all* cortical zones
 - Lymphoplasmacytic infiltrate
 - Medulla is unaffected



Hyperadrenalism

Hyperadrenalism



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

Hyperadrenalism



Pathology of Primary Hyperaldosteronism

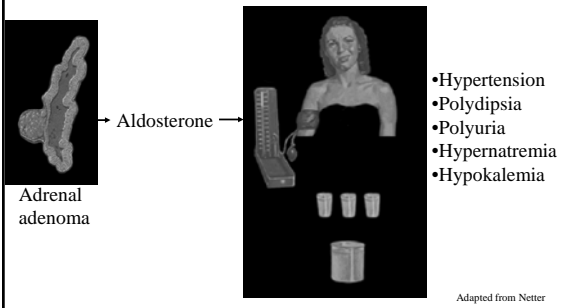
- Aldosterone-secreting adenoma
 - Conn Syndrome
- Bilateral idiopathic cortical hyperplasia
- Adrenal cortical carcinoma
 - Uncommon cause of hyperaldosteronism



“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


Conn Syndrome



Adrenal adenoma → Aldosterone →

- Hypertension
- Polydipsia
- Polyuria
- Hypernatremia
- Hypokalemia


Adapted from Netter



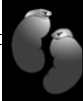
Cortical Neoplasms

Adenomas and Carcinomas

- Functioning
- Non-functioning

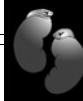


Adrenal Medulla




Cortical Neoplasms

<ul style="list-style-type: none"> • Adenomas – <u>Gross:</u> <ul style="list-style-type: none"> • Discrete, but often unencapsulated • Small (up to 2.5 cm) • Most <30 grams • Yellow-orange, usually without necrosis or hemorrhage – <u>Micro:</u> <ul style="list-style-type: none"> • Lipid-rich & lipid-poor cells with little size variation 	<ul style="list-style-type: none"> • Carcinomas – <u>Gross:</u> <ul style="list-style-type: none"> • Usually unencapsulated • Large (many >20 cm) • Frequently > 200-300 grams • Yellow, with hemorrhagic, cystic, & necrotic areas – <u>Micro:</u> <ul style="list-style-type: none"> • Ranges from mild atypia to wildly anaplastic
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Adrenal Medulla

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



Tumors of the Adrenal Medulla

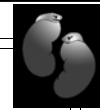
- Neuroblastoma
- Ganglioneuroblastoma
- Ganglioneuroma
- Pheochromocytoma

Neuroblastoma



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

Ganglioneuroma



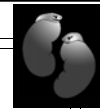
- *Differentiated* neoplasm of neural crest origin
- Benign
- Occurs in older age group
- Pathology:
 - Gross: Encapsulated, white, firm
 - Micro: Ganglion cells & Schwann cells

Neuroblastoma: Pathology



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

Ganglioneuroblastoma



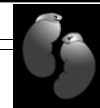
- Composed of malignant neuroblastic elements & ganglioneuromatous elements
- Prognosis depends on % of neuroblasts

Neuroblastoma: Prognostic Factors



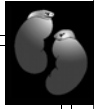
- Patient age
- Stage
- Site of 1^o involvement
- Histologic grade
- DNA ploidy
- N-myc oncogene amplification

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*.

