Adrenal and Thyroid Function and Disease

Medical Education Day

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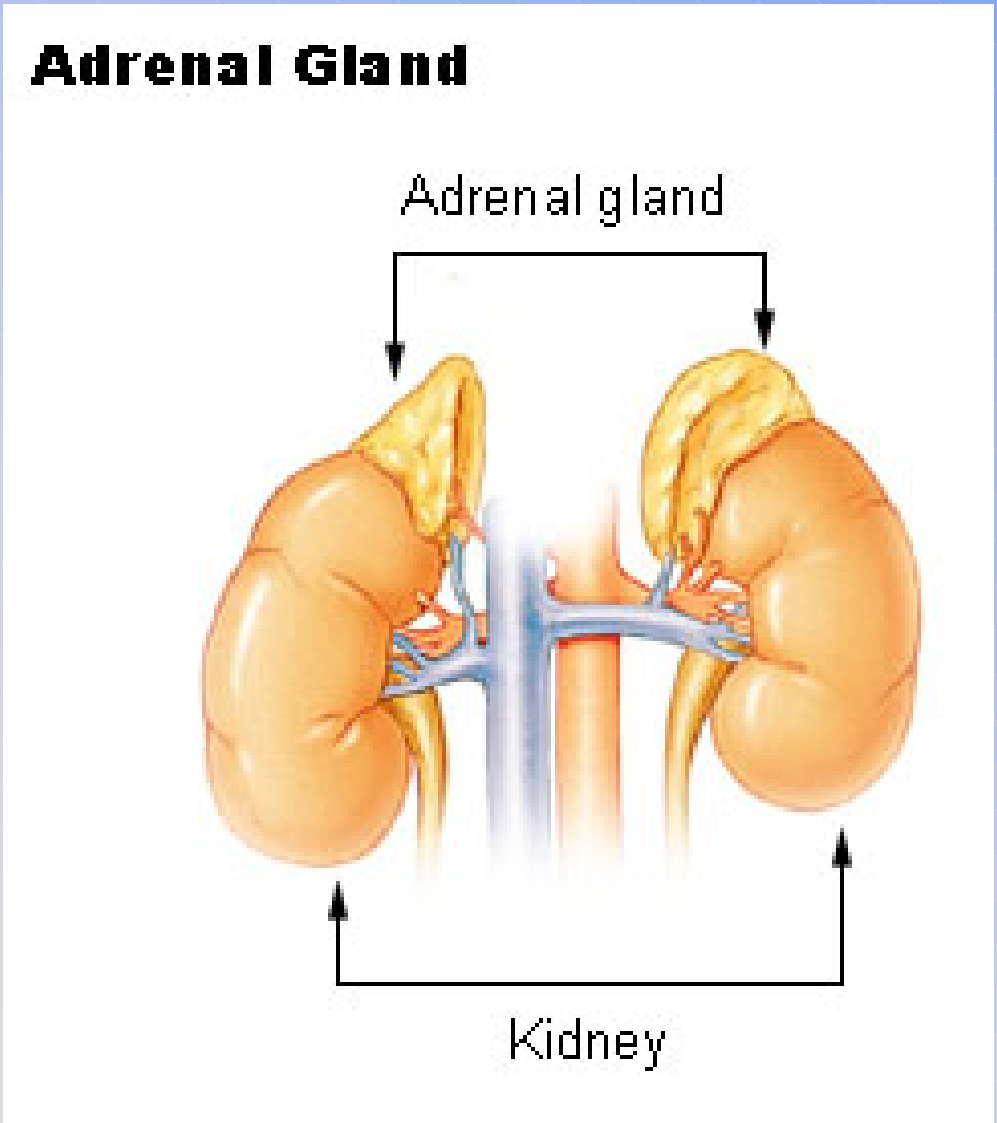
Objectives

- Adrenal Gland
  - anatomy and function
  - disorders and testing
  - corticosteroid replacement
- Thyroid
  - anatomy
  - function and testing
  - disorders

Adrenal Glands



- paired organ
- 'supra-renal'
- pyramid shaped

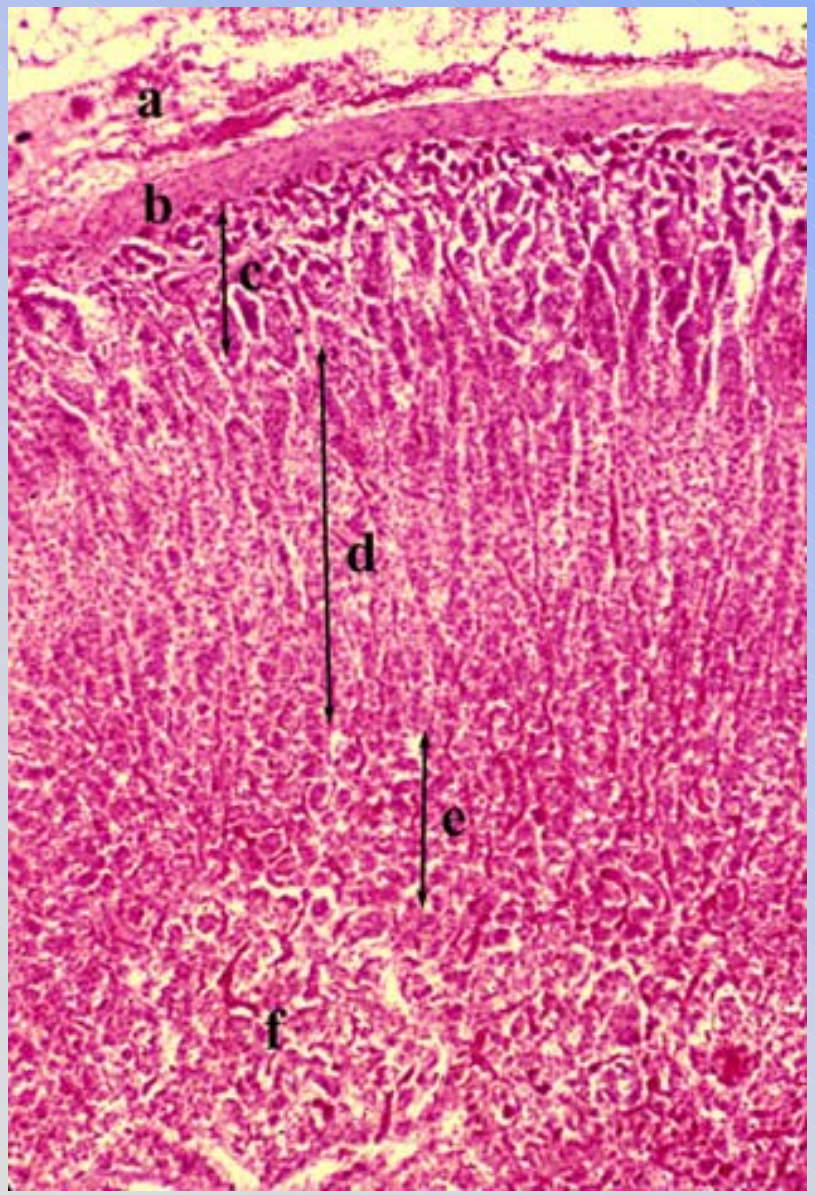
- artery / vein from renal circulation

Normal Adrenal Glands

Cortex and Medulla

Cortex and Medulla

Adrenal Gland



CORTEX

c. zona glomerulosa

d. zona fasciculata

e. zona reticularis

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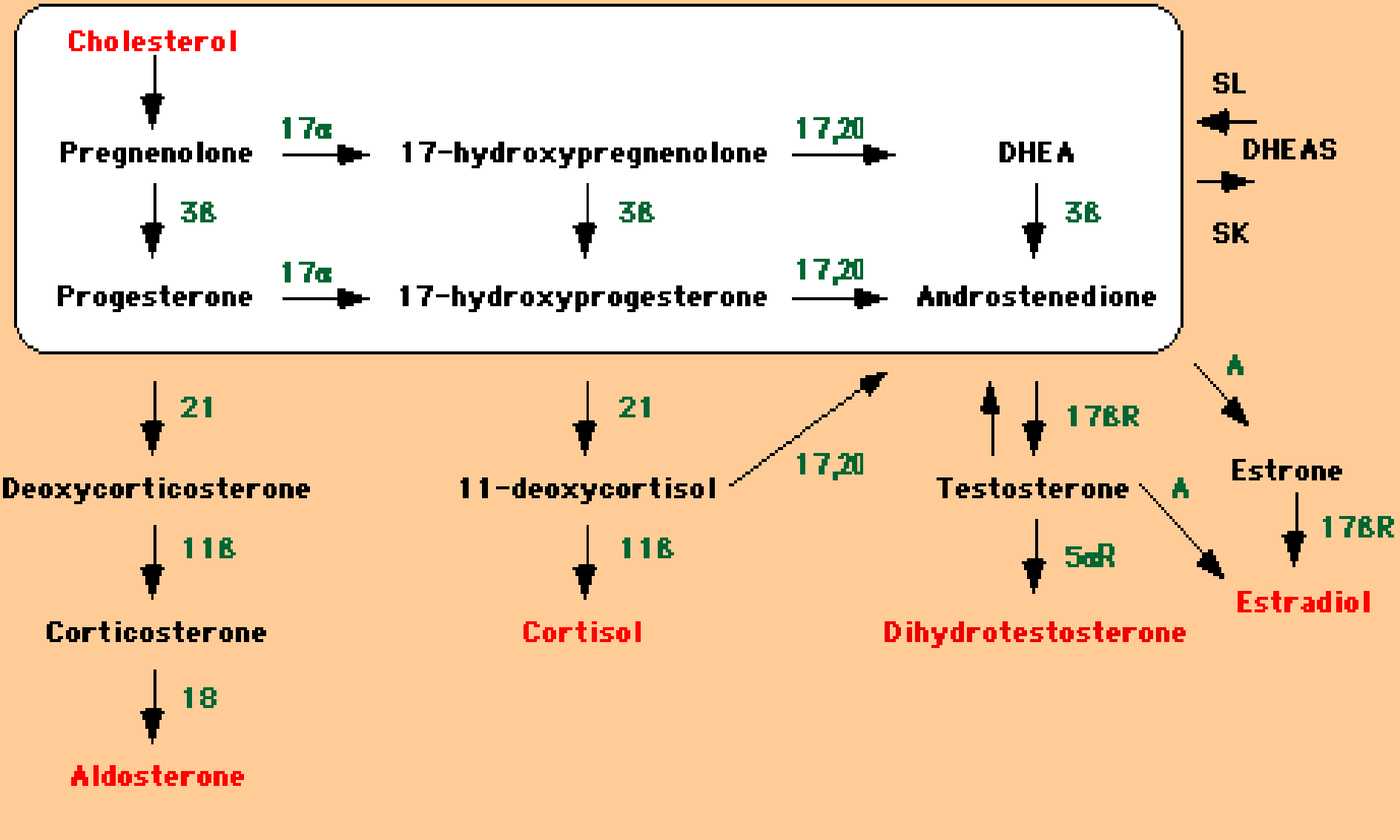
f. MEDULLA

Adrenal Cortex - 3 products

- **Mineralocorticoids**
  - ALDOSTERONE
  - rx: Fludrocortisone (Florinef)
- **Glucocorticoids**
  - CORTISOL
  - rx: prednisone (Deltasone), more
- **Androgens / Estrogens**
  - TESTOSTERONE and ESTROGEN
  - rx: testosterone (Androderm)
  - rx: equine estrogen (Premarin)

Sterol Biosynthesis

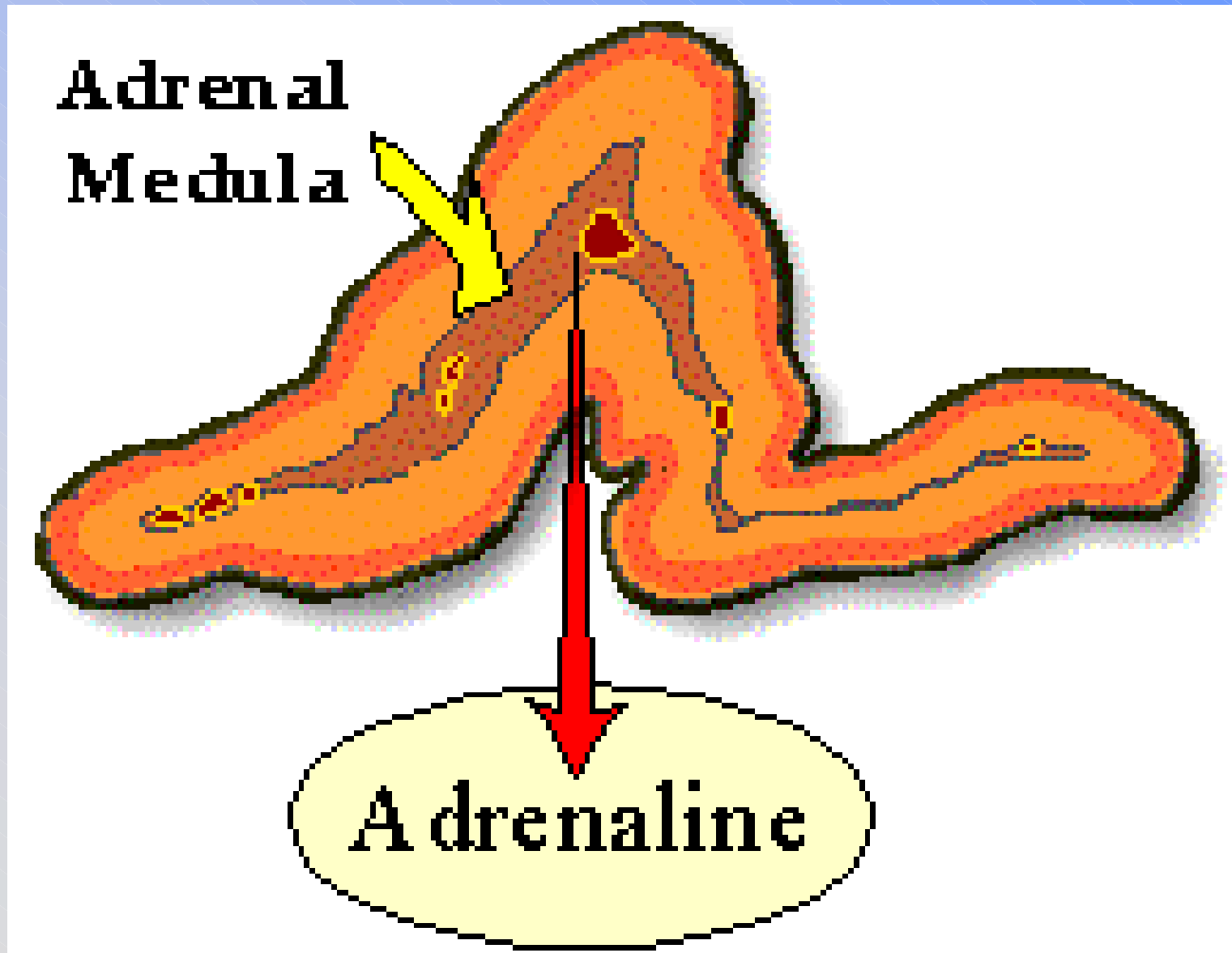


Adrenal Medula - 1 product

- **Catecholamines**
  - ADRENALINE (epinephrine)
  - NOR-ADRENALINE (nor-epinephrine)

  - rx: epinephrine (Epi-pen)
  - rx: nor-epinephrine (Levophed, Ephedrine)

Medula and Cortex



Endocrine Diseases

TOO MUCH

or

TOO LITTLE

Endocrine Disease

- Diagnosis and Treatment
  - what does the hormone do?
  - how is the hormone regulated?

Mineralocorticoids

- Aldosterone
  - renin and angiotensin increases production
  - Increases Blood Pressure
  - Increases Salt (Na+) and Water Retention
  - Decreases potassium (kidney dumps K+)

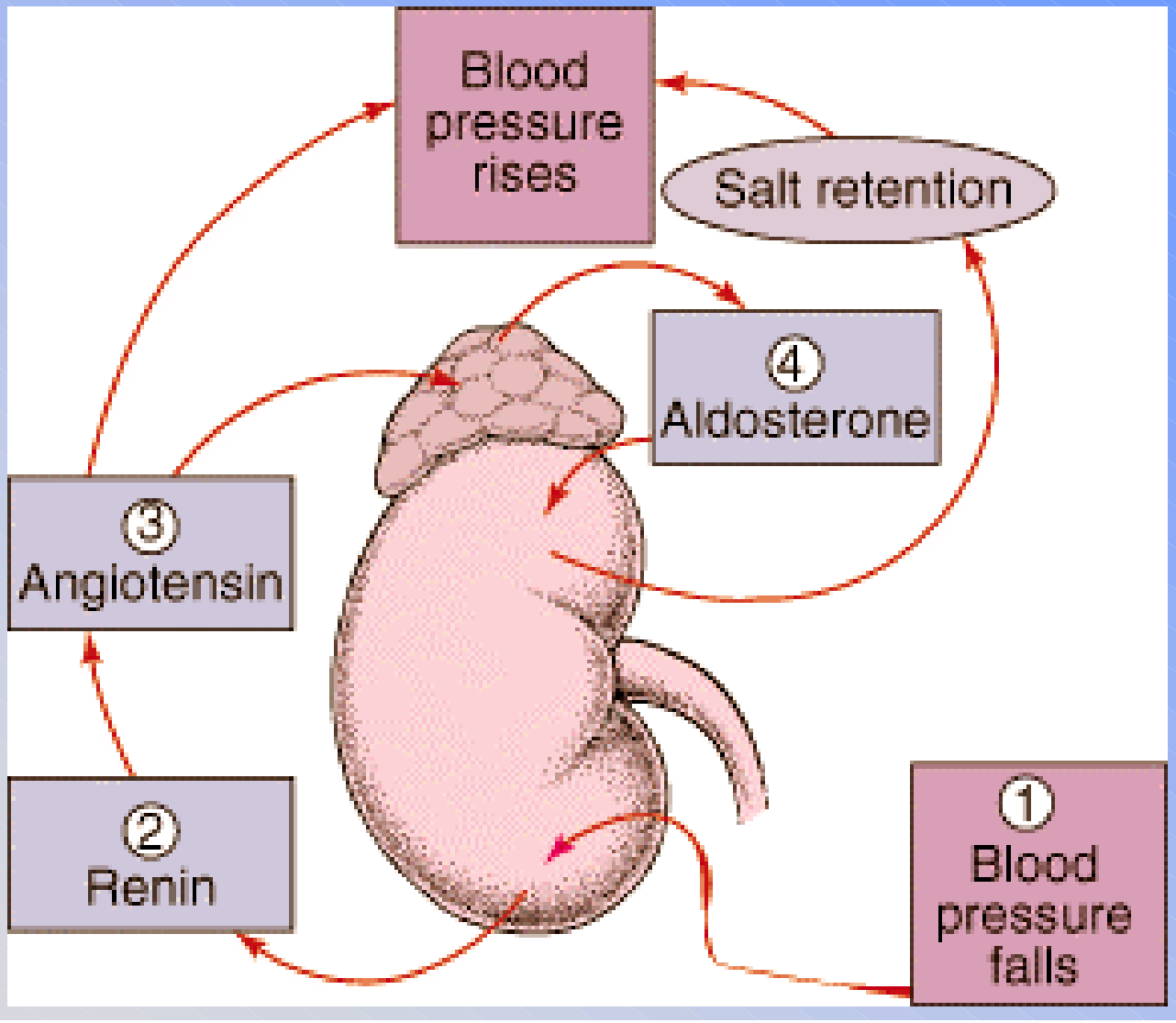
Too Much Aldosterone

Aldosterone

ACE-Inhibitors
captopril
enalipril
ramipril
lisinopril
benazepril
fosinopril
quinapril

Angiotensin Receptor Blockers
losartan
irbesartan
candesartan
telmisartan
valsartan

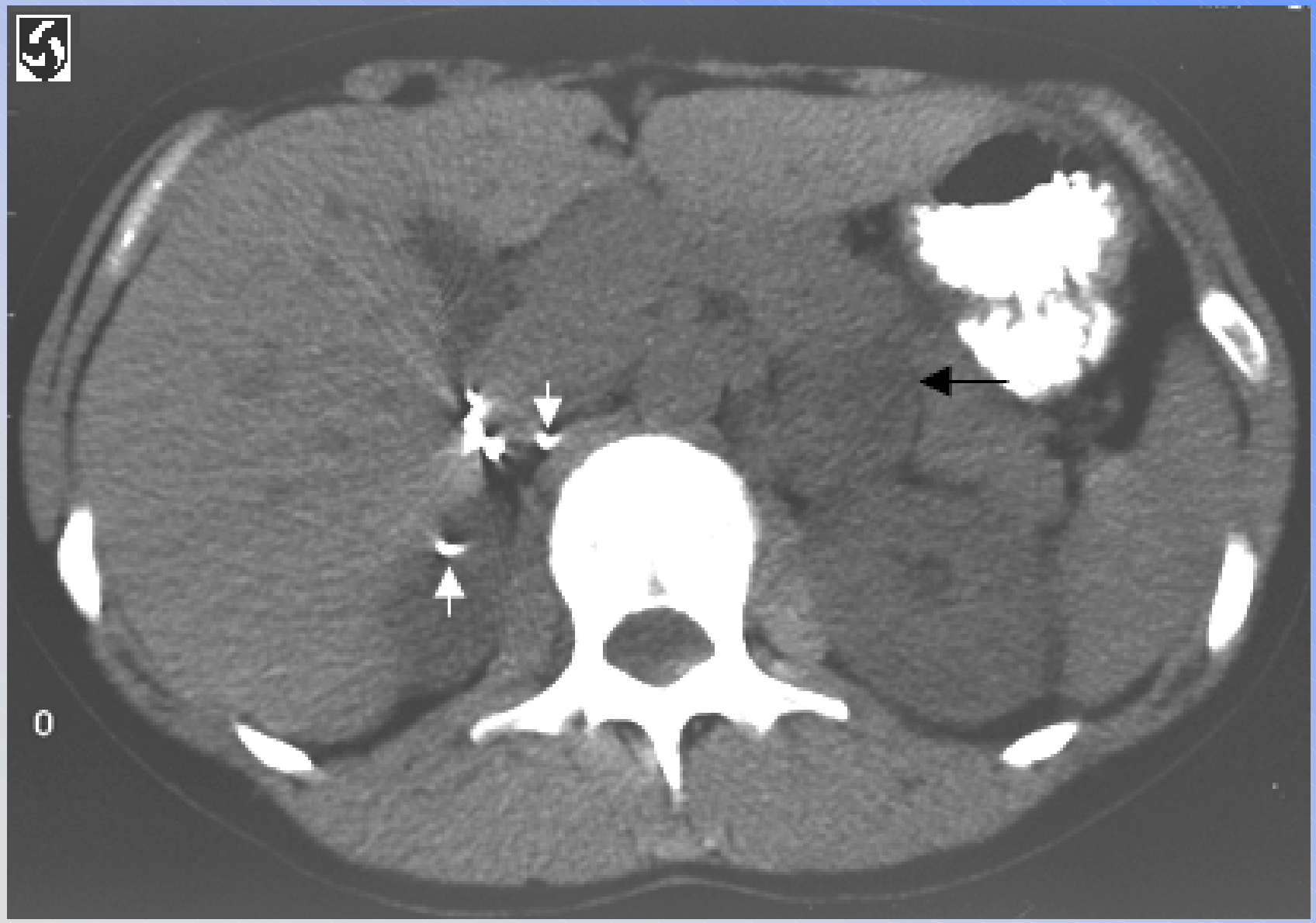
Aldosterone Blocker
spironolactone



Too Much Aldosterone

- Conn's Syndrome
  - tumor produces aldosterone
- Congenital Adrenal Hyperplasia
  - overactive production of aldosterone
- Atrophic Kidney
  - ischemic kidney makes angiotensin

Adrenal Tumor



Adrenal Tumor - Conn's

(they all look the same from a distance)

Treatments

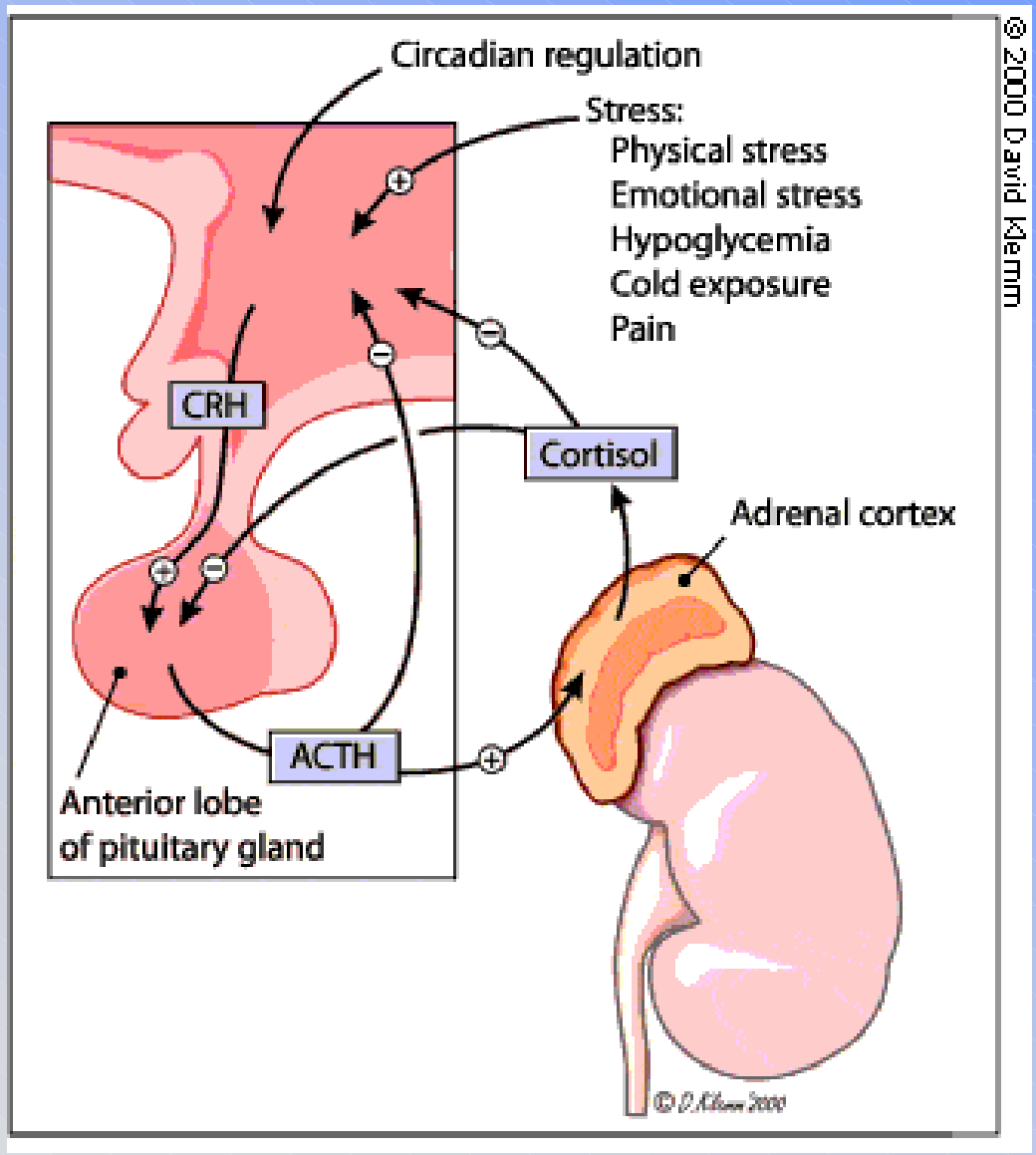
- Conn's Syndrome
  - resect the tumor
- Congenital Adrenal Hyperplasia
  - medication (ACE-I, ARB, Spironolactone)
- Atrophic Kidney
  - medications or resect the kidney

Too Much Cortisol

Glucocorticoids

- Cortisol (stress hormone)
  - increases available energy
  - increases protein breakdown
  - increases glucose production
  - increases fatty acid availability

Cortisol Regulation



Too Much Cortisol

- Cushing's Syndrome
  - thin skin, bruises, striae
  - moon facies, buffalo hump
  - cataracts
  - increases blood pressure
  - thins bones (osteoporosis)
  - immune dysfunction
  - increases glucose and obesity
  - muscle loss
  - mental status changes

Moon facies

Buffalo Hump

Central Obesity

Cushing's Syndrome

- Cushing's disease
  - pituitary tumor
- Adrenal Hyperplasia or Tumor
- Exogenous Glucocorticoids
  - cortisol
  - prednisone
  - dexamethasone

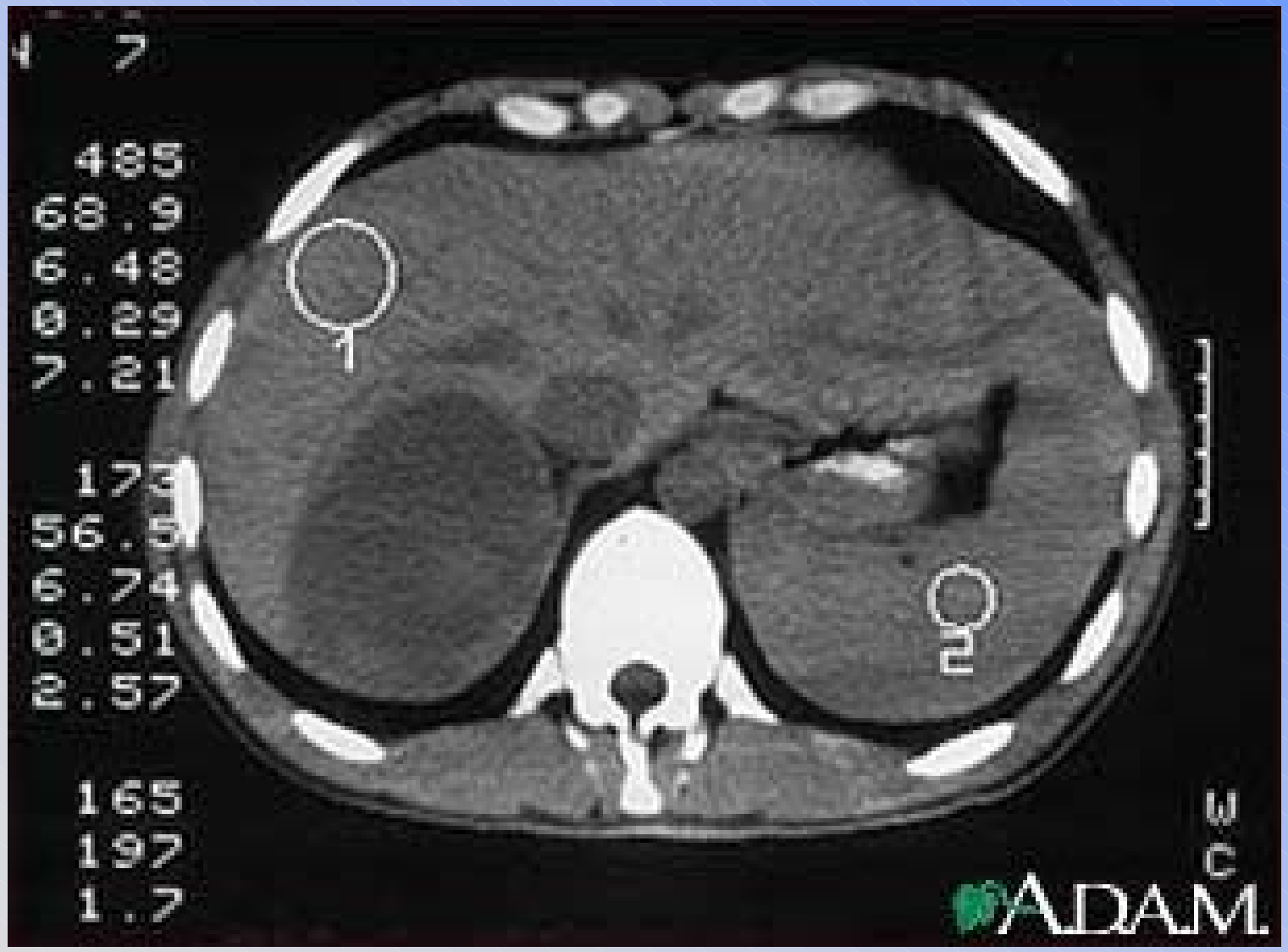
Cushing's Syndrome

- Screen
  - 24 hr urine production of cortisol
- Diagnosis
  - dexamethasone suppression test

Pituitary Tumor

Transphenoidal Surgery

Adrenal tumor



Too Little
Cortisol and Aldosterone

Not Enough Cortisol

- Adrenal Insufficiency
  - low blood pressure
  - nausea
  - low sodium
  - sometimes very tanned

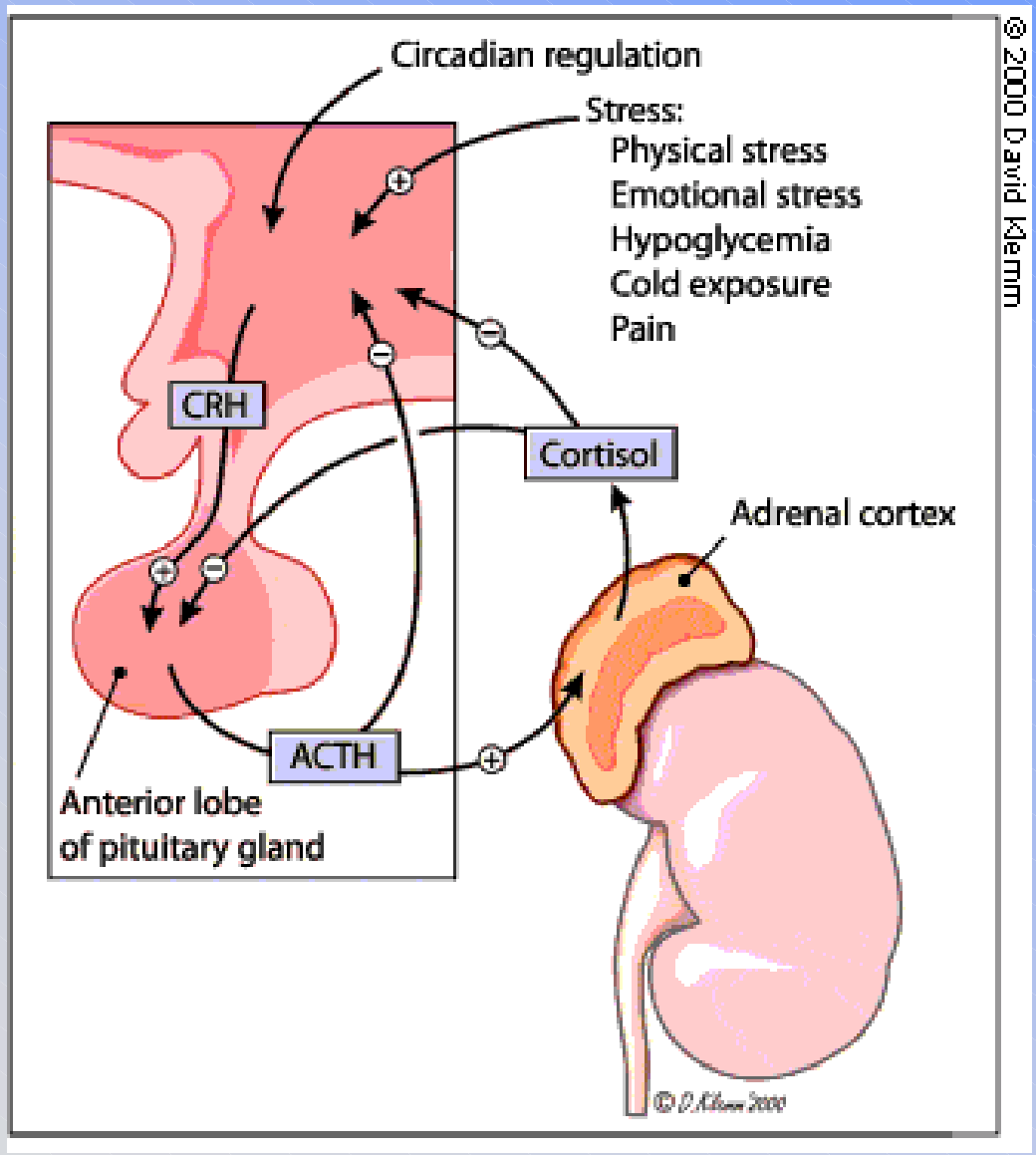
Hyperpigmentation

Addison's disease:

- Note the generalised skin pigmentation (in a Caucasion patient) but especially the deposition in the palmer skin creases, nails and gums.

- She was treated many years ago for pulmonary TB. What are the other causes of this condition?

Cortisol Regulation



Adrenal Insufficiency

- Addison's Disease
  - auto-immune destruction
- Other
  - hemorrhage into adrenal
  - infection
  - surgical resection
- Adrenal Suppression
  - among those receiving corticosteroids

Determine if Adrenal Functioning

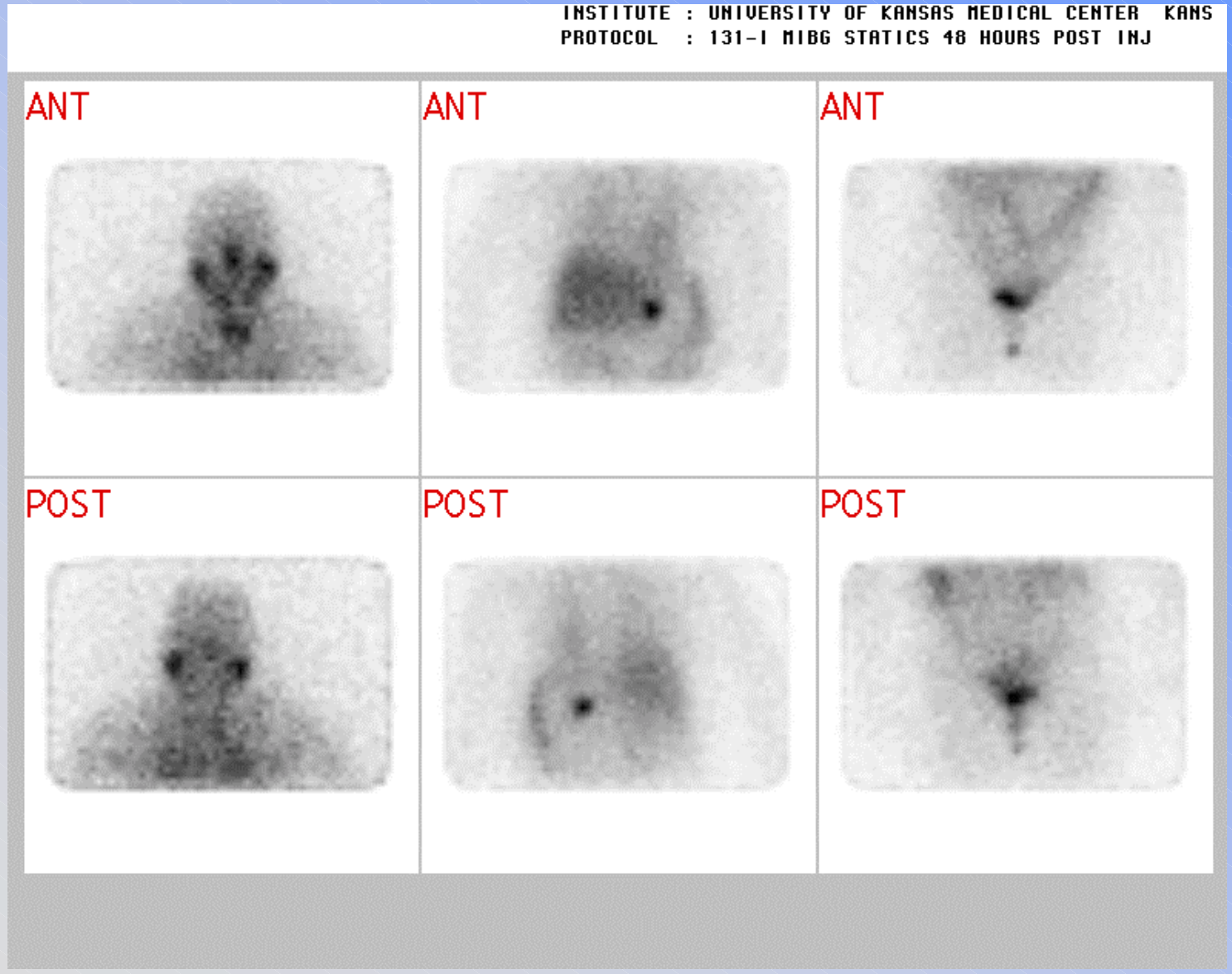
- ACTH Stimulaton Test
  - give ACTH --> see if adrenals respond
  - Time 00 min: baseline cortisol
  - Time 01 min: give ACTH 0.25 mg IV
  - Time 30 min: cortisol
  - Time 60 min: cortisol
  - > 500 umol /l if stimulated (like to see doubling, too)

Too much Adrenaline

Catecholamine Excess

- Pheochromocytoma
  - hypertension
  - palor
  - headaches
  - palpitations
  - anxiety
  - weight loss
- Increased Catecholamines in urine
  - metanephrines
- Treatment is Surgical

MIBG scan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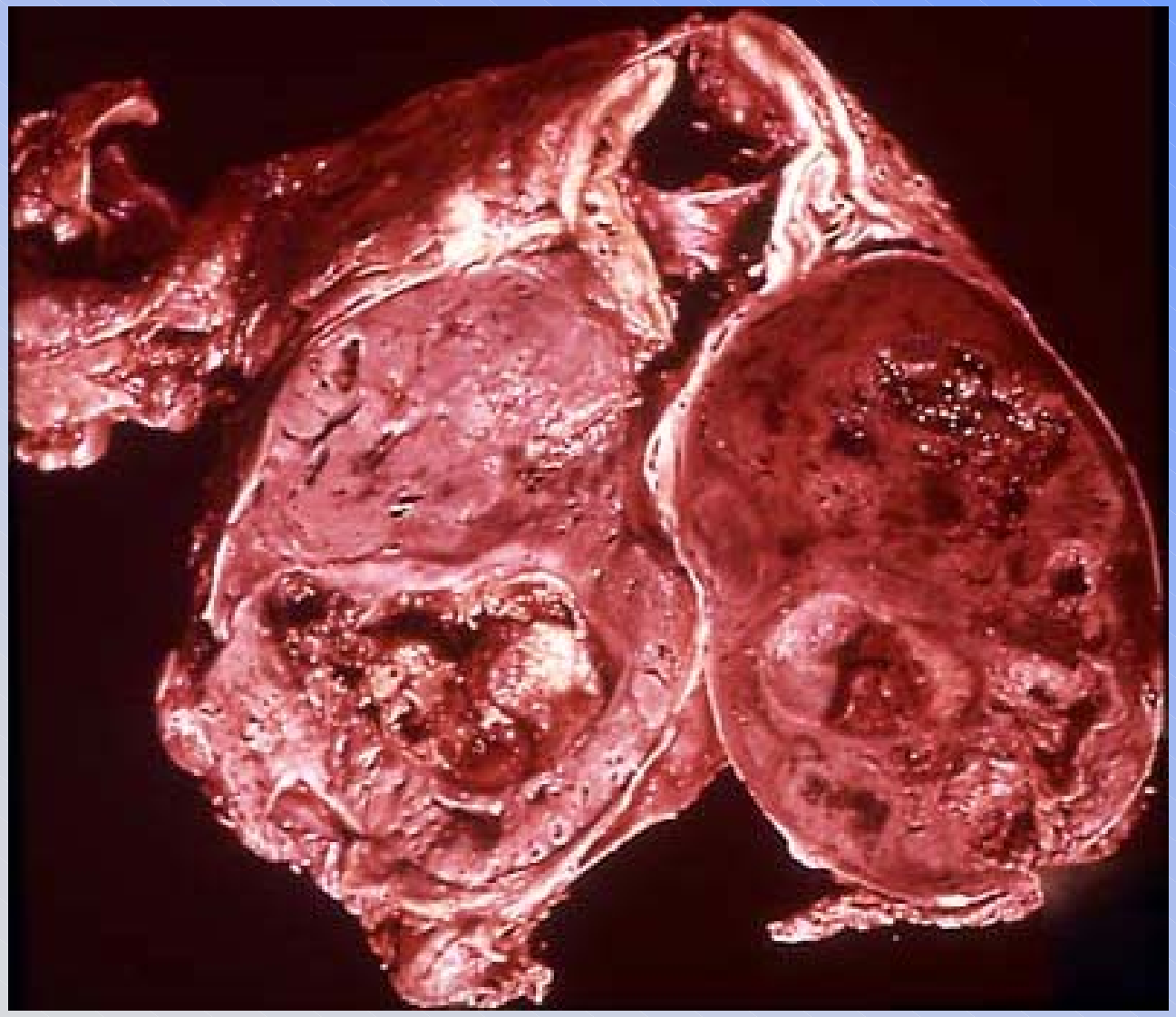
Pheochromocytoma



Corticosteroids and Stress Coverage

Systemic Corticosteroids

- cortisone 1
- hydro-cortisone (solu-cortef) 1
- prednisone 4
- methyl-prednisolone (s-medrol) 5
- dexamethasone (IV or po) 30

Stress Dose to Prevent Adrenal Insufficiency

- normal day - cortisol 30 mg
- maximum stress - cortisol 300 mg (probably a lot less)
- Therefore, solu-cortef 100 mg IV q8h should be ample to cover 'stress'

Who needs 'stress' coverage?

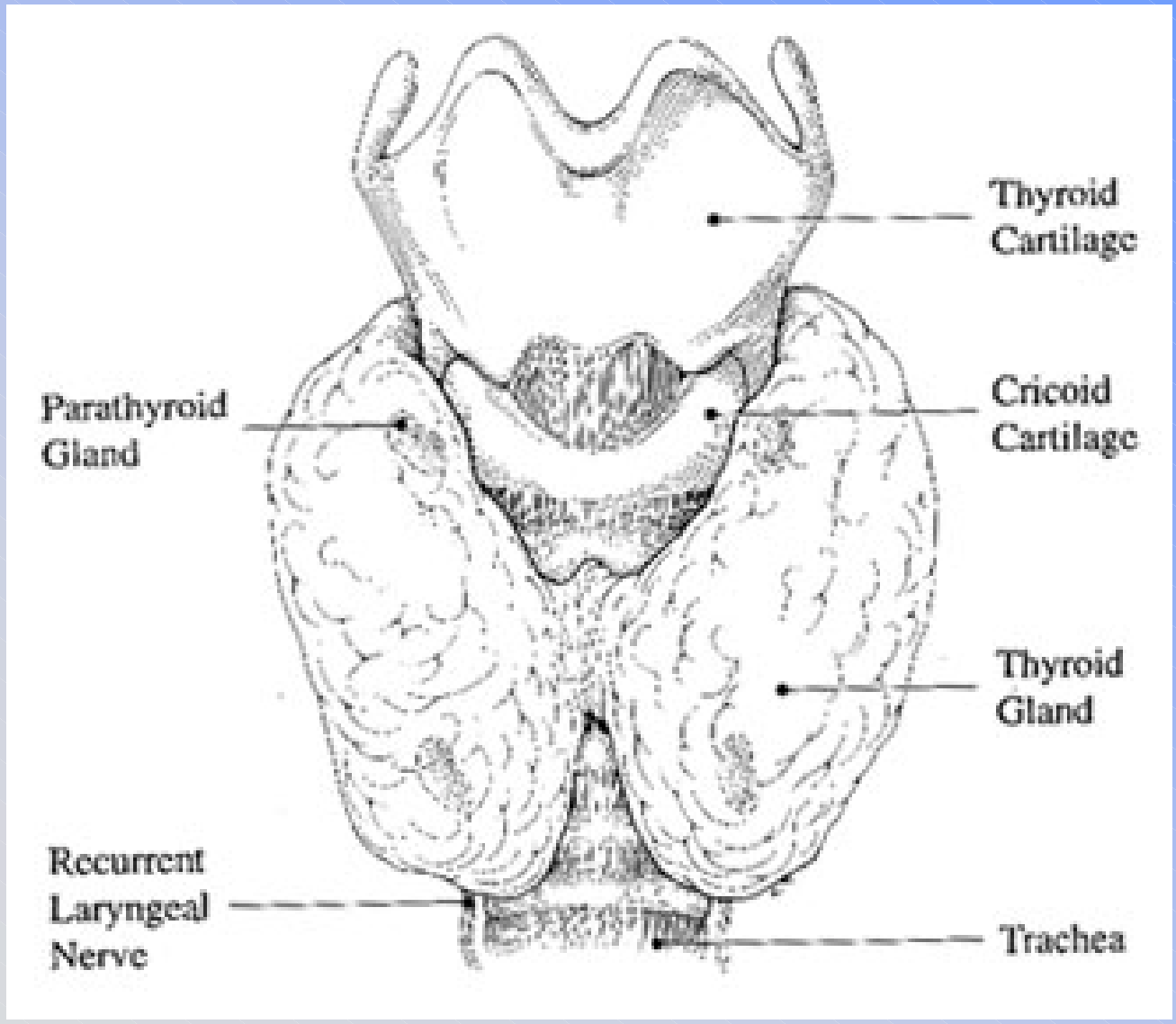
- Patient's with known adrenal failure

- Patient's who in the last year…
  - got pharmacological dose of steroid
    - > 30 mg cortisol equivalents per day
  - > 10 - 14 days

  - **probably very generous***

Thyroid

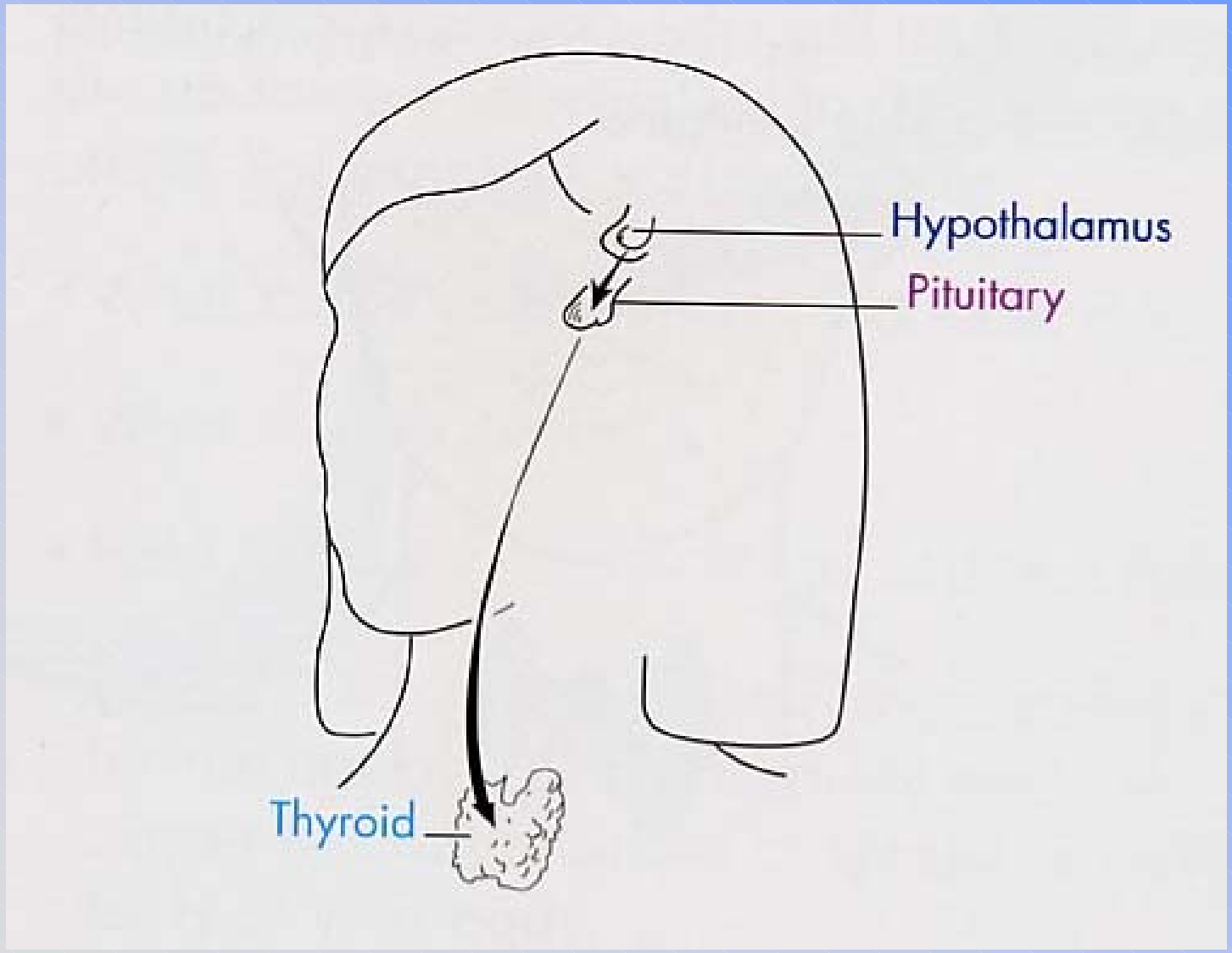
Thyroid Anatomy



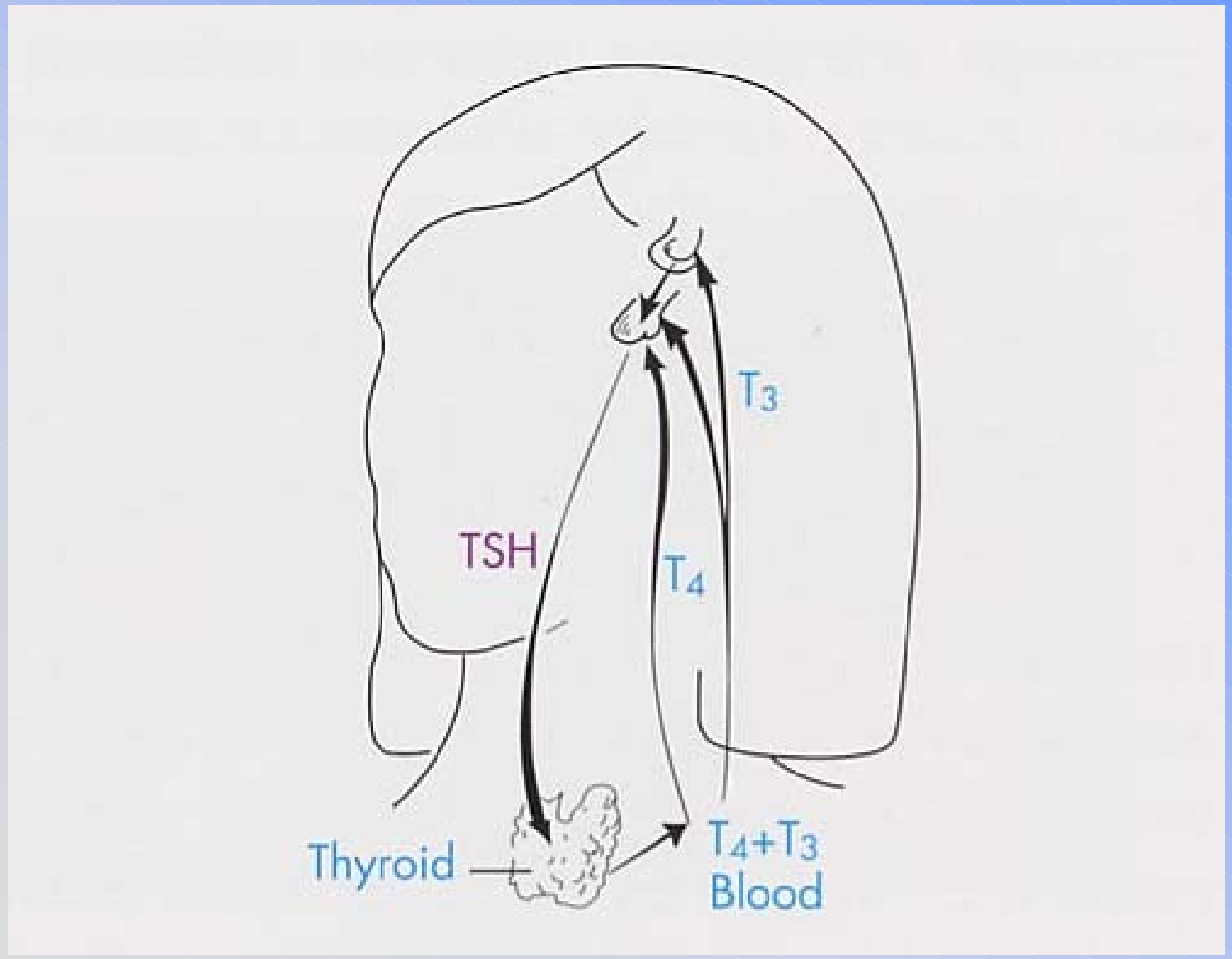
Thyroid Gland - 2 products

- Thyroid hormone
  - increases metabolic rate
- Calcitonin
  - decreases calcium resorption from bone
  - increases renal loss of calcium & phosphate

Thyroid Hormone Regulation



Thyroid Hormone Regulation



Endocrine Diseases

TOO MUCH

or

TOO LITTLE

+Hyperthyroid

- nervousness
- increased sweating
- heat intolerance
- palpitation
- fatigue
- weight loss
- increased appetite
- hyperdefecation
- diarrhea

-Hypothyroid

- mental lethargy
- dry skin
- fatigue
- cold intolerance
- dyspnea
- weight gain
- constipation
- hoarseness
- edema
- menorrhagia

+Hyperthyroid

- tachycardia
- goiter
- tremor
- bruit over thyroid
- atrial fibrillation
- lid lag

- *proptosis
- *pretibial thickening

-Hypothyroid

- slow movement
- slow speech
- delayed relaxation phase of reflexes
- bradycardia
- coarse skin
- puffy face
- signs of heart failure
- loss of brows

Hypothyroid Facies

Sub-clinical Disease

- Most folks with thyroid dysfunction
  - non-specific symptoms
  - subtle symptoms
  - no symptoms (or signs)

Negative Feedback Loop

Hypothyroid	Hyperthyroid
Low T3 and T4	High T3 and T4
High TSH	Low TSH
Exception pituitary failure	Exception pituitary failure

Function does not equal size

- Enlarged Thyroid
  - underfunction
  - normal function
  - overfunction
- Small Thyroid
  - underfunction
  - normal
  - rarely overfunction (with hot nodule)

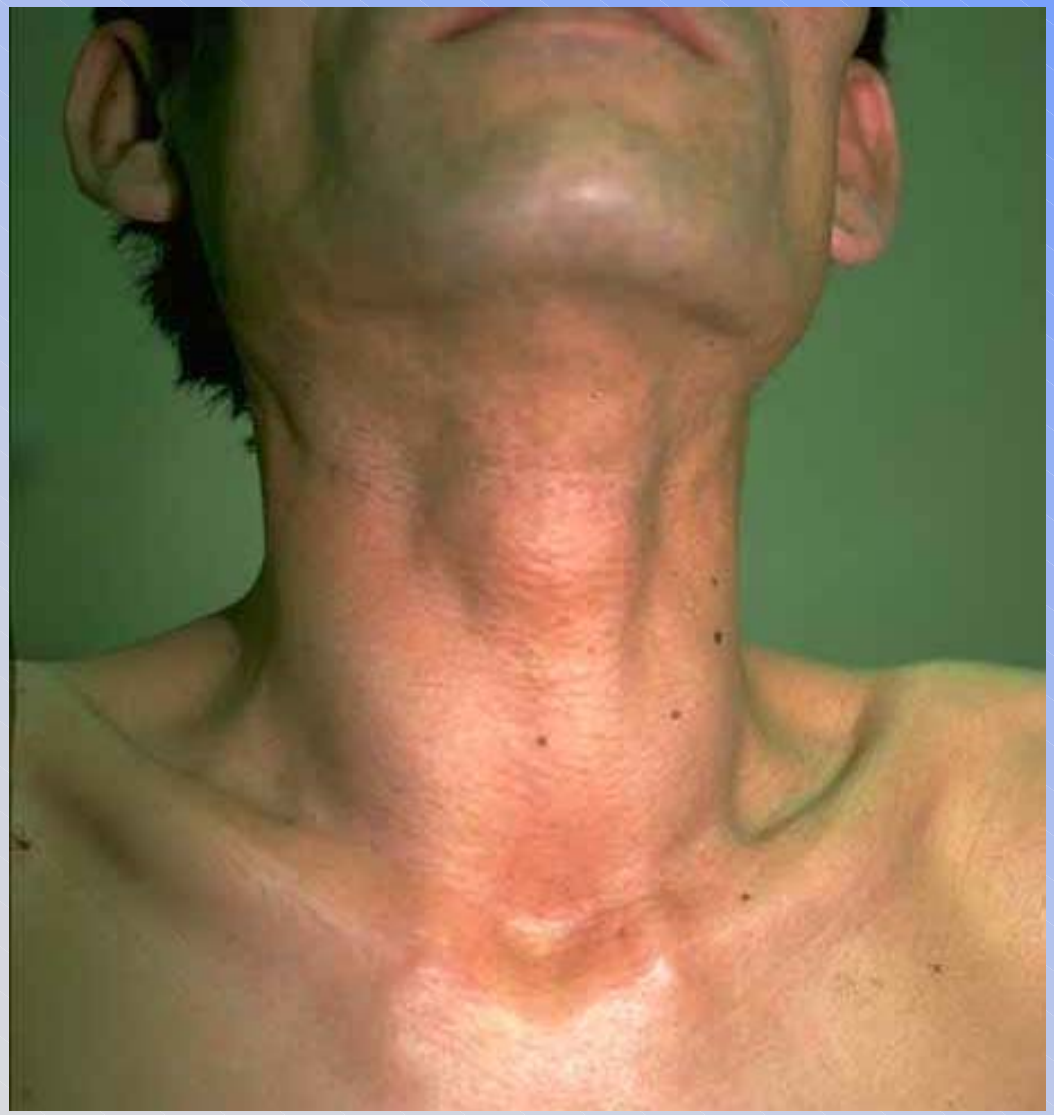
Function does not equal Disease

- Normal Function
  - does not exclude tumor
  - does not exclude nodule
  - does not exclude auto-immune thyroiditis
  - does not exclude Grave's disease

Size

- Goitre - increased size for any reason
- Nodule - discrete enlargement
- Symptoms:
  - Enlargement of the throat
  - Swallowing problems if large
  - Breathing problems if large
  - May or may not be painful

Goitre



Goitre

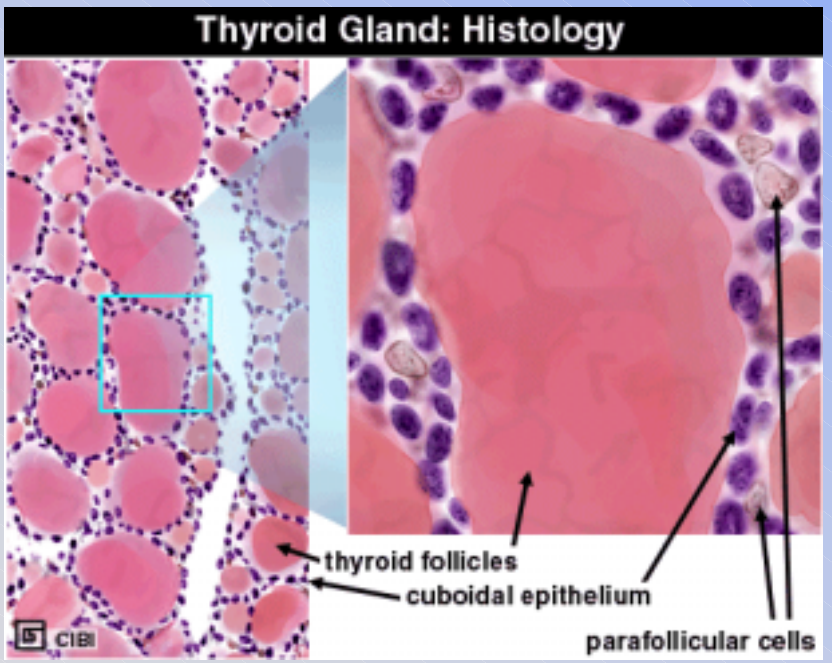
Goitre

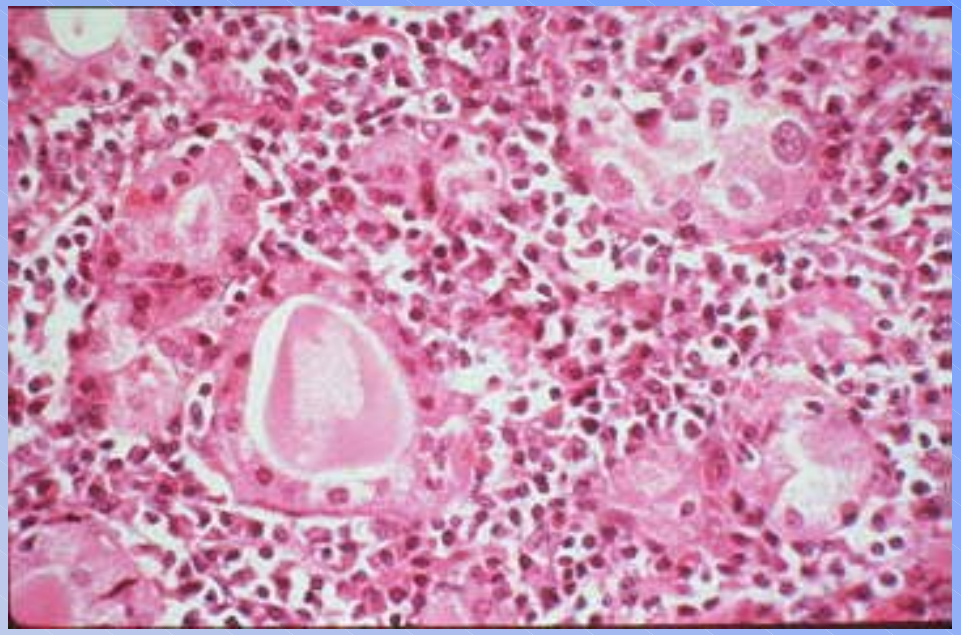
Common Thyroid Diseases

Hashimoto's Thyroiditis

- 4.6% of adult population (common)
- Lymphocytic destruction of gland
- Painless
- Goitrous or Atrophic varieties
- Anti-thyroid antibodies are common
- High TSH, Low T4
- Treatment: Thyroid Supplement

Normal and Hashimoto's





Subacute Thyroiditis

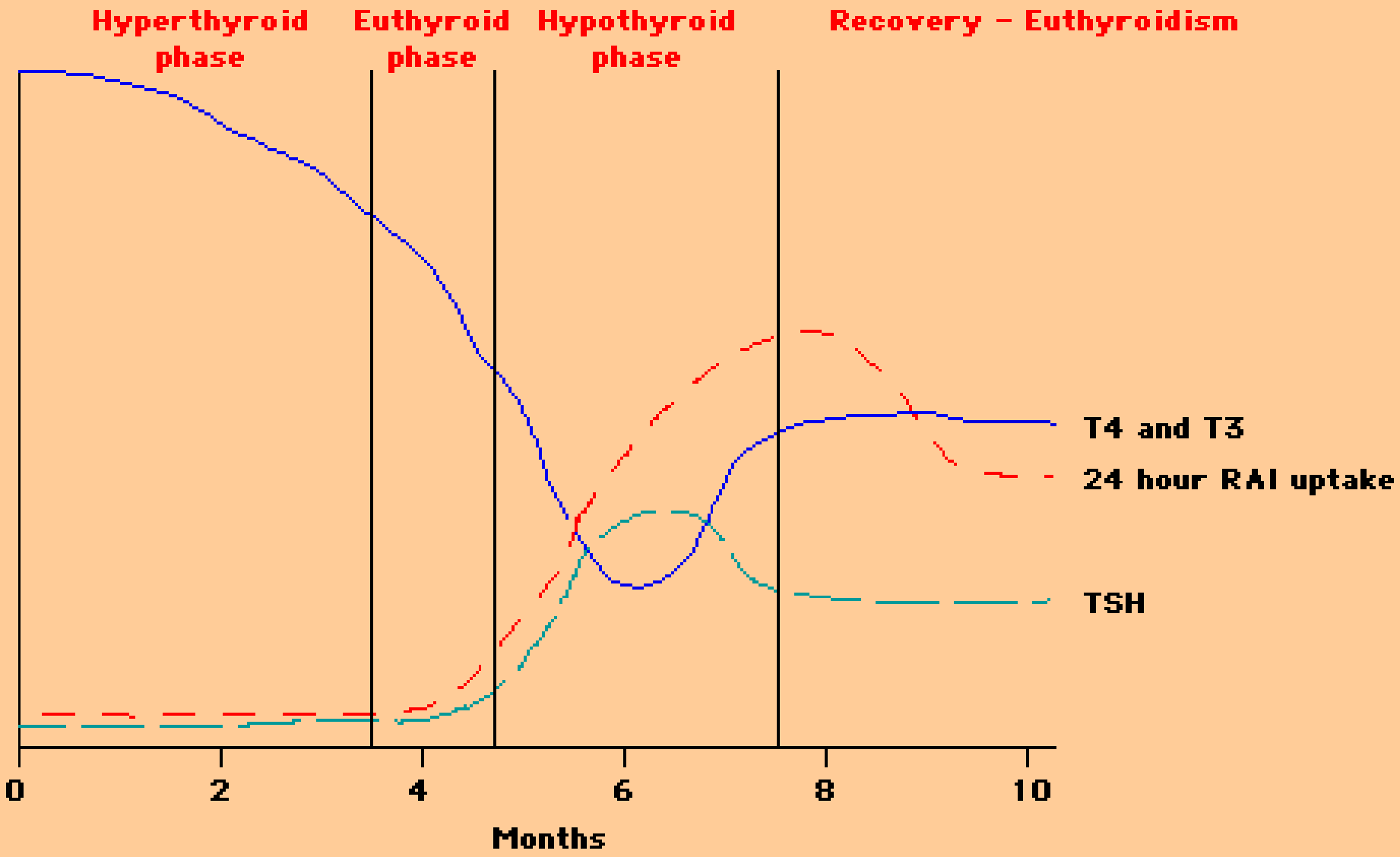
- Probably a viral induced immune attack
- Tender / painful thyroid

- Hyperthyroid > Hypothyroid > Euthyroid

- TSH fluctuates

- Self-limited
- Aspirin, NSAID, prednisone

Subacute Thyroiditis



Grave's Disease

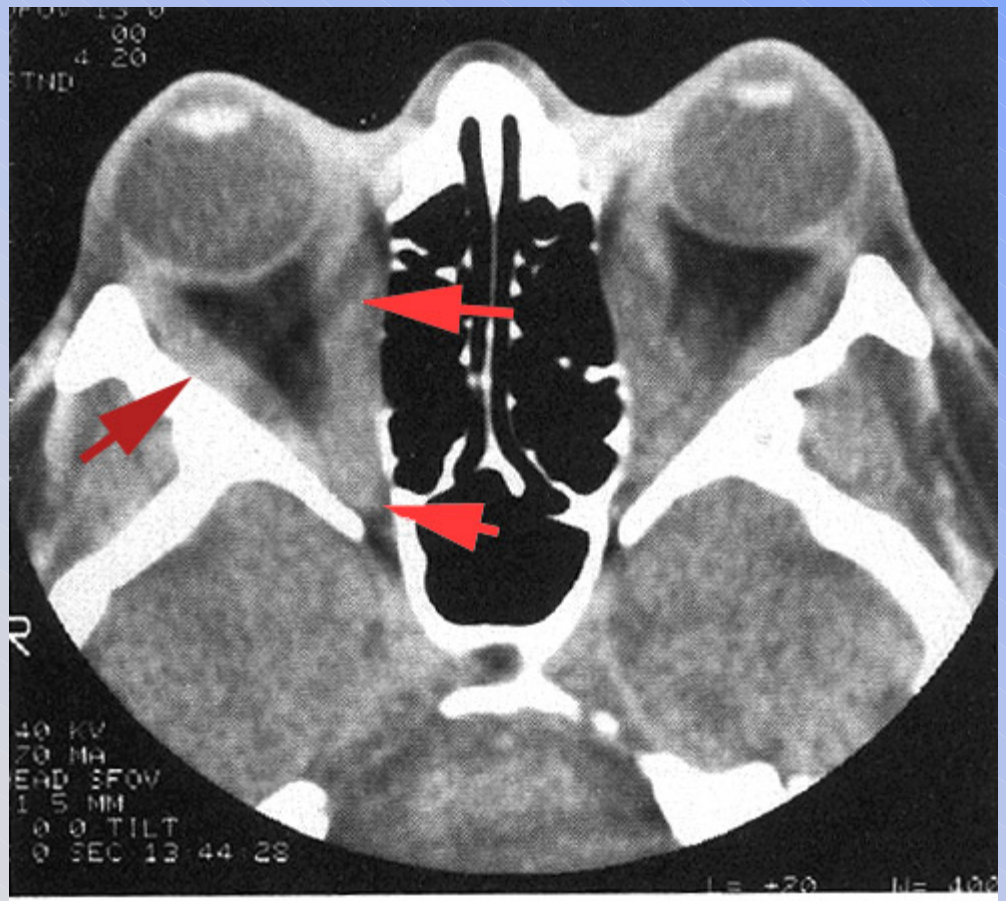
- Auto-immune thyroid disease
- Antibodies activate the TSH receptor on the gland

- Hyperthyroidism
- Goitre
- Grave's opthalmopthy
- Pre-tibial 'myxedema'

- Low TSH, high T4, anti-thyroid Ab

Grave's opthalmopathy

Grave's opthalmopathy



Computed tomogram of a patient showing enlargement of medial and lateral rectus muscles, which converge toward the orbital apex.

Used with permission. RP Yeatts, DM Clontz. Graves' Ophthalmopathy. Journal of Ophthalmic Nursing and Technology. 9(10): 16-21, 1990

- eyedrops
- steroids
  - prednisone
- surgery
- radiation

Pretibial 'myxedema'

Grave's Disease Treatment

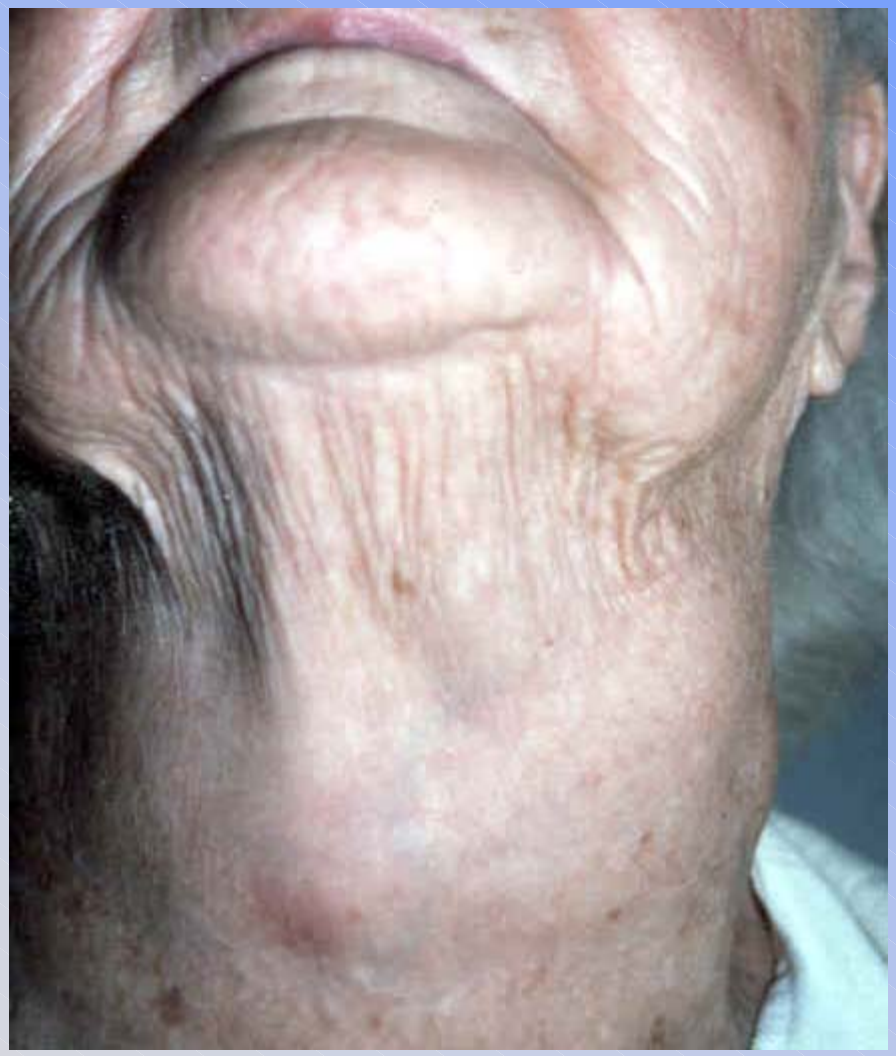
- Medications
  - methimazole (Tapazole)
  - propyl-thiouricil (PTU)
- Radio-active Iodine
- Surgery
- (beta-blocker for any hyperthyroid)

Thyroid Nodules

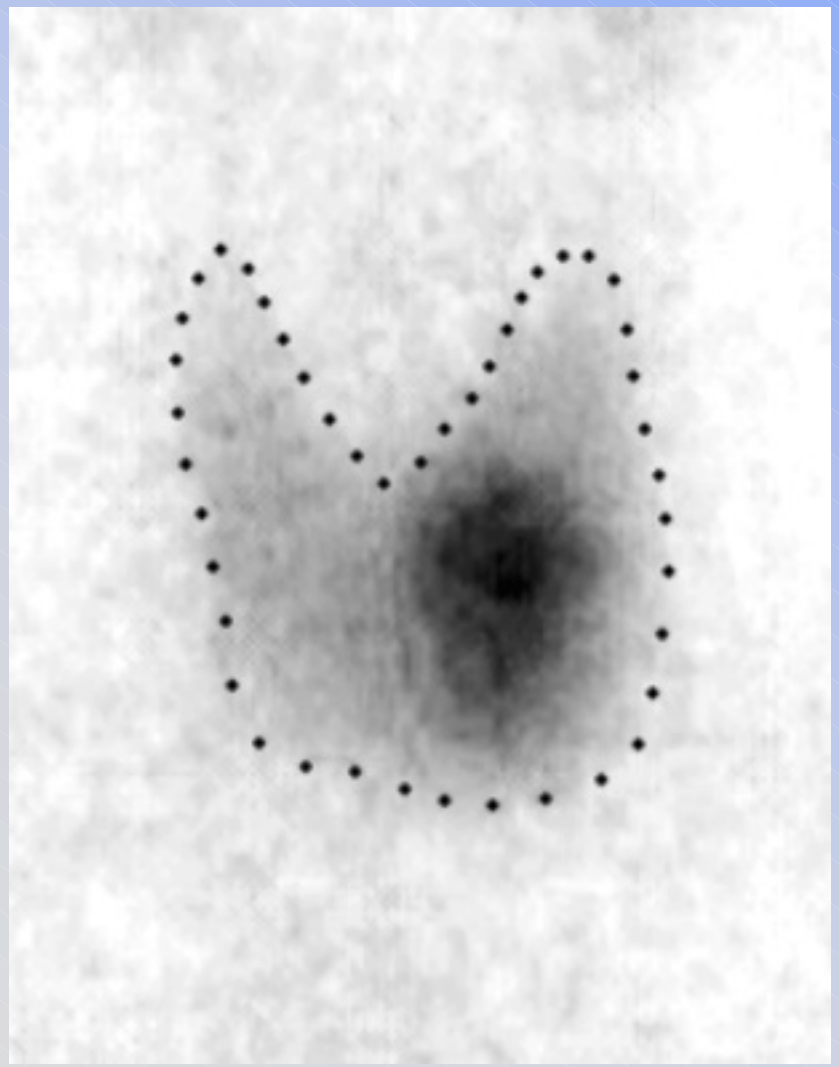
- Localized Thyroid Disease
  - benign adenoma
  - malignant thyroid

  - Fine Needle Aspiration
  - Surgery if indeterminant or malignant

Thyroid Nodule



Hot and Cold Thyroid Nodules



Thyroid Cancer

- Papillary carcinoma (70-75%)
- Follicular carcinoma
- Anaplastic carcinoma
- Medullary thyroid carcinoma
- Lymphoma
- ----------
- Surgery
- High dose radioactive Iodine
- External Beam Radiation
- Chemotherapy

Other Thyroid Conditions

- Medication associated
  - amiodarone
  - iodine excess
- Post-partum thyroiditis
- Sick Euthyroid Syndrome
- Cretinism (congenital hypothyroidism)

Summary

- Thyroid and Adrenal conditions are common
- Knowing the hormone is knowing the disease
- Knowing the regulation is knowing how to test and treat.

Questions

- Note: all pictures from internet, not local patients.

- www. ucalgary.ca/~jpschaef