# Adrenal Gland

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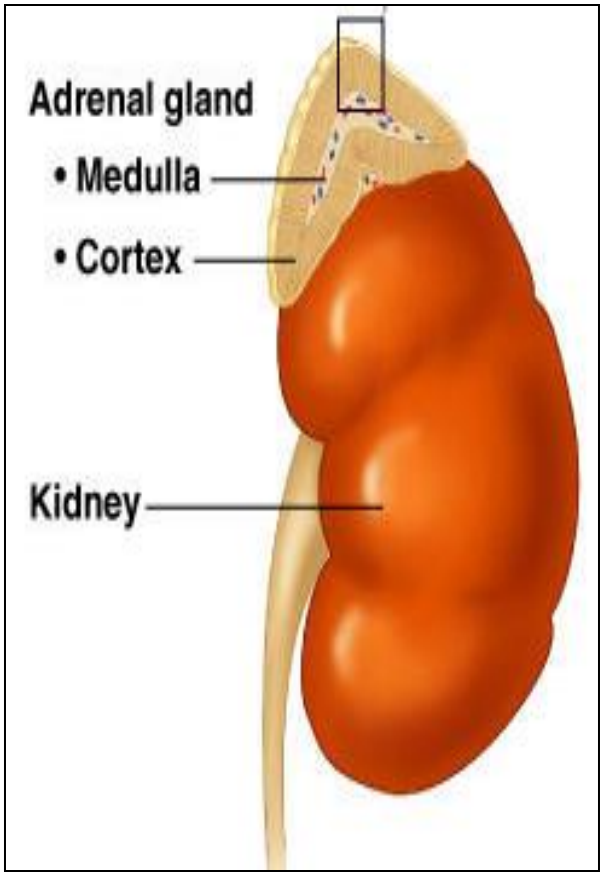
**Laparoscopic Bariatric Surgeon and Surgical Oncologist.**

# Adrenal Glands

- Divided into two parts; each with separate functions
- Adrenal Cortex
- Adrenal Medulla



# The Adrenal Cortex

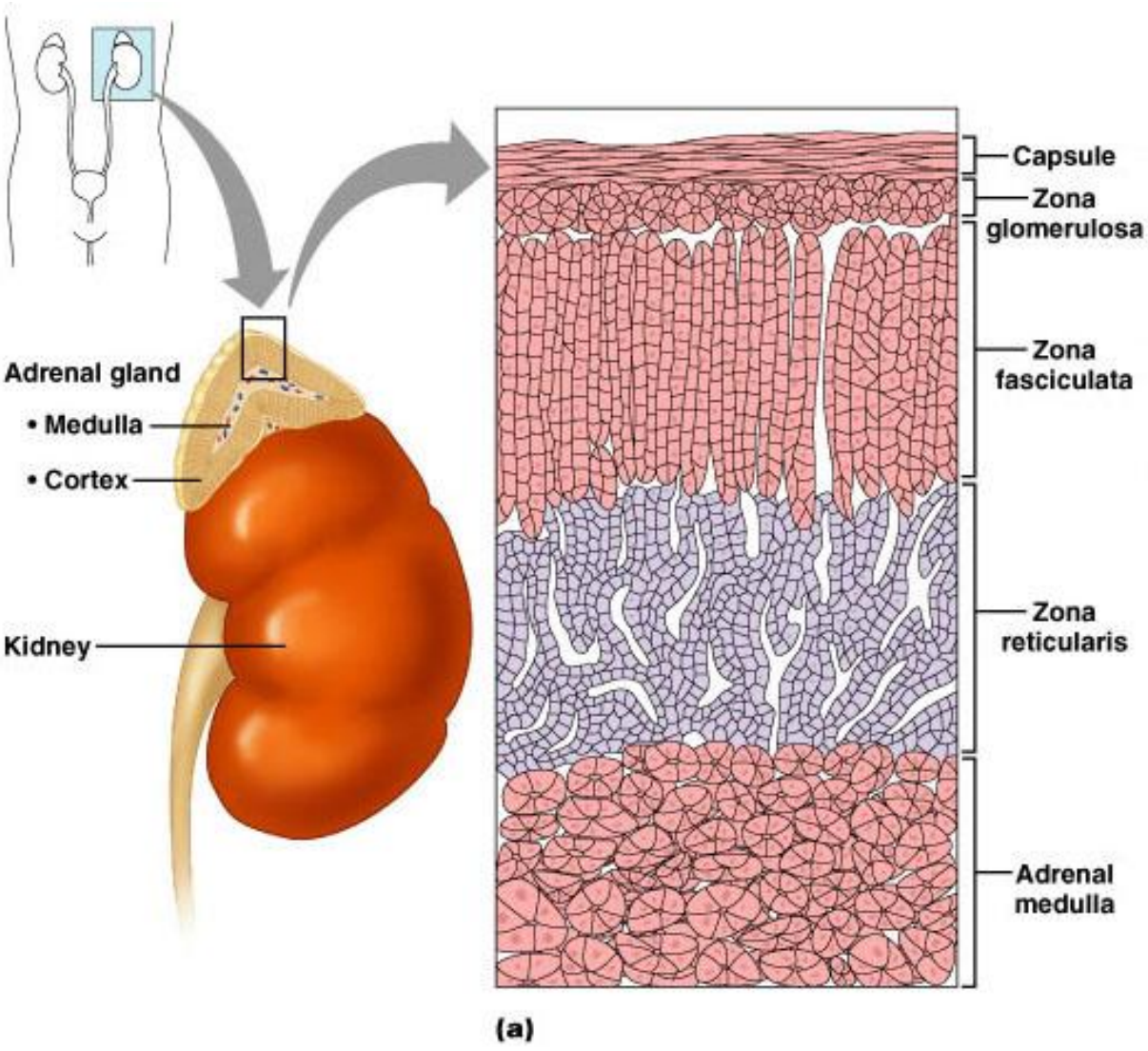
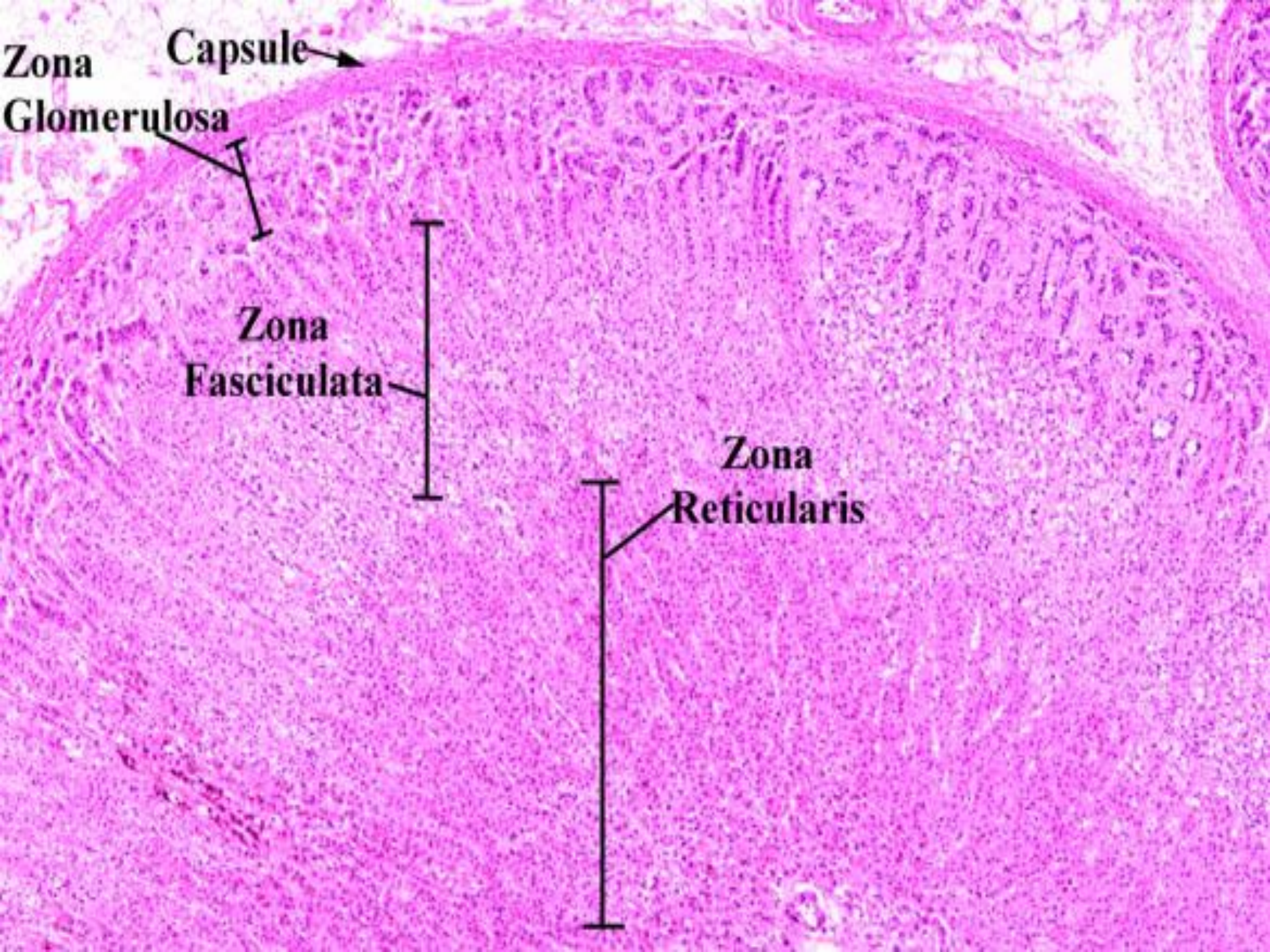



Figure 25.9a


Capsule
Zona Glomerulosa
Zona Fasciculata
Zona Reticularis

# C. The Adrenal Glands

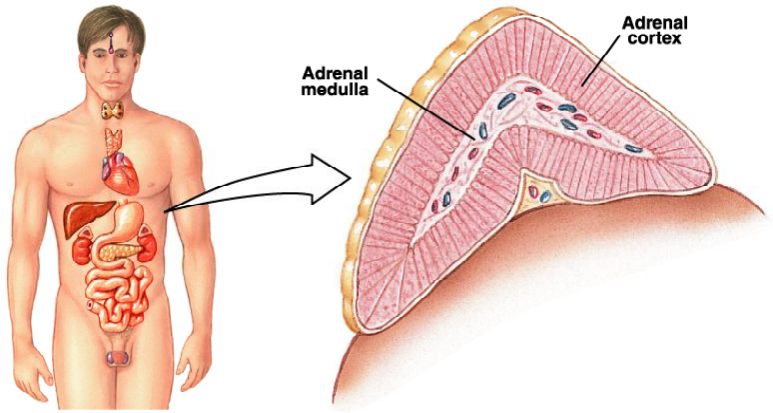
- Adrenal medulla
- Adrenal cortex

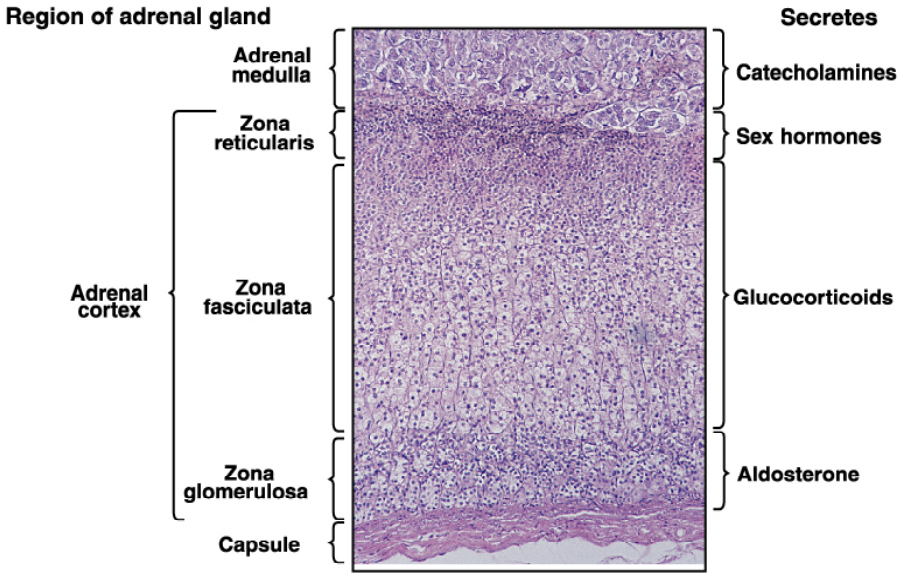
  Three specific zones and each produces a specific class of steroid hormone

  Zona glomerulosa – mineralocorticoids (**Aldosterone**)

  Zona fasciculata – glucocorticoids ( **Cortisole** )

  Zona reticularis - androgens



# Hormones of the Adrenal Cortex

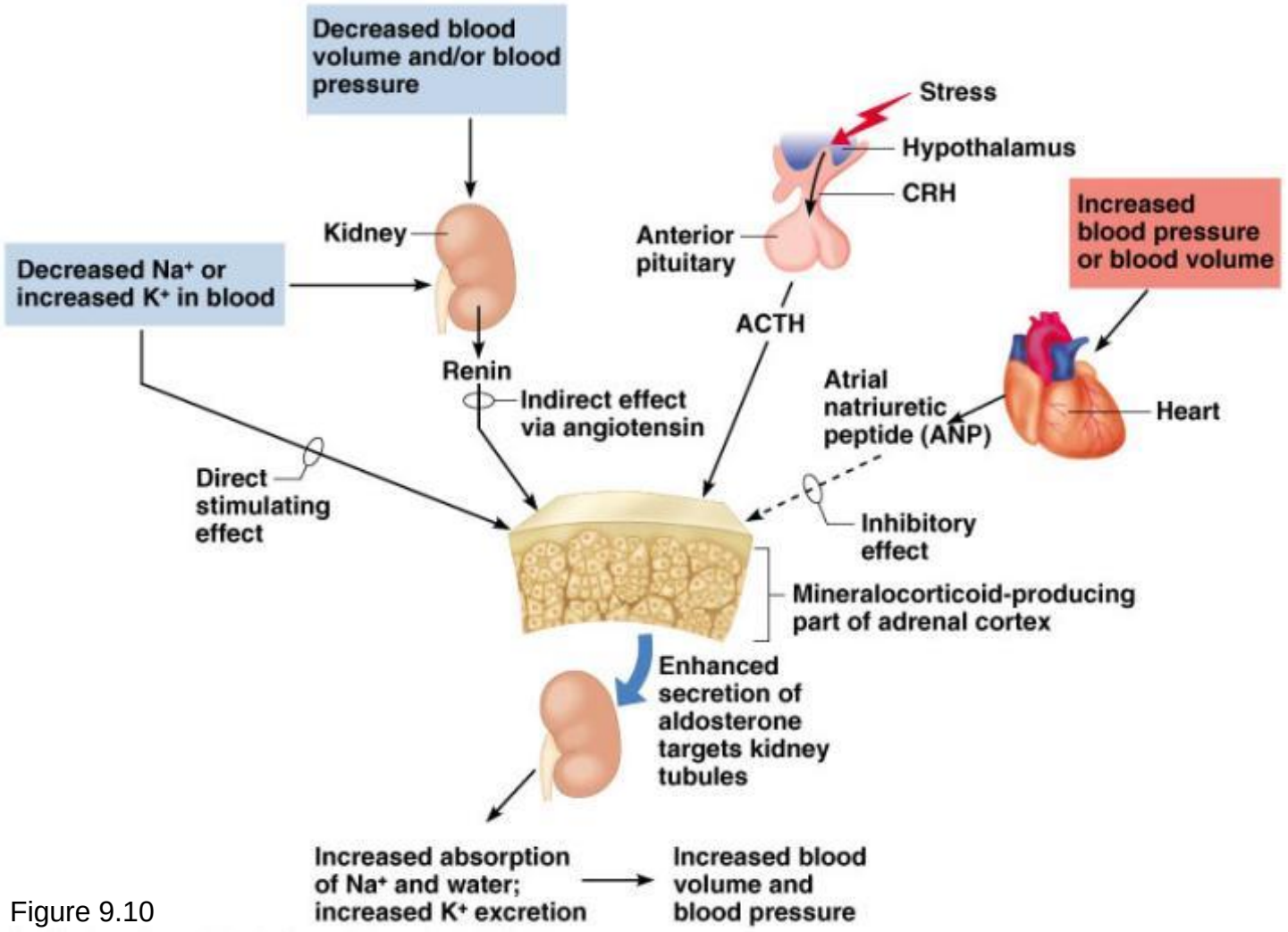
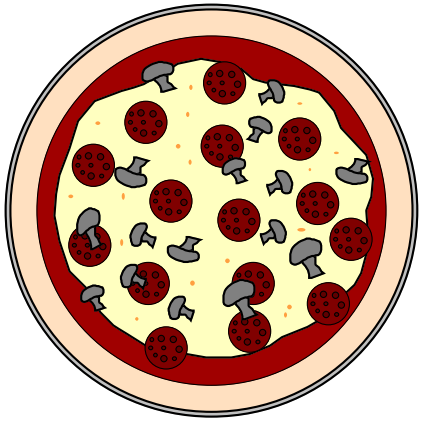
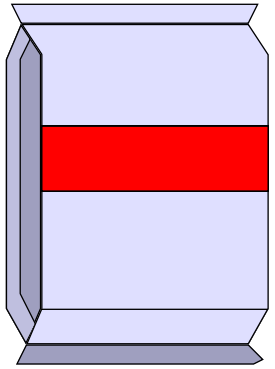


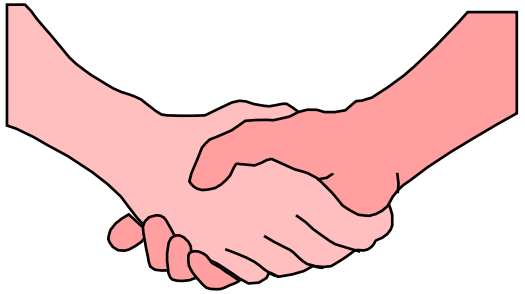

Figure 9.10

# ADRENAL CORTEX

- Salt
- Sugar
- Sex

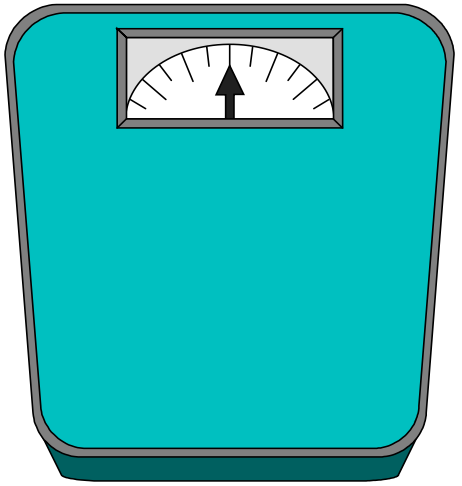






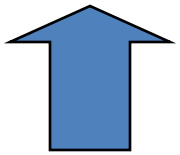
# SALT

- Mineralocorticoids (F & E balance)
  - Aldosterone (renin from kidneys controls adrenal cortex production of aldosterone)
    - Na retention
    - Water retention
    - K excretion



# Question:

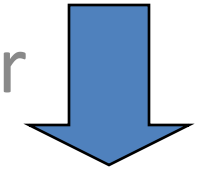
If your Na level is low, will aldosterone secretion

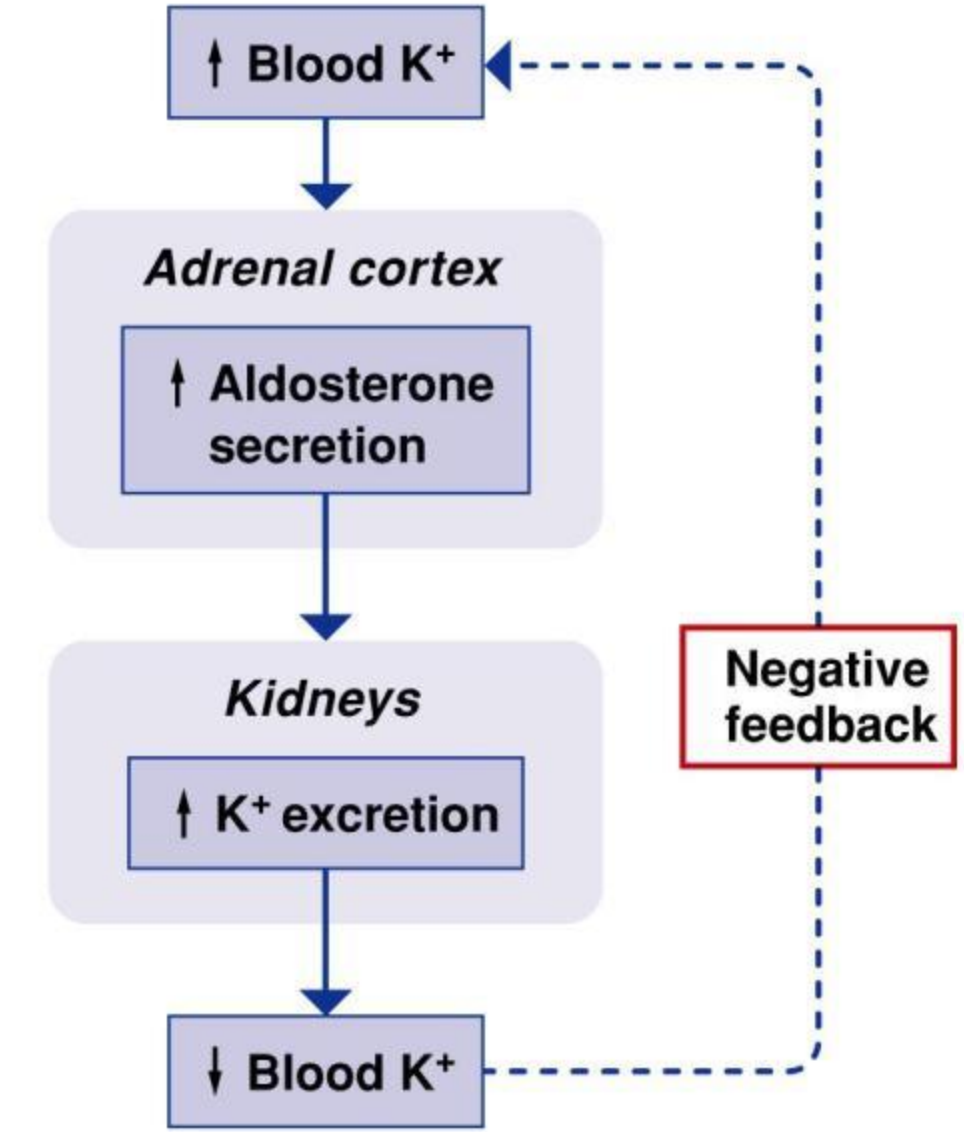


or

If your serum K+ level is high, will aldosterone secretion

or






**(b) Regulation of aldosterone secretion**



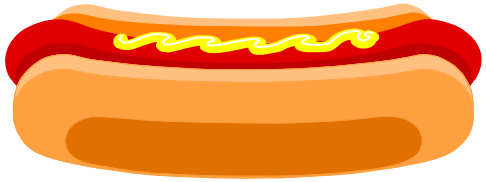
Figure 6.12b

# SUGAR

- <u>GLUCOCORTICOIDS</u> (regulate metabolism & are critical in stress response)
  - CORTISOL responsible for control and & metabolism of:

a. CHO (carbohydrates)

- ↑ amt. glucose formed
- ↑ amt. glucose released



# CORTISOL

**b. FATS-control of fat metabolism**

- **stimulates fatty acid mobilization from adipose tissue**

**c. PROTEINS-control of protein metabolism**

- **stimulates protein synthesis in liver**
- **protein breakdown in tissues**

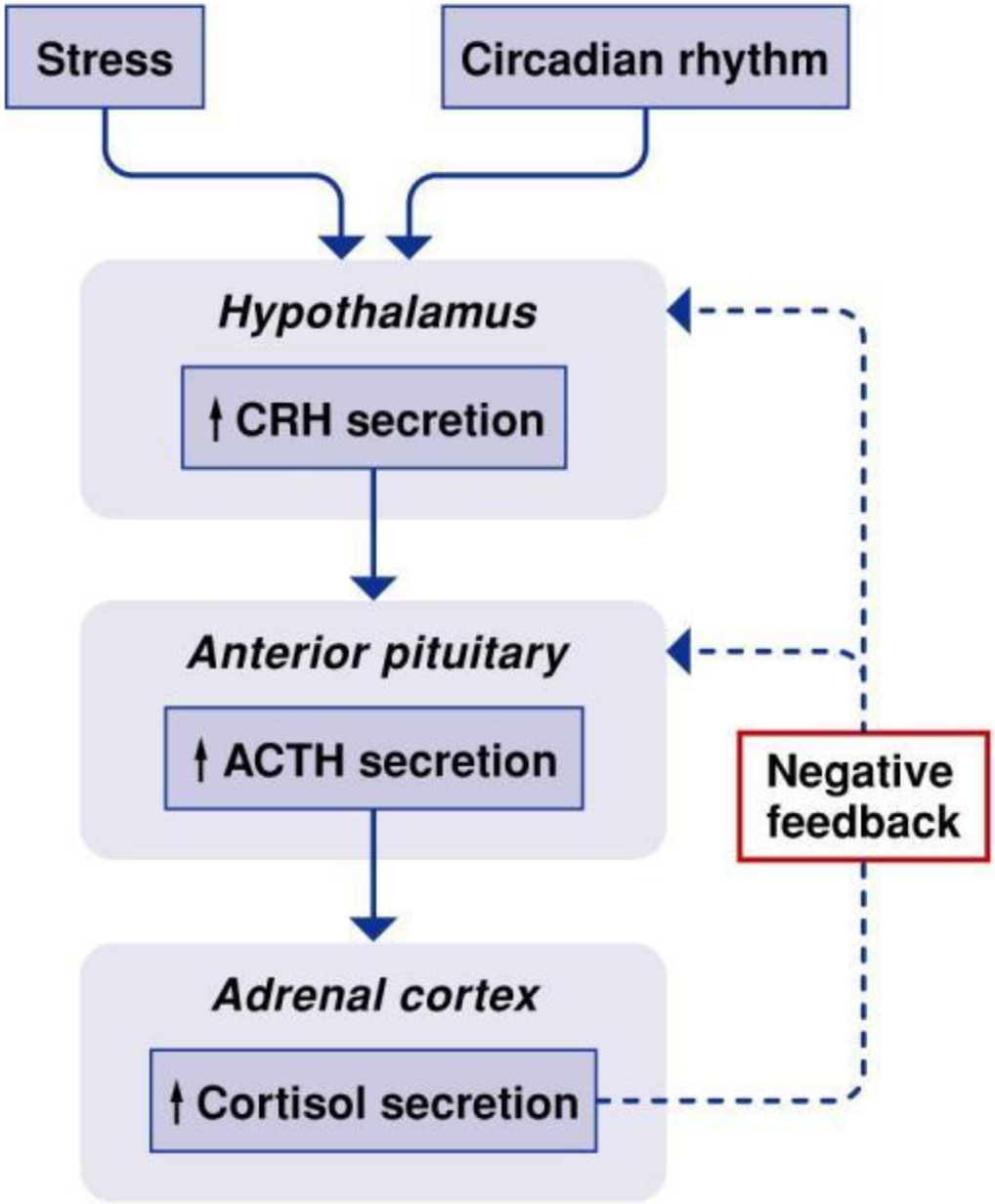





Figure 21.15

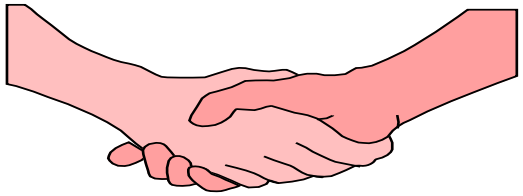
# SUGAR

- **Other fxs of Cortisol**
  - **↓ inflammatory and allergic response**
  - **↓ immune system therefore prone to infection**

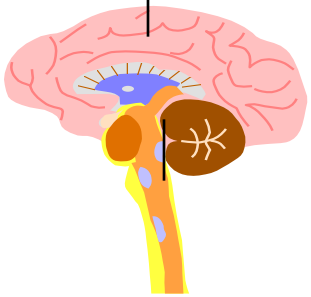
# SEX

- **ANDROGENS**
  - **– hormones which ↑ male characteristics**
    - **release of testosterone**

- **Seen more in women than men**

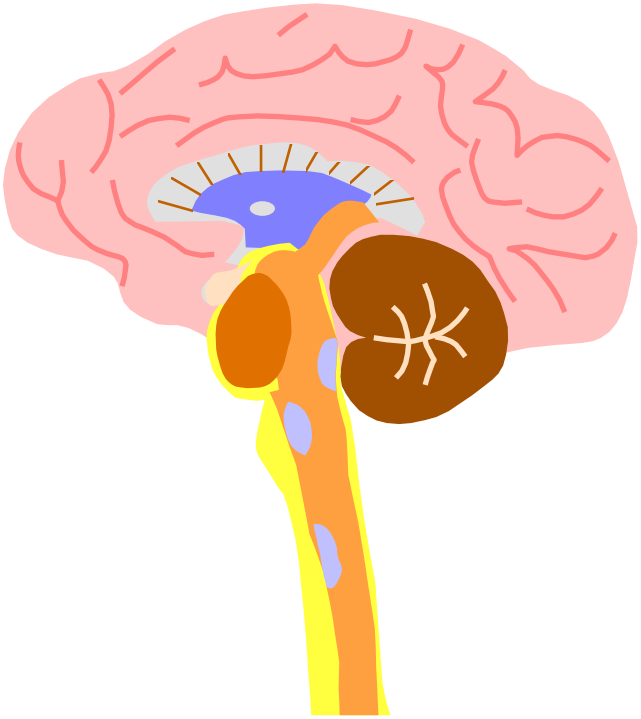


# RELEASE OF GLUCOCORTICOIDS IS CONTROLLED BY _____



# LET'S LOOK AT ACTH (adrenocorticotropic Hormone)

- **Produced in anterior pituitary gland**



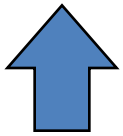
# ACTH

- **Circulating levels of cortisol**
  - **levels cause stimulation of ACTH**
  - **levels cause dec. release of ACTH**

think tank: What type of feedback mechanism is this??

# AFFECTED BY:

- **Individual biorhythms**
  - ACTH LEVELS ARE HIGHEST 2 HOURS BEFORE AND JUST AFTER AWAKENING.
  - usually 5AM - 7AM
  - these gradually decrease rest of day
- **Stress**- cortisol production and secretion

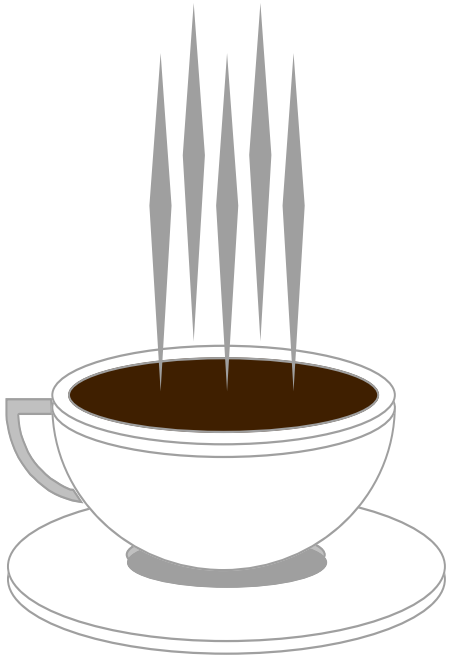


# ADRENAL MEDULLA

- **Fight or flight**
- **What is released by the adrenal medulla?**

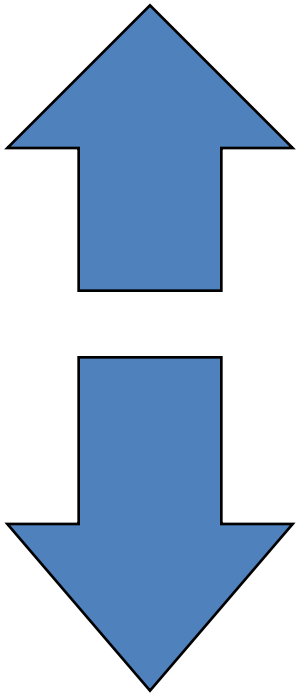
# CATECHOLAMINE RELEASE

- Epinephrine
- Norepinephrine



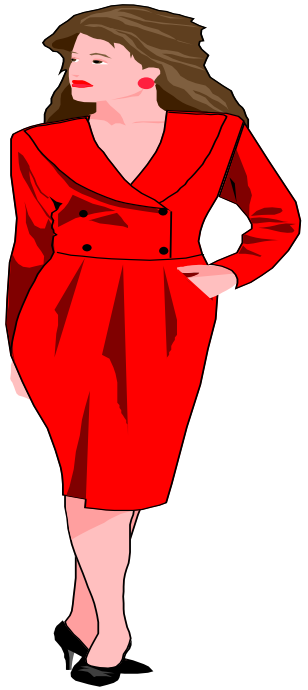
# HYPER AND HYPOFUNCTION ADRENAL CORTEX HORMONES

- Too much
- Too little



# I. CUSHING'S DISEASE (TOO MUCH CORTISOL!)

- ↑ secretion of cortisol from adrenal cortex
- 4X more frequent in females
- Usually occurs at 35-50 years of age



# ETIOLOGY
# Cushing's

- Primary-tumor on the adrenal cortex
- Secondary-tumor on the anterior pituitary gland
- Ectopic ACTH secreting tumor (lung, pancreas)
- Iatrogenic-Steroid administration

# SIGNS & SYMPTOMS Cushing's

- protein catabolism
  - muscle wasting
  - loss of collagen support
    - thin, fragile skin, bruises easily
  - poor wound healing

# SIGNS & SYMPTOMS
# Cushing's

- s in CHO metabolism
  - hyperglycemia
  - Can get diabetes-insulin can't keep up
  - Polyuria

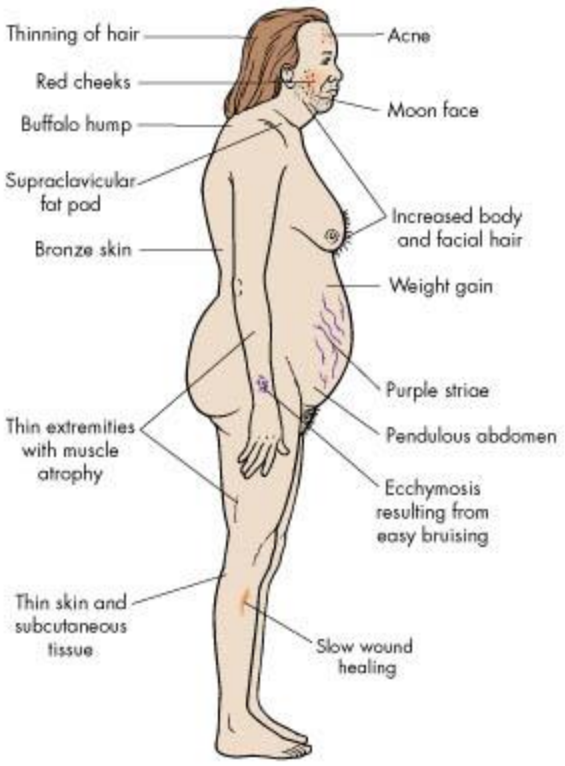



**Figure 47-9** Common characteristics of Cushing's syndrome.

# SIGNS & SYMPTOMS
# Cushing's

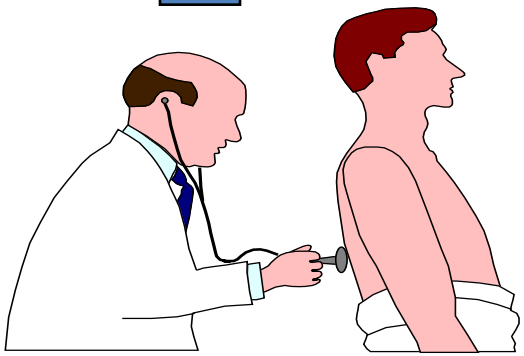
- s in fat metabolism
  - truncal obesity
  - buffalo hump
  - "moon face"
  - weight but strength

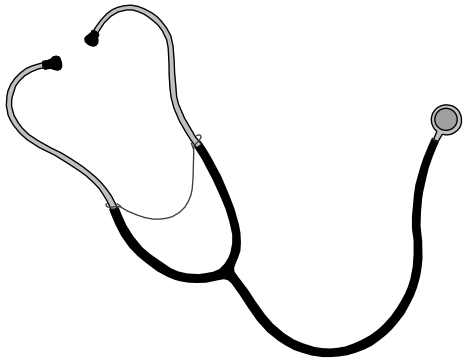
# SIGNS & SYMPTOMS

- ↓ immune response
  - More prone to infection
  - ↓ resistance to stress
  - Death usually occurs from infection

# SIGNS & SYMPTOMS

- ↑ **mineralocorticoid activity**
  - _____ retention
  - _____ retention
  - ↑ b.p. from _____





# II. HYPERALDOSTERONISM "Conn's Syndrome"

- Too much aldosterone secretion
- Question: What does aldosterone do????

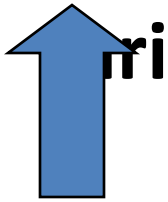
---

- usually caused by adrenal tumor

# SIGNS & SYMPTOMS
# Hyperaldosteronism

- Na and water retention
  - H/A, HTN
- ↓ K+ (hypokalemia)
- What is the normal serum K+ level???
- Usually no edema

# DIAGNOSIS-Hyperaldosteronism

- 
  **rinary K**
- 
  **plasma aldosterone levels with low plasma renin levels**

- **CT scan**
- **EKG changes**

# ADRENALECTOMY PRE-OP

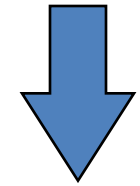
- Stabilize hormonally
- Correct fluid and electrolytes
- Cortisol PM before surgery, AM of surgery and during OR.

# ADRENALECTOMY POST-OP

- ICU-What type of problems to expect??
- IV cortisol for 24 hours
- IM cortisol 2nd day
- PO cortisol 3rd day
- Poor wound healing
- If unilateral- steroids weaned
  - other adrenal takes over 6-12 months

# ADDISON'S DISEASE hypofunction of adrenal cortex

- What hormones will you have too little of???



- glucocorticoids or _____
- mineralocorticoids or _____
- androgens or _____

# ETIOLOGY of Addison's

- Idiopathic atrophy
  - autoimmune condition Antibodies attack against own adrenal cortex
  - 90% of tissue destroyed

# ETIOLOGY of Addison's

- TB/fungal infections (histoplasmosis)

- Iatrogenic causes
  - adrenalectomy, chemo, anticoagulant tx

# SIGNS & SYMPTOMS
# Addison's Disease

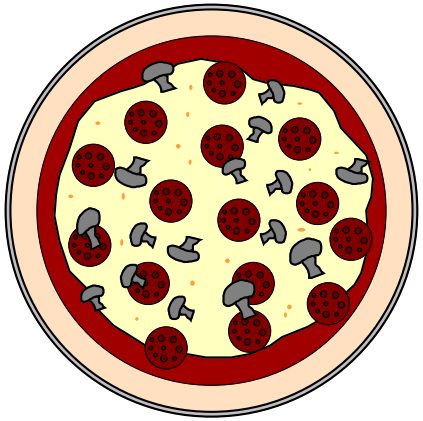
- **fatigue, weight loss, anorexia**
  - Why? think of cortisol fx
- **Changes in skin pigment**
  - small black freckles
  - cortisol -- ACTH-- MSH
- **Muscular weakness**
  - cortisol helps muscles maintain contraction and avoid fatigue

# SIGNS & SYMPTOMS
# Addison's

- **Fluid & electrolyte imbalances**
  - WHY???
- **b.p.**
  - WHY???
- **Hyponatremia-why?**
- **Hyperkalemia-why?**
- **Hypoglycemia-why?**

# SIGNS & SYMPTOMS
# Addison's

- **androgens**
  - hair loss, sexual fx
- **mental disturbances**
  - anxiety, irritability, etc.
- **salt craving-why?**

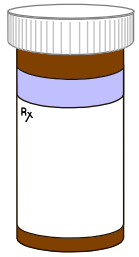


# DIAGNOSIS-Addison's

- serum cortisol
- urinary 17-OHCS and 17 KS
- K,
- Na
- serum glucose

# INTERVENTIONS
# Addison's Disease

- Life long hormone replacement
  - primary-need oral cortisone 20-25mgs in AM and 10-12mg in PM
  - change dose PRN for stress
  - also need mineralocorticoid-(FLORINEF)

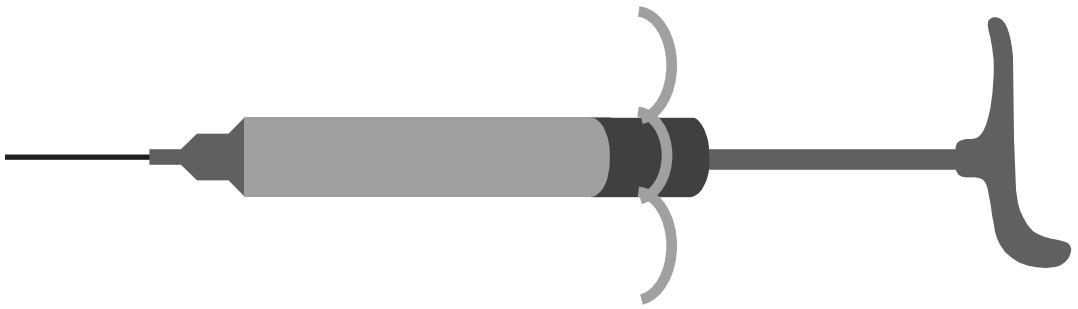


# INTERVENTIONS

- Salt food liberally
- Do not fast or omit meals
- Eat between meals and snack
- Eat diet high in carbs and proteins
- Wear medic-alert bracelet
- kit of 100mg hydrocortisone IM

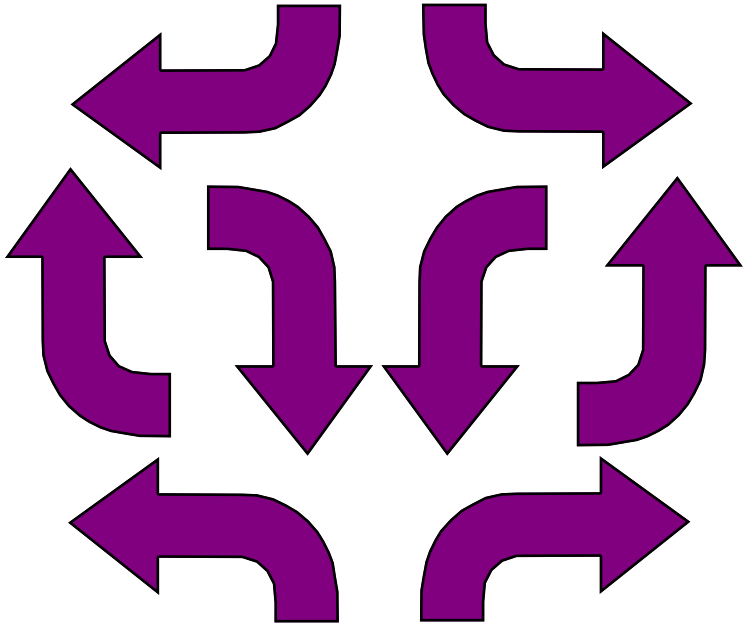
# INTERVENTIONS
# Addison's Disease

- Keep parenteral glucocorticoids at home for injection during illness
- Avoid infections/stress



# COMPLICATIONS
# Addison's Disease

- Adrenal crisis
- Electrolyte imbalance
- Hypoglycemia



# PHEOCHROMOCYTOMA

- **rare, benign tumor of the adrenal medulla**
- **oh no...what are we going to see a hypersecretion of????**

# SIGNS AND SYMPTOMS

- Hallmark is hypertension-200/150 or greater
- “Spells” -paroxymal attacks
  - bladder distension,emotional distress, exposure to cold.
- NE and Epinepherine released sporadically

# SIGNS & SYMPTOMS

- **Deep breathing**
- **Pounding heart**
- **Headache**
- **Moist cool hands & feet**
- **Visual disturbances**

# DIAGNOSIS

- **24 hour urine-VMA (metabolite of Epinepherine)**
- **Plasma catecholamines**
- **CT to locate tumor**

# INTERVENTIONS-PRE-OP

- **Adrenergic blocking agents**
  - Minipress to bp
- **Beta blocking agents**
  - Inderal to hr, b.p., & force of contraction
- **Diet**
  - high in vitamin, mineral,calorie, no caffeine
- **Sedatives**

# INTERVENTIONS

- **Monitor b.p.**
- **Eliminate attacks**
- **If attack- complete bedrest and HOB 45 degrees**

# DURING SURGERY

GIVE REGITINE AND NIPRIDE TO PREVENT HYPERTENSIVE CRISIS

# POST-OP

- b.p. may be ↑ initially, BUT CAN BOTTOM OUT
- Volume expanders
- Vasopressors
- Hourly I and O
- Observe for hemorrhage

# Adrenal incidentaloma

- Mass lesion greater than 1 cm.
- Serendipitiously discovered by radiologic examinations
- Such as : - Computed tomography (CT)
  - Magnetic resonance imaging (MRI)
- Two questions
  - Is it malignancy ?
  - Is it functioning ?