

بنام خداوند جان و

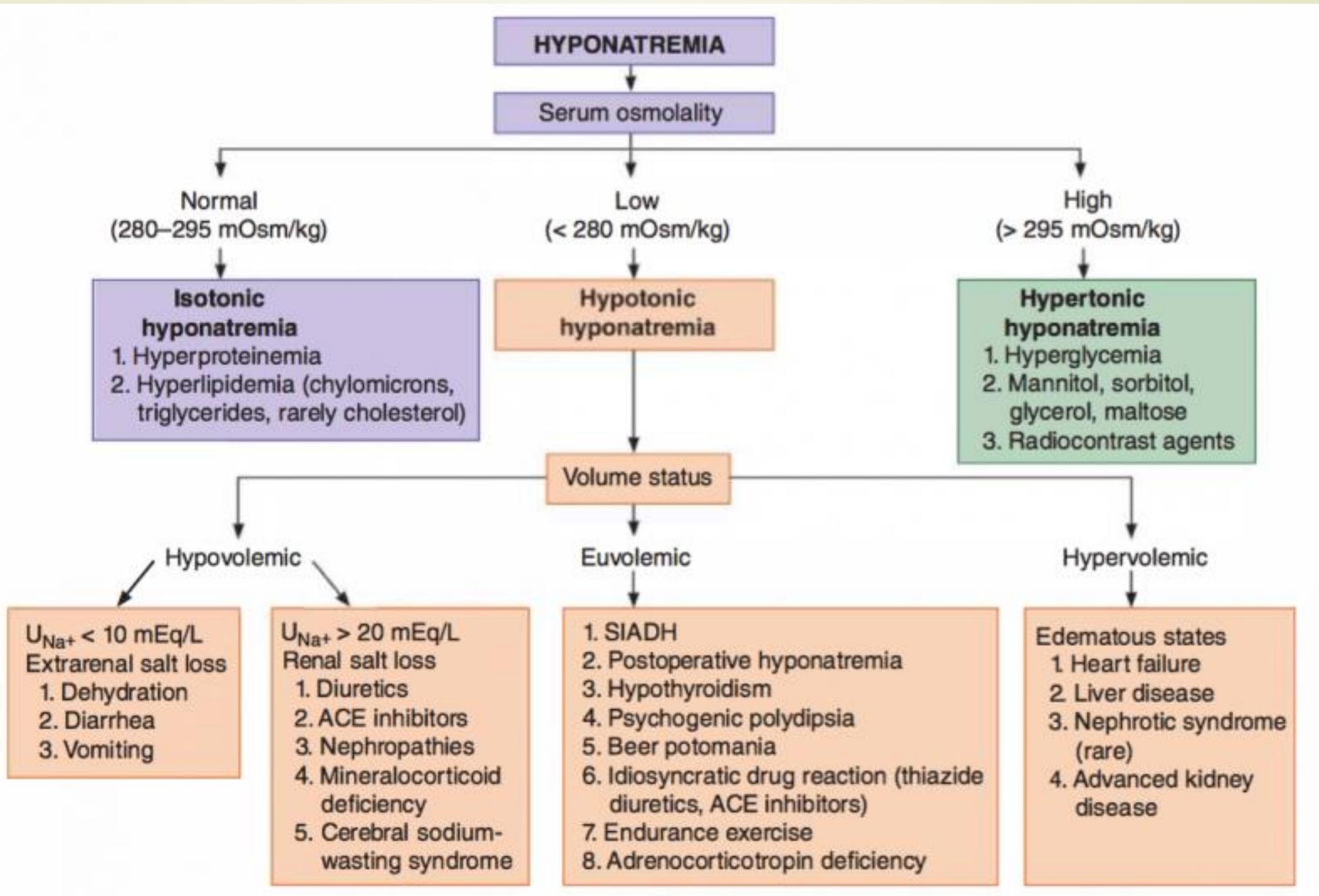
hyponatremia management

Dr. Mohamad Ahangar Davoodi

Pediatric endocrinologist , Associate Professor

Arak university

Children's Medical Center



Diagnostic Criteria for Syndrome of Inappropriate Antidiuretic Hormone Secretion

- Absence of:
 - Renal, adrenal, or thyroid insufficiency
 - Heart failure, nephrotic syndrome, or cirrhosis
 - Diuretic ingestion
 - Dehydration
- Urine osmolality >100 mOsm/kg (usually $>$ plasma)
- Serum osmolality <280 mOsm/kg and serum sodium <135 mEq/L
- Urine sodium >30 mEq/L
- Reversal of “sodium wasting” and correction of hyponatremia with water restriction



Features	CSW	SIADH
Dehydration	Present	Absent
Serum sodium	Decreased	Decreased
Urinary sodium excretion	Increased	Variable
Urine osmolality	Increased	Increased
Serum osmolality	Low	Low
Vasopressin	Low	High
Polyuria	Present	Absent
BUN	Increased	Normal
Blood pressure	Low	Normal or increased
ANP	Increased	Normal
Treatment	Saline/3% NaCl	Fluid restriction

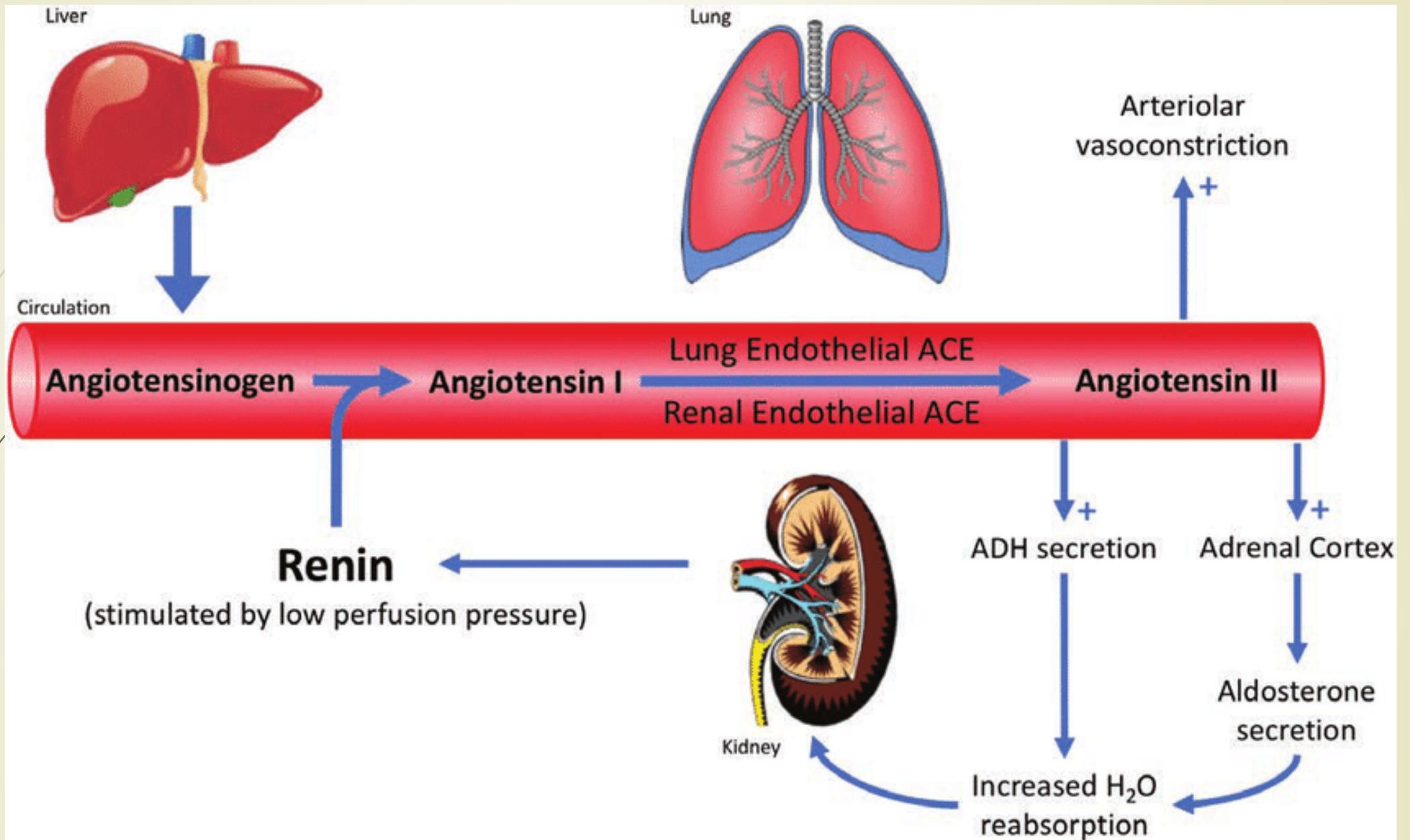




TABLE 15.24

Causes of Mineralocorticoid Deficiency

Addison disease

Adrenal hypoplasia

Congenital adrenal hyperplasia (21-hydroxylase and 3 β -hydroxysteroid dehydrogenase deficiencies)

Pseudohypoaldosteronism types I and II

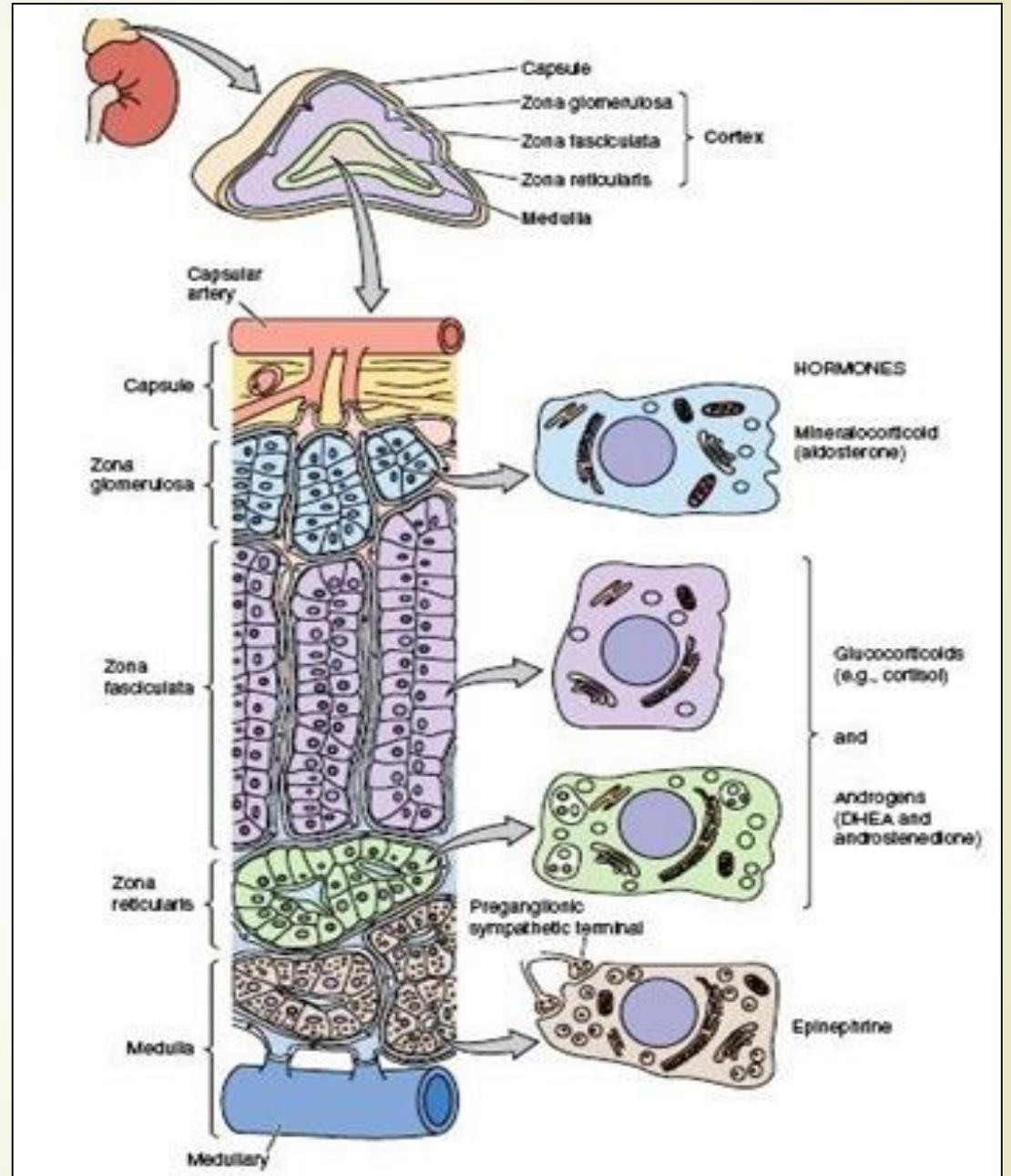
Hyporeninemic hypoaldosteronism

Aldosterone biosynthetic defects

Drug induced

Adrenal Glands

- The adrenal glands comprise 3 separate hormone systems:
 1. The zona **glomerulosa**:
 - secretes **aldosterone**
 2. The zona **fasciculata** & **reticularis**:
 - secrete cortisol & the adrenal androgens
 3. The adrenal **medulla**:
 - secretes catecholamines (mainly epinephrine)



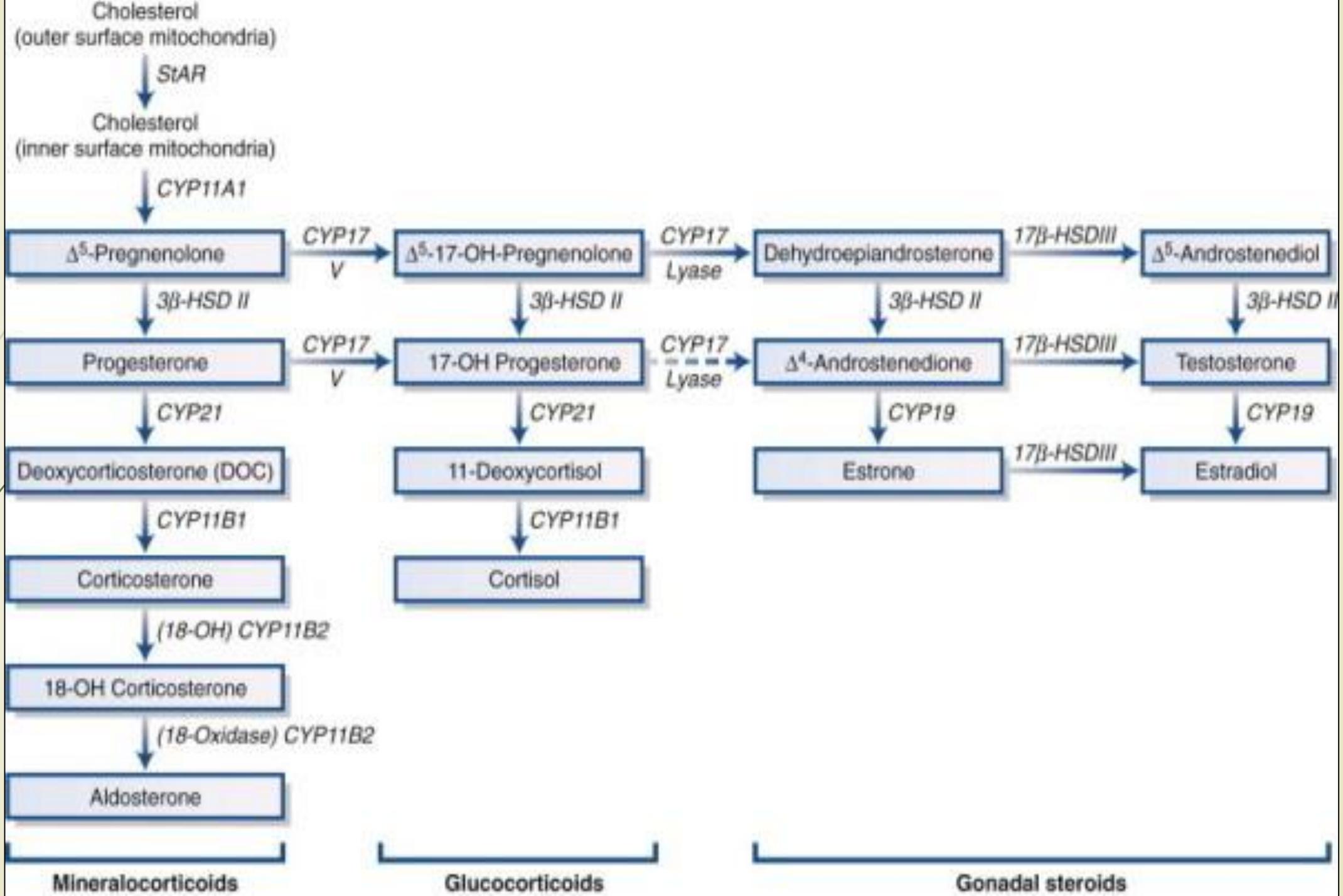


TABLE 15.19

Clinical and Laboratory Features of an Adrenal Crisis

- Dehydration, hypotension, or shock out of proportion to severity of current illness
- Nausea and vomiting with a history of weight loss and anorexia
- Abdominal pain, so-called acute abdomen
- Unexplained hypoglycemia
- Unexplained fever
- Hyponatremia, hyperkalemia, azotemia, hypercalcemia, or eosinophilia
- Hyperpigmentation or vitiligo
- Other autoimmune endocrine deficiencies, such as hypothyroidism or gonadal failure



Adrenal crisis can be triggered by

- ▶ significant physical stress
- ▶ illness
- ▶ fever, gastroenteritis,...
- ▶ undergo surgery with general anesthesia
- ▶ trauma
- ▶ Levothyroxine
- ▶ GH therapy



IV fluid therapy

- ▶ *Treatment of acute adrenal insufficiency must be **immediate** and **vigorous**.*
- ▶ An intravenous solution of **5% glucose in 0.9% saline** should be administered to correct hypoglycemia, hypovolemia, and hyponatremia.
- ▶ Hypotonic fluids (e.g., 5% glucose in water or 0.2% saline) must be avoided because they can precipitate or exacerbate hyponatremia.

APPROXIMATE RELATIVE POTENCY

Compound (tablet strength, mg)	Anti-inflammatory (glucocorticoid) effect	Sodium-retaining (mineralocorticoid) effect	Equivalent ^a dosage (for anti-inflammatory effect, mg) ^b
Cortisone (25)	0.8	1.0	25
Hydrocortisone (20)	1.0	1.0	20
Prednisolone (5)	4	0.8	5
Methylprednisolone (4)	5	Minimal	4
Triamcinolone (4)	5	None	4
Dexamethasone (0.5)	30	Minimal	0.75
Betamethasone (0.5)	30	Negligible	0.75
Fludrocortisone (0.1)	15	150	Irrelevant
Aldosterone (none)	None	500 ^c	Irrelevant

^aNote that these equivalents are in approximate inverse accord with the tablet strengths.

^bThe doses in the final column are in the lower range of those that may cause suppression of the hypothalamic–pituitary–adrenocortical axis when given daily continuously. Much higher doses, e.g. prednisolone 40 mg, can be given on alternate days or daily for up to 5 days without causing clinically significant suppression.

^cInjected.



Hydrocortisone

- ▶ 10 mg for infants
- ▶ 25 mg for toddlers
- ▶ 50 mg for older children
- ▶ 100 mg for adolescents
- ▶ as a bolus and similar doses should be divided q 6-hr
- ▶ These doses may be reduced during the next 24 hr if progress is satisfactory.



Management in neonates:

- ▶ **Hydrocortisone** 20 to 30 mg/m²/day divided 3 doses (ie, 2/5mg three times daily) higher doses of hydrocortisone (50mg/m²/day) may be used for initial reduction of markedly elevated adrenal hormones.
- ▶ **Fludrocortisone** 0/1-0/3 mg/daily in 2 divided doses (150µg/m²/daily), and one gram or 4 mEq/kg/day of sodium chloride divided in several feeding.

CAH Management in children & adolescents

► Children

Hydrocortisone 10-15 mg/m²/day divided in 3 doses although higher doses are sometimes needed.

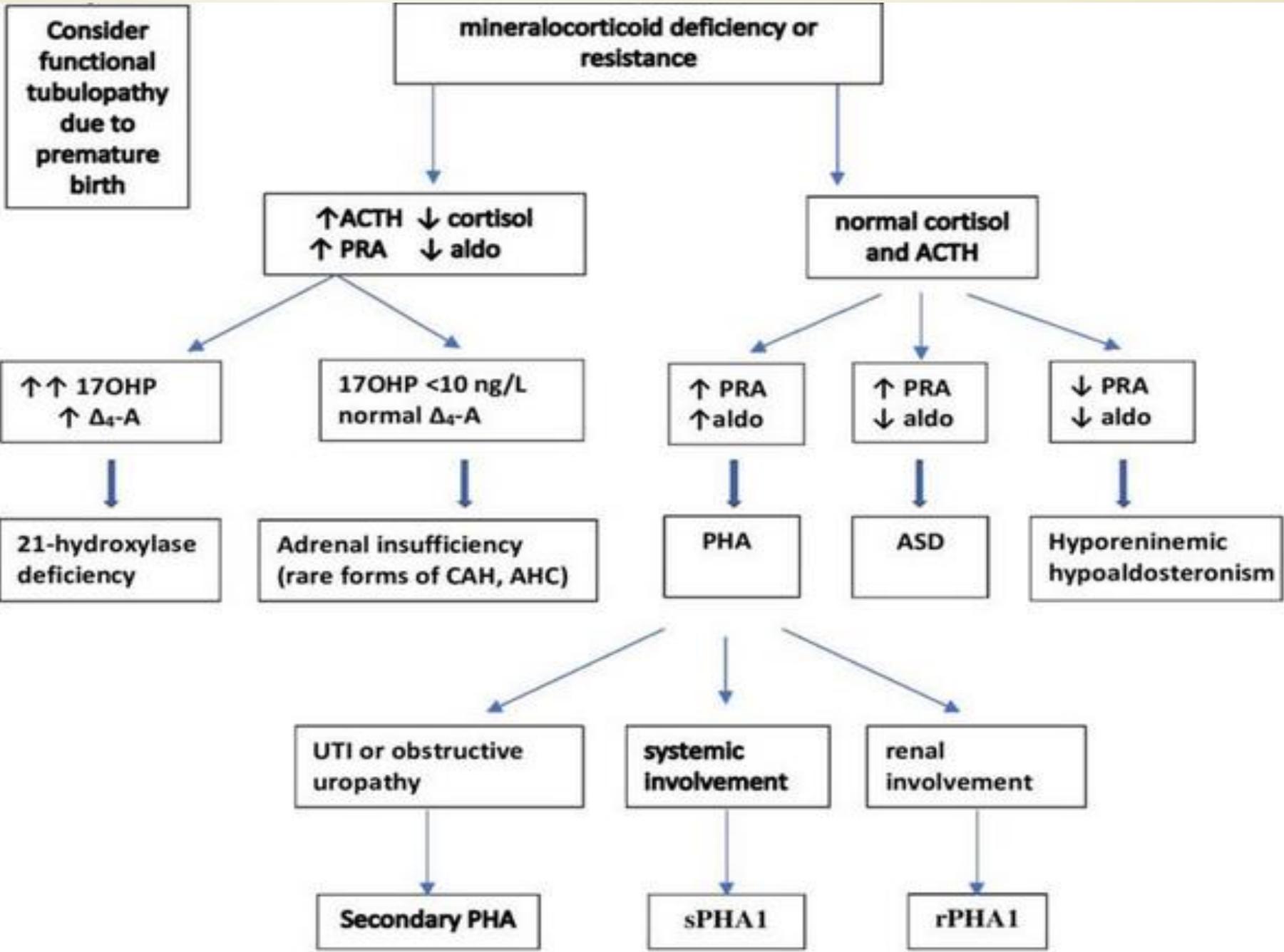
► Older adolescents & adults

► Dexamethasone 0/25-0/5 mg at bedtime

or

► Prednisolone 5-7/5mg divided in two doses

Fludrocortisone 0/05 to 0/2 mg/day





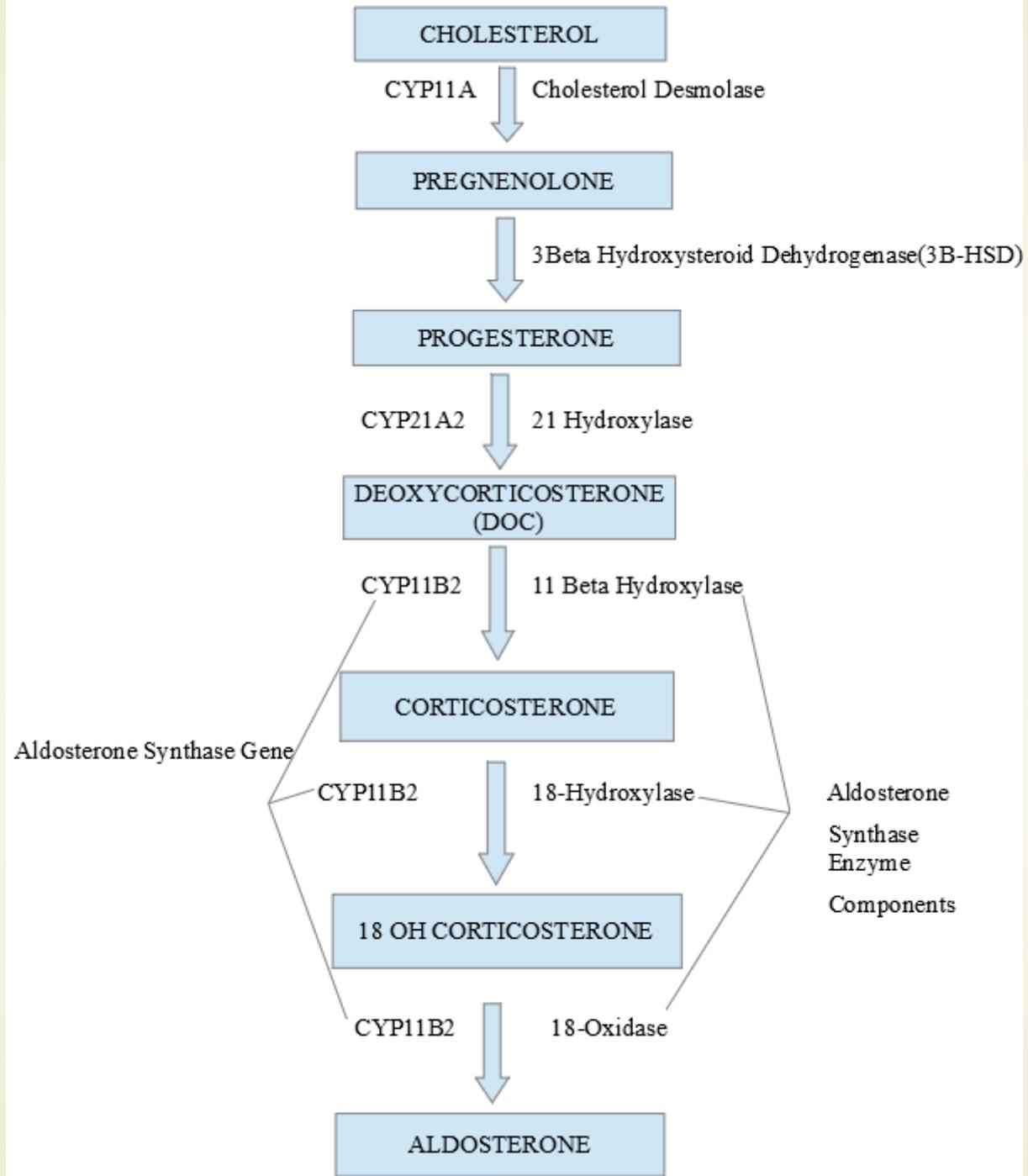
Hyperreninemic hypoaldosteronism

- **Immaturity**(aldosterone synthetic enzymes in VPT infants)
 - **Aldosterone synthase deficiency I and II**
 - **Critically ill patients**
 - **Delayed recovery of the suppressed gland after contralateral adrenalectomy**
 - **Drug-induced diminished synthesis**
 - **Discontinuation of drugs with mineralocorticoid activity after prolonged use**
- 



Hyporeninemic hypoaldosteronism

- **Congenital.**
 - **Acquired (type 4 RTA).**
 - **Diabetes (75%)**
 - **Various nephropathies**
 - **Autonomic neuropathy**
 - **Sickle cell disease, Amyloidosis, SLE, Myeloma**
 - **HIV disease**
 - **Medications such as NSAIDs, COX-2 inhibitors, ACEI/ARBs**
- 



Aldosterone synthase deficiency type 1

- ▶ **autosomal recessive**
- ▶ salt-wasting crisis involving severe dehydration, vomiting, and failure to grow and thrive. Hyperkalemia, metabolic acidosis, dehydration, and hyponatremia are found in neonatal period but Adults are usually asymptomatic.
- ▶ **low to normal levels of 18-hydroxycorticosterone**
- ▶ undetectable levels of aldosterone (or urinary tetrahydroaldosterone)
- ▶ **plasma renin activity is elevated**
- ▶ **9 α -fludrocortisone** (starting dose, 150 μ g/m² per day in neonates and infants) and may also benefit from **salt supplementation**.
- ▶ Electrolytes often tend to normalize **spontaneously between 3 and 4 years** of age.



Aldosterone synthase deficiency type 2

- ▶ autosomal recessive
 - ▶ high levels of 18-hydroxycorticosterone
 - ▶ subnormal or even normal levels of aldosterone
- 

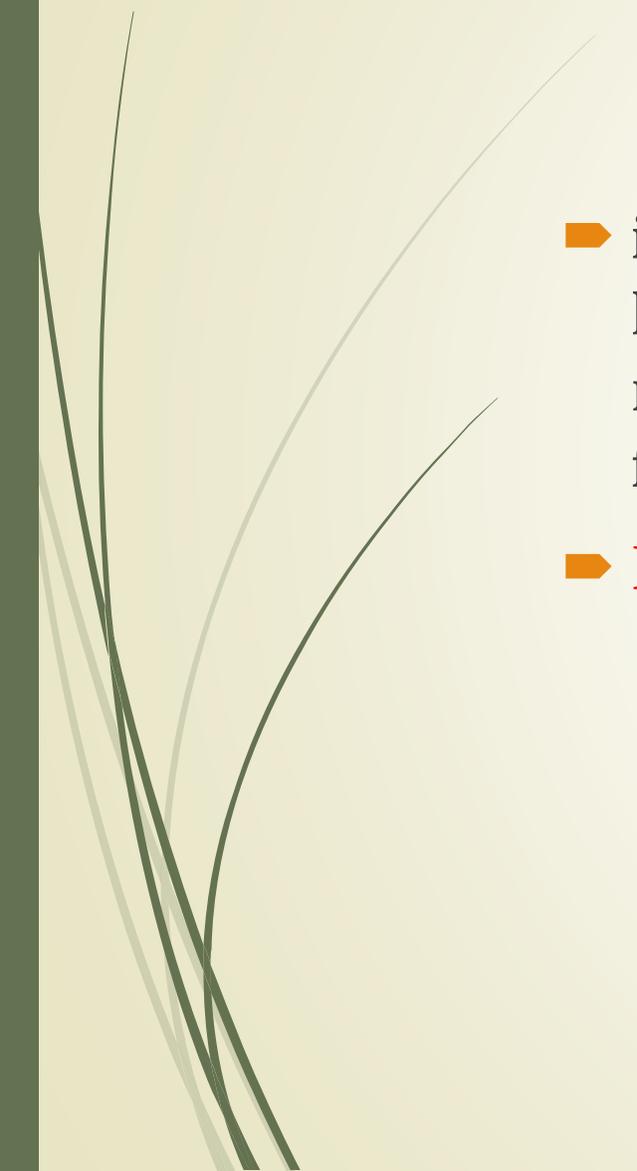


Hyperreninemic hyperaldosteronism (*Aldosterone resistance*)

- ▶ Autosomal dominant pseudohypoaldosteronism (PHA AD)
- ▶ Autosomal recessive pseudohypoaldosteronism (PHA AR)
- ▶ Urinary tract infection (UTI) and obstructive uropathy (PHA III, resistance to ALD)
- ▶ Medications
- ▶ Downregulation of MR in renal tubules (solid organ transplant)



Pseudohypoaldosteronism (PHA)

- ▶ in the **neonatal** period with dehydration, hyponatremia, hyperkalemia, metabolic acidosis, and failure to thrive despite normal glomerular filtration and normal renal and adrenal function.
 - ▶ **Renin** levels and plasma **aldosterone** are grossly **elevated**.
- 



PHA Autosomal Dominant

- **Renal** form of PHA
 - usually less severe
 - **improves spontaneously** within the first several years of life
- 

PHA Autosomal Recessive

- **Generalized** form of PHA.
- multiorgan disorder, with mineralocorticoid resistance seen in the **kidney, sweat** and **salivary** glands, and the **colonic** mucosa.
- opposite of Liddle syndrome.
- **recurrent respiratory infections** and neonatal respiratory distress, **cholelithiasis**, and **polyhydramnios**.
- **salt (2–8 g/day)** in the form of sodium chloride and sodium **bicarbonate**.
- very high amounts of salt in their diet (**up to 45 g NaCl per day**).
- In the **severe hyperkalemia**, peritoneal **dialysis** may be necessary.
- **Indomethacin**(reduction GFR or an inhibition PGE₂,reduce polyuria,sodium loss, and hypercalciuria).
- **Hydrochlorothiazide**(reduce hypercalciuria and hyperkalemia)
- **Carbenoxolone**, a derivative of glycyrrhetic acid in licorice



Type II PHA (Gordon syndrome)

- ▶ hyperkalemia
- ▶ metabolic acidosis
- ▶ **salt retention** with mild **hypertension**
- ▶ suppressed plasma renin activity rather than salt wasting
- ▶ opposite of Gitelman



Type III PHA

- ▶ acquired and usually **transient** form of mineralocorticoid resistance
 - ▶ obstruction and infection of **kidney** and urinary tract
 - ▶ salt wasting from gut or skin
 - ▶ **Reduced glomerular filtration** rate is a hallmark of the condition.
- 



سپاس از حسن توجه شما