**Adrenal Disorders in Pediatrics**

Adrenal Gland Physiology:

* + Embryology:
		- Cortex: mesodermal origin. Medulla: neuroectoderm origin (week 8 of gestation)

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| **Anatomy**Located on top of the upper pole of each kidney | **Adrenal Hormone** | **Function** |
| **Cortex** |
| Zona Glomerulosa | *Mineralocorticoid*Aldosterone | ***SALT***-Regulate renal retention of sodium and excretion of potassium-Regulated by renin-angiotensin axis |
| Zona Fasiculata | *Glucocorticoids*Cortisol | ***SUGAR***-Stimulate gluconeogenesis, lipolysis, and protein catabolism-Increase excretion of free water-Anti-inflammatory |
| Zona Reticularis | *Androgens*DHEA, DHEA-S, Androstenedione | ***SEX***-Induce virilization (pubic and axillary hair) -Precursor hormones for extra-adrenal testosterone synthesis and extra-gonadal estrogen synthesis-Important roles in bone mineralization |
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| **Medulla** | *Catecholamines* Epinephrine and Norepinephrine | -“Fight or Flight” response to physiological stress-Neuromodulator that mediate central and peripheral nervous system functions |

* **Adrenal Hyperfunction - Cortisol:**
	+ Pertinent History and Exam Findings:
		- History: rapid weight gain, declining growth velocity, headache, fatigue, delayed/arrested puberty, acne, nocturia
		- Exam Findings: hypertension, acne, dorsocervical fat pad, central adiposity, violaceous striae, cushingoid facies, hirsutism
	+ Work Up:
		- Initial Screening Labs and Referral to Endocrinology: midnight salivary or serum cortisol, 24 urine free cortisol (with creatinine) level, 1 mg Overnight Dexamethasone suppression test
	+ Interpretation of Laboratory Findings**:**
		- Midnight Serum Cortisol level of > 7.5 mcg/dL x 2
		- Midnight Salivary Cortisol > 0.13 mcg/dL x 2
		- 24 hour Urine free cortisol: >70 mcg/m2/day (>3 times the upper limit of normal)
		- Dexamethasone Suppression Test: Cortisol > 1.8 mcg/dL (95% sensitive, 90% specific)
	+ Differential Diagnosis**:**
		- Cushing Syndrome: Hypersecretion of cortisol from adrenal glands
			* Adrenal Adenoma, carcinoma, multinodular adrenal hyperplasia, Ectopic ACTH Syndrome
		- Cushing Disease: Pituitary overproduction of ACTH
			* Pituitary Microadenoma or Macroadenoma
			* Ectopic CRH
		- Conn Syndrome: Primary Hyperaldosteronism
		- Virilizing and Feminizing Adrenal Tumors: Androgen excess
* **Adrenal Hypofunction:**
	+ Pertinent History and Exam Findings:
		- History: fatigue, weight loss, nausea, vomiting, abdominal pain, weakness, salt craving, headaches, hyperpigmentation, hypoglycemia (pallor, seizure)
		- Exam Findings: hypotension; hyperpigmentation of gums, palmar creases, areolae, and scrotum
	+ Work Up:
		- Initial Screening Labs (sent by primary provider): sodium, potassium, glucose, cortisol (7-8 AM), ACTH, Plasma Renin Activity (PRA)
		- Other tests to consider after consultation with pediatric endocrinologist: ACTH stimulation test, 17-OH Progesterone, DHEA-S, adrenal autoantibodies (Anti-CYP11, 21-hydroxylase Ab), very-long chain fatty acids
	+ Interpretation of Laboratory Findings: 8 AM Cortisol level <5 mcg/dL (5-10 mcg/dL require further work up with stimulation test)
		- ACTH:
			* Primary AI: >200 pg/mL
			* Secondary AI: <50 pg/mL
		- Electrolytes (can be normal):
			* Primary AI: K+ (high), Na+ (low), Aldosterone (low), glucose (low)
			* Secondary AI: Na+ (low or normal)
		- 17-Hydroxyprogesterone
			* Primary: Normal (Autoimmune), High (Defects of steroid biosynthesis)
			* Secondary: Normal
		- PRA:
			* Primary AI: high
			* Secondary AI: Normal
		- ACTH Stimulation Test: 60 minute cortisol value <18 with a delta change from baseline of <10
	+ Differential Diagnosis:
		- Primary (Disease of the adrenal cortex):
			* Autoimmune: Isolated vs. Autoimmune Polyglandular Syndrome (APS 1, APS 2, APS 4, IPEX)
			* Acquired: Hemorrhage, infection, infiltration, medications (etomidate)
			* Defects of steroid biosynthesis: Congenital adrenal hyperplasia, Congenital lipoid adrenal hyperplasia
			* Adrenal Dysgenesis: Adrenal Hypoplasia Congenita, SF-1 deficiency, Pallister- Hall syndrome
			* Metabolic and Cholesterol disorders: X-linked adrenoleukodystrophy, Wolman disease, Smith-Lemli Opitz, Kearns-Sayre
		- Secondary (Disorder of ACTH):
			* Hypopituitarism
			* ACTH Deficiency
			* Familial glucocorticoid deficiency/ ACTH resistance
			* Iatrogenic