

FACULTY PRESENTATION

SLIDE 1

Individual: 15 minutes (Use 5 x 7 cards)

- Draw a diagram of the adrenal gland, label each zone, identify cells within each zone and list the product(s) made by the various cell types and what stimulates their secretion from the adrenal gland
- Also write a short paragraph on what you would expect to happen if the adrenal glands were destroyed and include its effect on ACTH and CRH
- Write your name on the file card as these will be collected by the faculty

As a Team: 15 minutes for discussion. Post your answer on dry erase boards (10 minutes), then walk around and evaluate answers

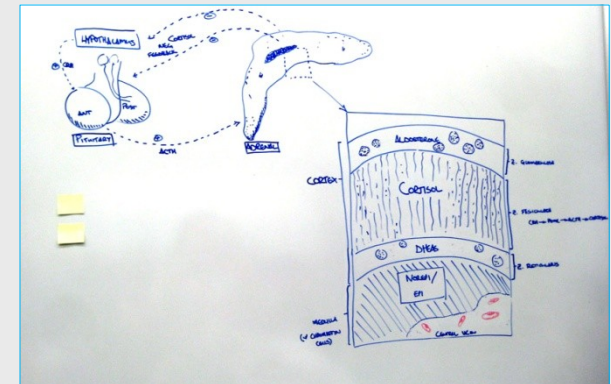
- Draw a diagram of the adrenal gland, label each zone, identify cells within each zone and list the product made by the various cell types and what stimulates secretion from the adrenal gland
- Review the drawings of the other teams
- Each team has one vote (Yellow sticker)
- Each team can place their yellow sticker on the drawing that they think best answers the question

SLIDE 2 EXPECTED TEAM ANSWER

The Adrenal Gland

■ Adrenal cortex

- The outer layer of the adrenal cortex called the zona glomerulosa produces mineralocorticoids. Mineralocorticoids regulate sodium and potassium homeostasis and water balance. Cells in this zone are under feedback control of the renin-angiotensin system.
- The middle layer of the adrenal cortex, the zona fasciculata produces glucocorticoids. The regulation of glucocorticoids is under control of the corticotropin-releasing hormone-ACTH, secreted by the pituitary gland.
- The layer closest to the medulla, the zona reticularis produce androgens. Cells in this zone are regulated by feedback control of the corticotropin-releasing hormone-ACTH system.



■ Adrenal medulla

- Contains chromaffin cells (modified postganglionic sympathetic neurons)
- They secrete norepinephrine and epinephrine under the influence of the sympathetic nervous system

SLIDE 3

As a team: 15 minutes team discussion / 10 minutes class discussion

What is the most likely diagnosis?

What would you expect the ACTH and aldosterone levels to be?

What test(s) could help confirm the diagnosis?

SLIDE 4

Diagnosis

- ✦ The patient's history, physical examination and laboratory data support the preliminary diagnosis of primary adrenal insufficiency
- ✦ The patient is presenting in acute adrenal crisis (primary adrenocortical failure)

SLIDE 5

Hormone Levels

- * With primary adrenal insufficiency ACTH levels will be elevated but steroid hormone levels (cortisol, aldosterone) will be low

Confirmatory Tests

- * Stable – ambulatory patients
 - * Diurnal variation in cortisol production
 - * Early morning (6am – 8am cortisol level)
- * Dynamic testing may be needed to confirm the diagnosis of adrenal insufficiency
 - * Cosyntropin (ACTH) stimulation test
 - * Assess the ability of the adrenal cortex to increase cortisol production in response to administration of ACTH

SLIDE 6

Additional Hormones

- ✦ Normal TSH (anterior pituitary) and T4 levels
 - ✦ Normal functioning of the hypothalamus
 - ✦ TRH synthesis and release
- ✦ Pituitary adenoma disrupting gland functions very unlikely
- ✦ High levels of ACTH indicate proper function of the anterior pituitary and the hypothalamus CRH

SLIDE 7

As a team: 15 minutes team discussion / 10 minutes class discussion

List the information in the case (history and physical examination) that you think is important to consider in making the diagnosis. What is the clinical significance of this information?

Explain the abnormal hyperpigmentation of the skin and oral mucosa, tachycardia and hypotension

Discuss the abnormal lab data and its significance in regards to the underlying condition

SLIDE 8

Historical Features

- * Non-specific symptoms (4-5 months)
 - * Generalized weakness
 - * Fatigue
 - * lightheadedness (worsens with standing)
- * Gastrointestinal symptoms (1 month or so)
 - * Anorexia
 - * Nausea
 - * Abdominal cramps
 - * Loose stools (recently)
 - * Weight loss

SLIDE 9

- ✦ Taken in isolation, nonspecific and GI complaints are just that...
 - ✦ **Nonspecific**
- ✦ Together these complaints raise concern of a serious underlying condition
- ✦ Point to GI pathology, however this can be misleading
- ✦ These nonspecific symptoms may confound the presentation leading to a delay in diagnosis and appropriate management

SLIDE 10

Physical Examination Findings

- * Evenly tanned skin in sun exposed areas
- * Hyperpigmentation in palmar creases and oral mucosa
 - * May be a subtle finding
 - * Attributable to excess pro-opiomelanocortin (POMC) and melanocyte-stimulating hormone
 - * The primary deficiency in cortisol production leads to a lack of negative feedback on the hypothalamus and anterior pituitary
 - * Results in increased production of ACTH, stimulates the synthesis of melanin and results in increased pigmentation

SLIDE 11

Physical Examination Findings

- * Hypotension and tachycardia exaggerated with standing
- * Hypotension that responds poorly to intravenous fluids
 - * Hallmark of adrenal crisis, occurs mostly as a result of mineralocorticoid deficiency
 - * Caused by sodium and plasma volume depletion
 - * Decreased production of aldosterone prevents sodium reabsorption

SLIDE 12

Laboratory Data

- * **Na+** 124 mEq/L Reference range 135 – 146

- * **K+** 5.8 mEq/L Reference range 3.5 – 5.0

- * Other findings outside of normal reference range include;
 - * **Cl-** 94 mEq/L 95 – 105
 - * **HCO₃-** 18 mEq/L 22 – 28
 - * **BUN** 37 mg/dL 7 – 18
 - * **Creatinine** 1.8 mg/dL 0.6 – 1.2
 - * **Glucose** 68mg/dL 75-105
 - * **Lymphocytes** (38%) 25 – 33
 - * **Eosinophils** (5%) 1 – 3
 - * **Cortisol (am)** 4 µg/dL >10

SLIDE 13

Laboratory Data

- ✦ Hyponatremia and hyperkalemia occur as a result of decreased secretion of cortisol and aldosterone (primary adrenal insufficiency)
- ✦ Hyponatremia can also occur in secondary adrenal insufficiency as a result of reduced glomerular filtration rate, increased antidiuretic hormone secretion, and possible concomitant hypothyroidism
- ✦ Hypoaldosteronism (also called type 4 renal tubular acidosis) is associated with hyperkalemia (urinary retention of potassium) and mild metabolic acidosis
- ✦ Hypoglycemia may occur as a result of low cortisol levels as cortisol stimulates gluconeogenesis

SLIDE 14

**As a team: 15 minutes team discussion / 10
minutes
class discussion**

What is the difference between primary and secondary adrenal insufficiency and the etiologies of each?

What treatment should be initiated?

SLIDE 15

Etiology

- ✦ Primary adrenal insufficiency results in impaired production of glucocorticoids (cortisol) and mineralocorticoids (aldosterone)
- ✦ The problem in this case is with the adrenal gland, not the pituitary or hypothalamus
- ✦ Primary adrenal insufficiency, or Addison's disease is caused most commonly by autoimmune adrenalitis
- ✦ Tuberculous adrenalitis remains a frequent cause in developing countries
- ✦ HIV infection and metastatic cancer are other important causes

SLIDE 16

Etiology

- ✦ Secondary adrenal insufficiency is due to a defect in the synthesis and release of ACTH from the anterior pituitary
- ✦ Levels of ACTH and glucocorticoids (cortisol) would be low and aldosterone may be near normal
- ✦ Can be caused by:
 - ✦ Pituitary or hypothalamic tumors, trauma, pituitary surgery or irradiation, infections, inflammatory or autoimmune disorders affecting the pituitary region (sarcoidosis), pituitary necrosis / hemorrhage (Sheehan syndrome) or can be caused by an acute interruption of prolonged administration of exogenous glucocorticoid therapy

SLIDE 17

Treatment

- ✦ Initial supportive care:
 - ✦ Repletion of intravascular volume
 - ✦ Correction of electrolyte abnormalities
 - ✦ Search for the precipitating or underlying cause
- ✦ Concurrently and most important is the administration of glucocorticoid replacement therapy
 - Acute phase of treatment
 - Hydrocortisone
- Primary adrenal insufficiency, mineralocorticoid therapy will also need to be administered
 - Fludrocortisone
- In women, the addition of DHEA supplements may be needed

Objectives of Workshop:

Upon completion of this exercise, the student will have:

- Reviewed the basic structure and function of the adrenal gland
- Reviewed the specific cell types in the adrenal gland and their function
- Understood the regulation of synthesis and secretion of the relevant hormones produced by the adrenal gland
- Understood the pathophysiology of adrenal insufficiency