

ADRENAL INSUFFICIENCY IN THE TRAUMA PATIENT

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Spring 2014



CASE STUDY

- ◉ 52-YEAR-OLD MALE ADMITTED TO Level I Trauma Center after suffering injuries in a MVC
- ◉ On presentation, Glasgow Coma Scale score is 3, blood pressure 106/70, and HR 122 bpm
- ◉ CT of head, cervical spine, chest, abdomen, & pelvis reveals bilateral adrenal injury, splenic laceration, lung contusion, rib fractures, and right-sided cerebral subarachnoid hemorrhage
- ◉ Trace amounts of cortisol in 24-hour urine collection
- ◉ Cosyntropin stimulation test shows adrenal insufficiency

INTRODUCTION

- Adrenal Insufficiency (AI) was first described by Thomas Addison in 1855
- AI is a disorder characterized by
 - Impaired adrenocortical function
 - Decreased production of glucocorticoids, mineralcorticoids and/or adrenal androgens
- AI is considered to be a life-threatening event, especially when associated with a serious event such as trauma
- Recognition and treatment of AI in the trauma patient tends to be a challenge for the clinical practitioner, even the most astute ones

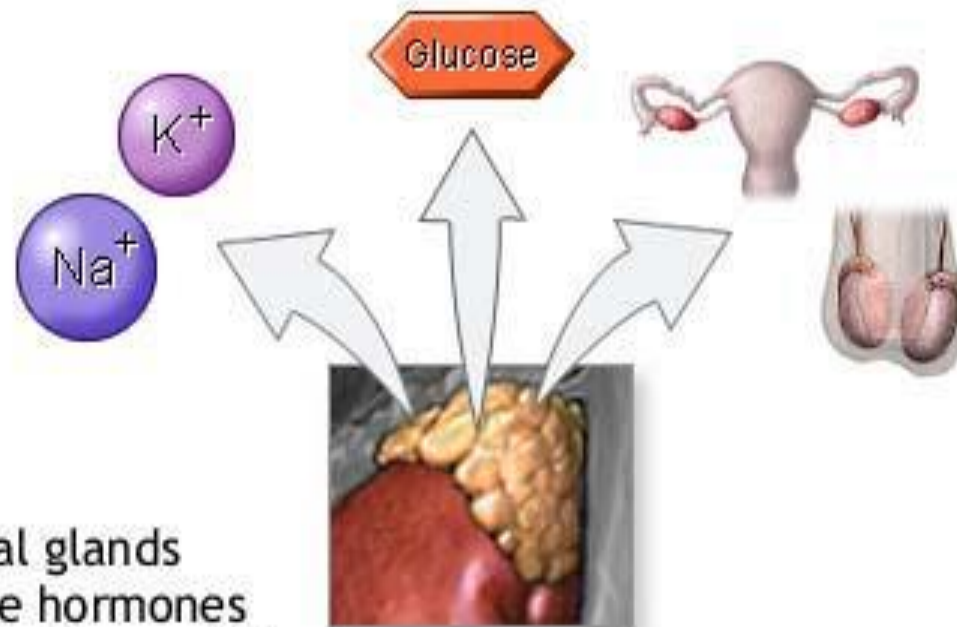
BACKGROUND

- Adrenal crisis and severe acute adrenocortical insufficiency are often elusive diagnoses that may result in severe morbidity and mortality when undiagnosed or ineffectively treated
- Although it is proposed that more than 50 steroids are produced within the adrenal cortex, cortisol and aldosterone are by far the most abundant and physiologically active

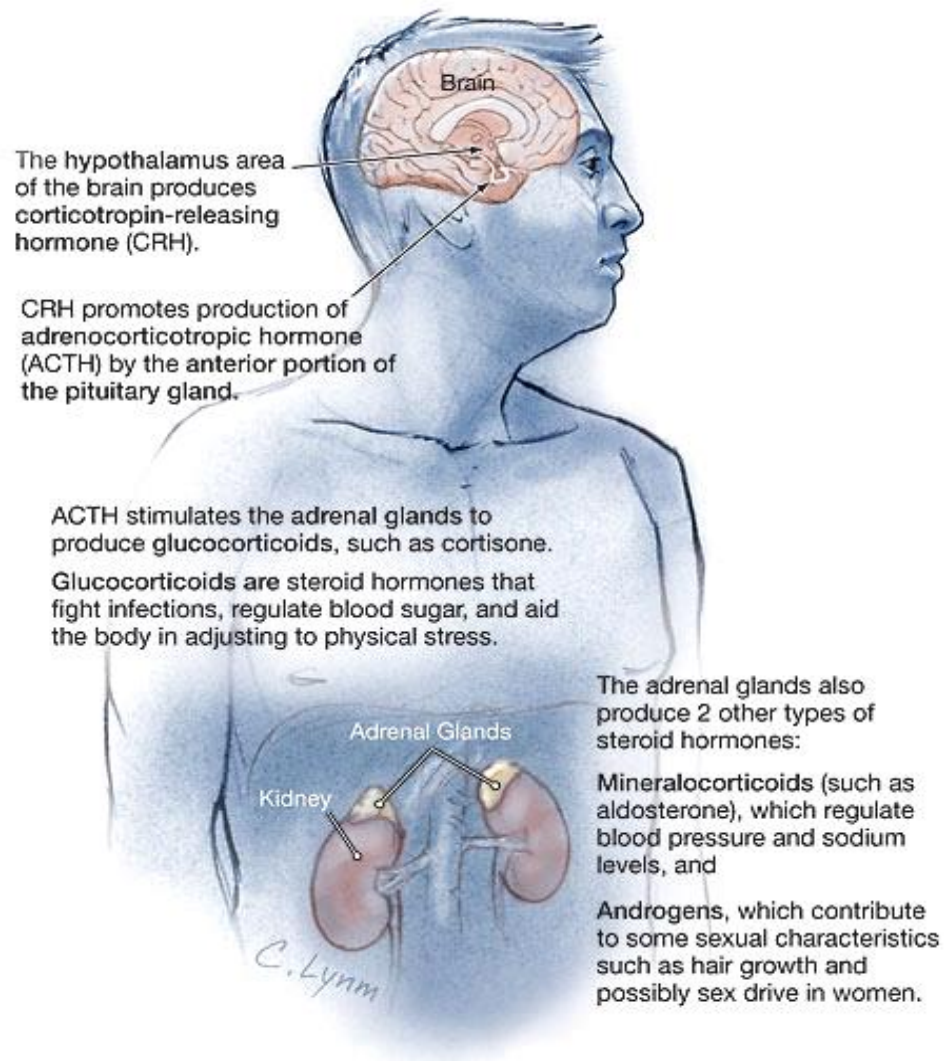
BACKGROUND, CONT'D

- ⦿ In the absence of corticosteroids in particular, hypotension, shock, and death may quickly occur
- ⦿ Many of the presenting signs and symptoms of acute AI are nonspecific making its diagnosis difficult
- ⦿ For instance, the development of a fever in the trauma patient may be mistakenly diagnosed and treated as an infection or SIRS when it may actually be subtle indicator of AI

QUICK REVIEW OF NORMAL ADRENAL PHYSIOLOGY



Adrenal glands secrete hormones which help regulate chemical balance, regulate metabolism and supplement other glands



PATHOPHYSIOLOGY OF ACUTE ADRENAL INSUFFICIENCY

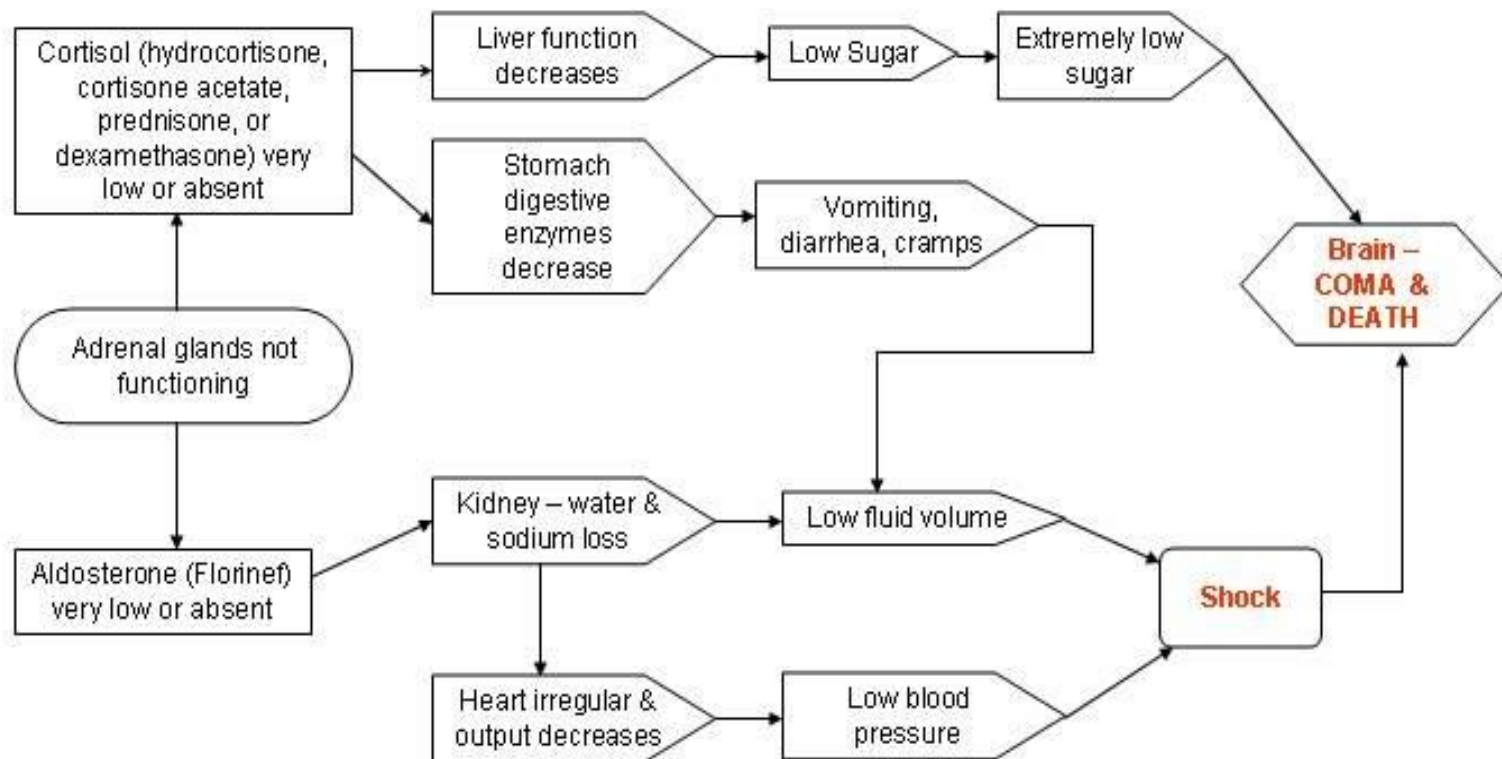
- ◉ Acute AI is associated with inadequate production or release of glucocorticoids (cortisol) and mineralocorticoids (aldosterone).
- ◉ Adrenocortical hormones are necessary for maintaining normal glucose, sodium, and fluid balance in the body.
- ◉ Aldosterone deficiency causes large urinary loss of sodium and water quickly leading to severe hyponatremia and hypovolemia.
- ◉ As result of hyponatremia, hyperkalemia and metabolic acidosis often occur.

PATHOPHYSIOLOGY OF ADRENAL CRISIS, CONT'D

- Hypovolemia is intensified by glucocorticoid deficiency as result of decreased vascular tone and decreased vascular response to circulating catecholamines (epinephrine & norepinephrine).
- Cortisol depletion quickly leads to hypoglycemia as body is unable to maintain blood glucose levels in the fasting state.
- Without treatment, severe hypotension, severe hypoglycemia, coma, and death will ensue.

Addison Crisis Pathway

This is from a unknown Nursing Encyclopedia



From this you can see how once a crisis begins, it begins to affect vital organs. The sooner you can use your injectable and receive IV fluids, the sooner you can halt the progress of the crisis.

BOTTOM LINE, ONE SICK DUDE

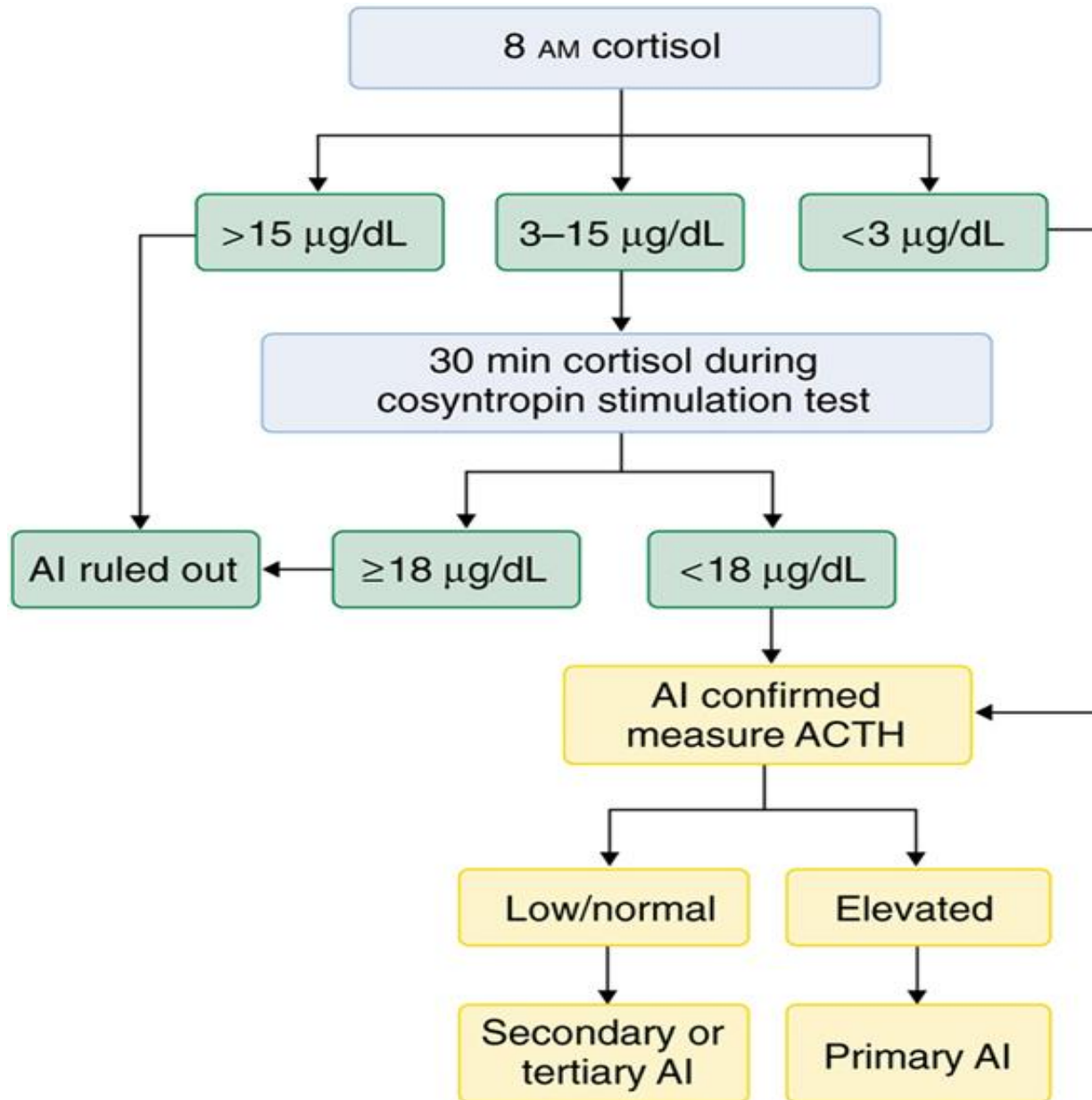


ADRENAL INSUFFICIENCY AND TRAUMA

- Acute AI is relatively RARE after trauma, but may produce life-threatening cardiovascular collapse, mimicking septic shock
- Offner, Moore and Ciesla (2002) found that although AI may not occur with moderate hypotension in the trauma patient, it does occur with severe hemorrhage
- These researchers theorized that since hepatocellular function is depressed following severe hemorrhage, perhaps the liver plays a role in the development of acute AI following trauma and severe hemorrhage

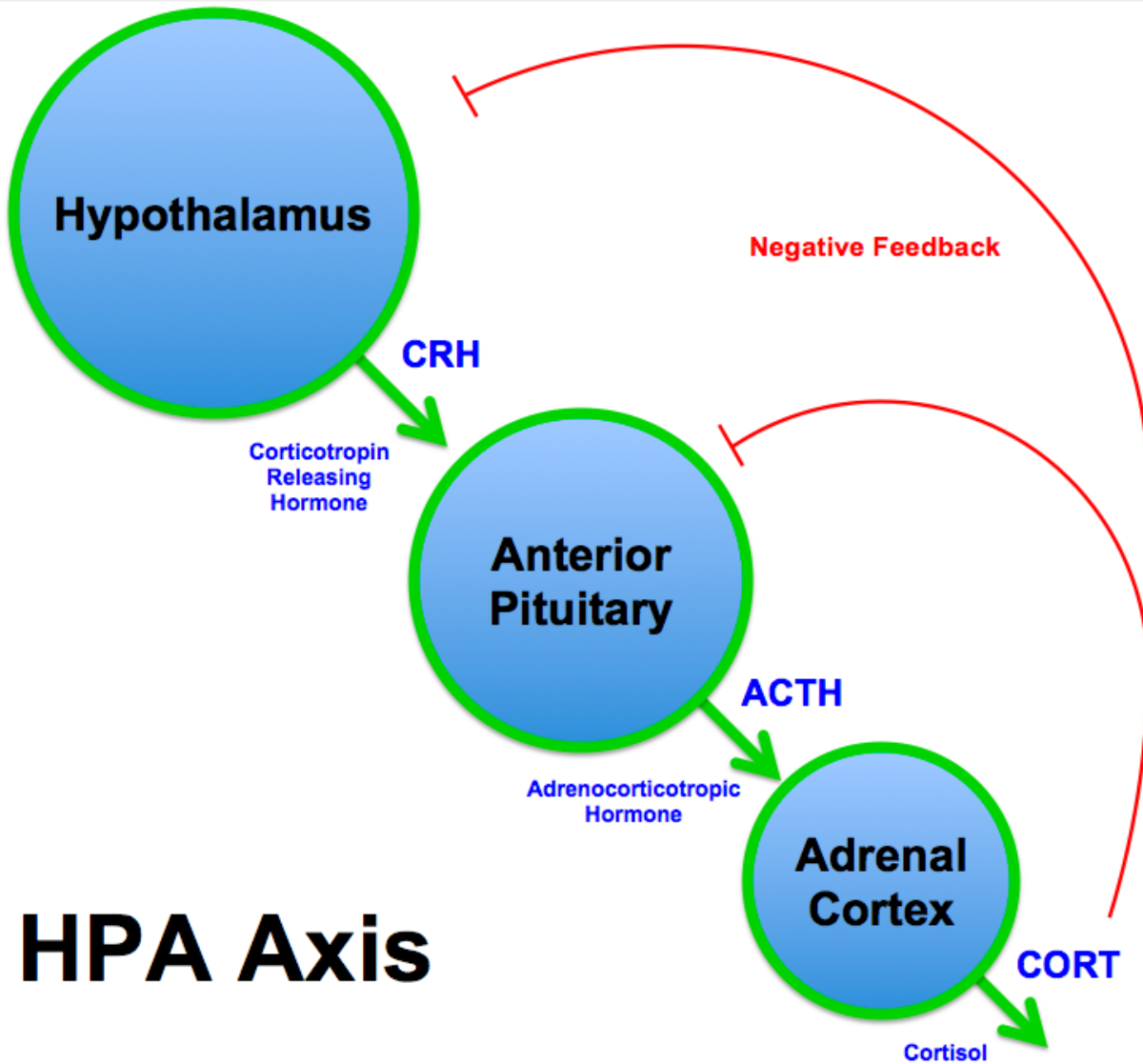
ADRENAL INSUFFICIENCY AND TRAUMA, CONT'D

- ◉ Cosyntropin stimulation testing can confirm the diagnosis of acute AI and has been found to be quite accurate in traumatized patients
- ◉ In a retrospective review study of 137 trauma patients who had undergone cosyntropin stimulation testing, Guillamondegui, et al. (2009) found that untreated adrenal insufficient patients had significantly higher mortality and longer hospital lengths of stay, intensive care unit days, and ventilator-free days



ACUTE AI AND TRAUMATIC BRAIN INJURY

- ◉ Acute AI seems to be especially prevalent in patients who have sustained traumatic brain injury
- ◉ It is proposed that the integrity of the hypothalamic-pituitary-adrenal axis is disrupted in traumatic brain injury leading to secondary adrenal insufficiency
- ◉ In a study of 80 traumatic brain injured (TBI) patients with moderate or severe brain injury (Glasgow Coma Scale score 3-13) and 41 trauma patients without traumatic brain injury, Cohan, et al. (2005) found that AI occurred in 42 of the TBI patients



HPA Axis

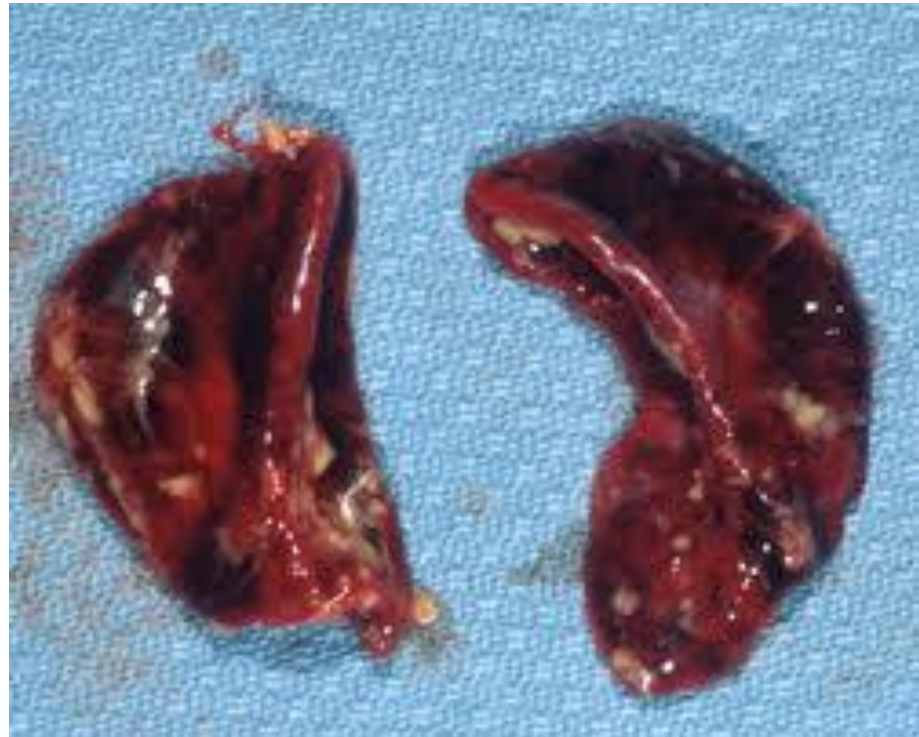
ACUTE AI AND TRAUMATIC BRAIN INJURY, CONT'D

- Younger age, greater injury severity, early ischemic insults, and the use of etomidate (short acting IV anesthetic agent) were all factors that Cohan, et al. found to be associated with AI in the TBI patient

ACUTE AI AND ADRENAL TRAUMA

- The most severe cases of AI in trauma patients are due to damage to the adrenal gland itself
- Adrenal hemorrhage or infarction associated with blunt abdominal trauma is uncommon, and thus, may not be suspected as a cause of hemodynamic instability in the trauma patient
- Without appropriate diagnosis and treatment, these patients generally develop major complications and die

GC1



ACUTE AI AND ADRENAL TRAUMA

- Currently, adrenal gland injuries are seen increasingly more frequently due to advances in modern imaging techniques
- Many patients with bilateral adrenal hemorrhage or injury regain adrenal function, and thus, may need life-long steroid therapy
- The good thing is that through modern imaging, these patients may now survive if their adrenal injuries are identified early!!

CLINICAL MANIFESTATIONS OF ACUTE ADRENAL INSUFFICIENCY

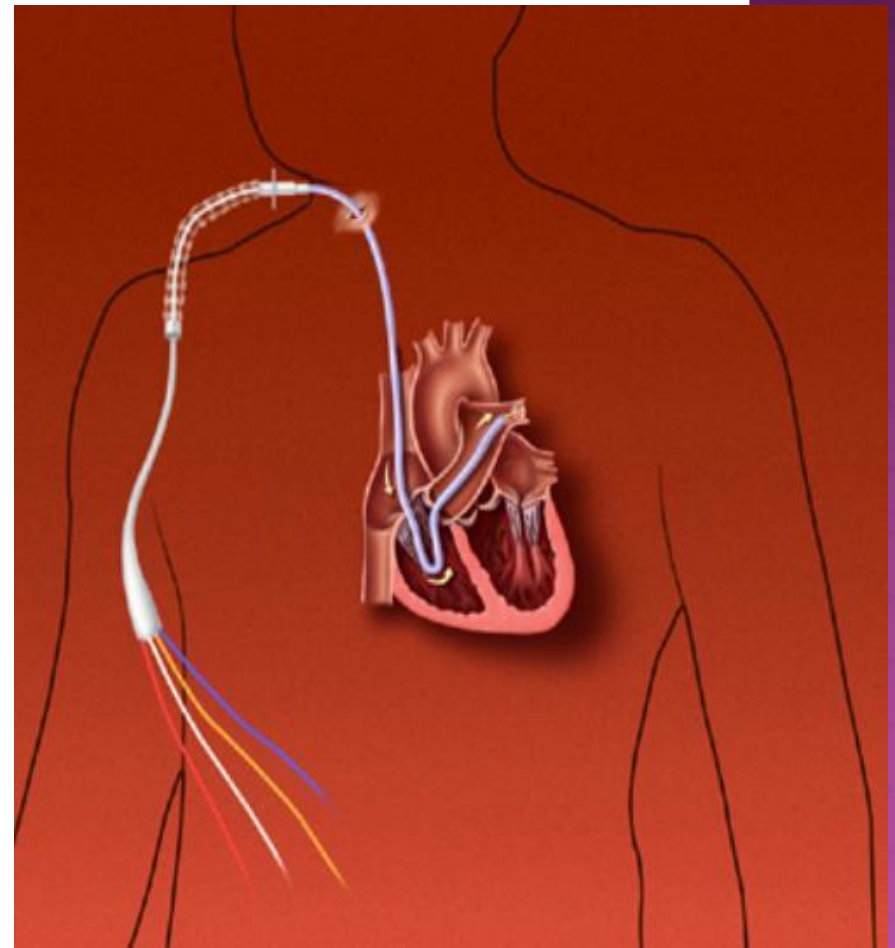
- ◉ Profound hypotension (especially postural)
- ◉ Confusion
- ◉ Muscle weakness
- ◉ Fatigue, lethargy
- ◉ Tachycardia
- ◉ Decreased urinary output
- ◉ Nausea, vomiting, diarrhea
- ◉ Abdominal pain
- ◉ Severe weight loss
- ◉ Possible hyperthermia

DIAGNOSTIC FINDINGS RELATED TO AI

- ⦿ **Laboratory:** hyponatremia (<137 mEq/L), hyperkalemia (>5 mEq/L), decreased serum glucose (<80 mg/L), decreased serum cortisol (<15 mcg/dl) & aldosterone levels, possible hypercalcemia
- ⦿ **ECG:** signs of hyperkalemia (peaked T waves, widened QRS, lengthened PR interval, flattened or absent p waves, possible asystole)

DIAGNOSTIC FINDINGS RELATED TO ACUTE AI

- **Hemodynamic:**
Decreased BP, CVP and PAWP;
Increased heart rate; Consult physician for BP <90/60, CVP <2 mm Hg, PAWP <6 mm Hg, HR >120 bpm



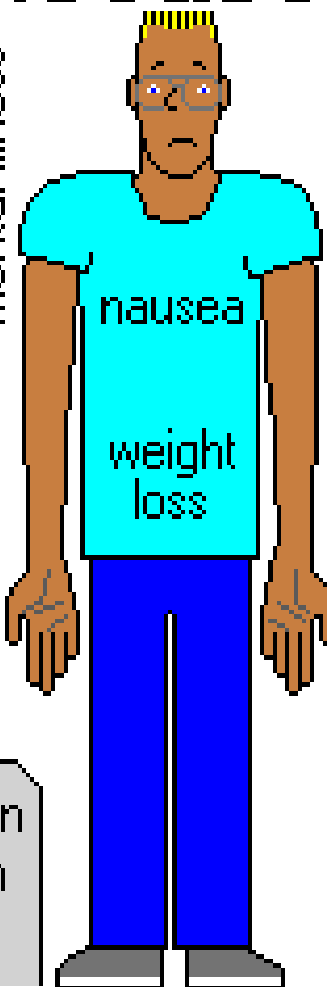
ACTH STIMULATION TEST

Addison's Disease

Easy to diagnose and treat -- if you think of it.

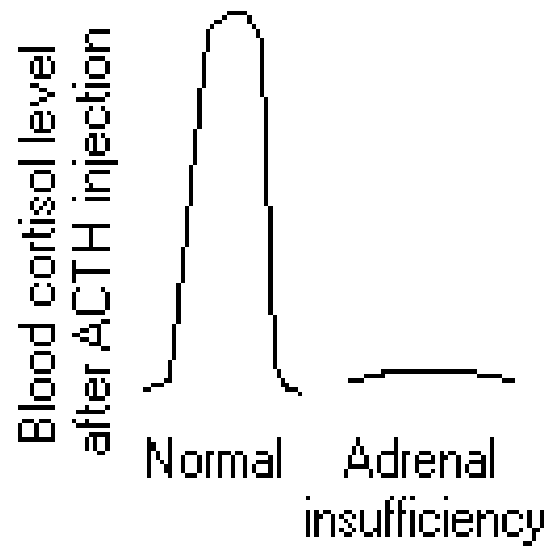


hyperpigmentation
"mental illness"
weakness



sudden death

ACTH stimulation test



Repeat: Improvement suggests pituitary disease ("secondary Addison's"); no improvement indicates primary adrenal disease.

BACK TO OUR CASE STUDY

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COLLABORATIVE TREATMENT OF ACUTE AI

- **Expected Outcomes (within 8 hours of initiating treatment):**
 - BP within patient's normal range
 - HR 60-100 bpm
 - CVP 2-6 mm Hg
 - PAWP 6-12 mm Hg
 - Normal sinus rhythm on ECG
 - Patient alert and oriented
 - *** UO may not return to normal for a few days

COLLABORATIVE TREATMENT OF ACUTE AI, CONT'D

- ⊙ **Identification and Treatment of Initial Cause**
- ⊙ **Fluid Replacement**
 - Rapid volume restoration is goal
 - D5NS is IV fluid of choice
 - Volume expanders (hetastarch) possible if hypotension persists

COLLABORATIVE TREATMENT OF ACUTE AI, CONT'D

◉ **Glucocorticoid Replacement**

- Immediate IV bolus of Hydrocortisone (Solu-Cortef), followed by maintenance doses every 6 to 8 hours

◉ **Mineralocorticoid Replacement:**

- Generally unnecessary b/o mineralocorticoid effects of hydrocortisone
- If emergency treatment needed, fludrocortisone is drug of choice

COLLABORATIVE TREATMENT OF ADRENAL CRISIS, CONT'D

⊙ **Glucose Replacement**

- Generally sufficient with IV fluids, but patient may need Dextrose 50% initially

⊙ **Sodium Replacement**

- Generally sufficient with IV fluids, but patient may need NaHCO₃ initially
- Correction of sodium imbalance will shift K⁺ back into normal balance

COLLABORATIVE TREATMENT OF ADRENAL CRISIS, CONT'D

⦿ **Vasopressors**

- May be used if initial treatments are ineffective
- Response to vasopressors, catecholamines, and inotropic agents is DECREASED for patients in adrenal crisis

COLLABORATIVE TREATMENT OF ACUTE AI, CONT'D

- ◉ **Close monitoring of vital signs, PAP readings, lab results, cardiac rhythm, I&O, & neuro status**
- ◉ **Oral & skin care**
- ◉ **Promote rest**

ADRENAL INSUFFICIENCY IN THE TRAUMA PATIENT

- Questions????
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