

(Assessment/Communication/Problem-Solving/Teaching-Learning)

CRITICAL THINKING EXERCISE: (Adrenal Insufficiency/ADDISON'S DISEASE)

Let's Talk About Normal Function and Pathophysiology of Addisons before getting to the Critical Thinking Scenario

First---hopefully, by knowing "normal", it will help you to understand the effects of hyper and hypo function of the adrenal gland

NORMAL Adrenal Function—refer to syllabus for hormones & there function

Adrenal Medulla—center portion

- Secretes catecholamines

Epinephrine (Adrenalin) —both an alpha and beta adrenergic stimulator	Norepinephrine —a more potent alpha adrenergic stimulator (little bit of beta 1)
<ul style="list-style-type: none">• ↑ HR dramatically ↑BMR ↑ contractility• dilated pupils• ↓ peristalsis• dilated bronchioles• vasodilated skeletal muscle• vasoconstricted skin/viscera• ↑use of fat for energy• ↑conversion of glycogen → glucose	<ul style="list-style-type: none">• vasoconstriction of blood vessels• ↑ B/P• ↑ HR moderately• Brain arousal

- Functions as part of ANS (sympathetic branch)
 - Fight or flight or exercise

NOTE: under secretion of the adrenal medulla doesn't really cause health problems because the sympathetic nervous system takes over

Adrenal Cortex—outer portion (refer to Hormone Function Sheet in Syllabus)

- Secretes corticosteroids
 1. Glucocorticoids (hydrocortisone—prototype) (cortisol)
 2. Mineral corticoids—aldosterone
 3. Sex hormones (androgen & estrogen)—mainly androgens-male sex hormone
- 1. Glucocorticoids

- Secreted in response to ACTH secreted from ant. pituitary (↑ACTH ↓ cortisol in primary adrenal disease)
 - Cortisol plays an important role in
 - directing the metabolism of carbs., proteins, and fats
 - raises blood glucose by stimulating gluconeogenesis (gluconeogenesis--this process maintains normal blood glucose levels during fasting)
 - maintains B/P by affecting vascular tone and supporting myocardial contractility (this is the only mineral-corticoid property of the glucocorticoid, hydrocortisone)
 - responses to stress (greatly rises with any stressor) (surgery, illness, trauma)
 - suppresses inflammation and immune response; inhibits scar tissue formation
 - patient will show signs of weight gain
2. Mineralocorticoid (aldosterone)
- Promotes Na and H₂O reabsorption and K excretion (aldosterone)
 - Addison's disease results in a low production and secretion of aldosterone thus contributing to hyperkalemia
 - When there is a decrease in extracellular fluid volume (bld. Loss, sodium loss, change in posture) then Renin is released
 - Angiotensin I increases when renin is released from the kidney in response to low BP
 - Angiotensin I converts to Angiotensin II which stimulates the secretion of aldosterone
 - Angiotensin elevates BP by constricting arterioles
 - Increased aldosterone causes increased sodium reabsorption by kidneys and GI restoring BP
 - Minimal influence from ACTH
 - A shortage of aldosterone (main mineralocorticoid) causes hypovolemia---pt. may crave/consume large amounts of table salt
 - Too much mineralcorticoid will cause the patient to show signs of pitting edema and weight gain due to sodium and water retention
3. Adrenal Sex Hormones (androgens and little to some estrogen)
- Stimulated by ACTH
 - Needed to stimulate protein anabolism
 - Not as important in men because of testosterone
 - Contributes to libido (sex drive) in women

Pathophysiology of Adrenal Insufficiency:

BECAUSE OF:

1. Insufficient secretion of ACTH (**secondary** adrenocortical insufficiency)
 - In secondary disease, usually glucocorticoid and androgens are deficient but, mineralocorticoids are unaffected

- ↓ cortisol and ↓ ACTH levels
- 2. Insufficient secretion of ACTH and adrenal atrophy resulting from suppression of hypothalamus/pituitary
 - Due to abrupt stopping of long term steroid use (**iatrogenic** adrenal insufficiency); pituitary tumors or radiation
- 3. Destruction of the adrenal cortex itself (**primary** adrenocortical insufficiency)-- ACTH is elevated because there is problems with the feedback mechanism
 - Also known as Addison's disease---- ↑ ACTH ↓ cortisol levels
 - caused by: metastasis, infection adrenal gland, surgical removal of the adrenal glands; autoimmune disease, AIDs, TB
 - life-threatening because of deficiency in all 3 corticosteroids (glucocorticoids, mineralocorticoids, and androgens)

Now for the Critical Thinking Scenario.....

1. Give Rationale for the Physician Orders

- **IV of NS---2000cc wide open, then hang D5NS at 200cc/hour X 24 hours or until further orders**
 - Monitor for signs of addisonian crisis
 - Goal is to combat shock; Volume Replacement to achieve normovolemia
 - note sodium is ↓ and NS was first ordered because it is an isotonic solution---isotonic solutions are good for hypovolemia/hypotension because they don't alter serum osmolality (watch breathsound changes)--reassess skin turgor/ I&O/ mucous membranes) then D5NS ordered (still maintain circulating volume and prevent edema; does contain some dextrose which will help w/ low BS)
- **Florinef 0.1 mg PO Daily**
 - A supplemental mineralocorticoid---(over treatment can cause hypertension, pitting edema and weight gain)
 - Have the patient monitor for this at home
 - Better to take this med in the evening
 - may need to ask MD for IV route or insertion of a NGT if pt. is too lethargic to take---discuss w/ MD---or the MD may hold the pill form and wait to give when more stable after fluid volume replacement and Mr. Roberts is more alert
 - mineralocorticoid stimulate renin-angiotensin system
 - increases sodium and water retention in the distal tubules
 - In Mr. Robert's case, his Na is ↓ and B/P ↓ so Florinef will help to increase both
 - causes potassium excretion (refer to Mr. R's high K level)
- **Solucortef 250mg IVPB Q12hrs (the alternative order could have been--- Hydrocortisone 100mg IV now and 30 mg daily ---another alternative**

- order could have been Prednisone 10mg daily or 8mg at 0800 and 2mg at 1600)**
- a supplemental glucocorticoid (cortisol support)—hydrocortisone also has mineralcorticoid properties
 - refer to diurnal cycle
 - Secretion of cortisol shows a “diurnal”(daily) cycle or circadian rhythm related to sleep/wake and dark/light patterns. Secretion rate of cortisol is:
 - highest in the AM (reflects daily physiologic demands)
 - lowest in the PM
 - THEREFORE, this is why the higher dose of steroid would be given in the AM and the lower dose given in the PM--to mimic the circadian rhythm or diurnal cycle
 - **FYI:** circadian rhythm could be the opposite if:
 - the person worked nights, then the afternoon would be when the cortisol level is the highest and therefore the best time to do a cortisol level (let the MD know pt sleep pattern if this is an issue)
 - **40% aerosol mask with continuous oximetry**
 - Maintain oxygen sat. > 92 %---requires cont. oxymetry due to low oxygenation; his respiratory rate is only 12/min probably shallow, and difficulty to arouse therefore a mask is appropriate delivery of oxygen--if sats. ↑ and Mr. R more awake, might be able to change to a cannula--discuss w/ MD
 - **Monitor V/S every 1-2 hours---notify MD if SBP < 80 and Pulse > 140**
 - needs to be monitored closely due to flurinef (minercorticoid replacement) and cortisol replacement that is started and the amount of fluid that is being given
 - Mr. R is at risk for circulatory collapse/shock (Addisonian Crisis)
 - Cardiovascular collapse could occur
 - Monitor vital signs for shock
 - **HOB flat with legs elevated**
 - due to orthostatic BP changes and shock
 - facilitate venous return
 - **Cortisol levels at 0800 and 1600**
 - Cortisol plays an important role in
 - Secretion of cortisol shows a “diurnal”(daily) cycle or circadian rhythm related to sleep/wake and dark/light patterns
 - Regulated by the hypothalamus but independent of stress
 - Could be reversed if person works nights or sleep deprived
 - Secretion rate is

- highest in the AM (reflects daily physiologic demands)
- lowest in the PM
- Therefore, at least 2 blood samples are needed to check diurnal variation (i.e. 8 AM and 4PM)
- Since cortisol levels are subject to change with stress/stressors--help the patient stay calm and relaxed

Glucoscans/Accucheck Q4hrs--call if < 50 or > 150

- in hypofunction of the adrenals, the body is unable to maintain normal glucose levels due to low cortisol levels (review normal function of the adrenal gland)—hypoglycemia occurs
- blood sugars will change with steroid therapy and therefore need to be monitored closely for hyper and hypoglycemia state

**Signs and Symptoms of Addison's disease: (Mr. Robert's S/S are highlighted in yellow)
NOT IN YOUR SCENARIO**

<ul style="list-style-type: none"> • Anorexia • Weight loss • Fatigue (common) increasing lethargy leading to hypoventilation (O2 Sat 89%) • Hypotension • Volume depletion due to water excretion ("frequent urination") • Hyponatremia • Hyperkalemia • Hypoglycemia 	<ul style="list-style-type: none"> • ↓ Resistance to stress • ↓ Cortisol level • Hyperpigmentation of skin (bronze color)—seen in primary cases due to ↑ ACTH and ↑ MSH (melanocyte stimulating hormone)
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2. Identify Nursing Diagnosis and Interventions for Mr. R.

Fluid Volume Deficit R/T hyperthermia and vasodilation, hypovolemia

- restore fluid balance
- V/S Q1-2hrs
- assess breathsounds at least q2hrs
- restore glucocorticoid and mineralocorticoid deficiencies by timely medication administration (replacement therapy)
- monitor orthostatic B/P changes--could mean volume depleted
- dietary intake to restore electrolyte imbalance
 - bouillon, juices when able to eat/drink; otherwise IV w/ electrolytes
- vasopressors (i.e. dopamine) if steroid and fluid therapy unsuccessful

Altered Cerebral and Renal Perfusion R/T hypovolemia

- administer fluids to increase perfusion
- monitor LOC every 2-4 hrs—report any changes---might need to discuss w/ MD the need to change oral medications to IV form if unable to take PO due to ↑ lethargy
- monitor u/o q shift—notify MD if <240cc/8hr shift = 30cc/hr---indicative of low perfusion

Activity Intolerance R/T weakness and hypotension

- Allow rest periods
- Mr. R will feel stronger after steroids started
- Plan care accordingly
- Plan activities that DON'T cause stress
 - Help Mr Roberts identify stressors

At risk for Sleep Pattern Disturbance R/T steroid therapy

- Give steroids earlier in the evening

Body Image Changes R/T skin hyperpigmentation, and diagnosis of chronic illness; Knowledge Deficit

- Wear medic alert bracelet
- Carry an emergency kit containing injectable hydrocortisone
- Teach Mr. Roberts that when he experiences increased stress or in a stressful situation (emotional, dental, minor surgery, infection) they the MD may need to ↑ the dosage of Mr. R's glucocorticoid

High Risk for Infection R/T immunocompromised state and steroid therapy

- Avoid people with infections
- May be reverse isolation if really immunocompromised
 - Private room
 - Universal precautions
- Report ANY signs of infection (which could trigger an adrenal crisis)—FYI: cortisol levels need to be higher during infection
 - I.e. sore throat, burning upon urination

High Risk for Injury R/T electrolyte imbalance

- Monitor pertinent labs (refer to assessment)
- Give IVF and steroids as ordered

3. Develop a teaching plan that explains signs of (1) excessive amount of hormone in the body and (2) insufficient hormone replacement

Excessive Hormone Replacement

- glucocorticoids are divided into 2 different doses---2/3 in AM and 1/3 in PM to mimic the diurnal cycle

- OR--glucocorticoids are given in the early AM when the gland is most active--
-by using this regime, you can minimize the side effects of Cushingoid in the
afternoon when the gland is least active, in the afternoon, the serum cortisol
levels are lower
- hyperirritability, insomnia, HTN, are signs of excessive glucocorticoid
replacement
- with the mineralocorticoid---excessive use would lead to HTN, CHF, fluid
retention, weight gain, edema and changes in sodium/potassium levels
- watch for signs and symptoms of long term steroid therapy—review your book
(S/S of Cushing's is the same as long term steroid use)
 - Double edged sword—the pt. needs the steroids but the side effects are
terrible

1. Metabolic Effects

- clinical S/S of Cushing's syndrome
- Stomach/duodenal/peptic ulcers---due to ↑ secretion of acids and ↓
resistance to acids----needs antacids to be administered with or
with food
- Diabetes Mellitus---because of changes in metabolism of
carbs/proteins/fats---may need oral anti-hyperglycemic or insulin
coverage
- Steroids have a potassium wasting effect—therefore watch the K+
levels (especially if pt is on K+ depleting diuretics)
- ↓ resistance to
 - infections could spread with minimal symptoms because of
suppression of the immune system and inflammatory
process
 - in viral and fungal infections, don't use steroids
- osteoporosis
- Hypertension

2. Endocrine Effects

- adrenal atrophy → suppression of pituitary release of ACTH
 - halted growth in children
- adrenal insufficiency during times of unusual stress
ie. Pt. may need to call MD when under unusual stress to see if
MD wants to ↑ the steroid dosage for a short time—OR, may
need to change from P.O. to I.M./I.V. steroids if vomiting

3. CNS effects

- euphoria and mood swings
 - excitement, depression, restlessness, sleeplessness
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- **TEACH** if the MD wants to decrease the drug for any reason, TAPER THE
MED to allow for some normal adrenal function to occur

Insufficient Hormone Replacement

- Patient will exhibit continued signs of adrenal insufficiency and will need to see MD for blood levels and probable increase in steroid need
- **TEACH** to call MD if sick and unable to take steroids--they will go into an adrenal insufficiency

4. Why is Addisonian Crisis (adrenal crisis) a medical emergency?

- Usually due to an abrupt stopping of glucocorticoids
- Because of the added stress, any crisis can throw the pt into a crisis
- Usually you see that the pt is under tremendous stress without the appropriate amounts of hormone (steroid replacement)
- Pt shows signs of cardiovascular collapse!, shock, volume depletion, loss of consciousness, major electrolyte imbalances