Response to Stress

Page 1. Introduction
- When there is an overwhelming threat to the body the nervous and endocrine systems produce a well-coordinated, generalized response designed to ensure the health of the individual.

Page 2. Goals/ What You Need to Know
Goals
- To understand stress in terms of endocrine function.
- To learn how the nervous system directs a generalized nonspecific response to stress.
- To review epinephrine.
- To review cortisol.

What You Need to Know
- The neural input to the hypothalamus.
- The relationship between the hypothalamus and the autonomic nervous system.
- The anatomy and function of the hypothalamic-pituitary axis.

Page 3. Stress Response
- Stressful situations put the body at risk and the body responds:
  - In individual ways to maintain homeostasis.
  - With a coordinated generalized nonspecific response called the stress response.
- Increased levels of epinephrine, norepinephrine, and cortisol are indicators that the body is under stress.
- Stressors are any stimuli that put the body at risk and stimulate the release of the stress response hormones.
- Stressors include:
  - Prolonged exposures to temperature extremes
  - Heavy exercise
  - Fright
  - Surgery
  - Emotional Stress (happy or unhappy)

**Now is a good time to go to the quiz question #1.**
- Click the quiz button on the left side of the screen.
- Click on the scrolling page list at the top of the screen and complete question 1.
- When you are finished you can click the return from link button on the left side of the screen to return to the topic.

Page 4. Hypothalamus and Stress Response
- The hypothalamus directs the body’s stress response.
- The nervous system sends input about stressful conditions to the hypothalamus which then engages both the nervous and endocrine systems in the stress response.
- **Fight or Flight response.**

  - The hypothalamus stimulates the sympathetic portion of the ANS and the endocrine system via the adrenal glands during the fight-or-flight response.

  ![Diagram](image)

- **Sympathetic responses include:**
  - Increases in cardiac output
  - Increases in ventilation
  - Changes in blood pressure
  - Redirection of blood flow to skeletal muscle and peripheral blood vessels
  - Increases in sweating

- **Epinephrine responses include:**
  - Enhancing the sympathetic responses outlined above
  - Mobilizes carbohydrate stores by synthesizing new glucose and breaking down fats

- **Prolonged Response**
  - Occurs at least 30 minutes after exposure to stressors.
  - Cortisol secretion by the adrenal cortex increases in the following pattern:
    - CRH → ACTH → Cortisol
  - Effects of cortisol include:
    - Mobilization of energy by breaking down glycogen, fats, and through the synthesis of new glucose by the liver.
    - Release of amino acids by skeletal muscle which can be used to repair damaged tissues.
    - Vasoconstriction of vessels such as those of the digestive organs.
    - Inhibition of inflammation and the immune response.

- **Additional Hormones**
  - ADH – helps maintain vasoconstriction and therefore blood pressure.
  - Aldosterone – helps to maintain blood pressure and blood volume during the stress response.
Page 5. Epinephrine Review
- Be sure to view all the steps in the animations on this page and make notes in the spaces provided below.
- All of these concepts have been covered in other topics.

- Secretion
- Transport
- Cellular Mechanism of Action
- Synthesis
- Functions
- Breakdown

Page 6. Epinephrine: HyPOSEcretion vs. Hypersecretion
- HyPOsecretion
  - There are no known pathologies associated with hyPOsecretion of the adrenal medulla.
  - This may be due in part to the fact that sympathetic nervous system can replace activities of the adrenal catecholamines.

- Hypersecretion
In rare cases a tumor called a pheochromacytoma secretes large amounts of catecholamines and is not under the control of the sympathetic nervous system.

Symptoms of hypersecretion include:
- High BP
- Palpitations
- Rapid heart rate
- Excessive sweating
- High Blood Glucose

This rare condition is usually treated with surgery and normal adrenal medulla function resumes.

**Page 7. Cortisol Review**

- Be sure to view all the steps in the animations on this page and make notes in the spaces provided below.
- All of these concepts have been covered in other topics.

- Secretion
- Transport
- Cellular Mechanism of Action
- Synthesis
- Functions
- Breakdown
**Now is a good time to go to the quiz questions #2-4**
- Click the quiz button on the left side of the screen
- Click on the scrolling page list at the top of the screen and complete questions 2-4.
- When you are finished you can click the return from link button on the left side of the screen to return to the topic.

**Page 8. Cortisol: Hypersecretion vs. Hyposecretion**
- Problems in the adrenal cortex can arise from primary sources (those in which the adrenal gland fails) and secondary sources (problems arising from the anterior pituitary or hypothalamus).
- **Hypersecretion.**
  - Cushing’s disease – often caused by a pituitary tumor.
  - Cushing’s syndrome – caused by over administration of glucocorticoids drugs.
  - Signs and symptoms include:
    - Moon-shaped face and ‘buffalo hump’ on back due to redistribution of fat
    - Hyperglycemia – sometimes leading to diabetes mellitus
    - High BP
    - Spindly limbs, easy bruising and poor healing
    - Overly susceptible to infections
- **Hyposecretion.**
  - Addison’s disease – caused by destruction of adrenal gland or pituitary damage.
  - Signs and Symptoms include:
    - Bronzed skin
    - Hypoglycemia
    - Low BP
    - Decreased levels of NA+, dehydrations, salt cravings - due to lack of aldosterone
- **Treatment.**
  - Cushing’s:
    - Removal of tumor.
    - Readjustment of drug dosages.
  - Addison’s:
    - Replacement of cortisol and aldosterone.

**Page 9. Summary**
- The stress response is mediated at first by the sympathetic nervous system and epinephrine and later by cortisol.
- The stress response protects the body from harm and ensures survival.
- All about epinephrine and cortisol, and the causes and consequences of hypo- and hypersecretion of each.
Notes on Quiz Questions

Quiz Question #1: Stress Response
- This question requires you to choose all the aspects of the stress response.
- There are several correct responses, not just one.

Quiz Question #2: Rapid vs. Prolonged Response
- This question requires you to place the correct hormones and descriptions into the proper categories.
- Be sure to do the pages that review epinephrine and cortisol before doing this question.

Quiz Question #3: Cortisol and Negative Feedback
- You must choose the symptoms associated with the stress response.
- In the second part you must choose all the hormones associated with the stress response.

Quiz Question #4: Stress and Stress Hormones
- This question leads you through a series of questions that review the functions of the stress response and the stress hormones.

Study Questions on the Stress Response

1. True or False: The stress response involves only the endocrine system.

2. List the five stressors that were introduced on this page.
   1.
   2.
   3.
   4.
   5.

3. Below is a list of responses to stressful stimuli. Next to each item mark whether it is part of the rapid response (R) or the prolonged response (P), or both (B).
   - increased cardiac output
   - release of amino acids by skeletal muscle
   - gluconeogenesis in the liver
   - increases in blood pressure
   - inhibition of the immune response
   - increased ventilation
   - the ‘fight or flight’ response

4. What is the main stimulus for secretion of adrenal medulla hormones?

5. How do ADH and aldosterone aid in the stress response?

6. How is epinephrine transported in the blood?

7. What is the unique feature of epinephrine synthesis that allows it to enter the circulation so quickly?

8. True or false: There are many more pathologies associated with hyosecretion of
epinephrine than there are for hypersecretion.

9. (Page 6.) List the symptoms of hypersecretion or epinephrine as outlined on this page.
   a.
   b.
   c.
   d.
   e.

10. (Page 6.) Although rare, one of the more common causes for hypersecretion of the adrenal medulla is a _________________.

11. (Page 7.) True or false: Cortisol is synthesized on an ‘as needed’ basis.

12. (Page 7.) How is cortisol transported through the blood, what effects does this have on its half-life?

13. (Page 7.) Where are cortisol receptors found in cells?

14. (Page 8.) What is the difference between Cushing’s disease and Cushing’s syndrome?

15. (Page 8.) Below is a list of symptoms, beside each symptom indicate whether it is related to hypo- or hypersecretion of adrenal cortex hormones.
   _____ Redistribution of body fat to places like the face and back of neck
   _____ Elevated BP
   _____ Bronzed skin
   _____ Overly susceptible to infections
   _____ Salt cravings due to hyponatremia
   _____ Hypoglycemia
   _____ Inhibition of the inflammatory response

16. (Page 8.) What are two of the major causes of Addison’s disease?

17. (Page 8.) Is adrenal hypossecretion caused by a tumor of the anterior pituitary classified as a primary or secondary source for Addison’s disease?