CHAPTER 26

Stress and Associated Problems

CHAPTER OUTLINE

Review of the Stress Response
Stress and Disease
  Potential Effects of Prolonged or Severe Stress
Coping with Stress
Case Study
Chapter Summary
Study Questions
Additional Resources

LEARNING OBJECTIVES

After studying this chapter, the student is expected to:

1. Describe the stress response.
2. Explain how the stress response is related to diseases.
3. Describe how severe stress may lead to acute renal failure, stress ulcers, or infection.
4. Suggest positive coping strategies.

KEY TERMS

bronchodilation
endorphins
homeostasis
lipolysis
maladaptive
physiologic

Review of the Stress Response

The stress response is a generalized or systemic response to a change (stressor), internal or external, and may be modified in specific situations. The role of stress in disease became more firmly established in the 20th century, when Hans Selye, in 1946, defined his *general adaptation syndrome* (GAS), or "fight or flight" concept. His work revealed that the body constantly responds to minor changes in its needs or environment, such as altered food intake or activity level, and thus maintains **homeostasis**. The body has built-in mechanisms that quickly compensate for **physiologic** changes in fluid balance or blood pressure. Minor fluctuations in body functions are normal.

A *stressor* is any factor that creates a significant change in the body or environment. It may be physical or psychological or a combination of the two. A stressor may be a real or anticipated factor, or it may be a short-term or long-term factor. Possible stressors include pain, exposure to cold temperatures, trauma, anxiety or fear, a new job, infection, or indeed, even a joyous occasion. *Stress* is considered to occur when an individual's status is altered by his or her reaction to a stressor. The stress response is the generic but complex response made by the body to any stressor. The body's physiologic response to different types of stressors is the same, although the response may vary in intensity and effects in a given situation or person. An additional, specific response may occur with certain stressors; for example, infection may initiate a fever.

Each person may *perceive* stressors differently. A certain stressor for one individual may be mildly exciting or stimulating, but for someone else the same stressor may be deeply depressing. It may even cause illness in another person. If the individual can cope with the stressor, the body returns to its normal status, but if the person cannot adapt, harmful effects may result from the stress. This may be termed "distress."

Stressors are a normal component of life and can be a positive influence on the body when appropriate coping mechanisms function well. Stressors may stimulate growth and development in many ways. Without any changes or stressors in life, a person would merely exist in a dull, inert, unresponsive form. But if a stressor is extremely severe or is perceived as a very negative influence, or when multiple factors effect change at one time, the body's adaptive mechanisms may not suffice. Then the body systems become more disrupted, **maladaptive** or inappropriate behavior can occur, and

homeostasis is not possible for that person. Factors such as aging or pathologic disorders may interfere with an individual's ability to respond adequately to a stressor. A vicious cycle may develop when the original stressor remains, and the effects of this stressor prevent the body from coping with new stressors. In some cases, more damage results, adding to the stress and lessening the person's coping capabilities even further, thereby decreasing the probability of a return to normal status. In the same way, maladaptive behaviors such as ignoring the stressor or eating unwisely are likely to add additional problems without removing the original stressful factor.

THINK ABOUT 26-1

a. Give examples of non-physical stressors that can result in physiological responses.
b. Describe several coping mechanisms that can be used in dealing with physical stressors.
c. Describe several coping mechanisms that can be used in dealing with psychological stressors.

Selye originally defined three stages in the stress response (GAS). In the alarm stage, the body's defenses are mobilized by activation of the hypothalamus, sympathetic nervous system, and adrenal glands. In the second, or resistance stage, hormonal levels are elevated, and essential body systems operate at peak performance. The final stage, or stage of exhaustion, occurs when the body is unable to respond further or is damaged by the increased demands. Extensive research into various aspects of stress has followed Selye's work. It has been found that the stress response involves an integrated series of actions, including the hypothalamus and the pituitary gland, the sympathetic nervous system, the adrenal medulla, and the adrenal cortex. The locus ceruleus, a collection of norepinephrine-secreting cells in the brain stem, provides the rapid response in the nervous system. Any type of stressor immediately initiates a marked increase in ACTH secretion followed by a great increase in cortisol secretion. The major actions are summarized in Figure 26-1.

Significant effects of the stress response include:

- Elevated blood pressure and increased heart rate
- **Bronchodilation** and increased ventilation
- Increased blood glucose levels (resulting from glycogenolysis and gluconeogenesis in the liver and protein catabolism in muscle as well as **lipolysis**)
- Arousal of the central nervous system
- Decreased inflammatory and immune responses (cortisol reduces the early and later stages)

These activities increase the general level of function in critical areas of the body such as the brain, the heart, and the skeletal muscles by such mechanisms as increasing oxygen levels, increasing circulation, and increasing the rate of cell metabolism. Short-term stressors, mild or moderate, appear to enhance cognitive function and short-term memory. The stress response also results in an increased release of **endorphins**, which act as pain-blocking agents (see Chapter 4).

In most cases, the body responds positively, the stressor is dealt with, the stress response diminishes, and body activity returns to normal. Additional distress results if the state of stress is severe or prolonged, or if the individual's adaptive mechanisms are impaired for some reason. It may be noticed that when an illness requires additional treatment, such as hospitalization or physiotherapy, extra stressors are added that may overwhelm the patient. For example, hospitalization may give rise to fear and pain or to anxiety associated with separation from the family or job, change in routine and diet, and loss of privacy and control over one's life. In other cases, hospitalization may offer positive relief from the burden of illness.

With major or prolonged stress, intellectual function and memory are frequently disrupted. One factor related to the change is the large amount of glucocorticoids released because memory impairment has been shown to occur in persons taking large doses of glucocorticoids.

THINK ABOUT 26-2

a. Using your knowledge of normal physiology, explain the probable source of the increased glucose level in the blood with stress.
b. Name the organs in which vasoconstriction occurs and blood flow diminishes during a stress response. Name the areas that have increased blood flow.
c. State two ways by which oxygen supplies to the brain may increase during a stress response.
d. List the hormones released during the stress response and two significant actions for each.

Stress and Disease

Greater than 40% of all adults experience adverse effects from stress and 75% to 90% of doctor's office visits are for stress-related problems and complaints. Stress may cause a specific problem such as a headache, which may develop during a stress response or, in some persons, as the stressor is relieved. Prolonged *vasoconstriction* may cause inflammation and necrosis that result in stomatitis (ulcers in the mouth) and necrotizing periodontal disease (Fig. 26-2), or nausea. More severe complications may arise if reduced blood supply impairs function or causes necrosis in the gastrointestinal tract or kidneys. In some patients who have preexisting pathologic conditions, a stress response may become an additive or exacerbating factor, creating an acute complication or adding to the severity of the original disorder. For

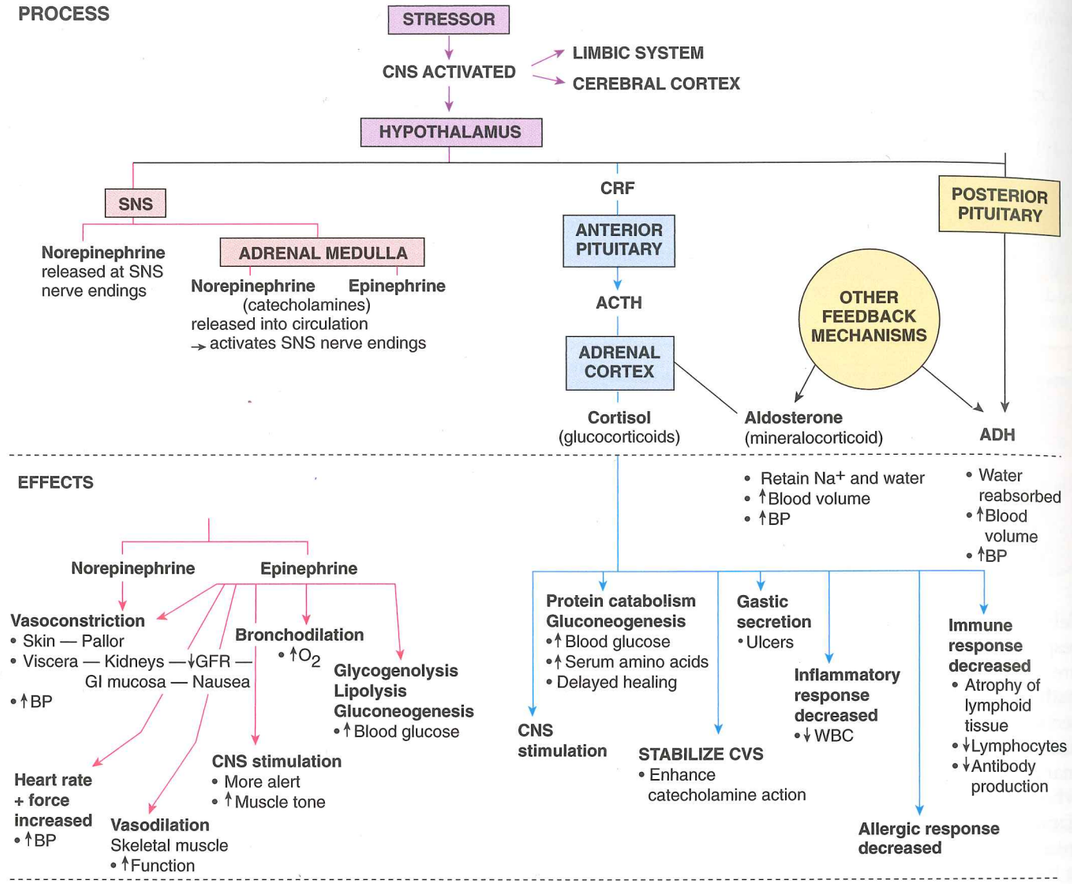

FIGURE 26-1 The stress response. ACTH, adrenocorticotropic hormone; ADH, antidiuretic hormone; BP, blood pressure; CNS, central nervous system; CRF, corticotropin-releasing factor; CVS, cardiovascular system; GFR, glomerular filtration rate; GI, gastrointestinal; SNS, sympathetic nervous system; WBC, white blood cell.

example, elevation of blood pressure or cardiac dysrhythmia (irregular heart rate) resulting from a stress response may seriously aggravate the condition of an individual with a damaged heart.

Stress has been shown to be a precipitating factor in some disorders. Chronic infections such as herpes simplex (cold sores) often erupt when the person is stressed. Acute asthma attacks or a seizure may be triggered in some individuals by a stressful situation. The onset of cancer or an infection frequently follows a serious life crisis, which suggests that the immune system has been depressed.

In many chronic disorders stress is an exacerbating factor. The stressor may be physical or emotional. For example, multiple sclerosis, rheumatoid arthritis, systemic lupus erythematosus, asthma, acne, ulcerative colitis, and eczema are some conditions that usually become more acute when a stressor is present. It is important for a person with a chronic illness to develop improved coping mechanisms and an adequate support system to delay exacerbations or progressive degeneration in chronic illness.

In some diseases such as hypertension, coronary artery disease, and diabetes mellitus, stress is thought

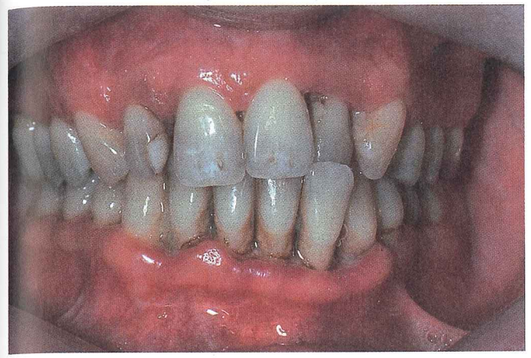

FIGURE 26-2 A possible effect of stress in the oral cavity: inflammation and necrosis (necrotizing periodontal disease seen in young adults at academic examination time). *(Courtesy of Evie Jesin, RRDH, BSc, George Brown College, Toronto, Ontario, Canada.)*

to be an etiologic factor. It has been noted that serum cholesterol is elevated during stress, and the reactive vasoconstriction affects blood pressure and blood vessels when stress is sustained.

A brief selection of stress-related disorders is summarized in Box 26-1.

Potential Effects of Prolonged or Severe Stress

Severe stress may lead to a variety of serious complications, such as renal failure or perforating stomach ulcers. *Acute renal failure* results from prolonged severe vasoconstriction and reduced blood supply to the kidney. Reduced blood supply causes tubular necrosis, obstruction of filtrate flow, and cessation of glomerular filtration or shutdown (see Chapter 18). In some cases, permanent kidney damage results. *Stress ulcers* may develop with severe trauma; a good example is Curling's ulcers, which are associated with burns. Stress ulcers are multiple gastric ulcers, often asymptomatic, but nevertheless dangerous because they frequently manifest with gastric hemorrhage (see Chapter 17). Several factors in the stress response contribute to ulcer formation. Intense vasoconstriction in the gastric mucosa decreases mucosal regeneration and mucus production, decreased motility causes stasis of chyme in the stomach, and the catabolic effects of glucocorticoids delay tissue regeneration—all of which contribute to ulcer formation.

When possible, preventive measures are taken to reduce the risk of complications from severe stress. For example, to prevent acute renal failure, caregivers promote fluid flow through the kidneys by encouraging increased hydration, and physicians order drugs that dilate the renal arterioles and thus protect renal function. To guard against stress ulcers, medications may be administered to protect the gastric mucosa and reduce acid secretions, thereby preventing ulcer development.

BOX 26-1 A Selection of Stress-Related Disorders

Gastrointestinal System
Peptic ulcer, stress ulcers
Ulcerative colitis
Regional ileitis
Nausea, diarrhea
Stomatitis, periodontitis

Nervous System
Multiple sclerosis
Seizures
Depression
CVA (stroke)

Respiratory System
Asthma

Musculoskeletal System
Rheumatoid arthritis

Cardiovascular System
Hypertension
Angina
Congestive Heart Failure

Skin
Herpes Simplex
Eczema
Acne

Urinary System
Acute renal failure
Cirrhosis due to alcohol abuse

Other
Cancer
Infection
Autoimmune Disorders
Obesity

Another potential complication of severe stress is *infection*, which is related to depression of the inflammatory response and the immune system by increased cortisol secretion. Because these body defense mechanisms are reduced, opportunistic infections may develop, and the person becomes susceptible to infection by unusual organisms that are not normally pathogenic (see Chapter 7). The lack of an inflammatory response may mask the signs of infection until it is well established. In time, lymphoid tissue atrophies, and the circulating leukocytes are reduced in number and function. The increased incidence and growth of malignant tumors associated with severe stress have also been linked with the decreased efficiency of the surveillance function of the immune system.

Continued stress may impede the *healing* of tissue following trauma or surgery. Two major factors are involved. First, the increased amounts of cortisol reduce protein synthesis and tissue regeneration, and second, the increased catecholamine levels lead to

vasoconstriction, reduced blood supply, and reduced delivery of nutrients to the traumatized area. In some cases, these effects lead to an increased risk of infection and increased amounts of scar tissue at the site of the trauma or the surgery.

Posttraumatic stress disorder (PTSD) has been recognized as a serious consequence of a major disaster. It was first recognized in war veterans, and now has been diagnosed in individuals involved in catastrophic events or personal trauma. This syndrome usually occurs within 3 months of the event, but may cause symptoms years later. Three categories of symptoms may occur: revisiting or reliving the event, avoidance of certain activities and a lack of emotional response, and a dissociative state in which the person is non-responsive. There is also a high risk of the person with PTSD developing a dependence on drugs and/or alcohol. With treatment, symptoms usually resolve in 6 months, but in some cases symptoms persist or reoccur for several years.

THINK ABOUT 26-3

Explain how reduced blood flow in an area can interfere with healing and increase the risk of infection.

Coping with Stress

To prevent stress from becoming a negative influence on the body, it is important for each individual to recognize stress-inducing factors and discover the best way to deal with them, both emotionally and behaviorally. People must take appropriate action to solve the problem or develop improved coping mechanisms if the stressor cannot be removed. For many people, this is easier to say than to do, especially when a stressor becomes overwhelming or when multiple stressors develop. Fatigue, age, inadequate nutrition, insufficient knowledge, or lack of emotional support are among the factors that may interfere with an appropriate response.

A support system, even short term, is essential to minimize the risk of development of pathologic effects caused by stress. Strategies may include:

- Ensuring adequate rest and a healthy diet
- A change in lifestyle in order to adapt to the new situation
- Adopting a regular moderate exercise program that assists in controlling stress, particularly if it is undertaken at a time when stress levels are high:
  - Aerobic exercise such as cycling, swimming, or running is useful to release muscle tension and improve circulation as well as to provide a distraction
  - During aerobic exercise, the body uses more fats for energy, and therefore blood sugar levels remain more stable
  - A relatively constant blood supply to the brain prevents mood swings and reduces irritability
- Engaging in distracting activities for a time and then assessing the problem more objectively
- Counseling and support services
- Using relaxation techniques, imagery, biofeedback therapy, and music and art therapy
- Using antianxiety medications (minor tranquilizers such as lorazepam [Ativan] for a short period of time). These medications must be used with caution because even low doses can have adverse side effects such as drowsiness, memory loss, impaired judgement, confusion, nausea, and lack of energy.
- Undertaking a methodical approach, assessing options or goals, and making immediate decisions

Just as each person perceives stressors differently, each must develop an individualized set of coping mechanisms, and these skills will probably have to be modified periodically.

It is well to recognize any tendency toward maladaptive behavior at an early stage in the response to stress. Avoiding sleep, eating junk food, drinking too much coffee, and smoking constantly are behaviors that are more likely to add stress than to alleviate it.

CASE STUDY A

Situational Stress Response

L.D. is a 13-year-old healthy teenager who is very anxious about getting her wisdom teeth removed by the dentist. She is afraid that the dentist will use a needle to "freeze" her mouth. In the past, she has felt light-headed and dizzy when receiving routine immunizations in the doctor's office. Her mother thinks that L.D.'s anxious behavior is silly and tries to reassure L.D. on the drive to the dental office that everything will be fine. The dental office is quite busy and the receptionist states that the dentist has had an emergency patient and there will be a delay before L.D. will be seen. L.D. waits 30 minutes for her appointment.

1. What stressors are present for L.D.?
2. How will the delay affect L.D.'s stress response? What could reduce L.D.'s stress during the wait?
3. When L.D. is finally called by the receptionist, she gets up and immediately feels like she is going to faint. Which change in the nervous system is responsible for her hypotension? Is this part of the usual response to stressors?
4. She is sweating and her pupils are dilated. What specific changes have occurred to cause these manifestations?
5. L.D.'s mother tells her to "calm down" and "be brave." How would this likely affect the stress L.D. is experiencing?

The dentist reassures L.D. that she will use a mask to deliver the anesthetic rather than a needle and L.D. agrees to go ahead with the procedure. L.D. has four teeth extracted and is sent home. At home she experiences pain and stiffness in her jaws.

1. How will continued pain and stiffness affect tissue healing and recovery?
2. What can L.D. do to reduce her stress the next time an invasive procedure is scheduled?

CHAPTER SUMMARY

The basic stress response is the same in all situations, with variations depending on the specific stressor or cause. Stressors are a normal part of life.

- The stress response is considered to include three stages—alarm, resistance, and exhaustion—involving the activities of the hypothalamus, pituitary, sympathetic nervous system, and adrenal glands.
- Stress may cause minor problems such as headache, may precipitate a more serious problem such as a seizure or cancer, or may exacerbate a chronic illness such as ulcerative colitis.
- Severe prolonged stress or multiple stressors may have serious consequences such as development of peptic ulcer or acute renal failure.
- An individual can resolve stressful situations in a positive manner and return to a normal state using appropriate coping mechanisms.

STUDY QUESTIONS

1. List the factors or mechanisms in the stress response that contribute to increased oxygen supplies for the cells and explain how each factor contributes to the stress response.
2. Describe a recent stressor in your life and the stress response that followed it.
3. List some disorders that are stress related.
4. Describe two potential complications of severe stress.
5. Why are maladaptive coping mechanisms such as excessive eating or alcohol intake not helpful?

ADDITIONAL RESOURCES

Web Sites

http://www.cmha.ca/?s=Post+Traumatic+Stress+Disorder&submit=Search&lang=en *Canadian Mental Health Association—Post Traumatic Stress Disorder*

http://www.apahelpcenter.org/articles *American Psychological Association*

http://www.nlm.nih.gov/medlineplus/stress.html *Medline Plus: Stress*

http://www.nimh.nih.gov/ *National Institute of Mental Health*

http://www.mayoclinic.com *Mayo Clinic*

http://www.webmd.com/ *Web MD*