CHAPTER 7 - MUSCULAR SYSTEM

OBJECTIVES

On completion of this chapter, you will be able to:

- Describe the muscular system.
- Describe types of muscle tissue.
- Provide the function of muscles.
- Describe muscular differences of the child and the older adult.
- Analyze, build, spell, and pronounce medical words.
- Comprehend the drugs highlighted in this chapter.
- Provide the description of laboratory test related to the muscular system.
- Identify and define selected abbreviations.
- Describe each of the conditions presented in the Pathology Spotlights.
- Complete the Pathology Checkpoint.
- Complete the Study and Review section and the Chart Note Analysis.

OUTLINE

I. Anatomy and Physiology Overview
   A. The muscular system is composed of all the muscles of the body. They are composed of long slender cells known as fibers and comprise approximately 42% of a person’s body weight. Each muscle is made up of a group of fibers held together by connective tissue and enclosed in a fibrous sheath or fascia (Fig. 7-1, p. 152). Each fiber within a muscle receives its own nerve impulses and has its own stored supply of glycogen, which it uses as fuel for energy. Muscle must be supplied with proper nutrition and oxygen to perform properly; therefore, blood and lymphatic vessels permeate its tissues.

   B. Types of Muscle Tissue – there are three basic types of muscle tissue, classified according to their functions and appearance (Fig. 7-2, p. 153).
      1. Skeletal Muscle (Table 7-1 and Figs. 7-3 and 7-4, pp. 154-156) – also known as voluntary or striated muscle. They are controlled by the conscious part of the brain and attach to bone. The muscles have a cross-striped appearance, thus striated muscle. There are 600 skeletal muscles that are responsible for the movement of the body. Muscles move through contractility, extensibility, excitability, and elasticity. The process of muscle movement is as follows:
         a. Contractility – allows muscles to change shape to become shorter and thicker.
         b. Extensibility – allows living muscle cells to be stretched and extended; they become longer and thinner.
         c. Excitability – muscles receive and respond to stimulation.
d. **Elasticity** - once the stretching force is removed, a living muscle returns to its original shape.

e. Muscles have three distinguishable parts: the body or main portion, an origin, which is the more fixed attachment, and the insertion, the point of attachment of a muscle to the part that it moves. The means of attachment is a tendon. An aponeurosis is a wide, thin, sheetlike tendon.

f. Muscles and nerves work together as a motor unit. They perform in groups and are classified as:

- **Antagonist** – a muscle that counteracts the actions of another.
- **Prime Movers or Agonist** – a muscle that is primary in giving movement. Its contraction produces the movement.
- **Synergist** – a muscle that acts with another muscle to produce movement.

2. **Smooth Muscle** – also known as involuntary, visceral, or unstriated. Smooth muscle is not controlled by the conscious part of the brain. These muscles are under the control of the autonomic nervous system and in most cases, produce relatively slow contractions with greater degree of extensibility. These muscles lack the cross-striped appearance of skeletal muscle. This type of muscles includes internal organs of the digestive, respiratory, and urinary tract plus certain muscles of the eye and skin.

3. **Cardiac Muscle** – the muscle of the heart or myocardium is involuntary but striated in appearance. It is controlled by the autonomic nervous system and specialized neuromuscular tissue located within the right atrium.

C. **Functions of Muscles**

1. Muscles are responsible for movement. The types of movement are locomotion, propulsion of substances through tubes as in circulation, and change in the size of the opening as in the contraction and relaxation of the iris of the eye.

2. Muscles help to maintain posture through a continual partial contraction of skeletal muscles in a process known as **tonicity**.

3. Muscles help to produce heat through the chemical changes involved in muscular action.

II. **Life Span Considerations**

A. **The Child** – at about 6 weeks, the embryo exhibits development of the skeletal and muscular systems. At 7 weeks, the **diaphragm** is completely developed. At the end of 8 weeks, the embryo is now known as the **fetus**. Fetal growth proceeds from head to tail (**cephalo to caudal**). The movements of the newborn are uncoordinated and random.
B. **The Older Adult** – there is a decrease in muscle strength, endurance, range of motion (ROM), coordination and elasticity, and flexibility of connective tissue. The number and size of muscle fibers decrease, and water content of tendons is reduced. Muscles need to be exercised regularly to prevent loss of strength.

III. **Building Your Medical Vocabulary**
   A. **Medical Words and Definitions** – this section provides the foundation for learning medical terminology. Medical words can be made up of four types of word parts:
   1. **Prefix (P)**
   2. **Root (R)**
   3. **Combining Forms (CF)**
   4. **Suffixes (S)**
   
   By connecting various word parts in an organized sequence, thousands of words can be built and learned. In the text, the word list is alphabetized so one can see the variety of meanings created when common prefixes and suffixes are repeatedly applied to certain word roots and/or combining forms. Words shown in pink are additional words related to the content of this chapter that have not been divided into word parts. Definitions identified with an asterisk icon (*) indicate terms that are covered in the Pathology Spotlights section of the chapter.

IV. **Drug Highlights**
   A. **Skeletal Muscle Relaxants** – used to treat muscle spasms that may result from strains, sprains, and musculoskeletal trauma or disease. These drugs act by depressing the CNS and can be administered either orally or by injection.
   
   B. **Skeletal Muscle Stimulants** – used to treat myasthenia gravis. Skeletal muscle stimulants act by inhibiting the action of acetylcholinesterase, the enzyme that halts the action of acetylcholine at the neuromuscular junction.
   
   C. **Neuromuscular Blocking Agents** – are drugs used to provide muscle relaxation in patients undergoing surgery and/or electroconvulsive therapy, endotracheal intubation, and to relieve laryngospasm.
   
   D. **Anti-inflammatory Agents and Analgesics** (See Chapter 6.)

V. **Diagnostic and Lab Tests**
   A. **Aldolase (ALD) Blood Test** – test performed on serum that measures ALD enzyme present in skeletal and heart muscle. Helpful in diagnosing Duchenne’s muscular dystrophy before symptoms appear.
   
   B. **Calcium Blood Test** – test performed on serum to determine levels of calcium, which is essential for muscular contraction, nerve transmission, and blood clotting.
C. **Creatine Kinase (CK)** – a blood test to determine the level of CK. It is increased in necrosis or atrophy of skeletal muscle, traumatic muscle injury, strenuous exercise, and progressive muscular dystrophy.

D. **Electromyography (EMG)** – test to measure electrical activity across muscle membranes by means of electrodes that are attached to a needle that is inserted into the muscle.

E. **Lactic Dehydrogenase (LDH)** – blood test to determine the level of LDH enzyme, which is increased in muscular dystrophy, skeletal muscle damage, and after a pulmonary embolism.

F. **Muscle Biopsy** – operative procedure in which a small piece of muscle tissue is excised and then stained for microscopic examination.

G. **Serum Glutamic Oxaloacetic Transaminase (SGOT)** – blood test to determine the level of SGOT enzyme. This test is also called **asparate aminotransferase (AST)**.

H. **Serum Glutamic Pyruvic Transaminase (SGPT)** – blood test to determine the level of SGPT enzyme. This test is also called **alanine aminotransferase (ALT)**.

VI. **Abbreviations** (p. 171)

VII. **Pathology Spotlights**

A. **Atrophy** – occurs with disuse of muscles over a long period of time. It is caused by prolonged bed rest and immobility. When immobility is due to a treatment mode, such as casting or traction, one can decrease the effects of immobility by isometric exercises, which involve active muscular contraction against stable resistance of the immobilized part and helps to prevent atrophy. Other benefits of exercise are:

1. Can slow down progression of osteoporosis.
2. Reduces the level of triglycerides and raises high-density lipoproteins.
3. Can lower systemic and diastolic blood pressure.
4. Can improve blood glucose levels in a diabetic person.
5. Combined with a low-fat, low-calorie diet, effective in preventing obesity and helping individuals maintain proper bodyweight.
6. Can elevate mood and reduce anxiety and tension. **Lipoatrophy** is atrophy of fat tissue. It is also known as **lipodystrophy** (Fig. 7-13, p. 172).

B. **Fibromyalgia (Fig 7-14, p. 173)** – also known as **fibromyalgia syndrome** (FMS), it is a widespread musculoskeletal pain and fatigue disorder. The cause of FMS is unknown, but some doctors feel that many causes contribute to the development of the syndrome. Researches have found that sufferers have abnormal levels of several chemicals used by the body to transmit and response to pain signals. To be classified as a FMS victim, one must have at least 11 of 18 trigger points and have pain lasting at least three months. Treatments are geared toward improving the quality of sleep along with reducing pain.
C. **Myasthenia Gravis (MG)** – a chronic autoimmune neuromuscular disease characterized by varying degrees of weakness of the skeletal muscles of the body. The primary symptom of MG is muscle weakness that increases during periods of activity and improves after periods of rest. It is caused by a defect in the transmission of nerve impulses to muscles. It occurs when normal communication between the nerve and the muscle is interrupted at the neuromuscular junction. In MG, antibodies block, alter, or destroy the receptors for acetylcholine, the neurotransmitter released by nerve endings, at the neuromuscular junction. MG occurs in all ethnic groups and both genders but most often affects young adult females and older men. Treatment includes lifestyle adjustments, medications to improve the communication between the nerve and muscle, and medications to suppress the immune response.

D. **Muscular Dystrophy (MD)** – a group of genetic diseases characterized by progressive weakness and degeneration of the skeletal or voluntary muscles that control movement. The prognosis of muscular dystrophy varies according to the type and the progression of the disorder. The major forms of MD include:

1. **Myotonic** – most common form affecting adults.
2. **Duchenne** – most common form affecting children.
3. **Becker**
4. **Limb-Girdle**
5. **Facioscapulohumeral**
6. **Congenital**
7. **Oculopharyngeal**
8. **Distal**
9. **Emery-Dreifuss**

There is no specific treatment for any of the forms of MD. Physical therapy to prevent contractures (a condition in which shortened muscles around joints cause abnormal and sometimes painful positioning of the joint), orthoses (orthopedic appliances used for support), and corrective orthopedic surgery could be needed to help improve quality of life in some cases.

VII. Pathology Checkpoint

VIII. Study and Review (pp. 176-181)

IX. Practical Application: SOAP: Chart Note Analysis