McCance: Pathophysiology, 6th Edition

Chapter 42: Alterations of Musculoskeletal Function

Key Points – Print

SUMMARY REVIEW

Musculoskeletal Injuries

1. The most serious skeletal injury is a fracture. A bone can be completely or incompletely fractured. A closed fracture leaves the skin intact. An open fracture has an overlying skin wound. The direction of the fracture line can be linear, oblique, spiral, or transverse. Greenstick, torus, and bowing fractures are examples of incomplete fractures that occur in children. Stress fractures occur in normal or abnormal bone that is subjected to repeated stress. Fatigue fractures occur in normal bone subjected to abnormal stress. Normal weightbearing can cause an insufficiency fracture in abnormal bone.
2. Dislocation is complete loss of contact between the surfaces of two bones. Subluxation is partial loss of contact between two bones. As a bone separates from a joint, it may damage adjacent nerves, blood vessels, ligaments, tendons, and muscle.
3. Tendon tears are called *strains,* and ligament tears are called *sprains.* A complete separation of a tendon or ligament from its attachment is called an *avulsion.*
4. Epicondylitis is inflammation of a tendon where it attaches to a bone. Bursitis is inflammation of the bursae or small sacs lined with synovial membrane and filled with synovial fluid.
5. Muscle strain is a mild injury of local muscle damage.
6. Rhabdomyolysis, or myoglobinuria, can be a life-threatening complication of severe muscle trauma wherein muscle cell contents are released into the circulation. It may result in myoglobinuria, the filtration of myoglobin into the urine, and is often associated with acute renal failure.

Disorders of Bones

1. Metabolic bone diseases are characterized by abnormal bone structure. In osteoporosis bone tissue is normally mineralized, but the density or mass of bone is reduced because the bone remodeling cycle is disrupted. Osteoporosis is a complex, multifactorial, chronic disease that often progresses silently for decades until fractures occur. It is the most common bone disease. Multiple factors are involved including alternation in the OPG/RANKL/RANK system.
2. Postmenopausal osteoporosis occurs in middle-aged and older women and is probably caused by changes in osteoprotegerin, IGF, a combination of inadequate dietary calcium intake and lack of vitamin D, possibly decreased magnesium, lack of exercise, decreased levels of estrogen, and family history.
3. Glucocorticoids increase RANKL expression and inhibit OPG production by osteoblasts, thus leading to lower bone density.

4. Osteomalacia is a metabolic bone disease characterized by inadequate bone mineralization.
5. Excessive and abnormal bone remodeling occurs in Paget disease. Sporadic Paget disease involves overexpression of RANKL.
6. Osteomyelitis is a bone infection caused most often by bacteria (e.g., *S. aureus*) that can enter bone from outside the body (exogenous osteomyelitis) or from infection sites within the body (hematogenous osteomyelitis).
7. Bone tumors originate from bone cells, cartilage cells, fibrous tissue cells, or vascular marrow cells. Each cell produces a specific type of ground substance that is used to classify the tumor as osteogenic (bone cell), chondrogenic (cartilage cell), collagenic (fibrous tissue cell), or myelogenic (vascular marrow cell). Malignant bone tumors are large, aggressively destroy surrounding bone, invade surrounding tissue, and initiate independent growth outside the site of origin. Benign bone tumors are less destructive, limit their growth to the anatomic confines of the bone, and have a well-demarcated border.

Disorders of Joints

1. Noninflammatory joint disease is differentiated from inflammatory joint disease by the absence of synovial membrane inflammation, the absence of systemic signs and symptoms, and the presence of normal synovial fluid.
2. OA, now known as inflammatory joint disease, is characterized by the degeneration and loss of articular cartilage, sclerosis of underlying bone, and formation of bone spurs (osteophytes).
3. RA is an inflammatory joint disease characterized by inflammatory destruction of the synovial membrane, articular cartilage, joint capsule, and surrounding ligaments and tendons. RA involves an aberrant immune response and the transformed antibodies are called *rheumatoid factors.* The OPG/RANKL/RANK system is also involved. Rheumatoid nodules may also invade the skin, lung, and spleen and involve small and large arteries. RA is a systemic disease that affects the heart, lungs, kidneys, and skin, as well as the joints.
4. AS is a chronic inflammatory joint disease characterized by stiffening and fusion of the spine and sacroiliac joints. Recent data show that synovitis and bone marrow inflammation, rather than solely enthesis involvement, explain the alteration in sacroiliac joints.
5. Gout is a metabolic disorder associated with high levels of uric acid in the blood and body fluids. Uric acid crystallizes in the connective tissue of a joint, where it initiates inflammatory destruction of the joint.

Disorders of Skeletal Muscle

1. A pathologic contracture is permanent muscle shortening caused by muscle spasticity, as seen in CNS injury or severe muscle weakness.
2. Stress-induced muscle tension is presumably caused by increased activity in the reticular activating system and gamma loop in the muscle fiber. Progressive relaxation training and biofeedback has been advocated to reduce muscle tension.

3. Fibromyalgia is a chronic musculoskeletal syndrome characterized by diffuse pain and tender points. Unknown but suspected is that muscle is the end organ responsible for the pain and fatigue. Comorbidities (e.g., irritable bowel syndrome, mood disorders and chronic fatigue) suggest a major role for neuroendocrine and stress-response alterations.
4. Atrophy of muscle fibers and overall diminished size of the muscle are seen after prolonged inactivity. Isometric contractions and passive lengthening exercises decrease atrophy to some degree in immobilized patients.
5. Hyperexcitable membranes cause the physical and electrical phenomenon of myotonia. The disorder is treated with drugs that reduce fiber excitability. Periodic paralysis is caused by an unresponsive muscle membrane and is accompanied by changes in serum potassium. The biochemical defect is possibly related to changes in the muscle membrane and sarcoplasmic reticulum.
6. Metabolic muscle diseases are caused by endocrine disorders, glycogen storage disease, enzyme deficiencies, and abnormal lipid function. The muscle depends on a complex system of carbohydrates and fats converted by enzymes to produce energy for the muscle cell. Abnormalities in these pathways can inhibit function or cause damage to the muscle fiber. These illnesses are rare, yet they account for significant functional abnormalities.
7. Viral, bacterial, and parasitic infections of muscles produce the characteristic clinical and pathologic changes associated with inflammation. These are usually treatable and self-limiting disorders.
8. Polymyositis (generalized muscle inflammation) and dermatomyositis (polymyositis accompanied with skin rash) are characterized by inflammation of connective tissue and muscle fibers, and muscle fiber necrosis. Cell-mediated and humoral immune factors have been implicated. Treatment with immunosuppressive agents is effective in many cases.
9. Primary disorders with weakness and atrophy are known as myopathies.
10. The most common toxic myopathy is caused by alcohol abuse. Direct toxic effects of alcohol-producing necrosis of muscle fibers and nutritional deficiency have been suggested. The only treatment is abstinence and improved nutrition. The toxic effects of many drugs on muscle fibers cause local trauma to the muscle fibers from direct effects of the needle, secondary infection, and changes caused by nonphysiologic acidity and alkalinity in the fibers.
11. Sarcomas of muscle tissue are rare. Rhabdomyosarcoma has a uniformly poor prognosis because of an aggressive invasion and early, widespread dissemination. The usual treatment includes surgical excision, radiation therapy, and systemic chemotherapy.