E. Anatomy, Physiology, and Pathology

- The owner's manual for your self!
- 11 major organ systems

- 25 hours of anatomy
- 50 hours of physiology
- 40 hours of pathology

Texts:

- "Salvo", Massage Therapy Principles and Practice, 6th edition
- "Werner", A Massage Therapist's Guide to Pathology, 7th edition
- "Trail Guide", Trail Guide to the Body, 5th edition, by Andrew Biel

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5a A&P: Introduction to the Human Body – Cells

Salvo: Chapter 18

Anatomy and Physiology

Anatomy Study of the structures of the human body and their positional relationship to one another.

Physiology Study of how the body and its individual parts function in normal body processes.

Pathology (AKA: Pathophysiology) Study of the process of disease.

Levels of Organization

Chemical level Chemical elements that make up the body.

Examples: water, oxygen, iron, and DNA.

Cellular level Cells are composed of organelles. Perform functions vital to life.

Examples: skin cells, blood cells, muscle cells, and nerve cells.

Tissue level Groups of cells that perform specific functions.

Examples: epithelial, connective, muscle, and nervous.

Organ level Two or more specialized groups of tissues with specific functions.

Examples: stomach, brain, and lungs.

Organ system level Related organs with complementary functions arrange themselves into organ systems that can perform certain necessary tasks.

Examples: skeletal, muscular, cardiovascular, and lymphatic.

Organism level Highest level of organization, representing living entities composed of several organ systems. The total of all structures and functions is a living individual.

5a A&P: Introduction to the Human Body – Cells

Salvo: Chapter 18

Cell Anatomy

Cell Fundamental unit of all living organisms and the simplest form of life that can exist as a self-sustaining unit.

Cell membrane Semi-permeable membrane that separates cytoplasm from the surrounding external environment. Governs exchange of nutrients and waste materials.

Cytoplasm Gel-like fluid within the cell membrane in which organelles float. Provides cellular nutrition and supports organelles.

Organelle Cellular structure that possesses distinct _____ and functions. The organs of a cell. Examples:

- **Nucleus** Control center of the cell. Directs nearly all metabolic activities. Contains DNA and RNA.
- **Ribosome** Synthesizes proteins.
- **Mitochondrion (p.mitochondria)** "Power plant" of the cell. Responsible for cellular respiration. Provides most of the cell's ATP.
- **Lysosome** Engulfs and digests bacteria, cellular debris, and other organelles.

5a A&P: Introduction to the Human Body – Cells

Salvo: Chapter 18

Cell Physiology

Adenosine triphosphate (AKA: ATP) The body's energy storage molecule.

Passive cell process Movement of substances across the cell membrane by means of pressure and concentration without the expenditure of ATP. Types: diffusion, filtration, and osmosis.

- **Diffusion** Movement of molecules from an area of higher concentration to an area of low concentration, a process that continues until the distribution of particulates is equal in all areas.

- **Filtration** Movement of particulates across the cellular membrane as a result of pressure.

- **Osmosis** Movement of a pure solvent such as water from an area of low concentration (most dilute) to an area of high concentration (least dilute). Movement continues until the two concentrations are equal.

5a A&P: Introduction to the Human Body – Cells

Salvo: Chapter 18

Cell Physiology, continued

Active cell process Movement of substances across the cell membrane that requires the expenditure of ATP.

Active transport pumps Carrier proteins that are part of a cell membrane attract charged particles (ions) and move them from one side of the cell membrane to the other. Example: sodium-potassium pump used during nerve conduction.

Active transport vesicles Small spherical sacs that transport various substances within a cell, as well as import and export materials into and out of the cell. Types:

Phagocytosis Process by which specialized cells ingest harmful microorganisms and cellular debris, break them down, and expel the harmless remains back into the body.

Pinocytosis Process by which specialized cells engulf liquids and draw them into the cell.

Cellular Metabolism

Metabolism The total of all physical and chemical processes that occur in an organism. Examples: anabolism and catabolism.

Anabolism The constructive phase of metabolism in which smaller, simpler molecules are built up into larger molecules.

Catabolism The destructive phase of metabolism in which larger, more complex molecules are converted to smaller, simpler molecules.

6a A&P: Introduction to the Human Body – Tissues

Salvo: Chapter 18

Tissues

Tissue Group of similar cells that act together to perform a specific function.
Types: epithelial, connective, muscle, and nerve.

I. **Epithelial tissue** Tissue that lines or covers the body's external surface (skin), internal organs, blood vessels, body cavities, and the digestive, respiratory, urinary, and reproductive tracts. Example: skin, endothelium that lines blood vessels and the heart.

6a A&P: Introduction to the Human Body – Tissues

Salvo: Chapter 18

Tissues, continued

II. **Connective tissue** Tissue that is the most abundant and diverse. Connects, supports, transports, and defends.

A. **Fibrous connective tissue** The packing material of the body. It attaches the skin to underlying structures in a basement membrane, serves to wrap and support the body cells, fills the gaps between structures such as organs and muscles, and helps keep them in their proper places. Types:

1. **Loose fibrous connective tissue** One of the most widely distributed connective tissues and has little tensile strength.

2. **Adipose fibrous connective tissue** Tissue that specializes in storage of fat that insulates the body against heat loss, provides fuel reserves for energy and provides a cushion around certain structures such as the heart, kidney, and some joints.
   - Example: yellow bone marrow.

3. **Reticular fibrous connective tissue** The supportive framework of bones and of certain organs such as the liver and spleen.

4. **Dense fibrous connective tissue** Compact, strong, inelastic bundles of parallel collagenous fibers that have a glistening white color. Types:

   - **Dense irregular fibrous tissue** Resists pulling forces in several directions. Examples: deep fascia, dermis of the skin, periosteum, and capsules of organs.
   - **Dense regular fibrous tissue** Resists pulling forces in two directions. Examples: ligaments, tendons, retinacula, and aponeuroses.

6a A&P: Introduction to the Human Body – Tissues

Salvo: Chapter 18

Tissues, continued

B. **Bone connective tissue** The hardest and most dense connective tissue type. Types: compact and spongy.

C. **Cartilage connective tissue** Avascular, tough, protective tissue capable of withstanding repeated stress and is found chiefly in the thorax, joints, and certain rigid structures of the body (trachea, larynx, nose, ears). Types: hyaline, fibrocartilage, and elastic.

1. **Hyaline cartilage (AKA: gristle)** Elastic, rubbery, and smooth that covers articulating ends of bones. Connects ribs to the sternum. Supports the nose, trachea, and part of the larynx.

2. **Fibrocartilage** Cartilage with a dense matrix of white collagenous fibers. Has the greatest tensile strength of all cartilage types.
   - Examples: intervertebral disks, knee joint, and between pubic bones.

3. **Elastic cartilage (AKA: yellow)** The sofest and most pliable cartilage type. Consists of elastic fibers in a flexible fibrous matrix.
   1. Examples: external nose and ears, epiglottis, part of the larynx, and auditory tubes.

D. **Liquid connective tissue** Contains a distinct collection of cells floating in a liquid matrix. Types: blood and lymph.

6a A&P: Introduction to the Human Body – Tissues

Salvo: Chapter 18

Tissues, continued

III. **Muscle tissue** Tissue that produces movement of the body. Has the ability to contract, elongate, respond to stimulus, and return to its original shape after movement. Types: smooth, skeletal, cardiac

A. **Smooth muscle tissue** Involuntary, non-striated muscle tissue that forms the walls of hollow organs and tubes. Controls the transport of materials, moving them along or restricting their flow.

Examples: stomach, bladder, and blood vessels.

B. **Skeletal muscle tissue** Voluntary, striated muscle tissue that is attached to bones or related structures and is stimulated by a nerve impulse to contract.

C. **Cardiac muscle tissue** Involuntary, striated muscle tissue located in the heart wall. Intercalated disks between each muscle cell synchronize the contraction to pump blood from the heart.

IV. **Nervous tissue** Tissue that has the ability to detect and transmit electrical signals by converting stimuli into nerve impulses.

Examples: brain and spinal cord.

7a A&P: Introduction to the Human Body – Body Compass

Salvo: Chapter 18

Homeostasis

Homeostasis Constancy of the body's internal environment. It represents a relatively stable condition within a very limited range.

Membranes

Membrane Soft pliable sheets of tissues that cover the body, line tubes or body cavities, cover organs, and separate one part of a cavity from another.

Cutaneous membrane (AKA: skin) Epithelial membrane that covers the entire surface of the body .

Mucous membrane (AKA: mucosa) Epithelial membrane that lines openings to the outside of the body.

- Example: nasal membrane.

Serous membrane Epithelial membrane that lines closed body cavities that do not open to the outside of the body.

- Example: pericardium.

Synovial membrane Connective tissue membrane that lines cavities of freely moving joints.

Anatomic Position

Anatomic position Standard body position used in Western medicine. The body is upright and facing forward, arms at the sides, palms facing forward , thumbs to the side, feet are about hip distance apart with toes pointing forward.

7a A&P: Introduction to the Human Body – Body Compass

Salvo: Chapter 18

Planes of Reference

Plane: A flat surface determined by three points in space such as height, depth, and width.

Midsagittal (AKA: median plane) Plane that runs longitudinally or vertically down the body, anterior to posterior, dividing the body into equal right and left sections.

Sagittal plane Plane that passes through the body parallel to the midsagittal plane.

Frontal (AKA: coronal plane) Plane that passes through the body side to side, creating anterior and posterior sections.

Transverse (AKA: horizontal plane) Plane that passes through the body to create superior and inferior sections.

7a A&P: Introduction to the Human Body – Body Compass

Salvo: Chapter 18

Directional Terms

Superior (AKA: cranial or cephalic) Situated above or toward the head end.
Inferior (AKA: caudal) Situated below or towards the tail end.

Anterior (AKA: ventral) Pertaining to the front side of a structure.
Posterior (AKA: dorsal) Pertaining to the back of a structure.

Medial Oriented toward or near the midline of the body.
Lateral Oriented farther farther from the midline of the body.

Ipsilateral (AKA: homolateral) Related to the same side of the body.
Contralateral Related to opposite sides of the body.

Proximal Nearer to the point of reference. Extremities only.
Distal Farther from the point of reference. Extremity only.

Deep (AKA: central) Pertaining to or situated at the center of the body.
Superficial (AKA: peripheral) Pertaining to the outside surface, periphery, or surrounding the external area of a structure.

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13a A&P: Skeletal System – Cells, Tissues, and Bone Shapes

Salvo: Chapter 19

Anatomy

Bones Connective tissue organs that consist of compact bone, spongy bone, collagenous fibers and mineral salts.

Joints (AKA: articulation or arthrosis) Where bones come together or join.

Cartilage Avascular, tough, protective connective tissue found in the thorax, joints, and some rigid tubes of the body such as the trachea and larynx.

Ligaments Dense regular connective tissue that attaches bones to one another.

Physiology

Support Supports the body through a bony framework.

Protection Protects vital organs.

Movement Contracting muscles pull on bones to cause movements at joints.

Blood cell production (AKA: hemopoiesis) Blood cells are produced in there red marrow of certain bones, especially long bones.

Fat storage Fats stored in yellow bone marrow.

Mineral storage Vital minerals and mineral compounds are stored in bone,

Classification of Bones

Long Longer than they are wide.

- Examples: humerus, femur, and tibia.

Short Small, cube-shaped, and contain multiple articulating surfaces.

- Examples: carpals and tarsals.

Irregular Catch-all category for bones that do not fit in other categories.

- Examples: facial bones and vertebrae.

Flat Possess a broad flat surface for muscle attachment or protection of underlying organs.

- Examples: sternum, scapula, ribs, and most cranial bones.

Sesamoid Small, round bones that are embedded in certain tendons

- Example: patella.

13a A&P: Skeletal System – Cells, Tissues, and Bone Shapes

Salvo: Chapter 19

Bone Tissue

Compact Forms the hard outer shell of all bones and a small portion of the shaft bulk of long bones. Provides protection, support, and resistance to stress of weight and movement.

Spongy (AKA: cancellous) A lattice of thin beams of bone within bones. Lightens the bone and is filled with red bone marrow.

Red bone marrow Blood forming cells found in flat and long bones. Produce red blood cells, platelets, and white blood cells.

Yellow bone marrow Adipose fibrous connective tissue that contains mainly fat cells and is found in the medullary cavity.

Anatomy of a Long Bone

Diaphysis Cylindrical shaft of a long bone.

Epiphysis The ends of a long bone.

Articular cartilage Hyaline cartilage covering an epiphysis.

Medullary cavity Hollow space within the diaphysis.

Periosteum Fibrous sheath surrounding the diaphysis containing blood and lymphatic vessels, nerves, and bone-forming cells for growth and fracture healing.

Endosteum Lining of the medullary cavity.

Haversian canal Vascular canal that runs logitudinally through a bone.

Volkmann canal Vascular canal that runs horizontally through a bone, connecting Haversian canals.

Bone Remodeling

Osteoblasts Bone-forming cells.

Osteoclasts Bone-destroying cells.

Osteocytes Mature bone cells.

22a A&P: Skeletal System – Appendicular and Axial Divisions

Salvo: Chapter 19

Divisions of the Skeletal System

206 Adult human

80 Axial Skeleton

29 Skull

- **8 Cranium** Frontal(1), occipital (1), sphenoid (1), ethmoid (1), parietal (2), temporal (2)
- **14 Face** Zygomatic (2), mandible (1), . . .
- **6 Ear** 2 each of malleus (hammer), incus (anvil), and stapes (stirrup).
- **1 Hyoid**

26 Vertebral Column

- **7 Cervical** C1 (atlas), C2 (axis), . . . C7
- **12 Thoracic** T1-T12
- **5 Lumbar** L1-L5
- **1 Sacrum**
- **1 Coccyx**

1 Sternum 3 fused parts: manubrium, body, and xiphoid process.

24 Ribs

- **14 True ribs** Directly attaching to the sternum by way of cartilage.
- **6 False ribs** Not *directly* attached to the sternum.
- **4 Floating ribs** Not attached to the sternum at all.

126 Appendicular Skeleton

- **4 Shoulder girdle** 2 each of clavicle and scapula.
- **60 Upper extremity** 2 each of humerus, ulna, radius. 16 carpals, 10 metacarpals, and 28 phalanges.
- **2 Pelvic girdle** 2 pelvic bones, AKA: innominate bone, os coxae.
- **60 Lower extremity** 2 each femur, patella, tibia, fibula. 14 tarsals, 10 metatarsals, and 28 phalanges.

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15a A&P: Skeletal System – Bony Landmark Palpation

Salvo: Chapters 19 and 21

Bony Markings

Condyle Rounded projection that forms a joint.

Fossa Shallow depression in a bone.

Head Rounded end of a bone. Example: head of the humerus.

Process General term for any prominence or prolongation from a bone.

Tuberosity Large, rounded rough projection.

Palpation

Calcaneus

Fibula head, lateral malleolus

Tibia tuberosity, medial malleolus

Patella

Femur greater trochanter

Pelvic bone

- **Ilium** ASIS (anterior superior iliac spine), PSIS (posterior superior iliac spine)
- **Ischium** ischial tuberosity
- **Pubic bone** pubic symphysis

Sacrum

Vertebrae

Scapula superior angle, inferior angle, spine of scapula, root of spine of scapula, coracoid process

Sternum xiphoid process, body, manubrium

Ribs costal cartilages, floating ribs, sternoclavicular joint

Mandible angle, ramus

Zygomatic arch

Temporal arch, mastoid process

Humerus deltoid tuberosity, medial and lateral epicondyles,

Ulna olecranon process, styloid process

Radius styloid process

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16a A&P: Skeletal System – Synovial Joints

Salvo: Chapter 19

Joints

Joint (AKA: articulation or arthrosis) Where bones come together or join.

Physiology

Enable the body to move
Bear the weight of the body
Provide stability

Structural and Functional Classification

Fibrous / Synarthrotic

- Connected by dense fibrous connective tissue, mostly collagen.
- Extremely limited movement.
- Examples: cranial sutures, facial sutures, teeth, and tibiofibular joints.

Cartilaginous / Amphiarthrotic

- Connected by cartilage.
- Slightly moveable.
- Examples: costochondral joints, pubic symphysis, intervertebral disk joints.

Synovial / Diarthrotic

- Contains synovial fluid to nourish and lubricate articulation.
- Freely movable.
- Examples: glenohumeral, iliofemoral . . . see E-26 for more examples.

16a A&P: Skeletal System – Synovial Joints

Salvo: Chapter 19

Synovial Joints

Articular cartilage Hyaline cartilage covering an epiphysis.

Joint capsule Double-layered structure around a synovial joint. The outer layer is fibrous and forms ligaments. The inner layer is the synovial membrane.

Joint cavity Space in joint capsule. Lined with a synovial membrane.

Synovial membrane Membrane in joint cavities, synovial sheaths, and bursae.

Synovial fluid Fluid secreted by synovial membranes to lubricate and nourish.

Synovial sheath Tube-like structure lined with synovial membrane that surrounds long tendons.

Bursae (s. bursa) Collapsed sac-like structures with an interior lining of vialsyno membrane. Contains synovial fluid.

Menisci (s. meniscus) Fibrocartilage pads that smooth joint movement and absorb shock. Examples: knee and jaw.

16a A&P: Skeletal System – Synovial Joints

Salvo: Chapter 19

Types of Synovial Joints

Hinge Limited to flexion and extension.

Pivot Limited to rotation.

Ellipsoidal / condyloid Slightly less mobile than ball/socket: Flexion, extension, abduction, adduction, protraction, retraction, rotation, and lateral deviation.

Saddle Allowing flexion, extension, abduction, adduction, opposition, reposition, and circumduction but not rotation.

Ball and socket Allowing all movements except gliding. Offers the greatest range of motion.

Gliding / planar Limited to planar movements but movement may be permitted in all directions.

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17a A&P: Skeletal System – Joint Actions and Articulations

Salvo: Chapter 21

Actions and Articulations

Flexion Bending or decreasing the angle of a joint.
Extension Straightening or increasing the angle of a joint.
Hyperextension A continuation of extension beyond anatomic position.

Abduction Movement away from the median plane.
Adduction Movement toward the median plane.

Supination Lateral rotation of the forearm so that the palm is turned up.
Pronation Medial rotation of the forearm so that the palm is turned down.

Plantar flexion Extension of the ankle such that the toes are pointing downward
Dorsiflexion Flexing the ankle dorsally. Toes are moving toward the shin.

Inversion Elevation of the medial edge of the foot. Sole is turned inward.
Eversion Elevation of the lateral edge of the foot. Sole is turned outward.

Circumduction Cone-shaped range of motion that occurs when the distal end moves in a circle and the proximal end is fixed.

Rotation Circular movement when a bone moves around its own central axis.

- **Left and right rotation** Rotation for joints within the median axis.
- **Lateral and medial rotation** Rotation for joints outside the median axis.
- **Upward and downward rotation** Rotation of the scapula so that the glenoid fossa faces either upward or downward.

Elevation Raising or lifting a body part, moving superiorly.
Depression Lowering or dropping a body part, moving inferiorly.

Protraction Movement forward or anteriorly.
Retraction Movement backward or posteriorly.

Anterior pelvic tilt Entire pelvis tilted forward in the frontal plane.
Posterior pelvic tilt Entire pelvis tilted backward in the frontal plane.

17a A&P: Skeletal System – Joint Actions and Articulations

Salvo: Chapter 21

Synovial Joints

Ball and Socket

Glenohumeral Shoulder joint.
Coxal (acetabulofemoral/coxal) Hip joint.

Hinge

Humeroulnar Elbow joint.
Humeroradial Elbow joint.
Talocrural Ankle joint.
Interphalangeal IP joint.

Pivot

Atlantoaxial "No-no" joint.
Radioulnar (proximal) Joint between the radius and the ulna.

Saddle

Carpometacarpal of the thumb

Ellipsoidal

Radiocarpal Wrist joint.
Metacarpophalangeal Large knuckle joints of the hand.
Atlantooccipital Joint between atlas (C1) and occiput. "Yes-yes" joint.
Temporomandibular TMJ, jaw joint.
Tibiofemoral Knee joint.

Gliding

Acromioclavicular
Sternoclavicular
Intercarpal Joints between carpals.
Patellofemoral Patella – Femur.
Intertarsal Joints between tarsals.
Scapulo-thoracic

23a Pathology: Medications

Werner: Appendix A

Knowing the effects of medications allows us to properly modify massage treatments. For testing purposes- Focus on the medication class in bold, the effects/side-effects, and massage modifications only.

The following are additional pharmaceutical resources:

- *Pharmacology for Massage Therapy*, by J. Wible
- *Massage Therapy and Medications*, by R. Persad
- *Nursing 2014 Drug Handbook*

Almost one-half of all adults in the United States use at least one prescription drug every month, and close to 12%- that's one in every eight people use five or more prescription drugs within a given month.

Medication Vocabulary

Bioavailability- The portion of a substance that is accessible at the site of physiological activity

Black box warning- Strictest warning issued by the FDA when a substance is associated with a substantial risk of harm.

Durations of action- The length of time a particular drug is effective.

Half-life- The period of time required for the concentration of a drug, usually measured in the plasma, to be reduced by one-half.

Onset of action- The time it takes between the administration of a drug and when the effects begin to take place.

Over the counter (OTC)- Refers to a drug that is available without a prescription

Parenteral- A non-oral administration route for a medication (for example, injection, topical, or mucous membrane application)

Peak action- The time after administration of a drug and when it has its strongest effect.

Prescription- An instruction or recommendation for a treatment from a medical practitioner—in this context referring to instructions to take specific medications in a specific way.

Anti-anxiety Using more stimulating strokes throughout the massage to help avoid dizziness and fatigue at the end of the session.

Benzodiazepines: Short-term anxiety, Seizures, Insomnia, Convulsions

Examples: Valium, Ativan, Xanax

Effects / Side Effects: CNS depression, poor reflexes, dry mouth, fatigue/feeling unusually exhausted, physical dependency

Modifications: Massage conservatively to respect client's potential reduced ability to adapt to external changes. Using more stimulating strokes throughout the massage to help avoid dizziness and fatigue at the end of the session.

23a Pathology: Medications

Werner: Appendix A

Anti-anxiety, continued

Buspirone HCL: Short-term anxiety, General anxiety

Examples: BuSpar

Effects / Side Effects: Dizziness, headaches, nausea

Modifications: Because this medication does not involve sedation or drowsiness, it has fewer implications for massage therapy. However, it is still necessary to work conservatively because the normal muscle tone has been altered.

Antidepressant Antidepressants all have some side effects, although these are usually temporary and mild. It takes time for the body to adapt to these changes, however; four weeks or more are often needed for the drugs to take effect. Massage therapy may exacerbate these symptoms, so the therapist should take care not to over-treat, especially when a client is just starting a new course of drugs.

Tricyclics: Depression

Examples: amitriptyline, desipramine, nortriptyline, clomipramine, amoxapine

Effects / Side Effects: Constipation, dry mouth, sedation, dizziness, light-headedness

Modifications: Clients may need some gently stimulating strokes at the end of the session to come back to full alertness.

MAOIs: Depression

Examples: Nardil, Parnate, Emsam, Marplan

Effects / Side Effects: Possible dangerous interactions with other drugs and foods, drowsiness, dizziness

Modifications: MAOIs and other antidepressants have the tendency to cause excessive drowsiness and dizziness; massage must be performed and concluded appropriately.

SSRIs / SNRIs: Depression, anxiety, eating disorders

Examples: Lexapro, Prozac, Zoloft, Pristiq, Cymbalta, Effexor, Cymbalta, Wellbutrin, Remeron, Pristiq

Effects / Side Effects: Fatigue, headache, tremor, dizziness, drowsiness, insomnia, nervousness, agitation, dry mouth, nausea, diarrhea, vomiting, decreased libido. Note: Most side effects occur with a new prescription and can be expected to subside within a few weeks.

Modifications: Accommodating for side effects is important, as is counseling clients to consult with their physicians if symptoms interfere with function or quality of life.

23a Pathology: Medications

Werner: Appendix A

Anti-inflammatory and analgesic Inflammation is frequently a source of nerve irritation at acute or chronic sites of tissue damage. Consequently, many analgesics work to reduce pain sensation by reducing or inhibiting the inflammatory process, changing tissue response. Other analgesics alter pain perception in the central nervous system (CNS), but do not affect inflammation. And still other drugs stabilize excitatory neurotransmitters, which interferes with the perception of pain.

Salicylates: Inflammation, Fever, Anticoagulant

Examples: Aspirin, Bayer Aspirin

Effects / Side Effects: Mild gastrointestinal discomfort, heartburn, nausea

Modifications: Reduced pain perception and inhibited inflammation means that compromised tissue may not send a strong signal about pain. Observation and careful palpation are key in this situation.

Bodywork needs to be conducted conservatively to avoid overtreatment, and massage with intrusive pressure must be used with caution. Also, the tendency for peripheral vasodilation raises the risk for hypotension (dizziness and lethargy) and chilling during and after a massage.

Acetaminophen: Fever, pain

Examples: Tylenol, paracetamol

Effects / Side Effects: Mild gastrointestinal discomfort, loss of appetite, itching, rash, headache. Note: Long-term use or use with alcohol can cause liver damage.

Modifications: As with other pain medications, caution must be used to avoid overtreatment.

Nonsteroidal Anti-inflammatory drugs (NSAIDs): Inflammation, pain

Examples: Celebrex, Lodine, ibuprofen/Advil®, Aleve/naproxen sodium, Motrin

Effects / Side Effects: Stomach pain, heartburn, peptic ulcers, headaches, dizziness, sweating, rash, back pain. Note: Some NSAIDs can increase the risk of heart failure, heart attack, and stroke.

Modifications: NSAIDs are often used for musculoskeletal pain, so it is not unusual for clients to use them at the same time as receiving massage therapy. It is important to work conservatively in this situation to avoid inadvertent overtreatment.

Narcotics and Mixed Narcotics: Pain, cough, g.i. tract slugishness

Examples: Demerol, OxyContin, Percocet, Vicodin, fentanyl, Dilaudid, morphine,

Effects / Side Effects: Altered sensation, euphoria, addiction, hypotension, constipation

Modifications: A client taking these medications has a problem that is too extreme to be managed with less intrusive analgesics. In the presence of narcotic analgesics, interference with pain perception is more complete, and appropriate caution is called for.

23a Pathology: Medications

Werner: Appendix A

Anti-inflammatory and analgesic, **Narcotics and Mixed Narcotics continued,**
Don't use aggressive stretching, contract/relax techniques, or any massage that involves intrusive pressure. Hydrotherapy that involves very hot or very cold applications should also be avoided.

The risk of dizziness with these drugs calls for caution at the end of the session; it may be a good idea to stay with clients at least while they come to a sitting position. Clients taking narcotic analgesics may be prone to mood swings and difficulties with accurate communication.

Anticonvulsants: Partial seizures; neuropathy, fibromyalgia, postherpetic neuralgia.

Examples: clonazepam, lamotrigine, divalproex, topiramate, gabapentin, levetiracetam

Effects / Side Effects: Dizziness, drowsiness, lack of coordination, tremors, constipation, dry mouth

Modifications: The main caution for clients who use anticonvulsants has to do with the painful conditions that may call for their use. Careless massage therapy may exacerbate symptoms of fibromyalgia, neuropathy, or postherpetic neuralgia.

The risk of dizziness with these drugs calls for caution at the end of the session; it may be a good idea to stay with clients at least when they come to a sitting position.

Topical Pain Medications: Inflammation, pain. Topical pain medication can be administered as a gel, cream, lotion, or patch.

Examples: Lidoderm, capsaicin, arnica cream

Effects / Side Effects: Skin irritation and damage

Modifications: In the interest of being conservative, it is a good practice to avoid the area for several inches around the site of application until the client has bathed and it is safe to assume that the bioactive elements of the medication have been dispersed.

Muscle Relaxants: Muscle relaxants are prescribed to minimize acute spasms related to trauma or anxiety, or to help with chronic spasticity from central nervous system damage as seen with multiple sclerosis, stroke, spinal cord injury, cerebral palsy, or other CNS dysfunction. They can act on the brain, on the spinal cord, or in the muscle tissue itself.

A client who uses muscle relaxants is not inherently relaxed, although their tissues may seem that way. Some of these drugs interfere with muscle protection reflexes, so the risk of overtreatment with deep tissue work, range of motion exercises, or stretching is significant.

They may also be described as skeletal muscle relaxants or smooth muscle relaxants. Smooth muscle relaxants are used for digestive tract or cardiovascular issues.

23a Pathology: Medications

Werner: Appendix A

Anti-inflammatory and analgesic, continued

Skeletal Muscle relaxants: Suppress reflexes that tighten muscles in response to stretching or damage, reduction of painful spasms, and/or weakness in muscles that are pathologically tight.

Examples: Soma, baclofen, Flexeril, Dantrium, Skelaxin, Robaxin, Norflex, Botox

Effects / Side Effects: Weakness, drowsiness, dizziness, headache, slowed heart rate, itching, rash (allergic reaction may cause asthma and/or anaphylaxis)

Modifications: May induce a parasympathetic state, which may then be intensified by massage. Client may be exhausted at the end of a session; finish with techniques that enhance alertness, and leave time for the client to make the transition back to full alertness. Do not try to create an increased range of motion while the client is in an altered state. Avoid massage at the site of Botox (Botulinum toxin) injections for several hours after the treatment so that the medication is not dispersed beyond the area for which it is intended.

Cardiovascular Disease Help minimize a sympathetic response or to dilate peripheral blood vessels. Parasympathetic state may be intensified by massage, leaving the client dizzy, fatigued, and lethargic. Ending a session with strokes that are more stimulating may help to minimize the feeling of sedation, as long as the strokes fit into a protocol that is suitable for a person with compromised cardiovascular health. It is a good strategy to stay close by while these clients come to a sitting position after their massage session.

Beta-blockers: Antihyperintensive. May effect the heart, bronchi, blood vessels, and the uterus. Lower blood pressure and cardiac output. Treats angina, hypertension, anxiety, and some other disorders.

Examples: atenolol, betaxolol, bisoprolol, metoprolol succinate, nebivolol

Effects / Side Effects: Slow heart rate, dizziness, fatigue, possible depression, memory loss, hallucinations, and nightmares. Stopping use suddenly may cause angina.

Modifications: Can lead to excessively low blood pressure, especially when the client is in a relaxed state. Hydrotherapy is generally safer with local applications than are systemic immersions in hot tubs, saunas, or other facilities.. It may be wise to finish the massage with strokes that promote alertness and wakefulness, and to leave the client ample time to come to full speed after the session.

Calcium channel blockers: Anti-hyperintensive drugs block the movement of calcium ions in smooth and cardiac muscle tissue resulting in vasodilation and more efficient myocardial function. They are used for hypertension and long-term (not acute) angina.

Examples: benzothiazepines, phenylalkyamines, dihydropyridines

Effects / Side Effects: Hypotension and bradycardia, ushing, head- ache, heartburn, peripheral swelling, headache, dizziness, occasional chest tenderness

23a Pathology: Medications

Werner: Appendix A

Cardiovascular Disease**, Calcium channel blockers continued**

Modifications: Because flushing and dizziness are issues with calcium channel blockers, massage should try to minimize the risk of exacerbating these: less emphasis on big, draining strokes and more emphasis on smaller, less circulatory strokes is appropriate. Avoid heat-based hydrotherapy that might promote flushing. Adjust positioning or use bolsters if chest tenderness is present.

ACE inhibitors: ACE inhibitors work by limiting the action of an enzyme that causes vasoconstriction. They promote the excretion of sodium and water, reducing load on the heart. They are used to control hypertension and heart failure.

Examples: Lotensin, Captopril, Vasotec, fosinopril, Prinivil, Zestril

Effects / Side Effects: Swelling in face and limbs, dry cough, fatigue, headache, possible hypotension

Modifications: As with other drugs for cardiovascular disease, excessive hypotension is a possible side effect. Clients may experience fatigue, dizziness, and lethargy if gentle invigorating strokes are not administered toward the end of the session.

Digitalis: Increases the force of the heartbeat by boosting calcium in cardiac muscle cells; it also slows the heartbeat through action in the CNS. It is used to treat arrhythmia and heart failure.

Examples: Lanoxin, digoxin

Effects / Side Effects: Arrhythmia, agitation, fatigue, muscle weakness, hallucinations, dizziness, vertigo, gastrointestinal (GI) upset

Modifications: Clients who take any form of digitalis to control heart failure are not good candidates for rigorous circulatory massage. Invigorating strokes to conclude a session must be chosen to support alertness rather than circulatory flow.

Anti-angina medications: Reduce myocardial oxygen demand, or they increase the supply of oxygen to the heart, or both. Chronic angina is treated with beta-blockers or calcium channel blockers. Acute angina is typically treated with various nitrates. These cause vasodilation, especially of veins, leading to decreased load on the heart. They are typically dissolved under the tongue for uptake via mucous membranes or applied with a skin patch or ointment for longer-lasting effect.

Examples: nitrates, calcium antagonists, beta blockers, ranolazine

Effects / Side Effects: Nausea, constipation, headache, dizziness, fast heartbeat, dyspnea, light-headedness, flushing, irritation at patch site

Modifications: If a client has a transdermal patch for anti-angina medication, that area and the adjacent tissue must be avoided so that dosage is not influenced. Clients taking these medications have the same risk of hypotension, flushing, and dizziness seen with other cardiovascular drugs, so massage therapy must be adjusted to avoid exacerbating these side effects.

23a Pathology: Medications

Werner: Appendix A

Cardiovascular Disease, continued

Anti-lipemic/Statins: Cholesterol-lowering drugs work by sequestering bile, or by inhibiting cholesterol synthesis. Bile-sequestering drugs promote the excretion of bile in stool, so the liver must use more cholesterol in bile manufacturing. Cholesterol synthesis inhibitors interfere with the ability of the liver to make cholesterol. Both strategies lead to lower low-density lipoprotein levels in the blood.

Examples: Lipitor, Lescol, Lipostat, Crestor, Zocor

Effects / Side Effects: GI pain, constipation, increased risk of gall- stones. Some anti-lipemics can cause leg cramps, fatigue, hypertension, dizziness, depression, and memory loss.

Note: Some anti-lipemic drugs are associated with a risk of muscle pain and injury along with a small chance of rhabdomyolysis, a serious kidney disorder.

Modifications: Massage may help with GI pain and constipation related to cholesterol management drugs, but if symptoms persist they need to be pursued with a doctor. If a client has musculoskeletal symptoms related to medication use, massage therapy may help, but it is important for that person to consult with the prescribing physician.

Diuretics: Fluid retention. Thiazide diuretics prevent sodium from being reabsorbed in the kidney. As it is processed into urine, sodium then pulls water along with it. Loop diuretics target specific parts of the nephron to prevent water and salt reabsorption, but can control the loss of other electrolytes more carefully. Diuretics are used to treat hypertension, heart failure, pulmonary edema, and renal failure.

Examples: Aldactone, Bumex, Esidrix, Lasix, Demadex, Zaroxolyn

Effects / Side Effects: Potassium depletion and other electrolyte imbalances that can cause arrhythmia, nausea, vomiting, headache, weakness, fatigue, cough, GI upset

Modifications: Rigorously applied massage may put an excessive load on the kidneys. Resting hypotension may also be a problem for people taking these medications. Electrolyte changes can contribute to muscle cramps. This needs to be addressed by a doctor rather than by a massage therapist.

Cancer drugs or chemotherapy drugs are a large group that share the goal of attacking cancer cells, cancer drugs are generally toxic to the whole body. Newer drugs can target cancer cells more carefully, but still tax the body as a whole. Some additional drugs are often prescribed to address the side effects of cancer drugs.

Massage should be applied very conservatively, and circulatory massage should be minimized. Timing of the session should be related to excretion rates of the drug, and discussed with the client's physician in detail. Therapist may need to wear gloves in medications are excreted through the client's skin.

Cancer drugs: Target cancer cells and kill them, block the growth of the cells, block the vascular feeding of the cells, or mitigate side effects of other cancer treatment drugs.

Examples: alkylating agents, nitrosoureas, antimetabolites, anti-tumor antibiotics, plant alkaloids, corticosteroids, etc

23a Pathology: Medications

Werner: Appendix A

Cancer drugs, continued

Effects / Side Effects: Fatigue; hair loss; GI irritation and nausea; bone marrow suppression with anemia, thrombocytopenia, and neutropenia; bruising and bleeding; neuropathy; "chemo brain" (poor concentration and memory loss); and more

Modifications: Massage in the context of cancer treatment is a complicated topic and should be done with advanced education. Always get appropriate training, and consult the client's health care team to minimize the risk of causing inadvertent harm. Massage does not spread cancer.

Clot Management Medications to manage blood clots come in three basic forms: anticoagulants to prevent the formation of new clots by inhibiting clotting factors; antiplatelet medications to prevent the clumping of platelets to form new clots; and thrombolytics, which are used to dissolve pre-existing clots. Thrombolytics are used only in emergency situations (i.e., in early treatment for heart attack or ischemic stroke).

Anticoagulants: Some anticoagulants are administered by injection; others are taken orally. All of them alter the formation of clotting factors in the liver to prevent the formation of new clots, although they do not dissolve pre-existing clots. These medications are used for people with atrial fibrillation or a high risk of deep vein thrombosis (DVT) or pulmonary embolism; they are also prescribed for people using hemodialysis. Heparin may also be used in orthopedic surgery to reduce the risk of postsurgical DVT.

Examples: Lovenox, heparin, Coumadin, Xarelto

Effects / Side Effects: Bruising, bleeding, thrombocytopenia, back pain, bradycardia, hypotension

Modifications: All blood-clotting medications carry a risk for bruising, even with relatively light massage. Furthermore, the need for these medications indicates a tendency to form blood clots that may contraindicate all but the gentlest forms of bodywork.

Anti-platelets: These drugs prevent platelets from clumping at the site where a clot might otherwise form. Risk of embolism.

Examples: Aspirin, Plavix, Brilinta, Effient, Persantine

Effects / Side Effects: Bruising, bleeding, thrombocytopenia, flushing, rash, GI pain, headache

Modifications: Although anti-platelet drugs are typically less powerful than anticoagulants, the risk of bruising must still be respected for clients who use them.

Diabetes management When type 2 diabetes cannot be managed by diet and exercise alone, other interventions like starting oral glucose management drugs, and may culminate with the supplementation of insulin in various forms. Insulin cannot be taken orally; it must be injected.

Diabetes management, continued

Type 1 diabetes is managed only with insulin. The implications for diabetes and massage therapists are many and complicated. While many people with diabetes manage their disease well and minimize their risk for secondary complications, others are prone to several problems that pose serious cautions for massage, including systemic atherosclerosis, an increased risk of stroke, diabetic ulcers, and peripheral neuritis/neuropathy, to name a few.

Furthermore, massage therapy appears to lower blood glucose, at least temporarily. is challenge to homeostasis may be enough to trigger a hypoglycemic episode. Massage therapists with diabetic clients should be aware of signs of hypo- and hyperglycemia and should consult with those clients about how best to address their needs in an emergency.

Insulin: Synthetic insulin comes in several forms that can be rapid, short-, intermediate, or long-acting, or mixed. In most cases, it must be injected or applied with a pump under the skin, but one inhalable form (Afrezza) is available for people with type 1 diabetes who also use an injectable long-acting form of insulin.

Oral glucose management: These drugs work in a variety of ways to inhibit the production of sugar in the liver, to improve the output of insulin in the pancreas, and to increase the sensitivity of insulin receptors on target cells.

Examples: Glucophage, Acarbose, Welchol, Bromocriptine, DPP-4 inhibitors, Meglithinides

Effects / Side Effects: Headache, muscle pain, weakness, nausea, diarrhea

Modifications: Any clients who manage their diabetes with any combination of drugs and insulin must be monitored carefully for blood glucose stability. As with insulin, it is safest to work with these clients after the peak of drug activity. If a client reports muscle pain after starting on any form of glucose management drugs, it is important to refer them to their doctor to see if an adjustment in dosage might help.

Insulin: Insulin is a protein-based hormone that would be destroyed by digestive juices if taken orally. Consequently, it is administered by injection, either through multiple daily injections or through an insulin pump. It decreases blood glucose by helping to deliver glucose to cells.

Examples: Humalog, NovoLog, Velosulin, Lantus, Levemir, Tresiba, Humulin, Afrezza

Effects / Side Effects: Irritation, bruising, skin hardening at the injection site, weight gain, peripheral edema

Modifications: Injection sites need to be locally avoided in order not to interfere with normal uptake of the drug. It is best to avoid massaging the injection area for roughly for 24 hours. Because blood glucose stability is an issue for diabetic clients, it is best for them to receive massage in the middle of their insulin cycle, rather than at the end or at the beginning. It is useful for a new client to check blood glucose before and after the session, so that if they need to take in sugar in an easily accessible form, the therapist can plan ahead and have some juice, milk, or glucose tablets available. Call emergency services if client continues to show lethargy/confusion after receiving glucose.

23a Pathology: Medications

Werner: Appendix A

Thyroid Supplements Hypothyroidism is typically treated with supplements to replace thyroid secretions T3 (triiodothyronine) and T4 (thyroxine). Levothyroxine sodium is chemically identical to the thyroid secretion T4. It is meant to be converted in the liver to bioactive T3. is is successful for many but not all people with hypothyroidism. Some patients are not efficient converters of T4, so they need to supplement T3. T3 has traditionally been available in the form of dessicated animal glands, but a synthetic form of T3 is now available, along with a thyroid supplement that includes both T3 and T4.

Levothyroxine Sodium: Synthetic thyroid hormones mimic the action of naturally occurring thyroid hormones to boost protein synthesis in cells, promote the use of glycogen stores, increase heart rate and cardiac output, and increase urine output.

Examples: Synthroid, Levoxyl

Effects / Side Effects: Increased appetite, weight loss, sweating, headache, nervousness, insomnia, anxiety

Modifications: New users of synthetic thyroid supplements may go through a temporary period of nervousness, agitation, and insomnia, which massage therapy may help to improve. If these symptoms persist, the dosage may not be correct, and the person should consult with the prescribing physician.

Someone who has been taking synthetic thyroid supplements for a long time probably has few significant side effects and requires little in the way of massage therapy accommodations.

Desiccated Extract: These forms of thyroid hormone have the same action as synthetic supplements: They mimic the action of naturally occurring thyroid hormones to boost protein synthesis in cells, promote the use of glycogen stores, increase heart rate and cardiac output, and increase urine output. The difference is that the potency of these dosages is more difficult to predict, so users may experience significant fluctuation of symptoms.

Examples: Armour Thyroid, Nature-Throid, WesThroid

Effects / Side Effects: Tremor, increased heart rate, anxiety, insomnia. Note: These are associated with having too much thyroid hormone and indicate that the dosage can be reduced.

Modifications: As with synthetic hormones, a new user may experience increased anxiety, insomnia, or agitation, all of which indicate massage. If symptoms persist, the person needs to consult with the physician. Otherwise, massage is perfectly appropriate for clients who supplement thyroid hormones.

24a A&P: Muscular System – Organization of Skeletal Muscle

Salvo: Chapter 20

Anatomy

Skeletal muscles .
Related fascial structures including tendons and aponeuroses.

Physiology

Movement Skeletal muscle contractions produce movement of the body as a whole, called locomotion, and movement of its parts.

Posture maintenance Skeletal muscles must contract to maintain static postures, such as in sitting and standing.

Moving substances Contraction of skeletal muscles promotes lymphatic flow and blood flow from the extremities to the heart .

Heat production (AKA: thermogenesis) Muscle contractions produce and release heat that is important for homeostasis.

Organization: Muscle Cells into Muscle Organs

Myofilaments Thick and thin protein strands within each sarcomere. Consist of actin and myosin.

Sarcomere A muscle's contractile unit. Found within myofibrils.

Myofibrils Thin strands within each muscle fiber. Contain myofilaments.

Muscle fiber Thread-like muscle cell.

Fasciculi (s. fascicle) Groups of muscle fibers or neurons.

muscle group -> skeletal muscle -> fascicle -> muscle fiber -> myofibril -> myofilament
covered by covered by covered by covered by
deep fascia -> epimysium -> perimysium -> endomysium

24a A&P: Muscular System – Organization of Skeletal Muscle

Salvo: Chapter 20

Connective Tissues

Endomysium Connective tissue layer that surrounds individual muscle fibers .

Perimysium Connective tissue layer that surrounds fascicle .

Epimysium Connective tissue layer surrounding an entire muscle .

Deep fascia Connective tissue layer that surrounds muscle groups .

Myofascial Referring to skeletal muscles and related fascia in the muscular system.

Tendon Cord-like structure anchoring the end of a muscle to a bone.

Aponeurosis (p. aponeuroses) Broad, flat tendon. Attaches skeletal muscle to bone, another muscle, or skin.

Retinaculum (p. retinacula) Bandage-like retaining bands of connective tissue found primarily around the elbows, knees, ankles, and wrists. May also act as a pulley for tendons.

Muscle Cells

Sarcoplasm Muscle cell cytoplasm .

Sarcolemma Muscle cell membrane .

Sarcoplasmic reticulum A fluid-filled system of sacs that store calcium.

T-tubules Runs transversely across the sarcoplasmic reticulum, forming inward channels. Transports stored calcium ions from the sarcoplasmic reticulum into the interior of the muscle cell.

Sarcomere A muscle's contractile unit. Found within myofibrils.

24a A&P: Muscular System – Organization of Skeletal Muscle

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Myofilaments

Thin myofilaments

Actin Protein molecules within a muscle cell that contain binding sites used during skeletal muscle contraction. Help make up thin myofilaments.

Tropomyosin Protein molecule.

Troponin Protein molecule.

Thick myofilaments

Myosin Protein molecules within a muscle cell that attach to actin during skeletal muscle contraction. Make up the bulk of thick myofilaments.

Muscle Cell Properties

Excitability The ability to respond to a stimulus.

Contractility The ability to shorten.

Extensibility The ability to lengthen.

Elasticity The ability to return to its original shape after movement.

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25a A&P: Muscular System – Mechanism of Contraction

Salvo: Chapter 20

Mechanism of Contraction

Nerve impulse Electrical signal that conveys information along a neuron.

Motor neuron Neuron that sends a nerve ___impulse___ to a muscle cell.

Motor unit Single motor neuron plus all the muscle _fibers_ it innervates.

Neuromuscular junction Junction between the ____motor___ neuron and the cell wall of the muscle fiber.

Synaptic cleft (AKA: synaptic gap) Space between the end of a motor neuron and another neuron, muscle cell, or gland.

Acetylcholine Neurotransmitter that crosses the synaptic cleft.

25a A&P: Muscular System – Mechanism of Contraction

Salvo: Chapter 20

Mechanism of Contraction, continued

Non-Contracting State: "Two protein molecules, troponin and tropomyosin, are positioned on thin myofilaments to block myosin binding sites. Without these regulatory proteins, muscles would be in a constant state of contraction."

Excitation of the Sarcolemma: "The contraction of a skeletal muscle begins with a nerve impulse sent from the central nervous system. When the nerve impulse reaches the neuromuscular junction, calcium ions are released from the sarcoplasmic reticulum."

Cross-Bridging: "Now that calcium is present in the sarcomere, it binds to troponin causing tropomyosin to slide off and expose the site allowing myosin heads to bind to thin myofilaments."

Power Stroke: "Myosin heads, which are hinged at their base, then toggle in a mechanism similar to a light switch. This action causes thin myofilaments to slide toward the center of the sarcomere which shortens the overall length of the muscle fiber. Yeah! We have contraction!"

25a A&P: Muscular System – Mechanism of Contraction

Salvo: Chapter 20

Mechanism of Contraction, continued

Detachment: "If ATP (adenosine triphosphate) is present, myosin heads then detach themselves, bind to the next exposed site, and pull again."

All or None Response: "When a motor neuron delivers a stimulus of contraction, all the muscle fibers of the motor unit receive the same signal at the same time and contract to their fullest extent. There is no partial contraction."

Recruitment: "Numerous motor units are linked to a single skeletal muscle. The nervous system regulates the amount of muscular contraction by activating only the motor units needed to perform a given action. If more strength is required, then additional motor units are recruited resulting in a stronger muscle contraction."

Relaxation: "Almost immediately after the sarcoplasmic reticulum releases calcium ions into the sarcomeres, it begins to actively pump them back into its sacs. Freed from its chemical bond with the calcium ions, the tropomyosin slides back to cover the myosin binding sites on thin myofilaments. This action releases the myosin heads and returns them to their pre-contraction resting state. The muscle is now at rest."

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26a A&P: Muscular System – Fiber Types, Actions, and Contractions

Salvo: Chapter 20

Energy Sources for Contraction

Adenosine triphosphate (AKA: ATP) The body's energy storage molecule.

Fuel Glucose, fat, or, rarely, protein. Used to form ATP in the mitochondria. By-products are CO2 and water (from aerobic metabolism), or, from the initial anaerobic process (which only uses carbohydrate, and not O2), lactic acid.

Oxygen Combined with fuel in the mitochondria during aerobic metabolism, yielding energy (for making ATP) plus CO2 plus H2O.

Types of Skeletal Muscle Fibers

Slow twitch (AKA: red muscle) Skeletal muscle fibers that contract slowly and are fatigue resistant. Examples: postural muscle, core muscle, or legs of long distance runners.

Fast twitch (AKA: white muscle) Skeletal muscle fibers that contract forcefully and fatigue rapidly. Examples: arm muscles.

Intermediate twitch (AKA: pink muscle) Skeletal muscle fibers that are more fatigue resistant than fast twitch, and more forceful than slow twitch. Examples: legs of world class sprinters and arms of world class boxers.

26a A&P: Muscular System – Fiber Types, Actions, and Contractions

Salvo: Chapter 20

Parts of a Skeletal Muscle

Belly The wide central portion of a skeletal muscle that contains the sarcomeres.

Origin Tendinous muscle attachment on the ___less___ movable bone or other structure. Typically medial or proximal to the insertion.

Insertion Tendinous muscle attachment on the ___more___ movable bone or structure. Typically lateral or distal to the origin.

Muscles Actions

Prime mover (AKA: agonist) Muscle responsible for causing a specific or desired action.

Antagonist Muscles that must relax and lengthen or eccentrically contract and lengthen to ___allow___ the actions of the prime mover to occur.

Synergist Muscle that aids movement by contracting at the ___same___ time as the prime movers.

Fixator Specialized synergist muscle that act as a ___stabilizer___.

26a A&P: Muscular System – Fiber Types, Actions, and Contractions

Salvo: Chapter 20

Types of Muscle Contractions

Isotonic contraction Contraction in which muscle changes length.

- **Concentric contraction** Isotonic contraction. The muscle shortens.
- **Eccentric contraction** Isotonic contraction. The muscle lengthens.

Isometric contraction Contraction in which muscle length remains the same.

Stretching and Stretch Receptors

Muscle spindle Stretch receptor located within the muscle belly. Detect sudden stretching, causing the nervous system to respond by reflexively contracting the muscle.

Golgi tendon organ Receptor located at the musculotendinous junction. Detect tension and excessive stretch, causing the nervous system to respond by inhibiting contraction.

Posture and Muscle Tone

Muscle tone (AKA: tonus) Continued partial contraction of skeletal muscle.

Flaccid Skeletal muscle with less tone than normal.

Spastic Skeletal muscle with more than normal tone.

Effects of Massage Therapy on the Muscular System (pages 99-102)

Decrease tension within the muscle-tendon unit.

Increase range of motion (ROM).

Decrease delayed onset muscle soreness (DOMS).

Enhance exchange of nutrients and waste to speed recovery from fatigue/soreness.

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27a Pathology: Musculoskeletal System

Werner: Chapter 3

Muscle Disorders

Muscular dystrophy Group of several closely related diseases characterized by genetic anomalies that lead to the degeneration and wasting away of muscle tissue.

Spasms Low-grade and long-lasting involuntary contractions of skeletal muscles or muscle groups.

Cramps (AKA: charley horse) Strong, painful, and usually short-lived involuntary contractions of skeletal muscles or muscle groups.

Fasciculations (AKA: twitching) Painless momentary contraction of a small number of superficial muscle fibers.

Strains Injuries to muscle fibers involving the tearing of muscle fibers and production of scar tissue.

Bone Disorders

Osgood-Schlatter disease (AKA: OSD) Irritation and inflammation at the site of quadriceps attachment on the tibial tuberosity. Due to vigorous use and rapid leg bone growth.

Osteoporosis Calcium is pulled off the bones faster than it is replaced, leaving them thin, brittle and prone to injury.

Osteopenia Pathological thinning of bones that may be a precursor to osteoporosis.

Hyperkyphosis A deformity of the spine characterized by extensive flexion.

Hyperlordosis A deformity of the spine characterized by extensive extension.

Scoliosis Abnormal lateral curve of the vertebral column.

Rotoscoliosis Combined lateral and rotational deviation of the vertebral column.

27a Pathology: Musculoskeletal System

Werner: Chapter 3

Joint Disorders

Adhesive capsulitis (AKA: frozen shoulder) Inflammatory thickening of a joint capsule, usually at the shoulder, leading to loss of range of motion.

Baker cysts (AKA: popliteal cysts) Synovial cysts found in the popliteal fossa, usually on the medial side.

Gout Type of inflammatory arthritis caused by uric acid deposits in and around joints, especially the feet.

Dislocations Articulating bones are no longer touching; the shared surfaces have become disconnected.

Subluxations Bones are out of best alignment, but the joint capsule is intact. The joint is functional, but lacks full range of motion.

Dysplasia Congenital anomaly that involves the formation of an abnormal acetabulum or femoral head. Increases risk of subluxation and dislocation.

Joint replacement surgery (AKA: arthroplasty) Procedure to repair articulating surfaces within a synovial joint. The goal is reduced pain with joint movement although the range of motion may be permanently limited.

27a Pathology: Musculoskeletal System

Werner: Chapter 3

Joint Disorders, continued

Lyme disease Infection with Borrelia burgdorferi bacteria resulting in joint inflammation as well as neurological and cardiovascular symptoms.

Osteoarthritis (AKA: degenerative joint disease) Synovial joint inflammation caused by hyaline articular cartilage that has been damaged by wear and tear.

Patellofemoral syndrome (AKA: PFS) Patellar cartilage becomes irritated and damaged as it repeatedly contacts femoral cartilage. Usually a precursor to osteoarthritis due to overuse.

Spondylolisthesis Structural problem in the lumbar spine that allows one or more vertebral bodies to slip anteriorly resulting in pressure on the nerve roots or spinal cord.

Spondylosis Degenerative arthritis involving age-related changes of the vertebrae, discs, joints, and ligaments of the spine.

Sprains Torn or permanently stretched ligaments.

Temporomandibular joint dysfunction (TMJ dysfunction) Umbrella term that can refer to a multitude of common problems in and around the jaw. Signs and symptoms include dysfunctional bite (malocclusion), teeth grinding (bruxism), and loose ligaments surrounding the jaw.

27a Pathology: Musculoskeletal System

Werner: Chapter 3

Fascial Disorders

Compartment syndrome Injury or repetitive stress creates pressure inside a tight fascial compartment that can lead to the starvation and death of muscle and nerve cells.

Dupuytren contracture (AKA: palmar fasciitis) Idiopathic thickening and shrinking of the palmar fascia that limits movement of the fingers.

Ganglion cyst Small connective tissue pouches filled with fluid that grow on joint capsules or tendinous sheaths.

Hammertoe Foot deformity that affects the lateral toes by permanently shortening the muscles and tendons. Results in hyperextension at the metacarpal-phalangeal and distal interphalangeal joints, but flexion at the proximal interphalangeal joint.

Hernia Hole or rip in fascia through which structures such as muscles or vertebral discs may protrude.

- **Inguinal hernia** Hole in the abdominal wall at the inguinal ring caused by a sudden change in abdominal pressure such as coughing, sneezing, or heavy lifting especially with simultaneous twisting.

- **Hiatal hernia** Enlargement of the diaphragmatic hiatus allowing the esophagus to pass from the thorax to the abdomen or the stomach to protrude into the thorax. Major contributor to gastroesophageal reflux disorder (GERD).

27a Pathology: Musculoskeletal System

Werner: Chapter 3

Fascial Disorders, continued

Plantar fasciitis (AKA: PF) Pain in the plantar fascia caused by repeated microscopic injury and collagen degeneration.

Pes planus (AKA: flat feet) Feet that lack the medial, lateral, and transverse arches of the plantar surface of the foot.

Pes cavus (AKA: high arches) Feet with hyperaccentuated arches that do not flatten out with each step, but instead stay high and immobile.

Neuromuscular Disorders

Carpal tunnel syndrome (AKA: CTS) Set of signs and symptoms brought about by the entrapment of the median nerve between the carpal bones of the wrist and the transverse carpal ligament that holds down the flexor tendons.

Disc disease Collection of problems in which the nucleus pulposus and/or annulus fibrosus of an intervertebral disc extends beyond its normal borders.

Herniated disc The nucleus pulposus of a vertebral disc extends beyond the vertebral body.

- **Bulge** Entire disc protrudes symmetrically.
- **Protrusion** Nucleus pulposus extends out in one direction.
- **Extrusion** Narrow piece of the nucleus pulposus protrudes.
- **Rupture** Nucleus pulposus bursts and leaks its entire contents.

27a Pathology: Musculoskeletal System

Werner: Chapter 3

Neuromuscular Disorders, continued

Myofascial pain syndrome (AKA: MPS) Condition involving the development of many myofascial trigger points.

Thoracic outlet syndrome (AKA: TOS) Nerves of the brachial plexus or blood vessels running to or from the arm are impinged or impaired at one or more of three places: anterior/medial scalenes, clavicle/ribs, pectoralis minor/ribs.

Other Connective Tissue Disorders

Bunions (AKA: hallux valgus) Bursa protrusion at the metatarsophalangeal joint of the great toe that occurs when the great toe is laterally deviated.

Bursitis Inflammation of a bursa due to irritation and generation of excess fluid.

Shin splints Variety of lower leg problems including medial tibial stress syndrome, periostitis, and stress fractures.

Tendinitis Acute tendon injury leading to inflammation.

Tendinosis Long-term degeneration of collagen fibers in tendons.

Tenosynovitis Irritation developing where tendons slide through their synovial sheaths.

De Quervain tenosynovitis Tenosynovitis of the abductor and extensor pollicis tendons.

Whiplash (AKA: cervical acceleration-deceleration, CAD) Mixture of injuries including sprains, strains, and joint trauma associated with the head whipping backward and then forward in rapid succession.

28a A&P: Integumentary System

Salvo: Chapter 22

Introduction

The integumentary system includes the skin and its appendages such as hair, nails, and glands that produce oil or sweat .

The skin houses more than half a million sensory receptors of pressure, pain, heat, cold, movement, and vibration.

Skin is composed mostly of connective tissue underneath a layer of epithelial tissue.

No other body system is more easily exposed to infections, disease, pollution, or injury than the skin.

The appearance of the skin reflects our physiology, including information about a person's nutrition, hygiene habits, circulation, age, immunity, genetics, and environmental factors.

Skin also mirrors our emotional self through muscular expression and neurological impulses.

Anatomy

- Skin
- Hair
- Nails
- Skin glands

28a A&P: Integumentary System

Salvo: Chapter 22

Physiology

Protection Physical, biologic, and chemical barrier.

Absorption Fat-soluble molecules and vitamins, steroids, resins of plants such as poison ivy and poison oak, and salts of heavy metals.

Sensation Extension of the ____nervous_____ system. Receives stimuli such as pressure, pain, and temperature.

Body temperature regulation As blood moves to the skin's surface and blood vessels dilate, heat is discharged. Heat can be dissipated through the evaporation of sweat produced by sweat glands.

Waste regulation Eliminating wastes through _____sweating_____.

Vitamin D synthesis Molecules in the skin are converted to vitamin D by the __UV__ rays in sunlight (with a little help from liver and kidney enzymes).

Immunity Langerhans cells trigger immunologic reactions.

Regions of the Skin

1. Epidermis
2. Dermis
3. Subcutaneous layer

Epidermis

Epidermis ____Outer_____ region of the skin. Composed of epithelial cells.

Keratinocyte Epidermal cell that produces ____keratin_____, a protein that waterproofs the skin.

Melanocyte Epidermal cell that produces _____melanin_____, a pigment that contributes to skin color and decreases the amount of ultraviolet light that can penetrate into the deeper layers of the skin.

Langerhans cell Epidermal cell that triggers immunologic reactions.

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Epidermis, continued

Epidermal Layers (from deepest to most superficial):

Stratum germinativum ____Deepest_____ epidermal layer. Through cell division it generates all of the other layers.

Contains Merkel cells and pressure receptors.

Stratum spinosum Bonding and transitional epidermal layer between germinativum and granulosum.

Stratum granulosum Epidermal layer containing an accumulation of keratin granules.

Stratum lucidum Translucent epidermal layer only found in the ____thick_____ skin of palms and soles.

Stratum corneum Outermost epidermal layer where cells are completely keratinized, not ____living_____, and ready to be sloughed off.

Dermis

Dermis (AKA: corium, hide, true skin) Inner region of the skin. Contains blood vessels, sensory ____nerve_____ receptors, hair follicles, muscles, sweat and oil glands, and connective tissue.

Scar A dense collection of new connective tissue that forms as the result of an injury to the dermis.

Subcutaneous Layer

Subcutaneous layer (AKA: hypodermis or superficial fascia) Layer beneath the dermis but not a true layer of skin. Consists of loose connective tissue, fat, and nerve receptors.

Hair

Hair Composed of keratinized _____filaments_____ arising from pouch-like follicles located in the dermis. Protects the scalp from injury and UV radiation. Protects the eyes, nose, and ears from foreign particles.

Arrector pili Tiny _____muscle_____ attached to hair follicles that contract to pull the hair upright.

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Skin Glands

Sebaceous gland Skin gland that secretes ___sebum_____ (oil) to lubricate both the hair and the epidermis.

Sudoriferous gland Skin gland that secretes _____sweat_____in response to excess heat. Types: eccrine (all over), apocrine (axilla, genitals).

Nails

Nail Compact keratinized ____cells_____ that form the hard thin plates found on the distal surfaces of the fingers and toes. Protect the ends of fingers and toes. Used as tools for digging, scratching and manipulation of objects.

Nervous System's Role in Touch

Discriminative touch Touch that is subtle and can be easily located on the skin.

Crude touch Touch that is more easily identified, but is more difficult to locate on the skin.

Meissner corpuscle (AKA: tactile corpuscle) Receptor that mediates sensations of discriminative touch such as ____light_____ versus deep pressure, as well as low-frequency vibration.

Ruffini corpuscle Receptor that mediates deep or ____continuous____ pressure. They adapt slowly and permit the body to stay in contact with grasped objects. May also detect heat.

Pacinian corpuscle Receptor that responds to crude and deep pressure, vibration, and stretch, and perceives __proprioceptive_____ information about joint positions.

Krause end bulb Receptor involved in discriminatory touch and low-frequency vibration. May also detect cold.

Merkel disk Receptor that responds to _discriminative_ touch and discriminative touch.

Hair root plexus (AKA: hair follicle receptor) Receptor that responds to light touch and ____hair_____ movement.

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Lesions

Lesion Wound or injury. Pathogenic change in tissues.

"If the skin is not intact, the client is susceptible to infection."

Common Skin Lesions

Laceration Rip or tear.

Incision Cut.

Excoriation Scratch.

Papule Firm raised areas, like pimples.

Vesicle Blister.

Pustule Vesicle filled with pus, like a whitehead.

Puncture Hole.

Avulsion Something that has been ripped off.

Abrasion Scrape.

Ulcer Sore with dead tissue. Doesn't go through a normal healing process.

Contagious Skin Disorders

Animal parasite Animal that lives in/on humans or their clothing, and draws nutrients from a host. All types contraindicate massage.

- **Mites** Cause skin lesions called scabies. Prefer warm, moist places such as the axillae or between fingers. Leave itchy trails or nodules where they burrow under the skin.
- **Head lice** Wingless insects that live in head hair and suck blood from the scalp.
- **Body lice** Wingless insects that live in the seams of host's clothing.
- **Pubic lice** Tiny crab-like insects that live in pubic and armpit hair, mustaches, beards, eyebrows, and eyelashes.
- **Pediculosis** Infestation of lice.

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Contagious Skin Disorders, continued

Mycoses (AKA: dermatophytoses) Fungal infections of human skin caused by several different types of fungi called dermatophytes. Result in lesions called tinea that locally contraindicate massage.

- **Tinea capitis** Fungal infection of the scalp.
- **Tinea corporis (AKA: body ringworm)** Fungal infection that typically develops on the trunk or extremities as red circles or rings.
- **Tinea cruris (AKA: jock itch)** Fungal infection of the groin area.
- **Tinea pedis (AKA: athlete's foot)** Fungal infection of the feet.
- **Tinea manuum** Fungal infection of the hands.
- **Onychomycosis (AKA: tinea unguium)** Fungal infection of the fingernails or toenails.

Herpes simplex Contagious viral infection resulting in painful blisters on a red base. Locally contraindicates massage during the acute stage.

- **Herpes simplex virus type 1 (AKA: HSV-1)** Viral infection associated with herpes lesions around the mouth.
- **Herpes simplex virus type 2 (AKA: HSV-2)** Viral infection associated with herpes lesions in the genital area.

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Contagious Skin Disorders, continued

Staphyloccocal infections (AKA: staph) Variety of localized infections caused by a common group of bacteria that is known for colonizing human skin and nasal passages. Locally contraindicate massage.

- **Boils (AKA: furuncles)** Local staph infections of the skin that occur one at a time. Has a lot in common with acne, but is a virulent and aggressive bacterium that actively attacks healthy tissue.

- **Carbuncle** Group of boils connected by channels under the skin.

- **MRSA (AKA: methicillin-resistant staphylococcus aureus)** Group of infection-causing staph bacteria associated with healthcare facilities and high-density, low-hygiene settings.

- **Folliculitis** Multiple boils in close proximity usually affecting hair follicles. Outbreak occurs in a predictable diamond-shaped pattern. Frequently accompanied by mild fever and headache.

- **Sty** Version of folliculitis that affects hair follicles of an eyelash.

- **Pilondial cyst** Large staph infection within a cyst in the gluteal cleft.

- **Hidradentis suppurativa** Boils that occur in the axillae or groin.

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Contagious Skin Disorders, continued

Streptococcal infections (AKA: strep) Group of skin infections that involve one of the group A class of streptococcus bacteria. Absolutely contraindicates massage.

- **Cellulitis** Streptococcal infection of deep layers of the skin. It is a common complication of simple injuries such as a scraped knee or a contaminated blister from athlete's foot.

- **Necrotizing fasciitis** Flesh-eating bacteria infection most commonly caused by streptococcus bacteria that can cause circulatory shock and death. Can progress from a minor skin wound to a life-threatening infection in a matter of hours.

Warts Small, benign growths caused by varieties of human papillomavirus (HPV) that invade kerationcytes deep in the stratum germinativum of the skin and some mucous membranes. Locally contraindicated.

- **Common warts (AKA: verruca vulgaris)** Hard, flaky nodules on the hands, knees, and elbows that vary in size.

- **Plantar warts (AKA: myrmecia)** Warts on the soles of the feet that protrude and can be easily mistaken for a callus.

- **Cystic warts** Warts on the soles of the feet that are smooth and soft.

- **Plane warts (AKA: flat warts)** Small, brown, smooth warts. Commonly found on the hands, face, and shins and may be spread during shaving.

- **Genital warts** Sexually transmitted infection caused by several varieties of HPV. Most come and go with no symptoms, but others may trigger cellular activity leading to cervical cancer.

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Non-Contagious Inflammatory Skin Disorders

Acne rosacea Idiopathic chronic inflammatory condition involving facial skin and eyes. Massage may exacerbate this condition.

Acne vulgaris Small, localized skin lesions usually affecting sebaceous glands on the face, neck, and upper back. Closely associated with adolescence, but can persist well into adulthood. Locally contraindicates massage.

Dermatitis Umbrella term meaning non-infectious skin inflammation.

Eczema Non-contagious skin rash brought about by a systemic hypersensitivity reaction. Commonly seen along with allergic sinusitis (hay fever) and asthma.

Contact dermatitis Skin inflammation caused by an externally applied irritant or allergen such as poison ivy, metals, soaps, dyes, or latex.

Neoplastic Skin Disorders

Seborrheic keratosis (SK) Common non-contagious condition involving single or multiple benign skin growths that usually affect mature adults. Local caution if they itch or bleed. May be irritated by friction.

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Werner: Chapter 2

Neoplastic Skin Disorders, continued

Skin cancer Group of diseases involving potentially malignant changes in epidermal cells. Undiagnosed skin lesions are locally contraindicated.

- **Basal cell carcinoma (BCC)** Most common type of skin cancer. Slow-growing tumor of stratum germinativum cells on the face or head.

- **Squamous cell carcinoma** Skin cancer that arises in keratinocytes that are superficial to the stratum germinativum.

- **Melanoma** Cancer of the pigment cells deep in the epidermis. Metastasizes readily and is the leading cause of death by skin cancer. ABCs of recognizing malignant melanoma:
  - Asymmetrical: irregular in shape
  - Border: inconsistent
  - Color: multicolored
  - Diameter: greater than 6mm
  - Elevated or Evolving

Skin Injuries

Burns Damage to skin caused by heat, radiation, corrosive chemicals, and electricity. Contraindicate massage due to risk of infection and pain.

- **First degree or superficial burn** Burn involving mild but painful irritation of the superficial epidermis. Red without blisters. Example: sunburn.

- **Second degree or partial thickness burn** Burn involving damage to deeper layers of the epidermis. Redness, blisters, and a permanent scar.

- **Third degree or full thickness burn** Burn that penetrates down to the dermis or deeper damaging glands, hair shafts, nerve endings, and muscle tissues.

Decubitus ulcer (AKA: bedsores, or pressure sores) Lesions caused by impaired circulation to the skin because of external pressure. Leads to localized cell death. A high risk of secondary infection contraindicates massage.

Scar tissue Development of new cells and extracellular matrix after an injury, infection, or surgery. Contraindicates massage if still injured and not yet healed.

35a A&P: Cardiovascular System – Blood Cells, Tissues, and the Heart

Salvo: Chapter 26

Anatomy

Blood

Blood vessels such as arteries, ___veins___, and capillaries

Heart

Physiology

Transportation The process of transporting respiratory gases, nutrients from the digestive tract, antibodies, waste ___materials___, and hormones from the endocrine glands, heat from active muscles to the skin.

Protection The process of protecting the body through disease-fighting white blood cells and the removal of ___impurities___ and pathogens.

Combat hemorrhage The process of preventing the loss of body fluids from damaged vessels through ___clotting___ mechanisms.

Blood

Blood Liquid connective tissue composed of plasma, erythrocytes, leukocytes, and thrombocytes.

Formed elements

Erythrocyte ___Red___ blood cell. Transports oxygen and carbon dioxide.

Leukocyte ___White___ blood cell. Serves as a part of the body's immune system.

Thrombocyte Platelet. Prevents blood loss through clotting mechanisms.

- **Thrombus** Stationary blood clot.
- **Embolus** Floating mass of broken thrombus flowing through the blood stream.
- **Embolism** Blockage of a blood vessel with an embolus.

Plasma Liquid portion of blood.

35a A&P: Cardiovascular System – Blood Cells, Tissues, and the Heart

Salvo: Chapter 26

Heart

Heart Wall

Pericardium Tissue that surrounds the heart and secretes a lubricating fluid that prevents friction.

Epicardium Thin outer connective tissue layer. Possesses adipose tissue and coronary vessels.

Myocardium Thick muscular layer that makes up the bulk of the heart wall. Its contraction forces blood out of the ventricles.

Endocardium Thin, inner lining of the heart. Continuous with the endothelial lining of the heart chambers and blood vessels, as well as the valves of the heart.

Heart Chambers

Atrium (p. atria) Superior heart chamber.

Ventricle Inferior heart chamber.

Heart Valves

Atrioventricular Valves

Mitral valve (AKA: bicuspid valve or left A-V valve) Valve located between the left atrium and left ventricle.

Tricuspid valve (AKA: right A-V valve) Valve located between the right atrium & right ventricle.

Semilunar Valves

Pulmonary valve (AKA: right semilunar valve) Valve between the right ventricle and the pulmonary trunk.

Aortic valve (AKA: left semilunar valve) Valve between the left ventricle and the aorta.

Coronary vessels Arteries and veins that circulate blood to and from the myocardium.

35a A&P: Cardiovascular System – Blood Cells, Tissues, and the Heart

Salvo: Chapter 26

Heart, continued

Blood Flow Through the Heart

Stage 1 Oxygen-depleted blood enters the superior and inferior vena cava and flows into the right atrium. When the __right__ atrium is full, it empties through the tricuspid valve into the __right__ ventricle. Occurs at the same time as Stage 3.

Stage 2 The __right__ ventricle contracts and pushes blood through the pulmonary valve into the pulmonary trunk. The pulmonary trunk then divides into left and right pulmonary arteries which take blood to each lung. Four pulmonary veins leave the lungs and carry oxygen-rich blood back to the _____ atrium.

Stage 3 Blood leaves the __left__ atrium and passes through the left ventricle through the mitral valve. The left ventricle contracts and pushes blood through the aortic valve into the aorta and descending aorta and to all parts of the body except the lungs. Occurs at the same time as Stage 1.

1. Superior and inferior vena cavae
2. Right atrium
3. Tricuspid valve (right A-V valve)
4. Right ventricle
5. Pulmonary semilunar valve
6. Pulmonary trunk
7. Pulmonary arteries
8. Lungs
9. Pulmonary veins
10. Left atrium
11. Mitral valve (bicuspid valve, left A-V valve)
12. Left ventricle
13. Aortic semilunar valve
14. Aorta (ascending and descending aortae)

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36a A&P: Cardiovascular System – Blood Vessels/Paths of Circulation

Salvo: Chapter 26

Blood Vessels

Walls of Arteries and Veins

Tunica interna (AKA: tunica intima) Innermost layer of a blood vessel. Endothelium fused with a small quantity of elastic connective tissue. Valves assist venous return by only allowing blood to move back toward the heart.

Tunica media Middle layer of a blood vessel. Contains both connective tissue and smooth muscle.

Tunica externa (AKA: tunica adventitia) Outer layer of a blood vessel. Possesses mostly dense connective tissue.

Lumen The open space within a tube such as an artery, vein, or intestine.

Vasodilation Enlargement of the vascular lumen's diameter.

Vasoconstriction Narrowing of the vascular lumen's diameter.

Hyperemia Increased local blood flow causing the skin to become reddened and warm.

Ischemia Local abnormal decrease in blood flow. Often marked by pain and tissue dysfunction.

Arteries

Artery Vessel that carries blood away from the heart to the tissues of the body.

Arterioles Small-sized arteries.

36a A&P: Cardiovascular System – Blood Vessels/Paths of Circulation

Salvo: Chapter 26

Arteries, continued

Ascending aorta Very large artery that begins at the left ventricle and travels superiorly.

Descending aorta Very large artery that is a continuation of the ascending aorta that branches off and travels inferiorly.

Common carotid arteries Two arteries located in the throat.

Pulse Expansion effect of arteries that occurs when the left ventricle contracts and produces a ____wave_____ of blood that surges through and expands arterial walls.

Capillary Vessel between an arteriole and a venule. Possesses a thin, permeable membrane for efficient gas exchange with tissues.

Microcirculation Flow of blood through a capillary ___bed___.

Veins

Vein Vessel that carries blood toward the heart.

Venule Small-sized vein that connects with capillaries.

Superior vena cava Very large vein that empties blood from the head and arms into the right atrium.

Inferior vena cava Very large vein that empties blood from the abdomen into the right atrium.

Jugular Vein in the throat that drains blood from the face, head, neck, and brain.

Avascular Lacking blood vessels.

36a A&P: Cardiovascular System – Blood Vessels/Paths of Circulation

Salvo: Chapter 26

Blood Vessels, continued

Venous Return

Venous return Veins return blood to the heart passively.

Venomotor tone Changes in smooth muscle tone in the walls of veins can increase or decrease venous circulation.

Skeletal muscle pump Skeletal muscles contract and squeeze venous walls which moves blood toward the heart.

Respiratory pump Pressure changes in the thorax and abdomen caused by skeletal muscular contractions of breathing muscles that act as a mechanism to assist venous return.

Blood Pressure

Blood pressure Pressure exerted by blood on the blood vessel walls.

Systolic pressure Maximal pressure in blood pressure measurement. Occurs when the left ventricle contracts.

Diastolic pressure Lowest pressure in blood pressure measurement. Occurs when the left ventricle relaxes.

High blood pressure (AKA: hypertension) Persistently more than 140/90.

Average blood pressure 120/80.

Low blood pressure (AKA: hypotension) Persistently less than 90/60.

36a A&P: Cardiovascular System – Blood Vessels/Paths of Circulation

Salvo: Chapter 26

Paths of Circulation

Pulmonary circuit Circuit that brings de-oxygenated blood from the right ventricle of the heart to the lungs to release carbon dioxide and regain oxygen, then transports the oxygenated blood to the left atrium.

Systemic circuit Circuit that brings oxygenated blood from the left ventricle of the heart though numerous arteries into the capillaries, then moves it through the veins and returns the now de-oxygenated blood to the right atrium of the heart.

1. Left ventricle
2. Aortic semilunar valve
3. Aorta
4. Ascending and descending aortae
5. Arteries
6. Arterioles
7. Capillaries
8. Venules
9. Veins
10. Inferior and superior vena cavae
11. Right atrium

37a Pathology: Circulatory System

Werner: Chapter 5

Blood Disorders

- **Anemia** Shortage of red blood cells or hemoglobin that limits oxygen carrying capacity. May cause fatigue, pallor, dyspnea, rapid heartbeat, intolerance to cold, or heart problems.

- **Embolus** Traveling clot or collection of debris. May cause blockage in lungs (if originating on the venous side) or brain, heart, kidneys or legs (if originating on the arterial side).

- **Embolism** The occlusion of a blood vessel by an embolus.

- **Thrombus** Blood clot formed in the wall of an artery or vein. If it breaks loose it becomes an embolus, and may lodge in the lungs, brain, heart, kidneys or other places.

- **Hemophilia** Collection of genetic disorders. Absence of plasma proteins that are crucial in the clot-forming process puts person at risk of serious complications due to inability to clot in normal amount of time.

- **Leukemia** Cancer that affects bone marrow cells, causing overproduction of non-functioning white blood cells.

- **Myeloma** Blood cancer involving B cells maturing in bone marrow.

- **Sickle cell disease** Faulty gene causes the production of short-lived and misshapen red blood cells.

- **Thrombophlebitis** Blood clots obstructing superficial leg veins – usually involves inflammation.

- **Deep vein thrombosis (AKA: DVT)** Blood clots obstructing deep leg veins – a more serious risk for embolism than thrombophlebitis - often occurs with no significant symptoms.

37a Pathology: Circulatory System

Werner: Chapter 5

Vascular Disorders

- **Aneurysm** Permanent bulge in the wall of a vein, artery, or heart. Aortic or cerebral most common. Risk of rupture and internal bleeding.

- **Atherosclerosis** Arteries become inelastic, brittle, and hardened. May be compounded by local spasm and blood clot formation, increasing risk of thrombosis and embolism.

- **Hypertension (AKA: high blood pressure)** Persistently above 140/90. Can lead to edema, atherosclerosis, stroke, enlarged heart, aneurysm, kidney disease or retinopathy.

- **Raynaud syndrome** Episodes of vascular constriction followed by dilation of the arterioles, usually in the fingers and toes. Pain, numbness and/or tingling may follow.

- **Varicose veins** Permanently distended superficial leg veins, due to weakening of vessel walls and compromised valves.

Heart Conditions

- **Heart attack (AKA: myocardial infarction)** Damage to the myocardium caused by obstructed coronary vessels. Dead cells are replaced by non-contractile scar tissue.

- **Heart failure** Progressive loss of cardiac function resulting in the heart not being able to keep up with the needs of the body. This may result in edema in the lungs, legs, or abdomen, enlarged liver, or renal failure.

- **Cardiac arrest** Heart completely stops working.

38a A&P: Lymphatic System and Immunity

Salvo: Chapter 27

Anatomy

Lymph

Lymph vessels

Lymph glands, such as the thymus

Lymphatic organs such as the spleen

Lymph nodes

Lymphocytes

Physiology

Transportation The process of transporting dietary proteins, lipids, and lipid-soluble vitamins such as A, D, E, and K from the digestive tract to the blood.

Immune response The process of active immune defense.

Maintains homeostasis The process of collecting accumulated tissues fluid and returning it to blood circulation. This maintains blood volume, blood pressure, and prevents edema (swelling).

Lymph

Lymph Liquid connective tissue that is part of the lymphatic system. Nearly colorless fluid. Chemically it is very similar to blood plasma. Contains white blood cells, proteins, and fats.

Lymph Vessels

Lymph capillary Tiny, open-ended channel located in tissue space throughout most of the body.

38a A&P: Lymphatic System and Immunity

Salvo: Chapter 27

Lymph Vessels, continued

Lymph vessel Larger vessel than a lymph capillary. Has __thinner__ walls and more __valves__ than veins. Has lymph nodes situated along them.

Lymphatic trunk Made up of large vessels into which lymph is drained from the lymph vessels.

Lymphatic duct The joining of lymphatic trunks. Examples:

- Right lymphatic duct drains the right side of the head, right arm, and right torso.
- Thoracic duct drains the rest of the body.

Lymphatic Structures

Red bone marrow Blood forming cells found in flat and long bones. Produce red blood cells, platelets, and white blood cells (specifically lymphocytes called B cells).

Lymphocyte Type of white blood cell. Examples: B cell, T cell, macrophage.

Thymus Bi-lobed gland posterior to the __sternum__. Secretes thymosin and thymopoietin, which stimulate the production and activation of T-cells.

Spleen Largest lymphatic organ. Located within the left lateral rib cage just posterior to the stomach. Stores __lymphocytes__, releasing them during immune responses.

Lymph node Bean-shaped structure located along lymph __vessels__. Filters lymph. House phagocytes and lymphocytes that destroy pathogens and other foreign substances in the lymph before it returns to the blood.

38a A&P: Lymphatic System and Immunity

Salvo: Chapter 27

Lymphatic Structures, continued

Mucosa-associated lymphoid tissue (AKA: MALT) Small masses of lymph_____tissue_____ in respiratory and digestive tracts. Examples: tonsils, Peyer patches, and vermiform appendix.

Lymph Flow

Lymphatic drainage The ____movement____ of lymph.

Lymphatic pump The mechanism of lymphatic drainage that uses pressure gradients from external sources exerted on its vessel walls to move lymph.

Examples:

- Skeletal muscle contractions against vessel walls
- Pressure changes in the thorax and abdomen during __breathing____
- Pulling of the skin and fascia during ___movement_____
- Contraction of smooth muscle in the walls of lymphatic vessels
- Rhythmic pumping of ___walking___ and grasping

38a A&P: Lymphatic System and Immunity

Salvo: Chapter 27

Immunity

Immunity Reaction that involves ___all___ body systems as they join together to destroy and eliminate pathogens, foreign substances, or toxic materials.

Non-specific immunity (AKA: innate immunity) Non-specific response to invading pathogens. Includes intact skin and mucous membranes, saliva, gastric juices, vomiting, urine flow, certain white blood cells, fever, and inflammation.

Specific immunity (AKA: adaptive immunity) Body's response to invaders. T cells and B cells become activated for a specific pathogen after they come into contact with it and then destroy it.

T cells Lymphocytes that begin as ___ cells that migrate from bone marrow to the thymus where they fully mature. They recognize pathogens and respond by releasing inflammatory and toxic substances.

B cells Lymphocytes that grow and mature in the bone marrow. Produce ___antibodies___ which circulate in body fluids such as blood and lymph. Their antibodies inactivate pathogens as they come across them.

39a Pathology: Lymph and Immune System

Werner: Chapter 6

Lymph System Conditions

- **Edema** Accumulation of excessive fluid between cells. May be local or systemic problem, and is usually associated with chemical imbalance, inflammation, or poor circulation.

- **Lymphangitis** Infection with inflammation in lymph capillaries, usually arising from a small injury on the skin.

- **Lymphadenitis** Infection of lymph nodes. Should bacteria get past the filtering action of the nodes, septicemia (blood poisoning), a potentially life-threatening situation, has occurred.

- **Lymphoma** A collective name for cancer that starts in lymph tissues. Mutated lymphocytes replicate in massive numbers, causing enlargement of lymph tissues, anemia, night sweats, itchy skin, and fatigue.

- **Hodgkin lymphoma** B cells mutate into large, malignant cells. These growths eventually metastasize to organ tissues.

- **Mononucleosis** Viral infection of salivary glands, throat, and lymph nodes. Eventually infects B-lymphocytes, which carry it on to lymph nodes, liver, and spleen. Mainly depletes stamina, resiliency, and strength. Seldom, but occasionally, has serious complications.

39a Pathology: Lymph and Immune System

Werner: Chapter 6

Immune System Conditions

- **Allergic reactions** Immune system reactions to stimuli which are not inherently hazardous. Usually involve inflammation, and may range from mild to life-threatening.

- **Chronic fatigue syndrome** Collection of signs and symptoms that affect multiple body systems and result in mildly limiting to debilitating fatigue. These may include tender lymph nodes, low-grade fever, sore throat, headache, muscle/joint pain, sleep or memory problems.

- **Fever (AKA: pyrexia)** Abnormally high (>101°F) body temperature. May include shivering, flushing, and sweating. Usually caused by bacterial or viral infection.

- **HIV** Human immunodeficiency virus. Causes AIDS.

- **AIDS** Acquired immune deficiency syndrome. Disables the immune system leaving a person vulnerable to a host of diseases that are usually not a threat.

39a Pathology: Lymph and Immune System

Werner: Chapter 6

Autoimmune Disorders

- **Ankylosing spondylitis** Progressive inflammatory arthritis of the spine, leading to stiff joints. Typically begins at sacro-iliac joints, and may progress up the spine and/or affect costovertebral joints, and thus, breathing.

- **Inflammatory bowel disease (IBD)** Crohn disease and ulcerative colitis.

- **Crohn disease** Progressive inflammatory disorder affecting the G.I. tract, characterized by deep ulcers, scarring, and formation of fistulas around small and large intestine. Involves abdominal pain, cramping and diarrhea.

- **Ulcerative colitis** Inflammation and shallow ulcers in the colon. Symptoms similar to Crohn disease, but only the colon is affected.

- **Lupus** Antibodies attack various tissues (skin, heart, lungs, joints, kidneys). Ranges from mild to life-threatening. Women are 9 times more likely than men to be diagnosed with lupus.

- **Multiple sclerosis** T cells, B cells, antibodies, and cytokines destroy myelin sheaths in the spinal cord and brain. May result in loss of motor control, cognitive changes, or motor and sensory paralysis.

- **Psoriasis** Non-contagious chronic skin condition involving excessive production of skin cells. These result in itchy, scaly plaques on the skin, usually on trunk, elbows and knees. Runs in cycles of flare and remission.

- **Rheumatoid arthritis** Synovial membranes of various joints are attacked by immune system cells. Other structures (muscles, tendons, skin, blood vessels and serous membranes) may also be affected.

- **Scleroderma** Abnormal accumulations of collagen in the skin, blood vessels, and other tissues. Usually involves the hands and face.

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40a A&P: Reproductive System

Salvo: Chapter 25

Introduction

Sexual reproduction Process by which spermatozoa and oocytes unite to produce offspring for the survival of the species and pass on hereditary traits from one generation to the next.

Anatomy

Gonads Primary reproductive organs. Testes and ovaries.

Gametes Sex cells. Types: spermatozoa and oocytes.

Physiology

Produce offspring Process of sexual reproduction that allows new individuals of a species to be produced and genetic material to be passed from one generation to another.

Release hormones Process of reproductive structures releasing hormones that regulate reproduction and other body processes.

The Reproductive System

Testes (AKA: testicles) Paired, oval glands enclosed in the scrotum. Site of sperm and testosterone production.

Interstitial cells of Leydig Endocrine cells located in the testes that produce testosterone and DHT.

Testosterone and DHT Hormones that are responsible for the development of the sex organs and secondary sex characteristic changes that appear at puberty.

Secondary sex characteristics Widening of the shoulders. narrowing of the hips. Appearance of facial, axillary, pubic, and chest hair. Enlargement of the larynx which contributes to deepening of the voice.

Sperm (AKA: spermatozoa) Sex cells that carry genetic information.

Spermatogenesis Sperm cell production that begins during puberty and continues throughout life.

40a A&P: Reproductive System

Salvo: Chapter 25

The Reproductive System

Ovaries Pair of almond-shaped organs. Produce hormones such as progesterone, estrogen, relaxin, and inhibin.

Progesterone and estrogen Hormones responsible for the regulation of the menstrual cycle and the development of secondary sex characteristics.

Secondary sex characteristics Distribution of adipose tissue in the breasts, hips, and abdomen. Wide hips. Pubic and axillary hair.

Oocyte (AKA: unfertilized egg) Sex cell that carries genetic information. Mature within ovarian follicles. One (or sometimes more) is released during ovulation.

Ovum (p. ova) Mature oocyte that has been released by the ovary.

40a A&P: Reproductive System

Salvo: Chapter 25

Menstrual Cycle

Menstruation Periodic discharge of built-up endometrial lining from the non-pregnant uterus lasting approximately 5 days. Estrogens and progesterone production is suddenly reduced causing uterine arteries to constrict which in turn causes the death of the internal lining of the uterus. Patchy areas of bleeding develop and small portions of the lining detach.

Menstrual cycle (AKA: reproductive or fertility cycle) A series of hormonal events that begins at puberty continues until ___menopause_____ unless interrupted by pregnancy, disease, or stress. Occurs about every _28__ days.

Follicular phase First phase of the menstrual cycle, days 1-13. Begins with menstruation to shed the uterine ling so that estrogens can prepare the uterine lining for implantation. Also FSH, estrogens, and LH promote the development of ovum in the ovarian follicles.

Ovulation Second phase of the menstrual cycle, day 14. Surge of LH causes the ovarian follicle to rupture and the ovum to be released. Ovum travels down the fallopian tubes toward the uterus.

Luteal Phase Third phase of the menstrual cycle, days 15-28. The former ovarian follicle secretes estrogens and progesterone, which maintain the uterine lining for implantation and pregnancy. Progesterone also slightly elevates body temperature, creating an incubating effect. Relaxin relaxes the uterus to facilitate implantation. Inhibin inhibits the secretion of FSH and LH.

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Disorders of the Uterus

- **Cervical cancer** Growth of malignant cells in the lining of the cervix, caused by infection with some variety of the human papilloma virus.

- **Dysmenorrhea** Menstrual pain that is severe enough to limit the activities of people of child-bearing age. May include headaches, nausea, vomiting, diarrhea, constipation, and frequent need to urinate.

- **Endometriosis** Implantation and growth of endometrial cells in the peritoneal cavity. These cells grow and then decay with the menstrual cycle. Symptoms may include heavy, painful menstruation, and other problems.

- **Fibroid tumors** Benign growths in the muscle or connective tissue of the uterus. Often asymptomatic, but may cause heavy menstrual bleeding or put mechanical pressure on other structures in the pelvis.

- **Uterine cancer** Cancerous cells in the endometrium or other tissues of the uterus.

Disorders of Other Reproductive Structures

- **Breast cancer** Malignant tumor cells in breast tissue. Small, painless lump or thickening in the breast tissue or near the axilla.

- **Ovarian cancer** Malignant tumors on the ovaries. Early symptoms are practically silent, and/or similar to those of perimenopause, thus often ignored.

- **Ovarian cysts** Fluid-filled growths on the ovaries, mostly benign. These may be asymptomatic, or cause pelvic pain or symptoms similar to early pregnancy.

41a Pathology: Reproductive System

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Disorders of the Reproductive System

- **Benign prostatic hyperplasia (AKA: BPH)** Prostate gland of a mature person begins to grow for the first time since the end of puberty, becoming enlarged. May be asymptomatic or involve problems with urination.

- **Prostate cancer** Growth of malignant cells in the prostate gland. Symptoms are similar to those of BPH.

- **Prostatitis** Inflammation or irritation of the prostate gland either from pathogenic or non-pathogenic causes. Symptoms may include fever, problems with urination, pain in the penis, testicles, perineum, and low back.

- **Testicular cancer** Growth of malignant cells in the testicles. Early signs include a painless lump in the scrotum, a dull ache in the lower abdomen or groin, or enlarged and tender breasts.

Other Reproductive System Conditions

- **Menopause** The moment when ovaries no longer respond to chemical signals to establish a reproductive cycle. Symptoms include night sweats, hot flashes, insomnia, and mood swings.

- **Pregnancy** The state of carrying a fetus. Implications for massage include possible loose ligaments, fatigue, shifting proprioception, and depression.

- **Premenstrual syndrome** Collection of many signs and symptoms that occur in the time between ovulation and menstruation. Symptoms may include breast tenderness, bloating, digestive upset, irritability, anxiety, depression, and mood swings.

- **Sexually transmitted infections** Contagious conditions that are spread through intimate contact. Symptoms may include penile or vaginal discharge, painful urination, and painful intercourse.

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Fertilization

Fertilization Penetration of the ovum by a spermatozoon about 24 hours after ovulation resulting in a zygote.

Zygote Fertilized ovum. Contains genetic information from each parent.

Blastocyst A zygote that has undergone multiple cell divisions and transformation from a solid mass to a hollow fluid-filled ball of cells.

Pregnancy

Pregnancy Sequence of events that includes implantation, embryonic and fetal growth and ends with birth. This process of gestation takes about 266 days and is divided into 3 trimesters.

First trimester Trimester in which the most embryonic development occurs and the pregnant client experiences few structural changes. Developments include: 3 primary germ layers, head and tail shape, G.I. tract, brain, heart, and placenta.

Second trimester Trimester in which the pregnant client begins to "show". By the end of this trimester the pregnant client should feel the baby move. The former embryo is now a fetus and grows to approximately 11 inches in length and weighs about 1.5 lb.

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Pregnancy, continued

Third trimester Trimester in which the pregnant client finds themself heavy with the baby and postural changes are evident. The fetus grows to about 20 inches in length and between 5 and 9 lbs. in weight. The pregnant client may experience occasional, preparatory contractions in which the uterus hardens and then returns to normal. The early form of breast milk, colostrum, may leak from the breasts.

Lactation Secretion and ejection of milk by the mammary glands. Facilitated by the pituitary hormones prolactin for milk production and oxytocin for milk expression.

Germ layers

Ectoderm Outermost germ layer that gives rise to the nervous system including the special senses (retina, taste buds, olfactory bulb, inner ear), mucosa of the mouth and anus, epidermis of the skin, fingernails, hair, skin glands, and pituitary.

Mesoderm Middle germ layer that gives rise to the muscles and connective tissues such as fascia, tendons, retinaculum, ligaments, cartilage, bone, mesenteries, dermis, hypodermis, blood, lymph, related vessels, pleurae, pericardium, peritoneum, and urogenital tract.

Endoderm Innermost germ layer that gives rise to the lining of the gastrointestinal tract, lining of the respiratory passages, and most tissues of organs and glands.

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Introduction

Therapists will encounter unique individuals with special needs and some physical, emotional, and health-related challenges.

Massage is safe during all stages of life if tailored to the client's health and particular situation and circumstance.

Modifications might involve placing a client in advanced pregnancy on their side.

General Suggestions

When your client mentions their special need or disability when making an appointment, spend time preparing for the session.

The best source of information comes from the client.

Each situation will be different, and you must be willing to be open-minded, patient, tolerant, and flexible.

Each client will teach you, if you are willing to listen and learn.

Pregnant Clients

Pregnancy massage has many benefits for the expectant client:

- Reduce stress
- Decrease swelling in the arms and legs
- Relieve aches and pains in muscles and joints
- Reduce anxiety and depression

Precaution for all Trimesters

- If client has severe abdominopelvic pain, cramping, or vaginal bleeding:
    - Seek immediate medical attention
    - Medical clearance is needed with subsequent massage

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Pregnant Clients, continued

Massage in the First Trimester

- Massage is safe during this 14 week long period.

Massage in the Second Trimester

- As the client's body changes, the pregnancy begins to show.
- Pressure on blood vessels occurs when they are lying supine.
- A small foam wedge or pillow under their right hip tilts the abdomen just enough to move the baby off the abdominal blood vessels.

Massage in the Third Trimester

- Baby's growth is greater.
- Postural changes in the expectant client are evident.
- Use positional and technique modifications listed below as needed.
- Expectant clients may notice occasional, preparatory, or Braxton Hicks contractions in which the uterus contracts and then relaxes.
- Colostrum, the early form of breast milk, may leak from the breasts resulting in many clients leaving on their bras during massage.

Massage and Common Discomforts of Pregnancy

Fatigue Feeling unusually tired.

- Eating, breathing, and eliminating for two requires a great deal of energy.
- Reduce treatment time to 30 minutes and use lighter-than-normal pressure.
- If dizzy when getting up from the massage table, have them sit up slowly and remain seated for at least 30 seconds before standing. Be ready to assist.

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Massage and Common Discomforts of Pregnancy, continued

Nausea and Vomiting Massage is contraindicated.

Heartburn Burning sensation in the chest. Common during the third trimester.

Nasal Congestion

- 30% of pregnancies report congestion without any other cold symptoms.
- Usually starts in the third month and can last until the baby is delivered.

Lower Back Pain

- As the uterus expands, the body may lean backward to compensate.
- Temporary relief: spend extra time on the lumbosacral area and buttocks.

Leg Cramps (AKA: Charley Horse)

- Heavy uterus presses on blood vessels compromising blood flow to the legs.
- To prevent plantarflexion, undrape or use a light drape while supine.
- If cramping occurs, dorsiflex the ankle to stretch the calf muscles.

Deep Vein Thrombosis and Blood Clots

- Decreased clot-resolving properties, and increased clot-producing factors.
- 5 to 6 times greater risk for blood clots.
- To assess for DVT, lightly palpate entire leg feeling for hot spots.

Varicose Veins

- Developed or worsened during pregnancy.
- Locally contraindicated if pressure causes pain.
- Use bolsters or pillows to elevate legs above the heart.

47a A&P: Pregnancy

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Massage and Common Discomforts of Pregnancy, continued

Edema

- Swollen feet and ankles due to fluid volume increases in the third trimester and enlarged uterus pressing on abdominal blood vessels.
- More prevalent at the end of the day. Worse during summer months.
- Pitting edema: dents left when edematous skin is compressed and released.
- For mild edema, elevate the affected area during massage.
- Widespread and pitting edema requires medical clearance.

Frequent Urination

- Caused by an enlarged uterus pressing on the urinary bladder.
- Hormonal changes also cause the retention of and the release of fluids.
- Suggest that the client void before the session or during if needed.

Additional Suggestions

Technique Restriction

- No connective tissue and deep myofascial release techniques due to relaxin.
- No manual traction of the legs to avoid separation of the pubic symphysis.
- Joint mobilizations must be adjusted to protect and support lax joints.

Additional Suggestions, continued

Body Temperature

- Avoid hot packs, heating elements, and hot stones.
- Remove the blanket and uncover their arms and legs.
- Place a cool washcloth over the forehead or across the base of the neck.
- An oscillating fan may also be used.

No Abdominal Bodywork

Comfort

- Be willing to make adjustments in techniques, pressure, or position.
- Be responsive to your pregnant client's mood.
- If your client is experiencing sadness or is grieving, be accepting and supportive of emotional expressions such as crying.

High Risk Pregnancies Pregnancies that put the client, the developing fetus, or both at higher-than-normal risk for complications during or after the pregnancy and birth.

- Twins, triplets, higher-order multiples
- History of pre-term labor or delivery
- Age of less than 15 or greater than 35
- Vaginal bleeding
- Complications caused by pregnancy itself, such as gestational diabetes or pre-eclampsia
- Abnormalities or infections of the urogenital tract
- History of miscarriage
- Pre-pregnant weight is less than 100 lb or the client is obese
- When pre-natal tests indicate fetal abnormalities

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48a A&P: Nervous System – Introduction, Physiology, and Cells

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The body uses two systems to _____monitor_____ and ____stimulate_____ changes needed to maintain homeostasis: endocrine and nervous.

The ____endorine_____ system responds more slowly and uses ____hormones____ as chemical messengers to cause physiologic changes.

The _____nervous_____ system responds to changes more rapidly and uses nerve _____impulses_____ to cause physiologic changes.

It is the _____nervous_____ system that is the body's master control and communications system. It also monitors and regulates many aspects of the _____endocrine_____ system.

Every thought, action, and sensation reflects nerve activity. We are what our brain has experienced. If all past sensory input could be completely erased, we would be unable to walk, talk, or communicate. We would remember no pain or pleasure.

Anatomy

- Brain
- Spinal cord
- Cranial nerves
- Spinal nerves
- Cerebrospinal fluid
- Meninges
- Sense organs
- Neurotransmitters

48a A&P: Nervous System – Introduction, Physiology, and Cells

Salvo: Chapter 23

Physiology

Sensory input Sensory receptors detect changes, or _____stimuli_____, inside the body such as lowered blood sugar levels, or outside the body such as an increase in temperature. Sensory neurons carry nerve impulses into the spinal cord and _____brain_____.

Interpretive functions The spinal cord and brain integrate ____sensory_____ information. They analyze it, store some of it, and decide on appropriate responses.

Motor output Motor neurons carry nerve impulses from the brain and spinal cord to smooth muscle, cardiac muscle, skeletal muscle, and __glands___.

Higher mental functioning and emotional responsiveness Examples: cognition, _____memory_____, joy, excitement, anger, and anxiety.

48a A&P: Nervous System – Introduction, Physiology, and Cells

Salvo: Chapter 23

Basic Organization

Central nervous system (AKA: CNS) Body system primarily concerned with ____interpreting_____ incoming sensory information and issuing instructions in the form of motor responses. Includes the brain, meninges, cerebrospinal fluid, and spinal cord.

Peripheral nervous system (AKA: PNS) Composed of the cranial and spinal _____nerves_____ emerging from the CNS.

Somatic nervous system (AKA: SNS) Voluntary division of the PNS that transmits information from bones, muscles, _____joints_____, skin, and special senses of vision, hearing, taste, and smell into the CNS. Carries impulses from the CNS to _____skeletal_____ muscles.

Autonomic nervous system (AKA: ANS) _____Involuntary_____ division of PNS supplying impulses to smooth muscle, cardiac muscle, and glands. Has sympathetic and____parasympathetic____ divisions.

Sympathetic division of the ANS – Fight, Flight, or Freeze

Parasympathetic division of the ANS – Rest and Digest

48a A&P: Nervous System – Introduction, Physiology, and Cells

Salvo: Chapter 23

Cells of the Nervous System

Neuroglia (AKA: glia, glial cells) ____Connective____ tissue that supports, nourishes, protects, insulates, and organizes neurons. Types: astrocyte, ependymocyte, microglia, oligodendrocyte, Schwann cell, satellite cell.

Neuron Impulse-conducting cell. Properties:

- **Excitability** The ability to ____respond____ to a stimulus and convert it to a nerve impulse.

- **Conductibility** The ability to transmit the ____impulses____ to other neurons, muscles, and glands.

- **Secretability** The ability to release ____neurotransmitters____ that help conduct an impulse.

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Parts of a Neuron

Cell body (AKA: cyton) Main region of the neuron containing the nucleus, ribosomes, and other organelles. The ____gray_____matter of the nervous system.

Dendrite Short, narrow, neural extensions that receive and transmit stimuli _____toward_____ the neuron's cell body.

Axon Neural extension that carries nerve impulses away from the neuron toward another neuron, a muscle cell, or gland. Axon structures:

- **Telodendria** Clusters of short, fine _____filaments_____ located at the end of each axon.

- **Myelin sheath** ___Fatty_____ tissue layer surrounding most axons in the PNS. Insulates the neuron and increases nerve impulse speed.

- **Nodes of Ranvier** __Gaps_____ along myelinated axons. Increase speed of a nerve impulse by allowing the impulse to jump from one node to another.

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Connective Tissues: Neurons to Nerve

neuron → fascicle → nerve

endoneurium → perineurium → epineurium

Fasciculi (s. fascicle) Bundles of ___neurons_____.

Nerve Bundle of _fasciculi___.

Endoneurium Connective tissue layer for a ____neuron_____.

Perineurium Connective tissue layer for a ____fascicle_____.

Epineurium Connective tissue layer for a _____nerve_____.

Classification of Neurons

Sensory neuron (AKA: afferent neuron) Carries impulses to the CNS.

Interneuron (AKA: association neuron) Neuron between a ___sensory_____ and _____motor_____ neuron. Participates in integrative functions.

Motor neuron (AKA: efferent neuron) Sends a nerve impulse to effectors.

Effector Any muscle or gland that motor nerves act on.

Nerve Impulses

Nerve impulse (AKA: action potential) An _____electrical_____ signal that conveys information along a neuron.

49a A&P: Nervous System – Synaptic Transmission and Central Nervous System

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Synapse

Synapse ___Junction_____ between two neurons or between a neuron and a muscle or gland.

Synaptic Structures

Synaptic bulb Small bulb-like structure on the ends of telodendria. Contains synaptic _____vesicles_____.

Synaptic cleft (AKA: synaptic gap) Space between two neurons, or between a neuron and a muscle or gland.

Synaptic vesicle Sac-like structure located within the synaptic bulbs that contains neurotransmitters.

Synaptic Transmission: A one-way process

1. A nerve impulse travels down an ___axon_____ to a synaptic bulb.

2. Neurotransmitters travel across the synaptic _____cleft_____ .

3. The neurotransmitters _____bind_____ with receptor sites which brings about either an excitatory or inhibitory response depending on which neurotransmitter is being used.

Neurotransmitters

Neurotransmitter Collective term for chemical ___messengers_____ involved in nerve impulse transmission.

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Central Nervous System
- Brain
- Spinal cord
- Meninges
- Cerebrospinal fluid

Peripheral Nervous System
- Cranial nerves
- Spinal nerves and their branches

Brain Central nervous system organ that contains an estimated 100 billion cells and is divided into 4 major regions.

Cerebrum Largest part of the brain. Where vision, smell, taste, and body movements are consciously perceived. Where skeletal muscle movements are initiated. Where emotional and intellectual processes occur.

Limbic system Part of the cerebrum that governs emotional aspects of behavior needed for survival, such as sexual feelings, rage, and docility.

Sulci (s. sulcus) Grooves in the outer layer of the cerebrum.
Gyri (s. gyrus) Elevated ridges of cerebrum tissue.

Corpus callosum Large fibrous bundles of transverse fibers which provide a communication pathway for impulses to move from one hemisphere to the other.

49a A&P: Nervous System – Synaptic Transmission and Central Nervous System

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Brain, continued

Cerebrum, continued

Left hemisphere Cerebral hemisphere that specializes in:

- Receptive and expressive language
- Math
- Reasoning
- Analytical skills

Right hemisphere Cerebral hemisphere that specializes in:

- Sound perception
- Art
- Emotional expression
- Perception and visualization of spatial relationships

Frontal Lobe Cerebral lobe that regulates:

- Motor output
- Cognition
- Speech production (Broca's area, left hemisphere)

Parietal lobe Cerebral lobe that governs somatosensory input (particularly skin and muscles), and receives information about:

- Proprioception
- Reading
- Taste

Temporal lobe Cerebral lobe that houses:

- Auditory areas
- Olfactory areas
- Wernicke area (language comprehension, left hemisphere)

Occipital lobe Cerebral lobe that contains centers for visual input.

49a A&P: Nervous System – Synaptic Transmission and Central Nervous System

Salvo: Chapter 23

Brain, continued

Diencephalon Part of the brain that houses the thalamus and the hypothalamus. Also includes the pituitary and pineal glands.

Thalamus Part of the diencephalon that relays sensory information (except olfaction) to appropriate parts of the cerebrum.

Hypothalamus Part of the diencephalon that governs and regulates the autonomic nervous system and pituitary gland. Controls:

- Hunger
- Thirst
- Temperature
- Anger
- Aggression
- Hormone release
- Sexual behavior
- Sleep patterns
- Consciousness

Pituitary Bi-lobed gland that extends from the hypothalamus. Its hormones control and stimulate other glands to produce and secrete their hormones. Sits in the sella turcica of the sphenoid.

Pineal Gland located on the posterior aspect of the brain's diencephlon. Produces and secretes melatonin.

49a A&P: Nervous System – Synaptic Transmission and Central Nervous System

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Brain, continued

Cerebellum Second largest part of the brain. Located posterior and inferior to the cerebrum. Involved with:

- Muscle tone
- Coordination of skeletal muscles
- Balance
- Control of fine and gross motor skills

Brainstem Part of the brain that is continuous with the spinal cord. Has three main divisions: mid-brain, pons, and medulla oblongata.

Mid-brain Part of the brain stem that conducts:

- Nerve impulses from the cerebrum to the pons
- Sensory impulses from the spinal cord to the thalamus

Pons Part of the brainstem that connects the cerebellum and cerebrum to the spinal cord.

Medulla oblongata Part of the brainstem that conducts sensory and motor impulses between other parts of the brain and the spinal cord.

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50a A&P: Nervous System – Peripheral Nervous System

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Spinal cord Structure that exits the skull through the foramen magnum and extends to approximately the second lumbar region. Functions as an integrating center and an information highway between the brain and the periphery.

Ascending tracts Collection of axons running up the spinal cord to the brain carrying sensory or afferent impulses.

Descending tracts Collection of axons running down the spinal cord from the brain carrying motor or efferent impulses.

Meninges Connective tissue coverings surrounding the brain and spinal cord.

Pia mater Innermost meningeal layer that is delicate, transparent, vascular, and attached to the surface of the central nervous system.

Arachnoid Middle meningeal layer that forms a loose, web-like covering around the central nervous system. Just deep to this layer is the space (subarachnoid space) where cerebrospinal fluid is contained.

Dura mater Outermost meningeal layer that is thick, dense, and lies against bone. The space just deep to this layer (subdural space) is filled with circulating serous fluid.

Cerebrospinal fluid (CSF) Fluid circulating around the brain and spinal cord within the subarachnoid space. Supplies oxygen and nutrients, carries away wastes, and acts as a shock absorber.

50a A&P: Nervous System – Peripheral Nervous System

Salvo: Chapter 23

Peripheral Nervous System

Cranial nerves Pairs of nerves originating in the brain. Mostly supply and control functions of the head, face and throat. 12 pairs total.

Spinal nerves Pairs of nerves originating from the spinal cord. 31 pairs total.

Ventral nerve root Attachment of a spinal nerve to the spinal column containing only motor neurons.

Dorsal nerve root Attachment of a spinal nerve to the spinal column containing only sensory neurons.

Cervical plexus (C1-C5) Network of intersecting nerves in the PNS that innervate skin and muscle of the head, neck, shoulders, and diaphragm.

Brachial plexus (C5-T1) Network of intersecting nerves in the PNS that innervate skin and muscle of the upper extremity.

Lumbosacral plexus (L1-S4) Network of intersecting nerves in the PNS that innervate skin and muscle of the abdomen, lower back, genitals, and lower extremity.

50a A&P: Nervous System – Peripheral Nervous System

Salvo: Chapter 23

Innervate To supply with nerves.

Dermatome Area of skin innervated by a specific ____sensory____ nerve root.

Myotome Group of skeletal muscles innervated by a single spinal segment.

Reflex Involuntary, ____predictable____ response to a stimulus. Examples: coughing, sneezing, blinking, correcting heart rate, respiratory rate, and blood pressure.

Reflex arc Nervous system's simplest functional unit. Carries a stimulus impulse to the spinal cord where it connects with a motor neuron that carries the reflex impulse back to an appropriate ____muscle____ or gland (effector).

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51a A&P: Nervous System – Autonomic Nervous System and Sensory Receptors

Salvo: Chapter 23

Autonomic nervous system Division of the PNS that supplies impulses to smooth muscle, cardiac muscle, and glands. Has two divisions: sympathetic and parasympathetic.

Parasympathetic division (AKA: craniosacral outflow) Part of the ANS that conserves the body's energy resources.

Sympathetic division (AKA: thoracolumbar outflow) Part of the ANS that spends the body's energy resources during physical exertion or emotional stress.

51a A&P: Nervous System – Autonomic Nervous System and Sensory Receptors

Salvo: Chapter 23

Sympathetic	Body Activity	Parasympathetic
Increased	Heart rate	Decreased
Stronger	Heart contraction	Weaker
Increased	Respiratory rate	Maintained
Dilation	Bronchi	Constriction
Released from the liver	Glucose	N/A
Increased	Blood sugar	N/A
Blood vessel constriction	Skin and viscera	Blood vessel dilation
Increased	Blood pressure	N/A
Pallor	Skin color	N/A
Blood vessel dilation	Skeletal muscle	N/A
Blood vessel dilation	Heart muscle	Blood vessel dilation
Blood vessel dilation	External genitalia	Blood vessels constriction
Dilation	Pupils	Constriction
Far-sightedness	Vision	Near-sightedness
Increased	Perspiration	N/A
N/A	Tears	Stimulated
Inhibited	Salivation	Stimulated
Inhibited	Pancreatic secretions	Stimulated
N/A	Insulin secretions	Stimulated
Decreased	Peristalsis/motility	Increased
Constriction	G.I. sphincters	Relaxation
Inhibited	Urination	Stimulated
Released by adrenals	Epinephrine	N/A
Released by adrenals	Norepinephrine	N/A

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Types of Receptors - classified by location of the stimulus

Exteroceptor Receptor located in the skin, mucous membranes, and sense organs. Responds to stimuli originating from ___outside___ of the body.

Proprioceptor Receptor located in the skin, ears, muscles, tendons, joints, and fascia. Responds to _____movement_____ and body position.

Interoceptor Receptor located in the viscera. Responds to stimuli such as digestion, excretion, and blood pressure originating within the body.

Adaptation _____Decrease_____ in sensitivity to prolonged stimulus.

Types of Receptors - classified by the types of stimuli they detect

Chemoreceptor Activated by chemical stimuli. Detects smells, tastes, and changes in blood chemistry.

Mechanoreceptor Receptor that detects ____pressure____ and movement. Found in the skin, blood vessels, ears, muscles, tendons, joints, and fascia. Detects pressure, blood pressure, vibration, stretching, muscular contraction, proprioception, sound, and equilibrium.

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Types of Receptors - classified by the types of stimuli they detect, continued

Stretch receptor Receptor that detect stretch in ___muscle___fibers, tendons, and arteries. Examples:

- **Muscle spindle** Stretch receptor located within the muscle ___belly_____. Detects sudden stretching, causing the nervous system to respond by reflexively ____contracting____ the muscle.

- **Golgi tendon organ** Receptor located at the musculotendinous junction. Detects ___movements___ and excessive stretch, causing the nervous system to respond by ___inhibiting____ contraction.

- **Baroreceptor** Detects blood ____pressure_____ by monitoring the amount of stretch exerted on certain arterial walls, namely carotid arteries and the aortic arch.

Photoreceptor Receptor that is sensitive to_____light_____. Examples: rods and cones in the eyes.

Nociceptor (AKA: free nerve ending) Receptor that detects ___pain_____.

Thermoreceptor Receptor that detects _____temperature_____ changes.

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Chronic Degenerative Disorders

Alzheimer disease Progressive and fatal degenerative disorder. Shrinkage and death of neural brain tissues. Causes memory loss and personality changes.

Amyotrophic Lateral Sclerosis (AKA: ALS or Lou Gehrig disease)
Progressive and fatal degenerative disorder. Destruction of motor neurons in the central and peripheral nervous systems. Causes atrophy of muscles.

Huntington disease Progressive and fatal genetic disorder. Destruction of certain neurons in the brain, leading to changes in motor function, emotional stability, and cognition.

Peripheral neuropathy Damage to peripheral nerves, either singly or in groups, caused by lack of circulation, chemical imbalance, trauma, or other factors. Damage to autonomic nerves could include problems with digestion, heart rate, breathing, or other issues. Signs and symptoms may include:

- Burning pain or tingling in hands or feet, spreading proximally into limbs and trunk
- Hypersensitivity to touch or reduced sensation
- Muscle twitching, cramps, or atrophy.

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Movement Disorders

Dystonia Repetitive, predictable, but involuntary muscle contractions in any plane.

Spasmodic torticollis (AKA: cervical dystonia) Most common form of dystonia. Unilateral contractions of neck rotators, usually sternocleidomastoid.

Parkinson disease Degenerative movement disorder caused by loss of dopamine production in the brain. Symptoms include resting tremor, rigidity, weakness, fatigue, and depression.

Tremor Involuntary and rhythmic oscillations of antagonistic muscle groups in a fixed plane.

Infectious Disorders

Encephalitis Infection of the brain – may be viral, bacterial, or fungal. Symptoms range from fever with headaches, drowsiness, irritability, and disordered thought process to stupor, coma, convulsions, and paralysis.

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Infectious Disorders, continued

Herpes Zoster Infection of sensory neurons with the varicella zoster virus, causing painful, fluid-filled blisters on all nerve endings of a dermatome. Causes chicken pox first, and sometimes shingles later.

Meningitis Infection causing inflammation of the meninges, mostly the pia mater. Symptoms include rapid onset of high fever and chills, rash, extreme headache, among others.

Polio Viral infection first of the intestines, then of the motor neurons of the anterior horn, where they leave the spinal cord, leading to atrophy and paralysis of muscles.

Postpolio syndrome Group of symptoms suffered by survivors of polio. Progressive muscular weakness develops 10-40 years after initial infection.

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Nervous System Injuries

Bell palsy Flaccid paralysis of one side of the face, caused by inflammation of the Facial nerve (Cranial Nerve VII).

Complex regional pain syndrome Chronic, progressive condition. An initial trauma causes pain that is more severe and self-sustaining than is reasonable to expect, usually to the distal part of an arm or leg.

Spinal cord injury Damage to some or all of the spinal cord fibers, caused by trauma, tumors, or bony growths. May cause loss of sensory and/or motor functions (temporary to permanent) - specifics of resulting conditions depend on location and severity of injury.

Stroke (AKA: cerebrovascular accident, or brain attack) Damage to brain tissue due to oxygen deprivation. Caused by blockage in blood flow or by an internal hemorrhage. Results in temporary or permanent loss of sensory and/or motor function.

Traumatic brain injury (AKA: TBI) Brain damage caused by trauma.

Trigeminal neuralgia (AKA: tic douloureaux) Sharp, stabbing pain in the lower face or jaw due to irritation of the Trigeminal nerve (Cranial Nerve V).

52a Pathology: Nervous System

Werner: Chapter 4

Nervous System Birth Defects

Spina bifida Neural tube defect, which results in an incompletely formed vertebral arch, damage to the meninges and/or spinal cord, and a high risk of distal paralysis and infection.

Cerebral palsy Collective term for CNS injuries that may occur prenatal, at birth, or in early infancy, resulting in motor impairment possibly leading to sensory and cognitive problems.

Other Nervous System Conditions

Fibromyalgia Chronic pain syndrome. Neuroendocrine disruption, sleep disorders, predictable patterns of tender points in muscles and other soft tissues.

Meniere disease Idiopathic condition affecting the inner ear, causing vertigo, tinnitus, and hearing loss.

Epilepsy Seizure disorder involving 2 or more seizures in a 24 hour period. A seizure is uncoordinated neuronal activity in the brain that allows electrical activities to become increasingly extreme, sometimes to the point of collapse or loss of consciousness.

52a Pathology: Nervous System

Werner: Chapter 4

Other Nervous System Conditions, continued

Sleep disorders Collection of problems that make it difficult to get enough sleep or to wake up feeling rested and refreshed. They include insomnia, sleep apnea, restless leg syndrome, narcolepsy, and circadian rhythm disruption.

Vestibular balance disorder Group of conditions (infection, inflammation, or tiny calcium deposits) that can cause malfunction of the vestibular branch of the Vestibulocochlear nerve (Cranial Nerve VIII), causing vertigo, dizziness, lightheadedness, blurred vision, nausea and GI upset.

54a A&P: Endocrine System

Salvo: Chapter 24

Introduction

The endocrine system works along with the _____nervous_____ system to coordinate most body system functions.

Whereas the nervous system uses neural impulses to communicate, the endocrine system uses chemical messengers called ____hormones_____.

The endocrine system regulates processes that continue for relatively long periods, and its effects are more widespread than those of the nervous system.

The two types of glands of the body are _____exocrine_____ and endocrine.

Exocrine gland Gland that secretes products into _____ducts_____ that open into body cavities, the hollow center of an organ, or onto the body's surface. Examples: sudoriferous (sweat), sebaceous (oil), ceruminous (wax), salivary, digestive.

Endocrine gland ____Ductless_____ gland that produces hormones.

Endocrine glands produce specialized hormones. Most are released in one part of the body and travel through the bloodstream, affecting cells in other parts of the body. Some hormones do not enter the bloodstream but work on neighboring cells instead.

Compared with other body systems, the glands of the endocrine system are small. Although the total weight of all the endocrine glands is less than 0.5 lbs., normal functioning of these glands is vital to the body process.

54a A&P: Endocrine System

Salvo: Chapter 24

Anatomy

- Hormones
- Hypothalamus
- Pituitary
- Pineal
- Thyroid
- Parathyroid
- Thymus
- Adrenals
- Pancreatic islets
- Ovaries
- Testes

Organs that possess endocrine cells or act as temporary endocrine glands

- Placenta
- Gastric and intestinal mucosa
- Heart
- Fat cells

Physiology

Produces and secretes hormones.

Regulates metabolic activities such as growth and development.

Regulates the activity of other organs and glands, as well as ___smooth___ and ____cardiac____muscle.

Assists the body to adapt during times of _____stress_____, such as trauma, infection, dehydration, emotional stress, and starvation.

Regulates the chemical composition and volume of body fluids (intracellular and extracellular).

Contributes to the _____reproductive_____ process.

54a A&P: Endocrine System

Salvo: Chapter 24

Hormones

Hormone Glandular secretion that acts as a catalyst in biochemical reactions and regulates the physiological activity of other cells. Chemical messenger.

Prostaglandins ____Local_____ hormones. Produced by many tissues and generally act near their site of secretion.

Hormonal Control Mechanisms

- **Negative feedback system** Hormone control mechanism that triggers the negative, or opposite, response. Example: low calcium in the blood triggers an increase of parathyroid hormone which releases stored calcium from the bones into the blood stream. Once the calcium level in the blood increases sufficiently, there is a decrease in the release of parathyroid hormone.

- **Hormonal control** Hormone control mechanism using hormones to stimulate or _____inhibit_____ the release of other hormones. Example: The hypothalamus regulates the function of the anterior pituitary gland by production of releasing or inhibiting hormones.

- **Neural control** Hormonal control mechanism where hormones are secreted as a result of neural stimulation. Example: Release of epinephrine and norepinephrine from the adrenal medulla due to signals received from the sympathetic nervous system.

54a A&P: Endocrine System

Salvo: Chapter 24

Hypothalamus

Hypothalamus Part of the diencephalon that regulates the ANS and the endocrine system by governing the _____pituitary_____. Controls hunger, thirst, temperature, anger, aggression, release of hormones, sexual behavior, sleep patterns, and consciousness.

Hypophyseal portal system Complex network of small blood vessels made up of two capillary beds connected by veins. Carries hormones from the hypothalamus directly to the _____anterior_____ ____pituitary_____ without having to travel to the heart and back again.

Pituitary

Pituitary (AKA: hypophysis) Bi-lobed gland that extends from the hypothalamus. Its hormones control and stimulate other glands to produce and secrete their hormones.

Infundibulum Stalk-like structure that extends from the hypothalamus to the pituitary.

54a A&P: Endocrine System

Salvo: Chapter 24

Pituitary, continued

Anterior lobe of the pituitary (AKA: adenohypophysis) Lobe of the pituitary that produces ___six___ hormones.

- **Adrenocorticotropic hormone (ACTH)** Pituitary hormone that stimulates the adrenal cortex to secrete hormones, especially cortisol.

- **Growth hormone (GH)** Pituitary hormone that stimulates protein synthesis for muscle and bone growth, maintenance and repair, and plays a role in ___metabolism___.

- **Thyroid-stimulating hormone (TSH)** Pituitary hormone that stimulates the thyroid to synthesize and secrete its hormone.

- **Follicle-stimulating hormone (FSH)** Pituitary hormone that stimulates ___estrogen___ production and development of ovarian follicle. Stimulates ___sperm___ production.

- **Luteinizing hormone (LH)** Pituitary hormone that stimulates the release of estrogens and progesterone, ovulation, and development of the corpus luteum. Stimulates testosterone production.

- **Prolactin (PRL)** Pituitary hormone that acts together with other hormones to promote milk production by the ___mammary___ glands.

54a A&P: Endocrine System

Salvo: Chapter 24

Pituitary, continued

- **Melanocyte-stimulating hormone (MSH)** Pituitary hormone that increases skin pigment production by stimulating the synthesis and release of _____melanin_____ from skin/hair.

- **Antidiuretic hormone (ADH)** Pituitary homone that decreases urine production by promoting the reabsorption of water in kidney tubules. Also constricts blood vessels, which raises blood pressure.

- **Oxytocin (OT)** Pituitary hormone that stimulates ____uterine_____ contractions and milk expression from mammary gland during lactation.

Pineal

Pineal gland (AKA: pineal body) Gland located on the posterior aspect of the brain's diencephalon. Produces and secretes the hormone melatonin.

- **Melatonin** Pineal gland hormone involved in the control of biorhythms (the body's 24-hour cycle), and in the growth and development of sexual organs.

54a A&P: Endocrine System

Salvo: Chapter 24

Thyroid

Thyroid Bi-lobed gland located at the base of the ____throat_____, posterior and inferior to the larynx.

- **T3 (triiodothyronine) and T4 (tetraiodothyronine)** Thyroid hormones that control metabolic rate and regulate growth and development.

- **Calcitonin (CT)** Hormone secreted by the thyroid that decreases blood _____calcium_____ by stimulating osteoblasts to increase calcium storage in bones.

Parathyroid

Parathyroids Glands located on the posterolateral surface of the thyroid. Usually four in number.

- **Parathyroid hormone (PTH)** Hormone that ___increases___ blood calcium by stimulating the ____osteoclast_____ activity to break down bone and release calcium into the blood, and increases calcium reabsorption from urine and the intestines back into the blood.

Thymus

Thymus Bi-lobed gland posterior to the sternum. Stimulates production and activation of T cells.

- **Thymosin and thymopoietin** Hormones secreted by the thymus that stimulate the maturation of T cells.

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Salvo: Chapter 24

Adrenals

Adrenals (AKA: suprarenals) Glands located superior to each ___kidney_____.

Adrenal cortex Outer region of the adrenals. Secretes glucocorticoids, mineralcorticoids, and sex hormones.

- **Cortisol (AKA: hydrocortisone)** Stress hormone. Glucocorticoid that ensures that glucose, lipids, and amino acids area available for cells to use for energy and protein synthesis. Also has an ___anti-inflammatory___ effect.

- **Aldosterone** Adrenal hormone that stimulates kidneys to conserve _____sodium_____, which results in water retention in the blood. Also helps maintain proper mineral balance.

- **Sex hormones** (testosterone and estrogens)

Adrenal medulla Inner region of the adrenals. Secretes epinephrine and norepinephrine.

- **Epinephrine (adrenaline) and norepinephrine (noradrenaline)** Enhance and prolong sympathetic arousal of the nervous system.

Pancreatic Islets

Pancreatic islets (AKA: islets of Langerhans) Islands of endocrine cells located within the pancreas. Secrete insulin and glucagon.

- **Insulin** Pancreatic hormone that ___decreases___ blood glucose levels.
- **Glucagon** Pancreatic hormone that increases blood glucose levels.

54a A&P: Endocrine System

Salvo: Chapter 24

Ovaries

Ovaries Glands located in the superior part of the pelvic cavity, lateral to the uterus. House developing oocytes within the follicles and produce the hormones progesterone and estrogen.

- **Estrogens** Hormones responsible for secondary sex characteristics. Promote the development and release of the ovum from the ovary at ovulation. Stimulate the uterine lining to proliferate and thicken in anticipation of a fertilized ovum.
- **Progesterone** Hormone that maintains the uterine lining for implantation and pregnancy.

Testes

Testes (AKA: testicles) Glands located in the scrotum that are the site of sperm and testosterone production.

- **Testosterone** Hormone that promotes secondary sex characteristics, libido, and sperm production.

Organs that Possess Endocrine Cells

Placenta Organ formed against the uterine lining that allows the developing embryo and the mother to exchange nutrients and wastes. Also secretes hormones required to maintain the pregnancy.

- **Human chorionic gonadotropin (hCG)** Placental hormone that stimulates estrogen and progesterone. Can be detected in the urine during pregnancy.
- **Relaxin** Placental hormone facilitating implantation of fertilized ovum and ____softening____ of connective tissue in pregnant clients.

54a A&P: Endocrine System

Salvo: Chapter 24

Organs that Possess Endocrine Cells, continued

Gastric and intestinal mucosa

- **Gastrin** Hormone secreted by the stomach that initiates the production and secretion of gastric juices and stimulates bile and pancreatic enzyme emissions into the __small____ ___intestines_____.

- **Cholecystokinin** Hormone produced by the intestinal mucosa that stimulates the ____gallbladder_____ to release bile and the ____pancreas_____ to secrete enzymes.

- **Secretin** Hormone produced by the intestinal mucosa that stimulates the pancreas to secrete an alkaline liquid that neutralizes the acid chyme and facilitates the action of intestinal enzymes.

Heart

- **Atrial natriuretic hormone (ANH)** Hormone secreted by the heart that decreases blood volume and blood pressure.

Fat Cells

- **Leptin** Hormone that plays a key role in energy (appetite and metabolism).

- **Resistin** Hormone that increases blood glucose levels by reducing insulin sensitivity.

55a Pathology: Endocrine System

Werner: Chapter 9

Endocrine System Conditions

Type 1 diabetes mellitus Autoimmune disorder resulting in hyperglycemia, caused by exposure to certain drugs or chemicals, or complications with certain types of infections. Insulin deficiency due to destruction of insulin-producing beta cells in the pancreas.

Type 2 diabetes mellitus Disorder resulting in hyperglycemia. Caused by pro-diabetes behavior and genetic predisposition. Can be controllable by diet, exercise, and medication, but many patients eventually benefit from supplementing insulin.

Hyperthyroidism Thyroid gland produces excessive levels of the hormones that stimulate the conversion of fuel into energy. Signs and symptoms are related to having too much energy, including: restlessness, sleeplessness, irritability, and unintended weight loss.

Hypothyroidism Thyroid gland produces inadequate levels of the hormones that stimulate the conversion of fuel into energy. Signs and symptoms may include weight gain, fatigue, depression, and sluggish digestion.

Metabolic syndrome Collection of signs that indicate a high risk of serious diseases such as diabetes, heart attack, atherosclerosis, and stroke. Involves having, simultaneously, 3 of these 5 risk factors: high fasting blood glucose, abdominal obesity, elevated triglyceride levels, low HDL levels, and hypertension.

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59a A&P: Psychoneuroimmunology

Psychoneuroimmunology (AKA: PNI) Study of the interaction between psychological processes and the nervous and immune systems of the human body.

Overview of Communication/Control Systems

- **Central Nervous System:** organs and ganglia send nerve impulses via neurons to skeletal muscle, cardiac muscle, smooth muscle, and glands.
- **Endocrine System:** organs send hormones to target organs via the bloodstream.
- **Hypothalamus**: the link between the Nervous and Endocrine systems.
- **Peptides** Protein molecules released by neurons and cells of the immune system. They circulate in blood, lymph and cerebrospinal fluid attaching to receptor sites on other cells and affecting their behavior. They may excite, inhibit, or merely render unusable, the cells they attach to. *Some are taken into the nucleus of the cell, and affect its DNA expression.*

The PNI Communication Network

- Body-wide network that includes all major systems
- Continually communicates via "information substances" which are primarily peptides
- Coordinates body-mind functions including consciousness, memory, digestion, and immunity

59a A&P: Psychoneuroimmunology

The PNI Communication Network, continued

Positron emission tomography scans (AKA: PET scans) allow mapping of peptides receptors in the body.

Nodes Concentrated areas of peptide receptors that allow peptides to influence memory, learning, and interpretation of reality. They are found in many places:

- Brain
  - Limbic area (emotions)
  - Cerebral cortex (interprets sensory input)
  - Amygdala (rage center)
  - Hypothalamus (hunger, thirst, anger, sleep, sexual behavior)
- G.I. Tract
- Endocrine glands
- White blood cells
- All cell membranes

Opiate Peptides (endorphin family)

- Chemically similar to morphine
- Produced by immune cells, GI tract, gonads, pituitary, and hypothalamus
- Can increase immune function, alpha waves (relaxation), feelings of happiness and are associated with states of expanded consciousness
- Released regularly in circadian rhythm – also from exercise, breathing, orgasm, smiling, laughing, exposure to art, beauty, and nature
- Found in the brains of fish, reptiles, birds, mammals, and insects

59a A&P: Psychoneuroimmunology

Stress

Stressor An event that occurs.

Stress Our response to an event. Some stressors produce a "stress response" in almost everyone such as loud noises, lack of sleep, and bad air.

In 1936, Hans Selye observed that a variety of "noxious agents" introduced into the body over time produced the same syndrome of gastric ulcers, shrinkage of the thymus gland, lymph nodes and spleen, and over-activity of the adrenal glands.

Eustress Caused by a stressor that is perceived as a challenge, but the person maintains a sense of control over the situation.

Distress Opposite of eustress; the demand in the environment exceeds our control over it.

External stressors

- Lack of supportive relationships, change in family relations, divorce, death, change of living arrangement, overcrowding.

Internal stressors

- Feeling of helplessness, hopelessness, low self-esteem, boredom, depression, fear of failure, unexpressed feelings (anger, resentment, hostility, grief), not living up to your expectations of yourself.

59a A&P: Psychoneuroimmunology

The Stress Response

- Beneficial in the short run if we need to fight or flee, but exhausting if prolonged
- Phase 1 (via nervous system): the hypothalamus triggers the release of:
    - Epinephrine from the adrenal medulla that increases:
        - Heart rate
        - Respiratory rate
        - Metabolic rate
        - Clotting ability
        - Blood sugar
        - Stomach acid
    - Norepinephrine from the adrenal medulla that increases:
        - Blood pressure
        - Blood flow to skeletal muscle
        - NOTE: Long-term effects may include stomach ulcers, and heart disease
- Phase 2 (via endocrine system): triggers the release of:
    - Cortisol from the adrenal cortex to:
        - Sustain high blood sugar and fat
        - Suppress inflammation and other immune function
        - NOTE: Long-term effects may include diabetes, arteriosclerosis, sluggish immune function, and osteoporosis

59a A&P: Psychoneuroimmunology

Compounding

- A certain amount of stress is unavoidable because of our nervous system – designed to create boundaries, stabilize (inevitable) change, and hold onto (fleeting) pleasures and avoid pain

- But we often tend to compound our stress by loading unnecessary suffering (berating ourselves, guilt, worry, etc.) on top of the initial stressor

Stress Related Disease

- 70-80% of all physician visits are for stress-related problems

- 80% of all diseases are stress-related

- Anger and hostility are highly correlated with high blood pressure and coronary artery disease

- Feelings of isolation are correlated with significantly higher risk of early death

- Hardy personality (sense of personal control over life events, viewing change as challenge, committed to people and activities in life) correlates with improved immune function and 60% lower risk of early death

59a A&P: Psychoneuroimmunology

Managing Stress to Optimize Health and Happiness

- Recognize signs of stress
- Manage what is manageable (diet, exercise, relationships, sleep, etc.)
- Make different choices about your Thoughts and Feelings
    - First there are Feelings
    - Next there are Thoughts for observing, analyzing and considering
    - The cycle continues as you have Feelings about your Thoughts, and Thoughts about your Feelings
- We can learn to *exercise choice over how we respond to our thoughts and feelings*. This begins by observing how our mind works, and noticing our patterns.
- Are we taking things personally that may not be intended to insult us?
- Are we allowing ourselves to unnecessarily feel humiliated or offended by the actions or opinions of someone else?
- Are we projecting a negative outcome on something that has not happened yet?
- Are we looking to lay blame?
- Are we actually "choosing" to experience these "unproductive" thoughts or "unpleasant" feelings? There is some kind of "payoff" for this habitual behavior. Perhaps it allows us to at least control events.

59a A&P: Psychoneuroimmunology

Managing Stress to Optimize Health and Happiness, continued

We all have habitual patterns of thinking and feeling, learned long ago, which may not serve us or others, and can be replaced through repetition of more functional thoughts or healing practices. The brain is more verb than noun, and can be changed!

Cues that we are experiencing or creating stress

- Breath is short
- Blood pressure is going up
- Feeling irritable, angry, blaming, negative
- Projecting anger out or in
- Getting ready to complicate an interaction
- Procrastinating

59a A&P: Psychoneuroimmunology

Strategies for making change in the moment:

- Tune into and deepen breathing
- Ask for a break (to relax and think)
- Relax what you can
- Do not respond immediately
- Try to step outside the interaction and "see" it differently

Strategies for making change in the longer term:

- Get out of the rushing stream of events regularly
- Breathe and relax
- Meditate/pray (repetition of sound or movement pattern)
- Receive bodywork
- Get out in nature (water)
- Try on different choices, try adopting new attitudes
- Be committed to treating yourself as well as your dearest love
- Be gentle with yourself, and persist

59a A&P: Psychoneuroimmunology

PNI Exercise

1. Identify an issue, situation or behavior that is causing you stress.
2. Answer these questions:
    a. How can I change this?
    b. Am I resisting changing this and why?
    c. What strategies and tactics can I apply to making the change?

Resources

Healing Massage – A Simple Approach – Marsha and Jonathan Walker, Thomson - Delmar Learning

Buddha's Brain – Rick Hanson, PhD, New Harbinger Publications

Just One Thing – Rick Hanson, PhD, New Harbinger Publications

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61a A&P: Respiratory System

Salvo: Chapter 28

Introduction

Respiration Movement of air in and out of the __lungs__, and the exchange of oxygen and carbon dioxide between the blood and body tissues.

The respiratory and ___cardiovascular_____systems work together to provide oxygen to the tissues and remove metabolic wastes including carbon dioxide.

Failure of either system results in disruption of _____homeostasis_____ and rapid cell death from oxygen deprivation.

Anatomy

Upper respiratory tract

- Nose and nasal cavity
- Pharynx
- Larynx
- Sinuses

Lower respiratory tract

- Trachea
- Bronchi and Bronchioles
- Alveolar ducts and alveoli
- Lungs
- Diaphragm

61a A&P: Respiratory System

Salvo: Chapter 28

Physiology

Exchange gases Oxygen and CO2 exchange occurs through the _____capillary_____ walls in the lungs and in the systemic circulation.

Olfaction The sense of _____smell_____. During inhalation, scent molecules are forced against ends of the olfactory nerves which connect to the olfactory bulb. The nerve impulse is then carried to the cortex for interpretation.

Sound production Air moving over the ____vocal___ ___cords_____ combined with movements of the lips, facial muscles, and tongue forms words and produces speech.

Maintenance of homeostasis Maintains oxygen levels in the ___blood_____. Eliminates wastes such as carbon dioxide and heat. Also regulates blood ___pH_____.

61a A&P: Respiratory System

Salvo: Chapter 28

Upper Respiratory Tract

Nose Port of entry for air and the beginning of the air conduction pathway.

Nasal hair Traps particles and foreign matter as air flows through the nose.

Nasal cavity Cavity just behind the nose where air is____warmed_____ by superficial blood vessels and _____moistened_____ by mucosal secretions.

Cilia Tiny hair-like projections of the mucosae that trap foreign particles and transport them down the throat where they are either swallowed or coughed out through the mouth.

Pharynx (AKA: throat) _Muscular tube_ tube shared by the respiratory and digestive systems. Contains tonsils and openings to the Eustachian tubes.

Larynx (AKA: voice box) Connects the pharynx to the ___trachea_____. Houses the vocal cords where sound is produced when air passes over them.

Epiglottis Elastic cartilage in the larynx that closes the trachea during swallowing to prevent food and water from entering the lower respiratory tract.

61a A&P: Respiratory System

Salvo: Chapter 28

Lower Respiratory Tract

Trachea (AKA: windpipe) Tube that connects the larynx to the lungs.

Primary bronchi Air conduction passageways from the trachea to each lung.

Lungs Primary organs of respiration. Extend from the diaphragm to just above the clavicles. Right lung has 3 lobes. Left lung has 2 lobes.

Secondary and tertiary bronchi (not detailed in Salvo) Branches from the primary bronchi, similar to them but decreasing in size.

Bronchioles Smaller branches off the tertiary bronchi, having no cartilage, and surrounded by smooth muscle.

Alveolar ducts Connect bronchioles to alveoli.

Alveoli Tiny sacs attached in clusters resembling grapes to alveolar ducts. Made of single-layer epithelial tissue and surrounded by capillaries which together make gas exchange possible.

61a A&P: Respiratory System

Salvo: Chapter 28

Diaphragm Main _____muscle_____ of respiration and structure separating the thoracic cavity from the abdominal cavity.

Breathing

Breathing A _____mechanical_____ action consisting of two phases: inhalation (inspiration) and exhalation (expiration). These phases are the result of nerve stimulation, muscle contraction, and differences between the pressure in the lungs and the atmospheric pressure outside the lungs. Adults breathe 12-16 times per minute.

Inhalation (AKA: inspiration) Process of drawing air into the lungs.

1. Diaphragm contracts and moves down.
2. External intercostals contract to lift the ribcage up and out.
3. Pressure in the lungs is now lower compared to atmospheric pressure.
4. Air moves from higher pressure (atmosphere) to lower pressure (lungs).

Forced inhalation Intensified and voluntary inhalation that requires contraction of _____accessory_____ muscles of inhalation (sternocleidomastoid, scalenes, and pectoralis minor).

Exhalation (AKA: expiration) Process of expelling air from the lungs.

1. Diaphragm relaxes; elastic recoil of stretched tissues causes it to rise up.
2. External intercostals relax; elastic recoil of the stretched tissues causes the ribcage to move down and in.
3. Thoracic cavity and lungs are reduced in size as a result.
4. Pressure in the lungs is now higher compared to atmospheric pressure.
5. Air moves from higher pressure (lungs) to lower pressure (atmosphere).

61a A&P: Respiratory System

Salvo: Chapter 28

Breathing, continued

Forced exhalation Intensified and voluntary exhalation that requires contraction of accessory muscles of exhalation (internal intercostals and abdominals).

Volitional/voluntary breathing Allows you to ____hold____ your breath while swimming under water and to take ____deep____ breaths to project your voice during public speaking.

External and Internal Respiration

External respiration (AKA: pulmonary respiration) Gas exchange in the ____lungs____. Occurs by diffusion between blood in capillaries and air in the alveoli.

Internal respiration (AKA: tissue respiration) Gas exchange between blood and the body ____tissues____.

62a Pathology: Respiratory System

Werner: Chapter 7

Infectious Respiratory Disorders

Acute bronchitis Inflammation of the trachea, bronchi and bronchioles. Productive cough, sore throat, nasal congestion, fatigue, and fever.

Common cold Viral infection of the respiratory tract. Nasal discharge, sore throat, mild fever, dry coughing, and headache.

Influenza (AKA: flu) Viral infection of the respiratory tract. High fever, muscle and joint achiness, runny nose, coughing, and sneezing.

Pneumonia Inflammation of the lungs due to infection. Many symptoms including coughing, very high fever, delirium, chest pains and more. Very often follows same course as flu, but instead of getting better it gets rapidly worse.

Sinusitis Inflammation of the paranasal sinuses from infection, allergies, or physical obstruction. Symptoms include severe headache.

Tuberculosis Bacterial infection that begins in the lungs, but may spread to bones, kidneys, lymph nodes, central nervous system, and elsewhere.

62a Pathology: Respiratory System

Werner: Chapter 7

Chronic Obstructive Pulmonary Diseases (COPD)

Chronic bronchitis Long-term inflammation of the bronchi and bronchioles. Usually begins with a mild cough that lingers long after any infection has cleared.

Emphysema Alveoli become stretched out and inelastic, merging with each other. Destroys surface area and capillaries. Symptoms include pain with breathing, shortness of breath, dry cough, and wheezing.

Other Respiratory Disorders

Asthma Chronic airway inflammation and intermittent airflow obstruction due to hyper-reactive bronchioles. Causes shortness of breath, wheezing, coughing, and difficulty in exhaling.

Cystic fibrosis Congenital disease of exocrine glands that causes their secretions (mucus, digestive enzymes, bile, sweat) to become abnormally thick and viscous. Most commonly affects lungs, causing coughing, wheezing, and chest pain, but can affect digestive, integumentary, or reproductive systems as well.

63a A&P: Digestive System

Salvo: Chapter 29

Introduction

Digestive functions are initiated by the __parasympathetic__ division of the nervous system.

Because digestion requires an expenditure of energy, it occurs primarily during periods of ____low____ activity.

Stress and emotional responses serve to slow digestion because they stimulate the _____sympathetic_____ nervous system.

People in high-stress or high-responsibility positions are more likely than others to have problems with ulcers, heartburn, colitis, irritable bowel syndrome, and constipation because of frequent disruption of the digestive process.

The digestive system is primarily a long ___tube_____ with accessory organs and glands.

Gastrointenstinal tract (AKA: G.I. tract or alimentary canal) Muscular passageway of the digestive system. Leads from the mouth to the anus.

63a A&P: Digestive System

Salvo: Chapter 29

Anatomy

Gastrointenstinal Tract

- Oral cavity
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine

Accessory Organs

- Salivary glands
- Pancreas
- Liver
- Gallbladder

Physiology

Ingestion Process of orally taking materials into the body (eating and drinking).

Digestion Series of mechanical and chemical processes that occur as food is broken down into simple molecules.

- **Mechanical digestion** Digestive process that includes chewing, churning in the stomach, and peristalsis.
- **Peristalsis** Wave-like contractions that mix and propel materials in the gastrointestinal tract.
- **Chemical digestion** More significant of the two digestive processes; Includes the effects of acids, bases, and enzymes that are released into the digestive tract in response to food.

Absorption Process by which simple molecules from the digestive tract are moved into the bloodstream or lymph vessels and then into the body's cells.

Defecation Process of ___eliminating_____ indigestible or unabsorbed material from the body.

63a A&P: Digestive System

Salvo: Chapter 29

Peritoneum

Peritoneum Serous membrane of the abdominal cavity that surrounds the organs within it.

Oral Cavity

Oral cavity (AKA: mouth) ____First_____ portion of the gastrointestinal tract where food is masticated, chemically broken down, and mixed with saliva.

Mastication Chewing.

Saliva Fluid secreted by salivary and mucous glands in the mouth. Lubricates food and contains digestive enzymes that break down lipids and carbohydrates.

Bolus Soft ball of _____chewed_____ food.

Tongue Large, strong muscle that mixes food particles with ____saliva_____ and directs the bolus towards the back of the throat.

Teeth Accessory structures used to bite off and mechanically break up larger pieces of food into smaller ones that can be swallowed.

Salivary glands Three paired glands that secrete saliva into the oral cavity. Examples: submandibular, sublingual, and parotid.

Enzyme A catalyst that _____accelerates_____ chemical reactions.

63a A&P: Digestive System

Salvo: Chapter 29

Pharynx

Pharynx (AKA: throat) Muscular tube shared by respiratory and digestive systems.

Esophagus

Esophagus Muscular tube that connects the pharynx to the stomach.

Sphincter Ring of muscle that remains contracted or closed until it is triggered to relax and open. Examples: upper esophageal, lower esophageal, pyloric, iliocecal, and anal.

Stomach

Stomach Organ that is an enlargement of the gastrointestinal tract, bound at both ends by sphincters. Breaks bolus of food down into chyme. Secretes the digestive enzyme that breaks down proteins.

Chyme Semi-liquid substance created by churning bolus and gastric juices in the stomach.

Gastrin Hormone secreted by the stomach that initiates the production and secretion of gastric juices and stimulates bile and pancreatic enzyme emissions into the small intestines.

Gastric juices Fluid secreted by the walls of the stomach. Hydrochloric acid, enzymes, mucus, and water.

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Small Intestine

Small intestine (AKA: small bowel) Longest section of the G.I. tract. Situated in the central abdomen. Consists of the duodenum, jejunum, and ileum. 90% of nutrient absorption occurs here.

Plicae circulares Circular folds on the inside walls of the small intestine.

Villi Finger-like projections on the plicae circulares the small intestine that house blood and lymph capillaries.

Microvilli Microscopic protrusions from cellular membrane of villi.

Lacteals Lymph capillaries within villi of the small intestine that assist in the absorption of fat.

Duodenum First portion of the small intestine.

Jejunum Intermediate portion of the small intestine.

Ileum Final portion of the small intestine.

Mesentery Section of the peritoneum. Consists of lesser and greater omenta.

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Large Intestine

Large intestine (AKA: colon) Final section of the gastrointestinal tract through which undigested and unabsorbed food moves before the body eliminates it. Also forms and stores ____feces_____ until defecation. Consists of the cecum, ascending colon, transverse colon, descending colon, sigmoid colon, and rectum.

Cecum Small, sac-like structure that is the first section of the large intestine.

Ascending colon The portion of the large intestine that extends from the cecum to the hepatic flexure.

Transverse colon The ___horizontal_____ portion of the large intestine between the hepatic flexure and splenic flexure.

Descending colon The portion of the colon that extends from the splenic flexure to the sigmoid flexure.

Sigmoid colon The S-shaped part of the colon in between the sigmoid flexure and the rectum.

Rectum Section of the large intestine between the sigmoid colon and the anal canal.

Defecation Process of eliminating indigestible or unabsorbed material from the body.

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Accessory Organs

Liver Organ located in the upper right quadrant of the abdominal cavity. Largest and most complex internal organ. Filters toxins, produces bile, metabolizes nutrients, and produces plasma proteins.

Bile Emulsifies fat. Produced in the liver and stored in the gallbladder.

Gallbladder Hollow organ located on the inferior surface of the liver. Stores bile.

Pancreas Organ located behind to the stomach. Both an endocrine gland that secretes insulin and glucagon, and an exocrine gland that secretes enzymes that break down proteins, carbohydrates, and fats.

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Disorders of the Upper Gastrointestinal Tract

Celiac disease Inflammatory response to the consumption of gluten. Destroys intestinal villi and limits absorption of ingested nutrients. Symptoms include gas, bloating, and diarrhea.

Dermatitis herpetiformis Painful, itchy rash due to celiac disease.

Gastroenteritis Inflammation of the G.I. tract, specifically the stomach or small intestine. Symptoms include nausea, vomiting, and diarrhea.

Gastroesophageal reflux disease (AKA: GERD) Chronic splashing of acidic stomach secretions into the unprotected esophagus, causing a bitter taste, gas, indigestion, bloating and chest pain. May also involve trouble swallowing, coughing, wheezing, and coughing up blood.

Peptic ulcer Sores of the inner surfaces of the esophagus, stomach, or duodenum that do not heal normally and remain open and vulnerable to infection. Primary symptom is gnawing burning pain in the chest or abdomen.

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Disorders of the Large Intestines

Diverticular disease Combination of diverticulosis and diverticulitis.

Diverticulosis Development of small pouches that protrude from the colon or small intestine. May be asymptomatic.

Diverticulitis Inflammation that develops when diverticulosis pouches become infected. Symptoms include bloating, nausea, fever, cramping, and severe pain.

Irritable bowel syndrome (AKA: IBS) Collection of signs and symptoms that indicate a problem with colon function, and are aggravated by stress and diet. Symptoms, which range from occasionally inconvenient to severely debilitating, include recurrent abdominal pain, pain with defecation, changes in stool frequency or appearance, gas, bloating, headaches, and general malaise.

Disorders of the Accessory Organs

Cirrhosis Disorganization and dysfunction of liver cells that results in many of them being replaced or crowded out by scar tissue. Often the final stage of acute or chronic liver disease. Early symptoms may include nausea, vomiting, and weight loss.

Gallstones Crystallized formations of cholesterol or bile pigments in the gallbladder. Size ranges from as small as a grain of sand to as large as a golf ball. May be asymptomatic unless they lodge in a duct, causing acute local pain, as well as pain referred between the scapulae and over the right shoulder.

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Disorders of the Accessory Organs, continued

Hepatitis Inflammation of the liver, usually but not always due to viral infection. Symptoms include general malaise, weakness, fever, nausea, food aversion and jaundice.

Hepatitis A Short, acute infection of the liver that usually causes no long-lasting damage. One exposure creates lifelong immunity.

Hepatitis B Liver infection spread through exposure to intimate fluids such as blood, semen, breast milk, or vaginal secretions. Communicable through indirect blood-to-blood contact with a contaminated surface.

Hepatitis C Called a "silent epidemic", this contagious infection damages the liver so slowly that symptoms may not develop until decades after exposure.

Forms **D, E, F** and **G** also exist, but are rarer than the above.

Pancreatitis Inflammation of the pancreas, involving dull upper abdominal pain, which may refer to the back. Often accompanied by nausea, vomiting, fever, and rapid pulse.

Candidiasis Higher than normal levels of the fungus *C. albicans* in the G.I. tract resulting in the disruption of normal function of the digestive system and other systems in the body.

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Introduction

Cells of the body metabolize nutrients, producing wastes such as nitrogen, ____ammonia_____ and urea which are toxic to the body.

Other substances also accumulate as a result of metabolic activities: sodium chloride, sodium sulfate, phosphate, hydrogen molecules, and ions.

All of these waste materials must be excreted from the body for homeostasis to be maintained and for metabolism to function optimally.

Several systems contribute to waste elimination – respiratory, integumentary, digestive, and ___urinary_____.

The kidneys within the urinary system filter the waste products from the blood and produce urine. It travels through the ureters and down to the urinary bladder, which contains it until expelling it out of the body through the urethra.

Anatomy

- Kidneys
- Ureters
- Urethra
- Urinary bladder

Physiology

- Eliminates wastes and foreign substances
- Regulates chemical composition of blood
- Regulates blood pH
- Regulates blood volume and fluid balance
- Regulates blood pressure
- Maintains homeostasis

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Kidneys

Kidneys Principal organs of the urinary system located in the upper lumbar region. They process ___blood___ and form urine to be excreted.

Renal cortex ___Outer_____ region of the kidney where the nephron's glomerulus and Bowman's capsule are located.

Renal medulla ____Inner_____ region of the kidney where the nephron's loop of Henle is located.

Nephron

Nephrons Kidney's filtering units. Parts: glomerulus, Bowman's capsule, renal ____tubule_____.

Glomerulus In the nephron, a small ball of fine capillaries within the Bowman's capsule.

Bowman's capsule Hollow cup-shaped _____mouth_____ of a nephron.

Filtrate Resulting fluid filtered from the blood in the nephron of the kidney. After processing it becomes urine.

Renal tubule Small tube within the nephron through which filtrate flows as it is being processed. Subdivided into proximal and distal tubule and the loop of Henle.

Collecting duct Structure made up of the distal tubules of several nephrons. Joins several larger ducts to become the renal papilla.

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Nephron, continued

Renal papilla Structure made up of multiple collecting ducts that join together.

Calyx (pl. calyces) Cup-like structure protruding from the renal papilla in the kidney. Minor calyces join to form a major calyx that leads to the renal pelvis.

Renal pelvis Large urine collection reservoir within the kidney. Forms the upper region of the ureter.

Bowman's capsule → Renal tubule → Collecting duct → Renal papilla → Minor calyx → Major calyx → Renal pelvis → Ureter

Juxtaglomerular Apparatus

Juxtaglomerular apparatus Structure within the kidney that assists in maintaining blood pressure. Consists of juxtaglomerular cells and macula densa.

Juxtaglomerular cells Structure in the nephron that monitors blood pressure and secretes renin when blood pressure drops.

Macula densa Structure in the nephron that senses the concentration of filtrate and responds to a decrease in sodium by releasing prostaglandins, which also stimulate renin secretion.

Renin Enzyme which initiates a process which ultimately increases sodium and water resorption, increasing blood volume and pressure.

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Blood Vessels and Blood Flow in the Kidneys

Renal artery → Afferent arteriole → Glomerulus → Efferent arteriole →

Peritubular capillaries → Renal venule → Renal vein → Inferior vena cava

Filtration Process

Step 1: Filtration Water and small solids in the blood pass through the filtration membrane and enter the Bowman's capsule. Proteins and blood cells remain in the bloodstream.

Step 2: Reabsorption 99 % of the filtrate is reabsorbed back into the blood stream.

Step 3: Tubular secretion Before filtrate leaves the body as urine, a final adjustment to the blood composition is made. These tubular secretions rid the body of toxic compounds to regulate blood pH .

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Ureters

Ureters Slender hollow tubes transporting urine formed by the kidney to the urinary _____bladder_____.

Urinary Bladder

Urinary bladder Hollow, organ that is a storage reservoir for urine. Located in the pelvis behind the pubic symphysis.

Urethra

Urethra Narrow ___tube_____ that transports urine from the urinary bladder out of the body during urination.

Urine

Urine Concentrated _____filtrate_____ from the kidneys that is 96% water and 4% dissolved wastes.

Micturition (AKA: voiding) The act of urination.

Fluid Balance

Fluid balance Antidiuretic hormone (secreted by the pituitary) and aldosterone (produced in the adrenal cortex) regulate the balance of water in the body.

Fluid Imbalance

Fluid imbalance Dehydration can occur when water is unavailable or with severe diarrhea or vomiting and excessive sweating.

Turgor Skin ___resiliency_____, which decreases during dehydration.

Edema Abnormal _____accumulation_____ of fluids in body tissue.

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Kidney Disorders

Kidney stones (AKA: renal calculi or nephrolithiases) Solid deposits of crystalline substances in the kidney, usually due to inadequate fluid intake. May pass through unnoticed, or may cause extreme pain – sudden onset, often referring to the groin area - if they get stuck or scrape the lining of the urinary tract.

Calcium stones Most common kidney stone type. Composed of calcium. Associated with problems with calcium metabolism or too much incoming calcium such as supplements or antacids.

Struvite stones Composed of magnesium and ammonia. Associated with chronic urinary tract infections (UTIs).

Uric acid stones Associated with a diet high in meat and purines. Blood has abnormally high acidity. High risk for gout.

Cystine stones Relatively rare. Related to a genetic dysfunction with metabolism of an amino acid called cystine.

Renal failure Inability of the kidneys to function at normal levels. Symptoms affect nearly every major organ system and include reduced urine output, systemic edema, and changes in mental state brought about by the accumulation of toxins in the blood.

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Bladder and Urinary Tract Disorders

Interstitial cystitis Chronic irritation and inelasticity of the bladder, caused by failure of inner lining to protect bladder from acidity. Causes chronic pelvic pain and painful urination, with symptoms worse when bladder is full.

Urinary tract infection Infection caused by bacteria that live harmlessly in the digestive tract finding their way into the urinary tract. Symptoms include painful, burning urination, as well as possibly pain in the pelvic, abdominal or low back areas.