

Sixth Lecture

6. Body structure

Summary of previous lectures

In the previous lectures we talked about the basic elements of the medical word: word root, combining form, suffix, and prefix. The meaning of a word is determined by how these elements are combined. Detailed information about suffixes is mentioned. Suffix linking and suffix types are explained in detail and many examples related to the surgical, diagnostic, pathological, grammatical and plural suffixes are also provided. Detailed information about prefixes is also mentioned. Prefix linking and prefix types are explained in detail and many examples related to different types of prefixes are provided.

6.1. Introduction⁹²

This lecture provides the basic foundation for understanding the body system lectures that follow this one. It presents the basic structural and functional organization of the body from the cellular level to the organism⁹³ level. It also presents terms used to describe planes of the body, body cavities, quadrants⁹⁴ and regions of the abdominal⁹⁵ cavity, and divisions of the spinal column. These terms are an essential part of medical terminology and are used in all body systems.

6.2. Levels of Organization

The human body is made up of several levels of structure and function. Each of these levels builds on the previous level, and contributes to the structure and

⁹² Medical Terminology Systems - A Body Systems Approach: Body Structure – Introduction p. 40

⁹³ Organism: /'ɔ:gənɪzəm/ a living thing, especially one that is extremely small

⁹⁴ Quadrant: /'kwɒdrənt/ one of the four parts into which a plane is divided by two perpendicular lines

⁹⁵ Abdomen: /'æbdəmən/ the part of the body below the chest that contains the stomach, bowels, etc.

function of the entire organism. (See *Figure 6-1*). The levels of organization from least to most complex are:

- chemical element
- cell
- tissue
- organ
- system
- organism.

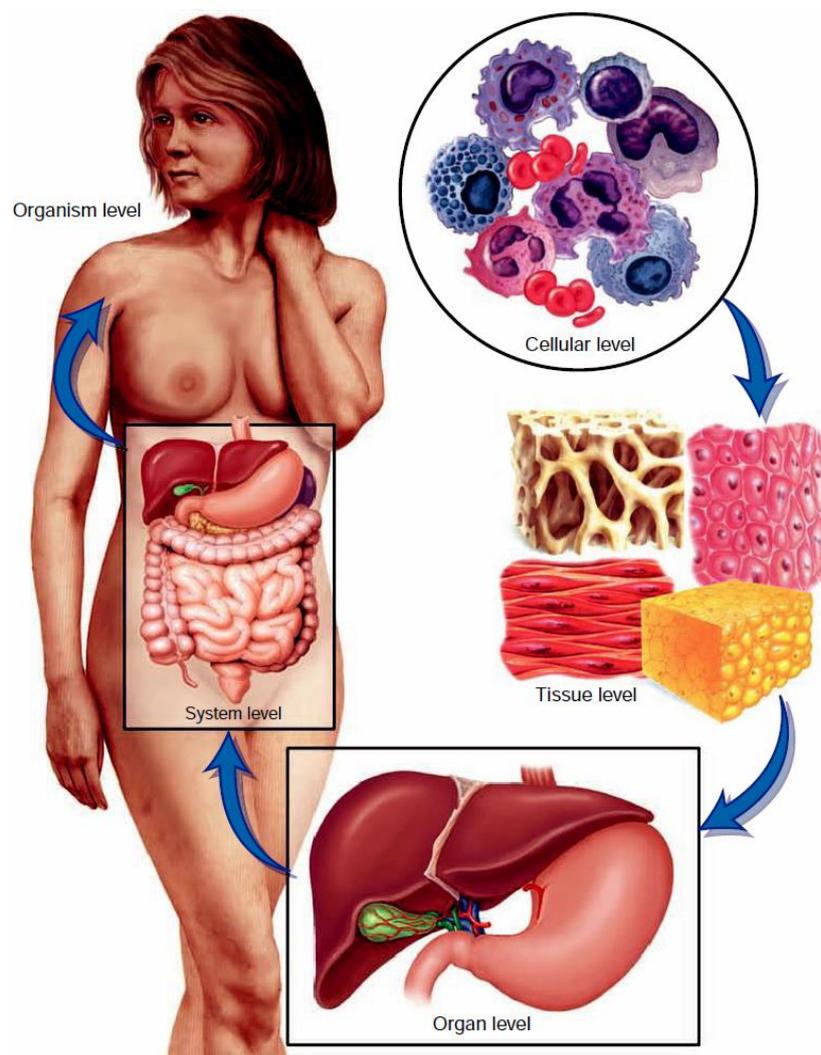


Figure 6-1: Levels of organization of the human body (not including chemical level)

6.2.1. Chemical element⁹⁶

The human body, like any material in this universe, consists of chemical elements. The four most common elements in the human body are carbon (C), oxygen (O), hydrogen (H), and nitrogen (N). In the human body, the chemical elements are joined together to form two types of chemical compounds: organic and inorganic. Inorganic chemicals, with some exceptions, are those that are made up of one or two elements that are not carbon (e.g. water, oxygen, calcium, carbon dioxide, etc.). The other category of chemicals, organic chemicals, consists mainly of the two elements hydrogen and carbon. Examples include fats, proteins, carbohydrates, and nucleic acids, etc.

6.2.2. Cell

The study of the body at the cellular level is called cytology. The cell is the structural and functional unit of life. Body cells perform all activities associated with life, including utilizing food, eliminating waste, and reproducing. Cells consist of a cell membrane that encloses cytoplasm⁹⁷ and a nucleus⁹⁸.

6.2.2.1. Cell Membrane and Cytoplasm

The cell membrane acts as a barrier that encloses the entire cell. It controls the transport of many substances to and from the cell. Within the cell membrane is a jellylike matrix of proteins, salts, water, dissolved gases, and nutrients⁹⁹ called cytoplasm. Inside the cytoplasm are various structures called organelles¹⁰⁰ that provide specialized functions for the cell. The largest cell organelle is the nucleus.

6.2.2.2. Nucleus

The nucleus is responsible for metabolism¹⁰¹, growth, and reproduction. It also carries the genetic blueprint¹⁰² of the organism. This blueprint is found in a complex molecule called deoxyribonucleic¹⁰³ acid (DNA) that is organized into threadlike structures called chromatin. When the cell is ready to divide, chromatin forms

⁹⁶ Encyclopedia of Human Body Systems: The Building Blocks of the Human Body - Chemical Components of the Body p. 3

⁹⁷ Cytoplasm: /'saɪtəʊplæzəm/ all the living material in a cell, not including the nucleus

⁹⁸ Nucleus: /'nju:kliəs/ the central part of some cells, containing the genetic material

⁹⁹ Nutrients: /'nju:triənt/ a substance that is needed to keep a living thing alive and to help it to grow

¹⁰⁰ Organelle: /,ɔ:gə'nel/ a structural and functional unit in a cell or unicellular organism

¹⁰¹ Metabolism: /mə'tæbəlɪzəm/ the chemical processes in living things that change food, etc. into energy and materials for growth

¹⁰² Blueprint: /'blu:prɪnt/ the pattern in every living cell, which decides how the plant, animal or person will develop and what it will look like

¹⁰³ Deoxyribonucleic: /di:,ɒksɪ,raɪbəs'nju:kli:ɪk/

chromosomes, which carry thousands of genes that make up our genetic blueprint. In the human, there are about 31,000 genes that determine unique human characteristics. Genes pass biological information from one generation to the next. This biological information includes such traits as hair colour, body structure, and metabolic activity. In the human, all cells except sperm cells and egg cells contain 23 pairs, or 46 chromosomes.

6.2.3. Tissue

Groups of cells that perform a specialized activity are called tissues. The study of tissues is called histology. Between the cells that make up tissues are varying amounts and types of non-living, intercellular substances that provide pathways for cellular interaction. More than 200 cell types compose four major tissues of the body:

- Epithelial¹⁰⁴ tissue covers surfaces of organs, lines cavities and canals, forms tubes and ducts, provides the secreting portions of glands, and makes up the epidermis¹⁰⁵ of the skin. It is composed of cells arranged in a continuous sheet consisting of one or more layers.
- Connective tissue supports and connects other tissues and organs. It is made up of diverse cell types, including fibroblasts¹⁰⁶, fat cells, and blood.
- Muscle tissue provides the contractile¹⁰⁷ tissue of the body, which is responsible for movement.
- Nervous tissue transmits electrical impulses as it relays information throughout the entire body.

6.2.4. Organ

Organs are body structures that perform specialized functions. They are composed of at least two or more tissue types. For example, the stomach is made up of connective tissue, muscle tissue, epithelial tissue, and nervous tissue. Muscle and connective tissue form the wall of the stomach. Epithelial and connective tissue cover the inner and outer surfaces of the stomach. Nervous tissue penetrates the

¹⁰⁴ Epithelium: /,epɪ'ti:liəm/ membranous tissue composed of one or more layers of cells separated by very little intercellular substance and forming the covering of most internal and external surfaces of the body and its organs

¹⁰⁵ Epidermis: /,epɪ'dɜ:mɪs/ the outer layer of the skin

¹⁰⁶ Fibroblast: /'faɪbrəʊ,blæst/ a cell in connective tissue that synthesizes collagen

¹⁰⁷ Contractile: /kən'træktɪl/ able to contract or, of an opening or tube, become narrower

epithelial lining of the stomach and its muscular wall to stimulate the release of chemicals for digestion¹⁰⁸ and contraction for peristalsis¹⁰⁹.

6.2.5. System

A body system is composed of varying numbers of organs and accessory structures that have similar or related functions. For example, organs of the gastrointestinal¹¹⁰ system include the oesophagus¹¹¹, stomach, small intestine, and bowel. Some of its accessory structures include the liver, gallbladder, and pancreas¹¹². The purpose of this system is to digest food, remove and use its nutrients, and expel waste products. Other body systems include the reproductive, respiratory, urinary, and cardiovascular systems.

6.2.6. Organism

The highest level of organization is the organism. An organism is a complete living entity capable of independent existence. All complex organisms, including humans, are made up of several body systems that work together to sustain life.

6.3. Anatomical Position

The anatomical position is a body posture¹¹³ used to locate anatomical parts in relation to each other. In this position, the body is erect and the eyes are looking forward. The upper limbs hang to the sides, with the palms facing forward. The lower limbs are parallel, with toes pointing straight ahead. No matter how the body is actually positioned (standing or lying down, facing forward or backward) or how the limbs are actually placed, the positions and relationships of a structure are always described as if the body were in the anatomical position.

6.4. Planes of the Body

To identify the different sections of the body, anatomists use an imaginary flat surface called a plane. The most commonly used planes are midsagittal¹¹⁴ (median),

¹⁰⁸ Digestion: /daɪ'dʒɛstʃən/ the process of digesting food (changing food into substances that the body can use)

¹⁰⁹ Peristalsis: /ˌpɛrɪ'stælsɪs/ the wave-like movements of the intestine, etc. caused when the muscles contract and relax

¹¹⁰ Gastrointestinal: /ˌɡæstrəʊɪn'testɪnəl/ of or related to the stomach and intestines

¹¹¹ Oesophagus: /i'sɒfəgəs/ (pl. oesophaguses or oesophagi /i'sɒfəgaɪ/) the tube through which food passes from; gullet /'gʌlɪt/

¹¹² Pancreas: /'pæŋkriəs/ an organ near the stomach that produces insulin and a liquid that helps the body to digest food

¹¹³ Posture: /'pɒstʃə(r)/ the position in which you hold your body when standing or sitting

¹¹⁴ Sagittal: /'sædʒɪtəl/ (in direction or location) from front to back in the median plane

coronal (frontal), and transverse¹¹⁵ (horizontal). (See *Table 6-1*). The section is named for the plane along which it is cut. Thus, a cut along a transverse plane produces a transverse, or horizontal, section. (See *Figure 6-2*).

Table 6-1: Planes of the body and their anatomical divisions

Plane	Anatomical Division
Midsagittal (median)	Right and left halves
Coronal (frontal)	Anterior ¹¹⁶ (ventral) and posterior (dorsal) aspects
Transverse (horizontal)	Superior (upper) and inferior (lower) aspects

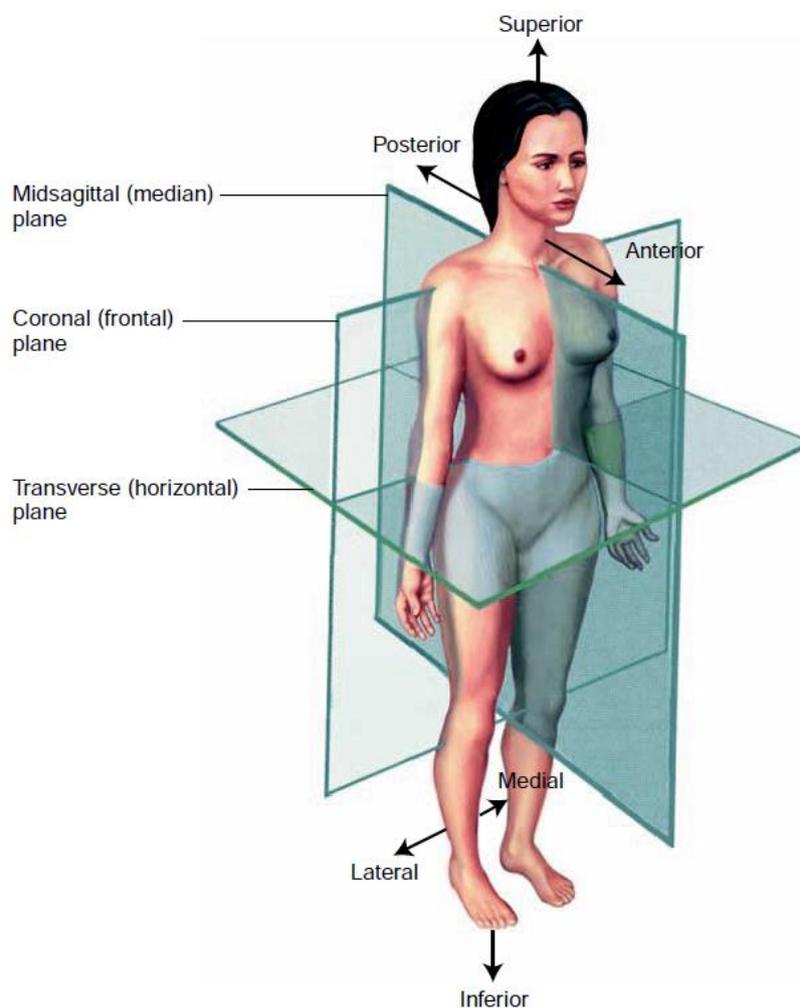


Figure 6-2: Body planes. Note that the body is in the anatomical position

¹¹⁵ Transverse: /'trænzvɜ:s/ placed across sth; diagonal /daɪ'ægən/

¹¹⁶ Anterior: /æ'n'tɪəriə(r)/ (of a part of the body) at or near the front (opp. Posterior /pə'stɪəriə(r)/)

Prior to the development of modern imaging techniques, standard x-ray images showed only a single plane, and many body abnormalities¹¹⁷ were difficult, if not impossible, to see. Current imaging procedures, such as magnetic resonance imaging (MRI) and computed tomography¹¹⁸ (CT), produce three-dimensional images on more than one plane. Thus, structural abnormalities and body masses that were previously not found using a standard single plane x-ray are now detected with scanning devices that show images taken in several body planes.

6.5. Body Cavities

Medical professionals locate structures or abnormalities by referring to the body cavity in which they are found. The body has two major cavities:

- dorsal (posterior), including the cranial¹¹⁹ and spinal cavities
- ventral (anterior), including the thoracic and abdominopelvic cavities.

6.6. Abdominopelvic Divisions

The abdominopelvic area of the body lies beneath the diaphragm¹²⁰. It holds the organs of digestion (abdominal area) and the organs of reproduction and excretion (pelvic area). Two anatomical methods are used to divide this area of the body for medical purposes:

- quadrants
- regions.

6.6.1. Quadrants

Quadrants are four divisions of the lower torso¹²¹ used to show topographical¹²² location. They provide a means of locating specific sites for descriptive and diagnostic purposes. The divisions of quadrants are used in clinical examinations

¹¹⁷ Abnormality: /ˌæbnɔːˈmæləti/ a feature or characteristic in a person's body or behaviour that is not usual and may be harmful, worrying or cause illness

¹¹⁸ Tomography: /təˈmɒgrəfi/ a way of producing an image of the inside of the human body or a solid object using X-rays or ultrasound

¹¹⁹ Cranium: /ˈkreɪniəm/ (pl. craniums or crania /ˈkreɪniə/) the bone structure that forms the head and surrounds and protects the brain

¹²⁰ Diaphragm: /ˈdaɪəfræm/ the layer of muscle between the lungs and the stomach, used especially to control breathing

¹²¹ Torso: /ˈtɔːsəʊ/ the main part of the body, not including the head, arms or legs

¹²² Topography: /təˈpɒgrəfi/ the physical features of an area of land, especially the position of its rivers, mountains, etc; the study of these features

and medical reports. Pain, lesions¹²³, abrasions¹²⁴, punctures, and burns are commonly described as located in a specific quadrant. Incision¹²⁵ sites are also identified by using body quadrants as the method of location. An imaginary cross passing through the navel identifies the four quadrants. (See *Figure 6-3A*.)

6.6.2. Regions

Whereas the quadrants of the body are used primarily to identify topographical sites, the abdominopelvic regions are used mainly to identify the location of underlying body structures and visceral¹²⁶ organs. (See *Table 6-2*). For example, the stomach is located in the left hypochondriac¹²⁷ and epigastric¹²⁸ region; the appendix is located in the hypogastric¹²⁹ region. (See *Figure 6-3B*.)

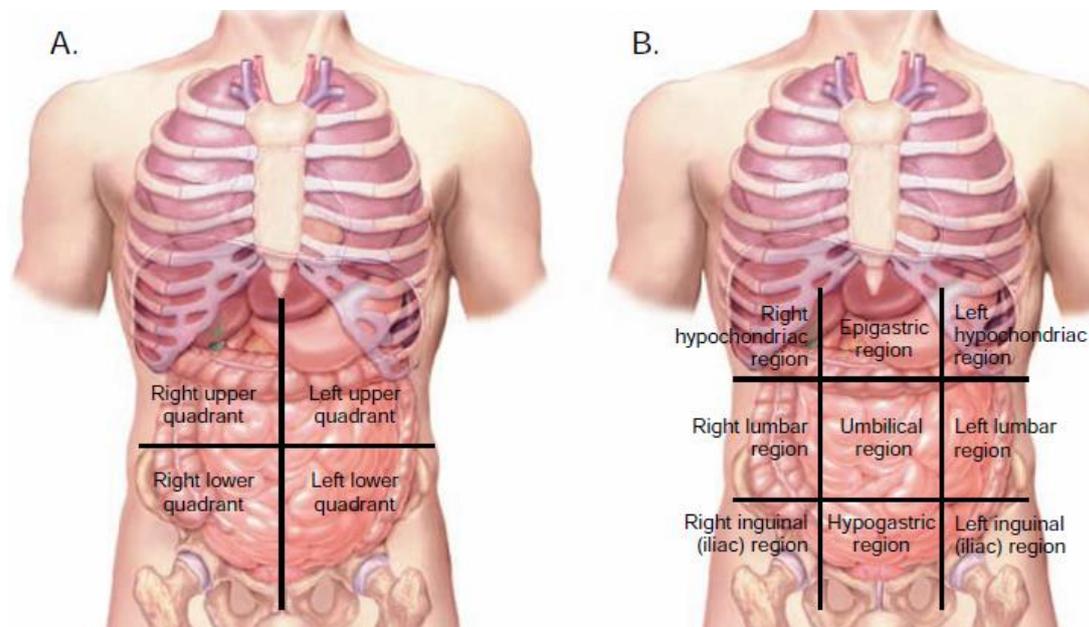


Figure 6-3: Quadrants and regions. (A) Four quadrants of the abdomen. (B) Nine regions of the abdomen

¹²³ Lesion: /'li:ʒn/ damage to the skin or part of the body caused by injury or by illness

¹²⁴ Abrasion: /ə'breɪʒn/ a damaged area of the skin where it has been rubbed against sth hard and rough

¹²⁵ Incision: /ɪn'sɪʒn/ a sharp cut made in sth, particularly during a medical operation; the act of making a cut in sth

¹²⁶ Visceral: /'vɪsərəl/ relating to the viscera (/'vɪsərə/ the large organs inside the body, such as the heart, lungs and stomach)

¹²⁷ Hypochondrium: /,haɪpə'kɒndrɪəm/ the upper region of the abdomen on each side of the epigastrium, just below the lowest ribs

¹²⁸ Epigastrium: /,epɪ'gæstriəm/ the upper and median part of the abdomen, lying over the stomach

¹²⁹ Hypogastrum: /,haɪpə'gæstriəm/ the lower and median part of the abdomen

Table 6-2: The names of the abdominopelvic regions and their location

Region	Location
Left hypochondriac	Upper left region beneath the ribs
Epigastric	Region above the stomach
Right hypochondriac	Upper right region beneath the ribs
Left lumbar ¹³⁰	Left middle lateral region
Umbilical	Region of the navel
Right lumbar	Right middle lateral region
Left inguinal ¹³¹ (iliac ¹³²)	Left lower lateral region
Hypogastric	Lower middle region beneath the navel
Right inguinal (iliac)	Right lower lateral region

6.7. Spine

The spine is divided into sections corresponding to the vertebrae located in the spinal column. These divisions are:

- cervical¹³³ (neck)
- thoracic (chest)
- lumbar (loin)
- sacral¹³⁴ (lower back)
- coccyx¹³⁵ (tailbone)

6.8. Directional Terms

Directional terms are used to show the position of a structure in relation to another structure. For example, the kidneys are superior to the urinary bladder. The directional phrase “superior to” denotes “above”. This example indicates that the kidneys are located above the urinary bladder. (See [Table 6-3](#)).

¹³⁰ Lumbar: /'lʌmbə(r)/ relating to the lower part of the back

¹³¹ Inguinal: /'ɪŋɡwɪnəl/ of or relating to the groin (/ɡrɔɪn/ the part of the body where the legs join at the top including the area around the genitals (= sex organs))

¹³² Ilium: /'ɪlɪəm/ the uppermost and widest of the three sections of the hipbone

¹³³ Cervical: /'sɜːvɪkl/ connected with the neck

¹³⁴ Sacrum: /'seɪkrəm/ (pl. sacra /'seɪkrə/) a bone in the lower back, between the two hip bones of the pelvis

¹³⁵ Coccyx: /'kɒksɪks/ (pl. coccyxes or coccyges /'kɒksɪdʒiːz/) the small bone at the bottom of the spine

Table 6-3: Directional terms along with their definitions. In this list, opposing terms are presented consecutively to aid memorization

Term	Definition
Abduction	Movement away from the midsagittal (median) plane of the body or one of its parts
Adduction	Movement toward the midsagittal plane of the body
Medial /'mi:diəl/	Pertaining to the midline of the body or structure
Lateral /'lætərəl/	Pertaining to a side
Superior /su:'piəriə(r)/ (cephalad /'sefə,læd/)	Toward the head or upper portion of a structure
Inferior /ɪn'fiəriə(r)/ (caudal /'kɔ:dəl/)	Away from the head, or toward the tail or lower part of a structure
Proximal /'prɒksɪməl/	Nearer to the centre (trunk of the body) or to the point of attachment to the body
Distal /'dɪstl/	Further from the centre (trunk of the body) or from the point of attachment to the body
Anterior (ventral /'ventrəl/)	Front of the body
Posterior (dorsal /'dɔ:sl/)	Back of the body
Parietal /pə'raɪtəl/	Pertaining to the outer wall of the body cavity
Visceral /'vɪsərəl	Pertaining to the viscera, or internal organs, especially the abdominal organs
Prone /prəʊn/	Lying on the abdomen, face down
Supine /'su:pain/	Lying horizontally on the back, face up
Inversion /ɪn'vɜ:ʃn/	Turning inward or inside out
Eversion /ɪ'vɜ:ʒən, -ʃən/	Turning outward
Palmar /'pælmə/	Pertaining to the palm of the hand
Plantar /plæntə(r)/	Pertaining to the sole of the foot
Superficial /,su:pə'fi:ʃl/	Toward the surface of the body (external)
Deep	Away from the surface of the body (internal)