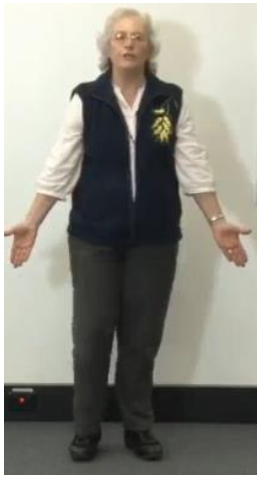
Terms, Tissues and Imaging

INTRODUCTION TO ANATOMY AND ANATOMICAL TERMINOLOGY

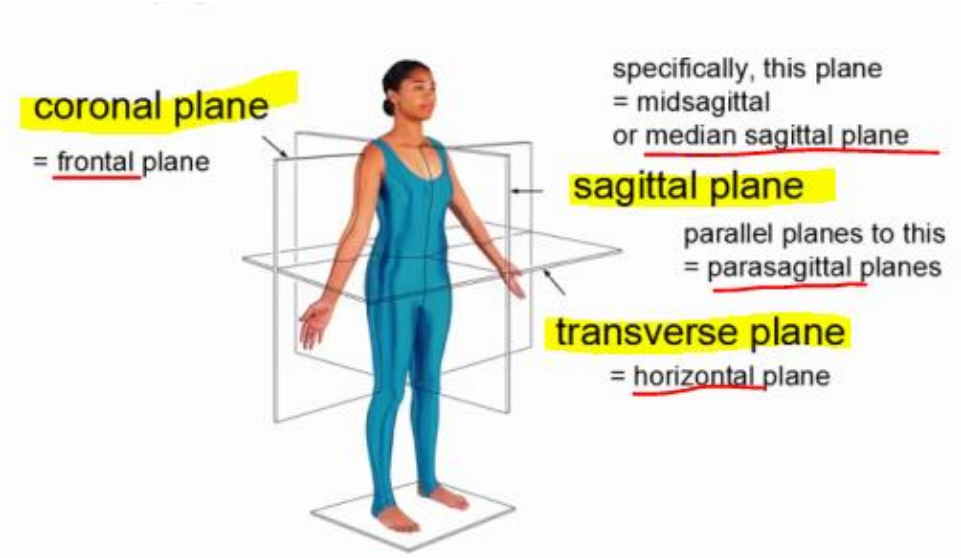
1. **Anatomical Facts;** isolated observations or statements about structures (body parts) or events (happenings)
   Anatomical concepts; structures (or classes of structures) or events each with common, defining characteristics
   Anatomical principles; generalisations about recurring patterns of association of concepts in different parts of the body
2. **Anatomical relationships;** the relationship of an anatomical structure can be described in terms of where it is relative to something else. i.e. What lies anterior, posterior, superior, inferior, etc.

Anterior/ ventral	Front
Posterior/ dorsal	Back
Superior/ cranial	Towards top of head
Inferior/ caudal	Towards toes
Proximal	Close to spine/ point of attachment
Distal	Far from spine
Medial	Middle of body eg. Spine
Lateral	Side of body eg. Hands --> they are on the side of the body
Superficial	Towards the skin/ outside of body
Deep	Into the skin/ inside of the body eg. Heart is deep compared to the sternum which is superficial

3. **Standard Anatomical Position**



   - Head facing forward
   - Palms forward and near to sides
   - Toes facing forward and feet slightly apart

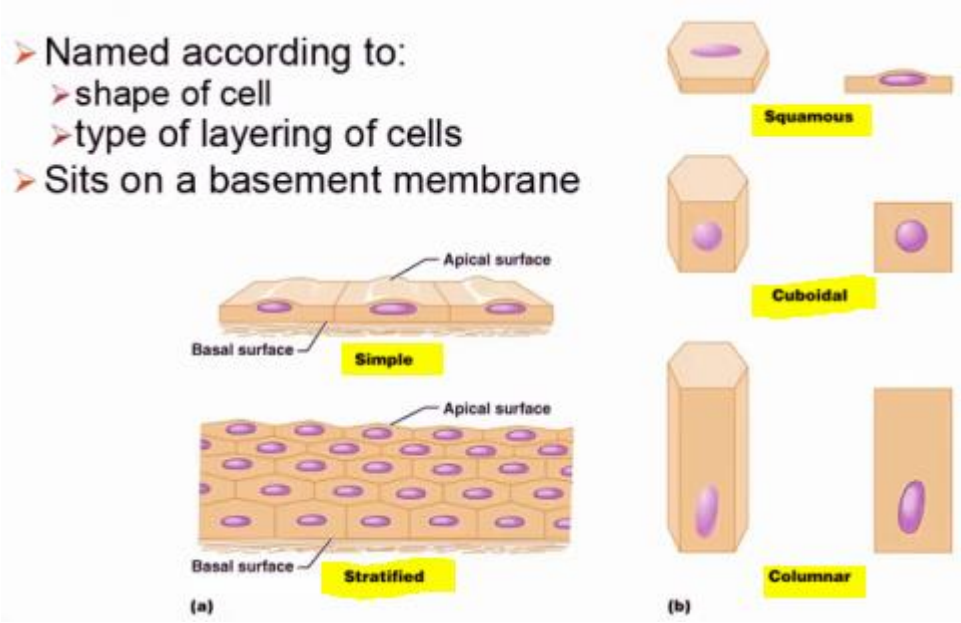


- Describe following movements;

Type of movement	Definition of movement	Plane it occurs in
Flexion	Decreasing the angle of the joint. Bending the joint.	Sagittal
extension	Increasing the angle of the joint. Straightening the joint.	Sagittal
Dorsiflexion (ankle)	Lifting ankle superiorly. Decreasing angle of the ankle joint. (pointing feet upwards)	Sagittal
Plantarflexion (ankle)	Pointing foot downwards. Increasing angle of the ankle joint. (pointing feet downwards)	sagittal
abduction	Moving a limb away from the centre line (medial line) of the body	coronal
adduction	Moving a limb towards the centre line (medial line) of the body	coronal
Pronation (forearm)	Rotating the forearm so that the palm faces down if the forearm is flexed.	transverse
Supination (forearm)	Rotating the forearm so that the palm faces upward if the forearm is flexed.	transverse
Elevation (jaw)	Shutting of jaw. Moving a body part in a superior direction.	
Depression (jaw)	Opening of jaw. Moving a body part in an inferior direction.	
Protraction (jaw)	Jaw pulled forward	
retraction (jaw)	Jaw pulled back	
circumduction	Moving arms in circular motion	

BODY TISSUES AND LAYERS

5. List and explain the 4 basic tissue types found in the human body.
    - **Epithelial tissue; covers**
        - **Covers a body surface or lines a body cavity**
        - **Covers walls and organs in the ventral body cavities**
        - **CHARACTERISTICS;**
            - **Firm and holds together well**
            - **One free surface**
            - **Supported by connective tissue**
            - **Nerve supply (= innervated) but doesn't have blood vessels in tissue (= avascular)**
            - **Regenerates (if skin is scratched, it will fix itself)**
    - **Connective tissue; supports + connects**
    - **Muscular tissue; movement**
    - **Nervous tissue; control**
6. Describe the characteristics of epithelial tissue and give examples of the following epithelial layers.
    - **Simple layer; one layer of skin**
    - **Stratified layer; many layers of epithelial cells**



a. **Simple squamous**
    - **FOUND IN;**
        - **Alveoli of lungs**
        - **Serous membranes**
        - **Lining of heart and blood vessels**

b. **Simple cuboidal**
    - **FOUND IN;**
        - **Kidney tubules**
        - **Ducts and secretory sections of small glands**

c. **Simple columnar**
    - **FOUND IN;**
        - **Digestive tract (secretory)**
        - **Bronchi, uterine tubes (ciliated)**
        - **Secretory OR ciliated**

d. **Stratified squamous**
    - **FOUND IN;**

- **Outer layer of skin**
- **Linings of oesophagus, trachea**

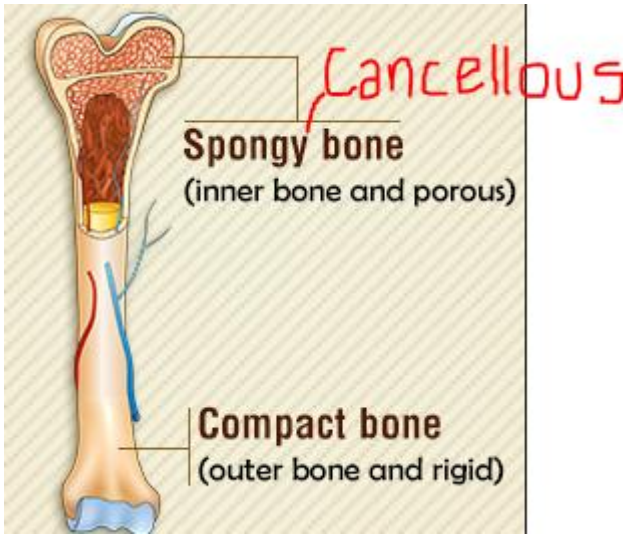
g. Components of connective tissue.
   - **Connective tissue made up of;**
     - **Specialised cells**
     - **Fibres**
       - **Collagen**
         - **Dense fibre which is stronger than steel**
       - **Elastin**
         - **Fibre that is elastic**
       - **Reticular**
         - **Fibres that help in making connective tissue**
     - **Ground substance**
     - **Fibres + ground substance = extracellular matrix that surrounds the cells**

- DEALING WITH DENSITY;
  - Blood is least dense followed by
  - Loose connective tissue
  - Dense connective tissue
  - Cartilage
  - Bone while is most dense
- Types of connective tissue;

Connective tissue proper
- **Loose connective tissue**
  - **Semifluid of gelatinous ground substance**
  - **Variety of cell types present**
  - **Loose arrangement of fibres**
  - **Appears to be full of holes (= areolar)**
  - **Eg. Areolar tissue, adipose (fat) tissue, found in hypodermis**
- **Dense connective tissue**
  - **Tendon**
  - **Ligament**
  - **Deep fascia**

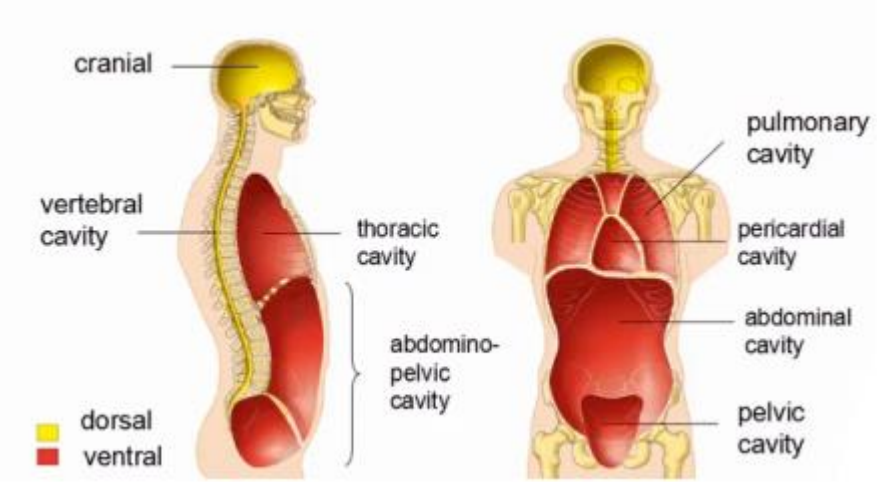
Cartilage
- **Dense ground substance**
- **Cells contained in small spaces (called lacunae) in ground substance**
- **Tough but flexible**
- **TYPES OF CARTILAGE**
  - **Hyaline cartilage**
    - **On the bone ends at joints**
    - **Forms developing bones**
    - **Forms the medial border of the rib cage**
  - **Fibrocartilage cartilage**
    - **Intervertebral disks of the vertebral column**
    - **Disk in the pubic symphysis of the pelvis**

Bone
- **Calcified matrix**
- **Cells found in lacunae**



d. Blood

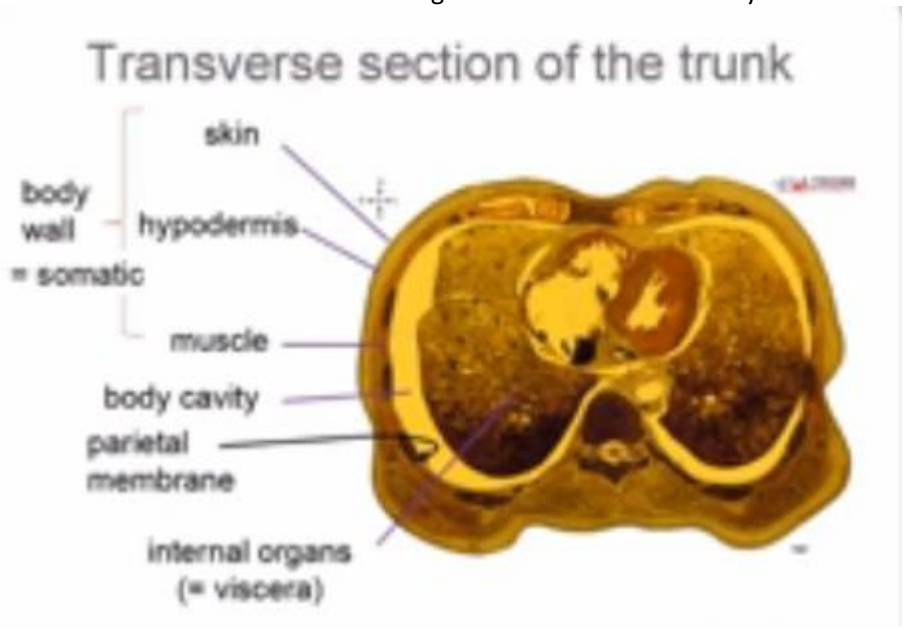
8. Body cavities
   - **TYPES OF CAVITIES;**
     - **Dorsal Cavity**
       - **Cranial cavity- brain**
       - **Vertebral canal- spinal cord**
     - **Ventral cavity**
       - **Thoracic cavity**
         - **Pulmonary cavity- lungs**
         - **Pericardial cavity- heart**
       - **Abdominopelvic cavity**
   - **Serous membranes; membranes that produce serous fluid**
     - **Serous membranes line the ventral body cavities**
       - **Parietal membranes; membranes which line the walls**
     - **Serous membranes are formed of a simple squamous epithelial layer lying on a loose connective tissue layer**



   - **Principle RV6;** in serous fluid-filled cavities which occur within the major body cavities, friction between organs and the body wall and between the organs themselves is limited, and mobility enhanced, by serous fluid derived from the membranes lining the walls of the cavity
     - **Serous membranes** means that the organs can move and not stick to the body walls
   - NAMING SEROUS MEMBRANES;
     - **Pleural Cavity;** parietal pleural lines thoracic wall

- **Pericardial cavity;** parietal pericardium lines pericardial wall
- **Abdominopelvic cavity;** parietal peritoneum lines abdominal wall

- FUNCTION OF SEROUS MEMBRANE;
  - To produce serous fluid
  - Provide lubrication for organs to slide across the body wall



- What factors control tissue repair
  - **Good blood supply = tissue growth and repair**
  - **Skin + bone has good blood supply so will heal relatively quickly**
  - **Tendons/ ligaments on the other hand will take a very long time to heal as they have very little blood supply (blood vessels can't fit in dense connective tissue)**

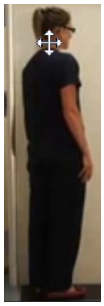
MEDICAL IMAGING

POSITIONS


Lateral Position


Prone Position

Supine Position



Right Anterior Oblique

Left Anterior Oblique

Right Posterior Oblique

Left Posterior Oblique

- There are 2 types of Medical Radiation;
  - **Ionizing**
    - All ionizing radiation is harmful
      - Tissue sensitivity
      - Risk vs Benefit
    - Types of imaging;

        - X Rays
        - Nuclear Medicine (Gamma)
        - Fluoroscopy
        - CT
    - **Non-ionizing**
        - Types of imaging;
            - Ultrasound
            - MRI
- Correct Practices include;
    - **ALARA Principle;** As low as reasonably achievable (ALARA) principle
    - Lowest radiation dose for maximum amount of information
- Imaging Modalities;
    - **General X-Rays**
        - Is a shadowy negative image of internal structures
        - Visualize hard, bony structures and **locate abnormally dense structures** (tumors, TB nodules)
        - Positives
            - Cost effective
            - Readily available in most towns and cities
            - Quick, easy, good starting point for suspected injury
            - Excellent visualisation of bones
        - Negatives
            - Uses X-Rays (ionizing radiation) to produce images
            - Relatively low dose
            - Poor visualisation of soft tissues
        - Positions;

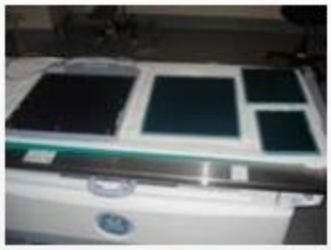
WHY 2 OR MORE VIEWS?

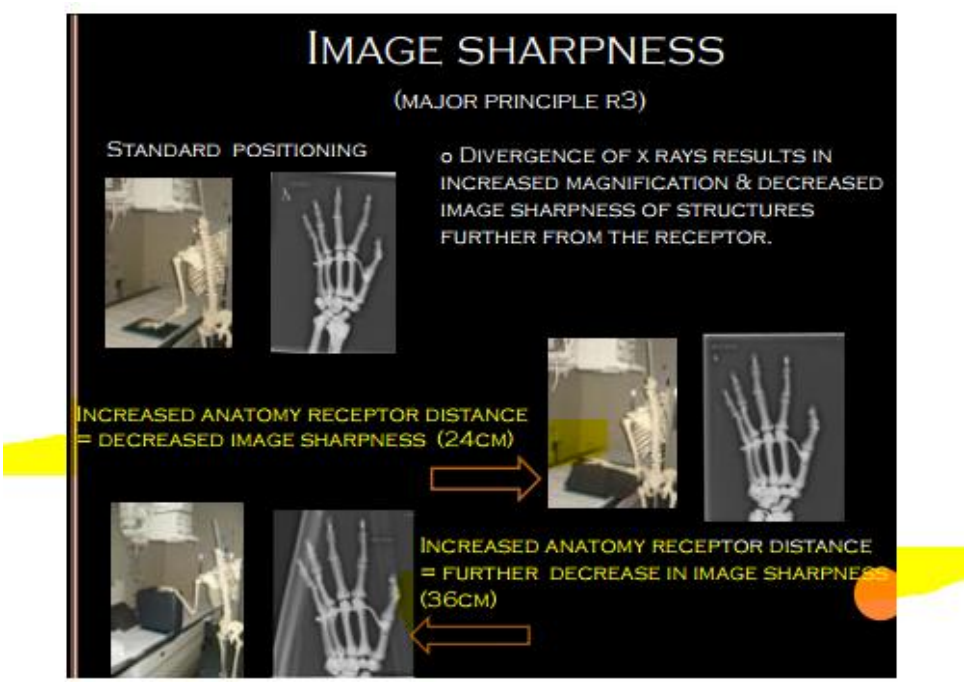
(MAJOR PRINCIPLE R4)

- A MINIMUM OF TWO VIEWS PERPENDICULAR TO EACH OTHER ARE REQUIRED TO EXCLUDE ABNORMALITY.

X RAY IMAGE PRODUCTION

- X-RAY TUBE
- IMAGE RECEPTORS
  COMPUTED RADIOGRAPHY (CR)
  DIGITAL RADIOGRAPHY (DR)

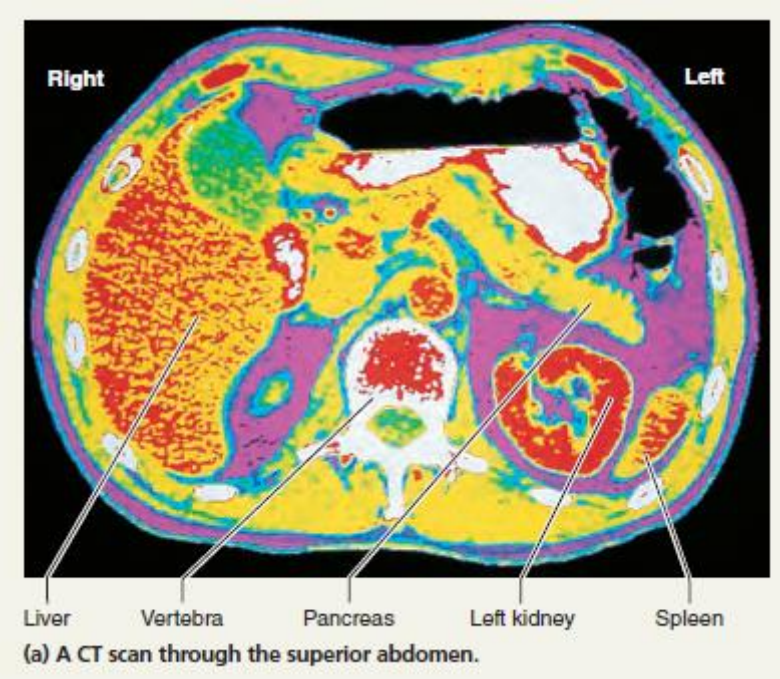




- Image Quality;
  - Tissues of greater density absorb more X-rays, therefore appear whiter on a radiograph
  - Lighter/white regions of image; less X rays reaching the receptor
  - Black/ dark regions; many X rays reaching the receptor

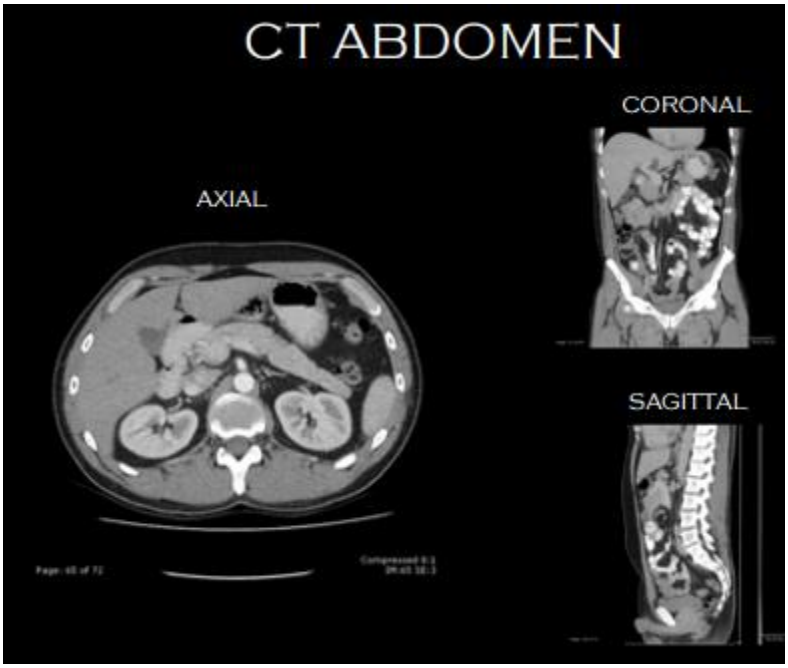
- **Fluoroscopy**
  - Is a study of moving body structures
  - A continuous **X-Ray beam is passed through body part being examined.** It is then transmitted to a TV-like monitor so that the body part and its motion can be seen in detail
  - Positives
    - Excellent for functional studies
    - Simple and low cost tests for diagnosis
    - Real time imaging
  - Negatives
    - Uses X Rays to produce images
    - Need to introduce contrast
    - Increased dose compared to plain x rays

- **Computed Tomography (CT)**
  - Uses a refined version of X ray equipment.
  - As the patient is moved through the doughnut shaped CT machine, its **X ray tube rotates around the body and sends beams from all directions to specific level of the patient's body.**
  - CT ends the confusion resulting from overlapping structures seen in conventional X Rays. (because at any movement **its beam is confined to a 'slice' of the body about as thick as a dime)**
  - Computer translates information into a detailed, cross-sectional picture of each body region scanned
  - Forefront for evaluating most problems that affect the brain and abdomen

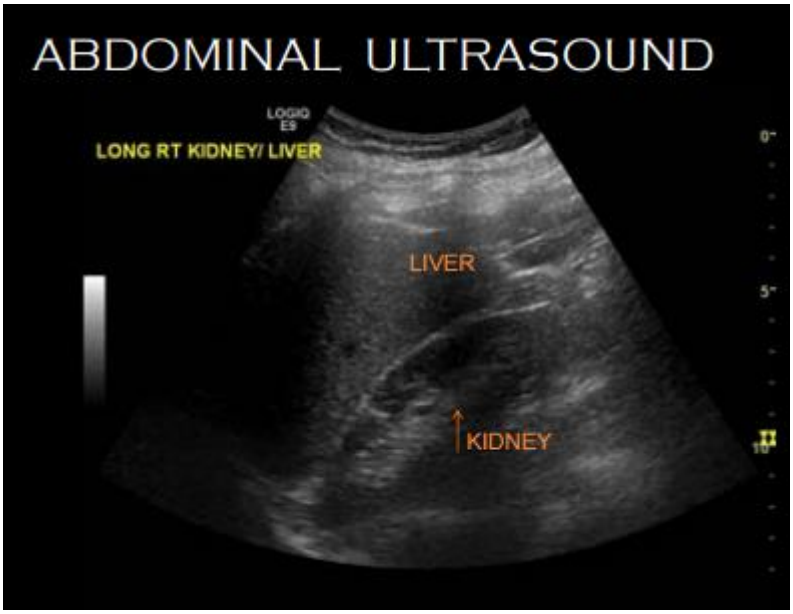


(a) A CT scan through the superior abdomen.

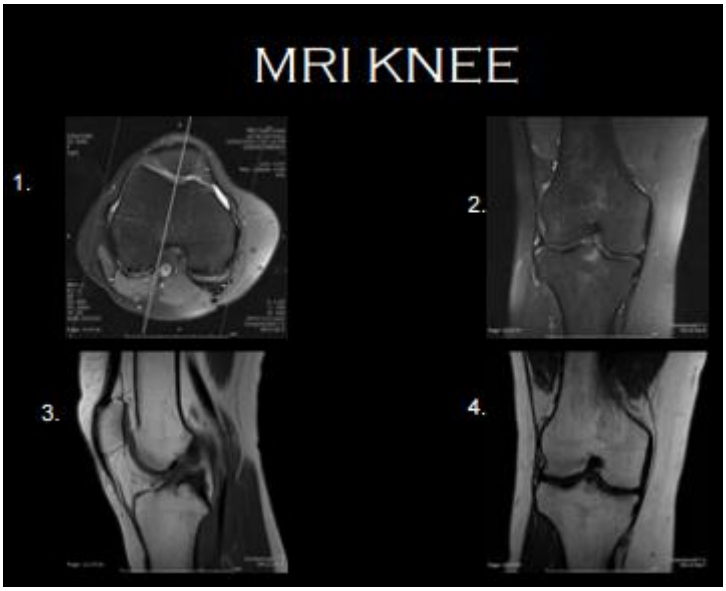
  - Positives
    - Excellent visualisation of bones when high resolution is required
    - Excellent visualisation of blood vessels (post contrast) and internal organs
    - Non-invasive
  - Negatives
    - Uses X Rays to produces images
    - Limited soft tissue (muscles and tendons) demonstrated
    - Increased dose when compared to x rays
    - Increased cost compared to x rays, still low compared to MRI



- **Ultrasound**
  - The body is probed with pulses of sound waves that cause echoes when reflected and scattered by body tissues.
  - A computer **analyses these echoes to construct somewhat blurry outlines of body organs**
  - Handheld device emits the sound and picks up on the echoes
  - The sound waves use have low penetrating power and rapidly dissipate in air. Hence won't work for looking at air-filled structures (lungs) or those surrounded by bone (brain and spinal cord)
  - Positives
    - Uses sound waves to produce images
    - Non ionizing radiation
    - Safe to use for pregnant women
    - Low cost
    - Excellent for soft tissues, internal organs and musculoskeletal imaging
  - Negatives
    - Operator dependent
    - Large body habitus



- **Magnetic Resonance Imaging (MRI)**
  - Produces high-contrast images of our soft tissues, an area in which x rays and CT scans are weak
  - Maps the body's content of hydrogen (which is mostly water)
  - Whilst in an MRI, hydrogen molecules act like tiny magnets. Their energy is further enhanced by radio waves.
  - When the radio waves are turned off, the energy released is translated into a visual image
  - MRI **distinguishes body tissues based on their water content**, so it can differentiate between the fatty white matter and the more watery gray matter of the brain
  - Dense structures DO NOT show up at all on an MRI. It enables the view of delicate nerve fibres of the spinal cord.
  - They can accurately diagnose heart attacks or ischemic strokes- conditions that require rapid treatment to prevent fatal consequences
  - Positives
    - Magnetic field to produce images
    - Non ionizing radiation
    - Greater soft tissue resolution than other imaging
    - Non invasive
  - Negatives
    - High cost compared to other imaging
    - Long scan time (45+ min) compared to CT (<10min)
    - Some patients excluded due to foreign bodies (ie. Metal shavings and pacemakers)
    - Claustrophobia



- **Nuclear Medicine (NM)**
  - Positives
    - Unique information
    - Can help to find disease and assess the extent
    - Less expensive and less invasive than exploratory surgery
    - Can be used to for pregnant or lactating women (when essential)
  - Negatives
    - Uses radiation to produce images
    - Poor contrast in images
    - Patient can be radioactive when they leave department


LIMITED BONE SCAN