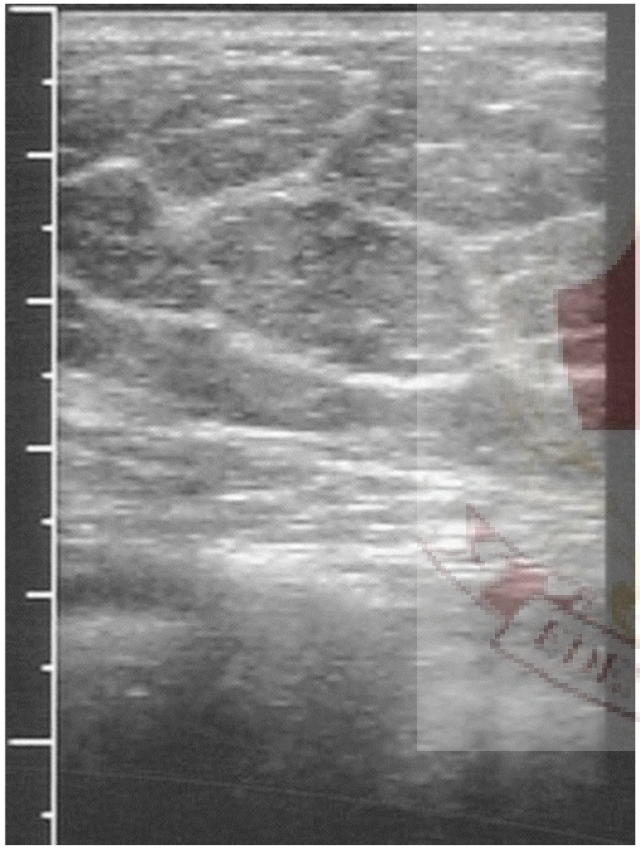
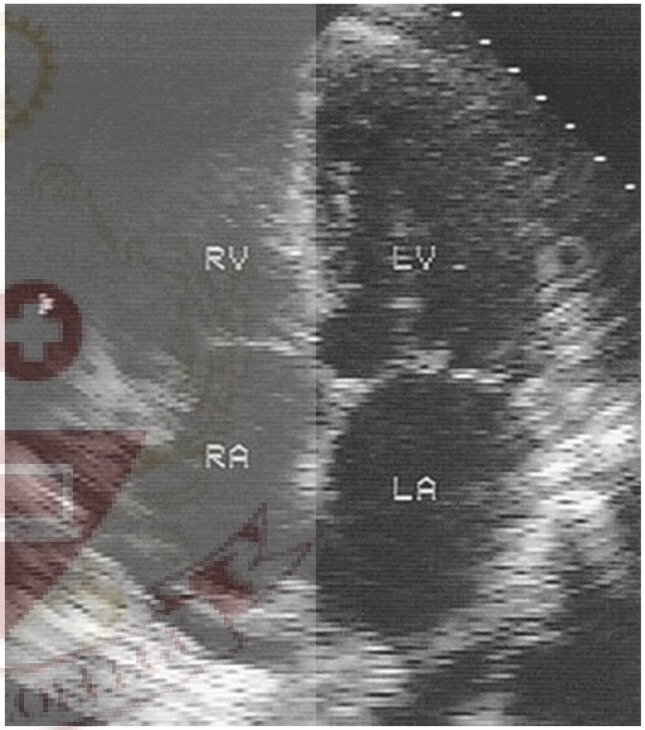
Ultrasound Imaging (Sonography)

MRT Program

What Can You See?





- Source: Textbook of Radiographic Positioning and Related Anatomy, Bontrager & Lampignano. © Mosby Elsevier. Used with permission.

What is Ultrasound Imaging?

- Ultrasound Imaging (Sonography) uses high frequency sound waves to produce images of organs and structures in the body.
- The frequency of sound waves heard by human ears is about 20 Hz to 20 kHz (20–20,000 cycles/sec).
- The frequency used in diagnostic medical sonography is from 2 MHz to 15 MHz (2–15 million cycles/sec).
  - Only transmissible in liquids and solids, not in air or gas.
- Painless and harmless, no ionizing radiation involved.
- Safe and preferred imaging modality for radiosensitive exams—such as in obstetrics.
- ALARA still applies!
  - Sound energy ultimately converts to heat.
  - Avoid unnecessary tissue heating.

How does Ultrasound Work?

- Transducer
  - Converts energy from one form to another.
  - In ultrasound, electrical energy converts to sound energy, then is directed into body.
  - Returning sound energy from the body is turned back into electrical energy.
  - Made of a special ceramic that creates a high frequency sound when an electrical current passes through it and causes it to vibrate.
    - Called the piezoelectric effect.
  - Transducer placed on skin where gel has been applied.

Transducers



- Source: *Textbook of Radiographic Positioning and Related Anatomy,* Bontrager & Lampignano. © Mosby Elsevier. Used with permission.

Transducers (cont'd)

- Higher frequency
  - 5–7 MHz for average or small abdomen
  - Results in higher resolution, lower penetration
- Lower frequency
  - 3.5 MHz
  - Results in lower resolution, but increases penetration
- Intraluminal
  - Up to 17 MHz
  - Used when minimal penetration required, but need the highest resolution

How it Works

Echoes



How it Works (cont'd)

- Pulsed system
  - Short bursts of ultrasound energy.
  - Burst followed by silent period as transducer listens for returning echo.
  - Echoes are measured and shown on the monitor as shades of grey.
  - Shades of grey depend on intensity and amount of time it takes for echoes to return.
- Continuous system
  - Sends and receives energy constantly.
  - No listening time gap.
  - Cannot produce diagnostic anatomic images.
  - Used in vascular and therapeutic exams.

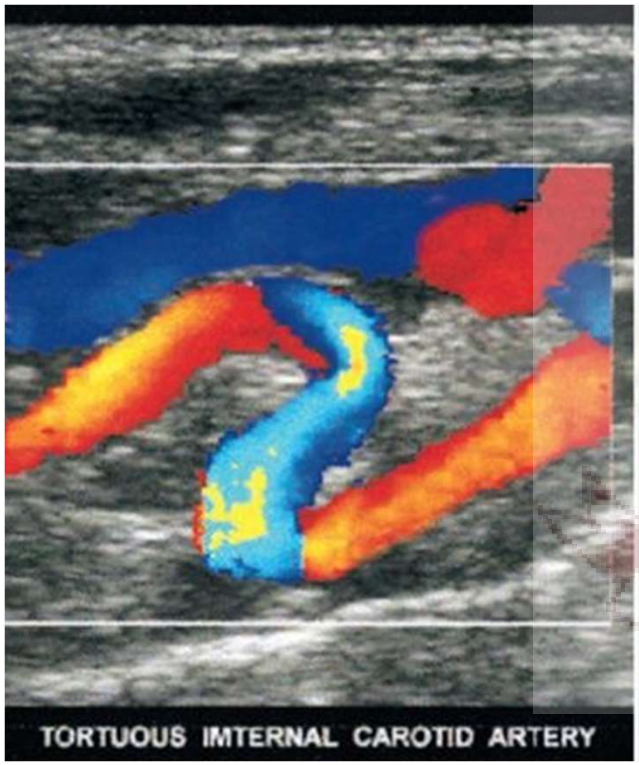
How it Works (cont'd)

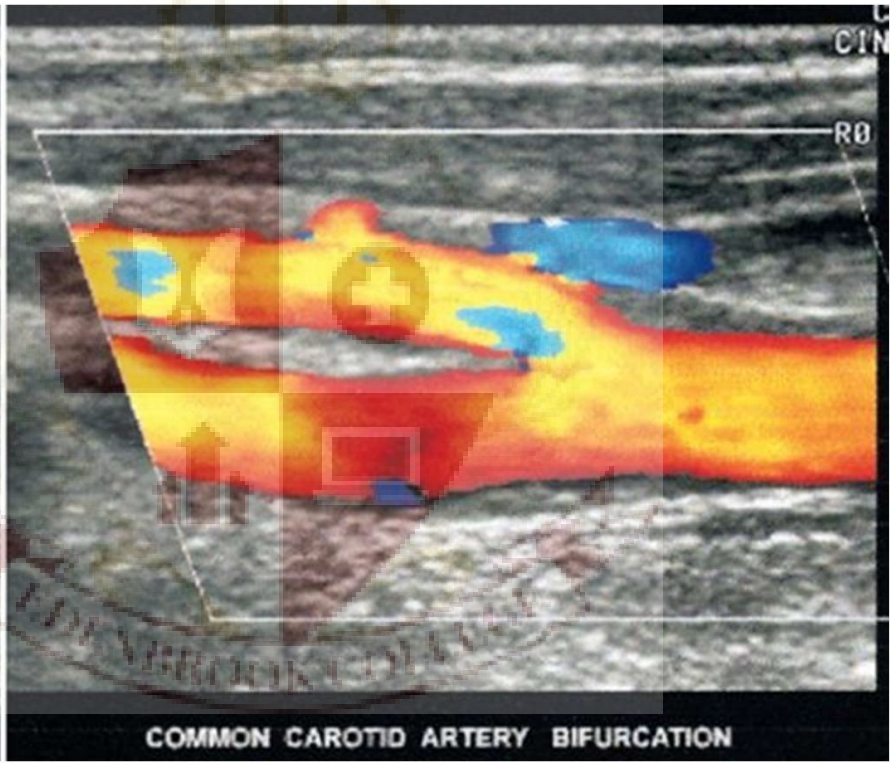
- Viewing images
  - Can be viewed on a monitor in real time.
  - Can be recorded on film/tape for later viewing and storage.
  - Each image is a slice.
    - 2-D like CT images
  - Plane of orientation:
    - Depends on how transducer is positioned
      - Longitudinal
      - Transverse

Doppler Imaging

- Used to study vascular structures and flowing blood.
- Colour flow Doppler ultrasound shows blood flow in different colours.
  - Colours show velocity and direction (in relation to transducer, not source).
- Uses Doppler transducer:
  - Transmits a fixed frequency into a moving object (flowing blood).
  - Shift in the transmitted frequency is reflected back.
  - Shifted frequency is called Doppler shift.
  - Shows strictures, restricted flow, plaque formation.
  - Advantage: can visualize pathologies without the use of contrast media.

Doppler Imaging (cont'd)





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Advantages of Ultrasound

- Dynamic evaluation of joint structures.
- Excels in differentiating between solid and fluid-filled structures.
- Gold standard for pancreas, liver, gallbladder and uterus exams.
- Safe for use in studies during pregnancy.
  - Replaced pelvic outlet measurements, fetal position, pelvimetry.

Limitations of Ultrasound

- Difficult to visualize anatomy surrounded by bone.
- Air-filled structures can obstruct the soundwaves.
- Requires fluid/gel medium to perform exam.
  - E.g., for a pelvic exam, need to have a full bladder.
  - Can be difficult and uncomfortable for patients.