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Sonography Tech (Quickstudy: Academic)

BarCharts, Inc.®

Quick Study Academic

Sonography Tech

Essentials of Physics & Sound, Image Interpretation, Tools, Techniques, Equipment & Terminology

OVERVIEW

Scope of Practice

- **Diagnostic** (i.e., **ultrasonography**) involves the following aspects: medical, scientific and technical
 - patient care
 - quality control
 - diagnostic procedures
 - computer data acquisition & processing
- **Diagnostic** technology is a **multidisciplinary field**, in which medicine, biology, mathematics and other sciences, including:
 - anatomy
 - physics
 - computer technology
- **Diagnostic** imaging technique is used to **visualize subcutaneous body structures**, for possible **pathology** or **lesions**.
 - **Imaging** best suited for **sonographic imaging** include:
 - **skin**
 - **muscles**
 - **joint**
 - **viscera**
 - **internal organs**
 - **ultrasound**, the term "ultrasound" applies to **ultrasonic waves** with a **frequency above human hearing** (20,000 hertz) or 20 kilohertz (kHz).
 - **Typical** diagnostic **ultrasonographic scanners** operate in the **frequency range** of 2-10 megahertz (MHz), hundreds of times greater than the **frequency of sound** we can hear.
 - However, the choice of **frequency** is a **trade-off** between **spatial resolution** of the image and **imaging depth**.
 - **lower frequencies** produce **less resolution**, but **image deeper** into the body.
 - **higher frequencies** produce **better resolution**, but **image closer** to the body.
- **However**, the choice of **frequency** is a **trade-off** between **spatial resolution** of the image and **imaging depth**.

How Ultrasound Works

- **Ultrasonography** is **effective** for **imaging soft tissue**.
 - **superficial structures** such as **muscles, tendons, veins, breast** and the **internal bones** are imaged at a **higher frequency** (7-10 MHz), which provides **better axial and lateral resolution**.
 - **deeper structures** with **less tissue and bone** are imaged at a **lower frequency** (3-5 MHz), which provides **better axial and lateral resolution** but **greater penetration** (i.e., **increased imaging depth**).
- **In general**, **ultrasonographic machines** may be used for most imaging purposes; **specialty applications** may be imaged by use of a **specialty transducer**.
 - **Imaging** of **deep structures** (e.g., **liver, kidney, heart, lungs, prostate, ovaries, etc.**) requires a **transducer** on the **surface** of the body; but **imperial diagnostic procedures** are often possible if a **transducer** can be placed **inside the body**.
 - **for diagnostic, specialty transducers** (including **endovaginal, endorectal and transesophageal transducers**) are commonly employed.

PHYSICS & SOUND

Understanding Sound Waves

- **Any** **physics** of **waves** vary **energy** from **one location** to **another**.
- **Sound** is a **mechanical wave** in which **particles move**, i.e., the molecules vibrate back and forth from a **fixed position**.
- **Sound** **travels** in a **straight line** and **sound waves** are **longitudinal waves**.
- **Sound waves** are **identified** by the following **acoustic variables**: **pressure, particle displacement, density and temperature**.
- **in diagnostic ultrasound**, **waves** (i.e., **sound, noise**) are **reflections** arising from structures in the body return to the **transducer** and are **processed** into **images**.
- **To understand exactly how that happens**, let's review how **sound waves work**.

Pressure

- The **ratio** of **force** acting on a **surface object**:
- If there were no **force**, or **pressure**, **everything would** be in a **state of constant rest**.
- The **law of inertia** **explains** that a **body in motion will remain in motion**; likewise, a **body at rest will stay at rest** until acted upon by an **outside force**.
- **Up-and-down** **motion** human soft tissue **out of its state of rest**.

FORMULA

$$\text{Pressure} = \text{Force}/\text{Area} \quad \text{OR} \quad P = F/A$$

Units of measure: **Newton/meter²** or **Pa**

Particle Displacement

- The **distance** the **body** has **moved** after being **impinged upon** by a **wave** (i.e., **how far** the **particle moved** from its **equilibrium position**).

Density

- The **property** common to all **matter** and the **one property** that **makes each type of matter unique**.
- **Density** is defined as **mass per unit volume**, the **more mass** confined to a **given volume**, the **greater the density**.

For ultrasound, **density** is referred to as **mass density**, which can be defined as the **mass of the object divided by its volume**.

FORMULA

$$\text{Density} = \text{Mass}/\text{Volume} \quad \text{OR} \quad D = M/V$$

Units of measure: **kg/m³**, **g/cm³**

Temperature

- The **measurement** of **relative coolness or warmth** of an **object**.
- **Temperature** in **ultrasound** **varies** **inversely** with the **speed of sound** **varies with the temperature of the tissue that is being scanned**.

Parameters of Sound Waves

- The **seven** **parameters** of **sound waves** are: **period, frequency, amplitude, power, intensity, wavelength, and speed**.
- **Period** and **frequency** **describe** the **speed** of the **wave**.
- **Amplitude, power and intensity** **describe** the **strength** of the **wave** (i.e., **Magnitude**); these **parameters tend to be directly related** when **intensity increases as its power and its amplitude**.

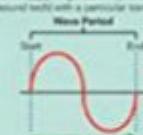
Period

• Time it takes for a wave to vibrate a single cycle (i.e., from the start of one wave to the start of the next).

Frequency

- **Reported** in **units** of **time** (seconds), **inversely** **hours, days**.
- The **value** of **period** in **diagnostic ultrasound** is **one period** to **one half** of **a millisecond** of **one second**.
- **period determined** by the **sound source** only, not by the **tissue being scanned**.
- **period** is **NOT adjustable** by the **sonographer**.

Wavelength



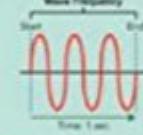
Frequency

- **Number** of **events** that **occur** in a **specific duration of time**.
- In **diagnostic ultrasound**, the **frequency** of a **wave** is **defined** as the **number of cycles occurring in one second**.
- **Frequency** is **important** in **diagnostic ultrasound** because it **affects penetration and image quality**.
- **Measured** in **units per second** or **Hz** (**Cycles/second** = **1 Hz**).
- **Frequency ranges** are **from 20 kHz to 10 MHz** (2 million to 10 million per second).
- **Frequency determined** by the **sound source only**, not by the **tissue being scanned**.
- **Frequency** is **NOT adjustable** by the **sonographer**.

Frequency Spectrum of Sound

Information: **low** **less than 20 Hz**
mid **between 20 Hz and 20 kHz**
ultrasound **greater than 20 kHz**

Wavelength



Amplitude

- **Defined** as the "height" of the wave, it is the **difference** between the **minimum value** and the **maximum value** of the **波形**.
- **Amplitude** is **inversely proportional** to **density**, **density** (ρ), and **particle motion** (Δx).
- **Amplitude** is **determined** by the **sound source**, but **amplitude decreases** as it **travels** through the **body**.
- **decrease in sound** depends on the **characteristics** of the **sound** and the **body tissue** the **wave** is **traveling through**.
- **The sonographer** **can** **alter** the **initial amplitude** in **an ultrasound machine**.

Amplitude

• **Amplitude** is **measured** from the **middle value** to the **maximum value**.



Synopsis

Our jam-packed 3-panel (6-page) guide is ideal for all sonography (ultrasound) students. This up-to-date guide features our customary easy-to-use format and informative, fluff-free style, with sections that cover all aspects of sonography • ranging from sound waves to image interpretation. Each section features •The Sonographer Knows• summary of critical points, set off graphically for easy reference.

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Customer Reviews

It's a good review for physics portion of my classes, but I wish it had other topics for Sonography as well.

Nice review of topics covered in sonography in a handy form

It is a pretty good product. I find it accessible for quick reminders. I highly recommend it for student even a professional.

good

Nice quick chart review.

A waist if money. You can find same info on line. Nothing special.

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