



# Medical Physics II

2<sup>nd</sup> semester

**Prof. Dr. Ehssan Al-Bermany**

Associated fellowship of the HAE, The UK.

[ehssan@itnet.uobabylon.edu.iq](mailto:ehssan@itnet.uobabylon.edu.iq)

# Lectures 6

## Sound in Medicine

# Applications of Sound in Medicine

1. Ultrasonic Scanner
2. The cavitron ultrasonic surgical aspirator (CUSA)
3. Bloodless surgery: High-intensity focused ultrasound (HIFU)
4. The Doppler flow meter

# Sound and Medicine

## **Diagnostic** Ultrasound Instrumentation and **Operation:**

The **principal reasons** for its wide application are

1. Its **ease** to use
2. The **relatively**
3. **Low cost** of the instrumentation,
4. The **lack of ionizing radiation.**

▶ The heart of diagnostic ultrasound is the **Transducer.**

# Ultrasound Transducer

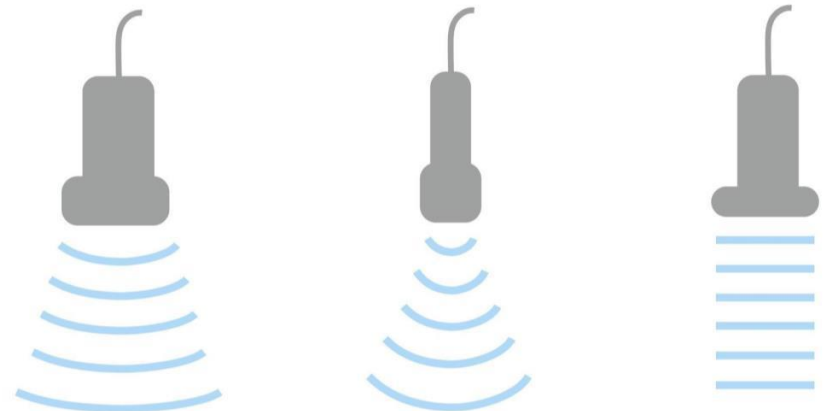
A **transducer** is any device that **converts energy** from one form to another.

An ultrasound transducer converts **electric energy** into **ultrasound energy** and ultrasound energy **back** into electric energy.

The **physical phenomenon** of an ultrasound transducer is the piezoelectric effect phenomenon.

## Piezoelectric Effect

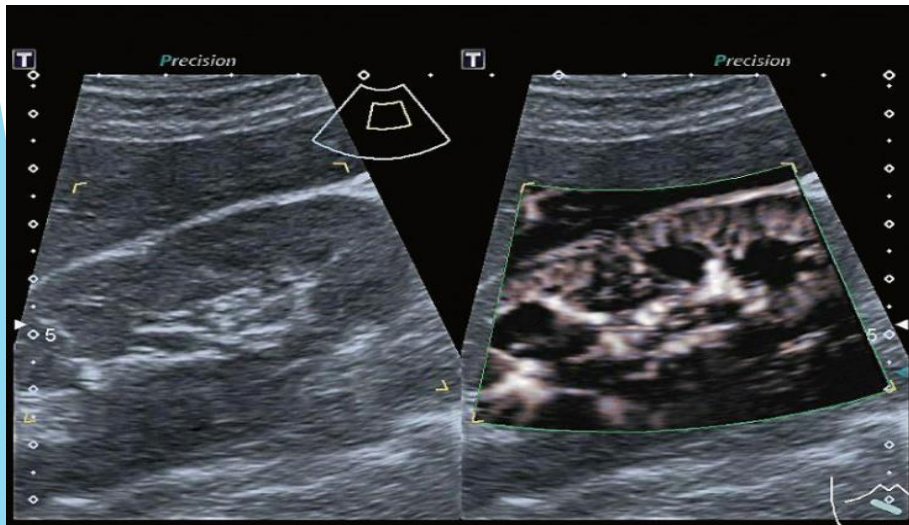
It is the ability of certain materials to **generate an electric charge** in **response** to **applied mechanical stress**.



# Diagnostic Methods of Ultrasound

**Diagnostic medical sonography** is an **imaging method** that uses **sound waves to produce images of structures** within your body. The images can provide **valuable information** for **diagnosing** and **directing treatment** for a variety of diseases and conditions :

- 1- A-mode:** is particularly useful for **measuring midline shifts of the brain.**
- 2- B-mode** is perhaps the most widely **employed** for **abdominal imaging.**
- 3- M-mode:** finds its principal application in **dynamic imaging of internal structures.**
- 4- Real-time:** ultrasound allows for **observation** of **structures in motion.**
- 5- Doppler ultrasound:** is used for **depth and flow measurements** and **moving surfaces.** It finds principal application in **fetal heart monitoring** and **peripheral blood flow measurement investigations.**



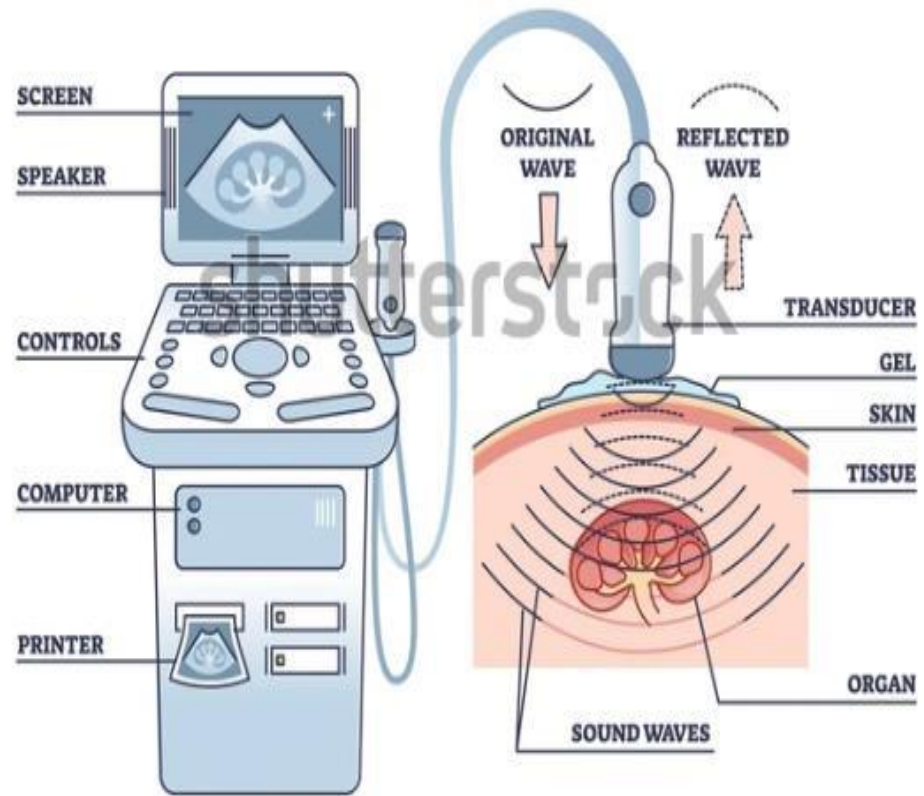
# Uses of Ultrasound

Ultrasound is used for many reasons, including to :

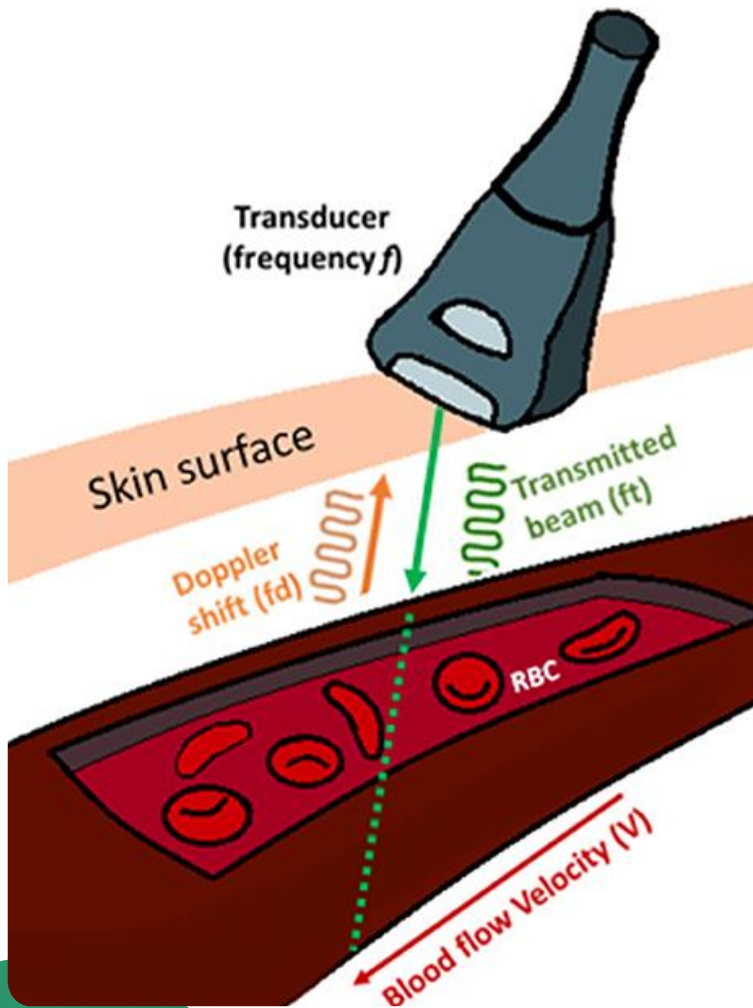
- 1- **View** the **uterus** and **ovaries** during pregnancy and **monitor** the **developing baby's health**.
- 2- **Diagnose** gallbladder disease and **Evaluate** **blood flow**.
- 3- **Guide** a needle for **biopsy** or **tumor treatment**.
- 4- **Check** the **thyroid gland**, **genital** and **prostate problems**.
- 5- **Assess** **joint inflammation** (synovitis) and **Evaluate** **metabolic bone disease**.



## ULTRASOUND



# Doppler effect

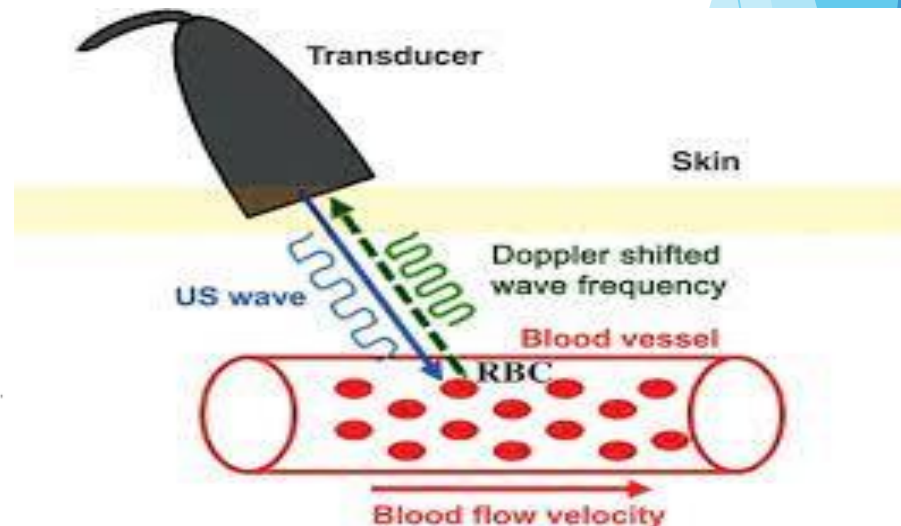
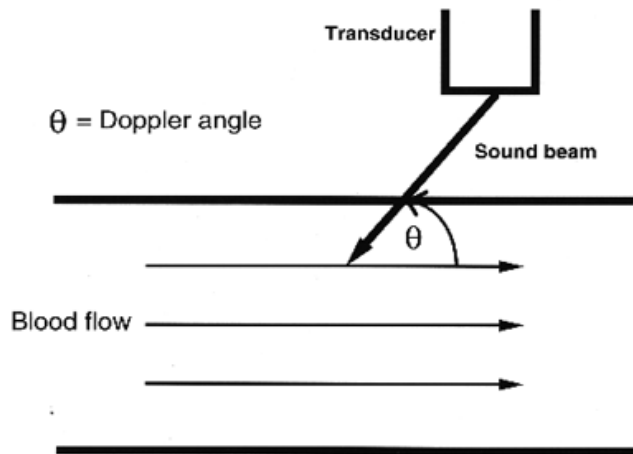


- ▶ The **Doppler effect** describes a **change** in the **frequency** of a **wave** resulting from the **motion** of the **wave source** or **receiver**. Or, in the case of a **reflected wave**, **the motion of the reflector**.
- ▶ If a **wave reflects off a moving object**, the reflected frequency is changed.
- ▶ This is called the **Doppler effect**.



# Medical Doppler ultrasound

- ▶ 1-Doppler ultrasound is used to detect and measure blood flow, and the major reflector is the red blood cell.
- ▶ 2-The Doppler shift depends on the insonating frequency, the velocity of moving blood, and the angle between the sound beam and the direction of moving blood.



# The Stethoscope

- ▶ Listening to the sound of the heart and lungs with a stethoscope is called **Auscultation**.
- ▶ The **main part** of the stethoscope is a **bell**, which is either open or closed.
- ▶ The volume of the tube should be **small**, and there should be **little frictional loss of sound to the walls of the tubes**.
- ▶ If the **diameter of the tube is too small** **frictional losses occur**, and if it is **too large**, the **moving air volume is too great**. In both cases, the efficiency is reduced.
- ▶ To obtain **diagnostic information** about the depth of structures in the body, we **send ultrasound pulses** into the body and **measure the time to receive the reflected sound** (echoes) from various surfaces. This procedure is **called the scan method**.



# When and why is it used ultrasound

1. There are many occasions when ultrasound is a **favorable method** of viewing inside the body.
2. An **obstetrician** can use ultrasound to **check the development of an unborn baby**.
3. **Doppler ultrasound** can be used to view **blood flow** through the heart and **diagnose circulation problems**.
4. **Ultrasound** is an **imaging method** with instant results, **relatively inexpensive**, and **little or no health risks**.
5. Recent advances, including **4D** with **surface rendering**, have increased the **resolution and detail of ultrasound scans**.

# Ultrasound or ultrasonography

- ▶ Is a **medical imaging technique** that uses **high-frequency sound waves and their echoes**.
- ▶ These **frequencies** are **between** (1 and 10 MHz), and **humans cannot hear** such frequencies.
- ▶ The **technique** is similar to the method of the location **used by bats, whales, and dolphins**, as well as **SONAR** used by submarines

