# Application of electricity and magnetism in medicine

## High- Frequency electricity In Medicine

There are many method used in the thermal treatment include :

1- short wave

2- Ultrasound wave

3- microwave

4- infrared wave

5- electrical stimulation

**Micro wave** diathermy. Is different from **short- wave** diathermy, in short wave diathermy the tissue to be heated is part of resonance circuit where the tissue to be heated is placed between two capacitor plates that have an oscillating electric field across them. The changing electric field forces the ions in the tissue to move back and forth . they thus acquire kinetic energy , Part of kinetic energy dissipated when the ions collide with molecules in the tissues. **While** in micro wave diathermy the tissue absorbs electromagnetic waves that are incident up on it. microwave diathermy is **used** to heat joints , tendon sheaths , and muscles

The use of frequencies near 30 MHz for heating is **called** short-wave diathermy . Long - wave diathermy , at frequencies near 10 KHz , is no longer used . In short-wave diathermy **two** methods are used to get the electromagnetic energy into the body : the capacitance method and the inductance method . short-wave diathermy is **used** in the treatment of arthritis , traumatic injuries , strains , and sprains . However, it does have limitations . The amount of energy absorbed depends upon the frequency of the microwaves , the energy is absorbed best at frequencies near 20 GHz and poorly at lower frequencies near 100 MHz and at higher frequencies around 1000 GHz . **Because** the energy is deposited more effectively in tissue with high water content , microwave energy is absorbed better in muscle tissue than in fatty tissues , which have less water . And **because**

of the large amount of energy deposited in surface fatty layers . For this reason microwave diathermy is frequently used.

**Low-frequency electricity and magnetism in medicine**

When electrical conductor is moved perpendicular to magnetic field , a voltage is induced in the conductor proportional to the product of the magnetic field and the velocity of the conductor (Faraday's Law). This Law also holds for conducting fluid moving perpendicular to the magnetic field . Blood acts as conducting fluid . If it passes with mean velocity (v) through magnetic field (B) as shown in ( fig. 11-9 page 245 ) . a voltage (V) is induced between the electrodes such that .

$$\mathbf{V = B\ d\ v}$$

Where (d) is the diameter of the blood vessel . since (V, B, d ) can all be measured , the mean velocity can obtained . The volume flow of blood (Q ) through the vessel can then be calculated , since ( Q) is the product of the mean velocity times the area of the vessel ( $\pi d2/4$ ) or

$$\mathbf{Q = \frac{\Pi\ d^2}{4} x \frac{V}{B\ d}}$$

**Example** : A magnetic blood flow meter is positional across a blood vessel ( $5 * 10^{-3}$ m ) in diameter. With a magnetic field of ($3*10^{-2}$ T) an induced voltage of ( $15*10^{-6}$ v ) is measured

**a-**Find the velocity in the vessel.

**From** $V = B\ d\ v$

$$v = \frac{V}{B\ d} = \frac{1.5*10^{-5}}{(3*10^{-2})\ (5*10^{-3})} = 0.1\ m/sec$$

**b-** Assuming all the blood travels at the mean velocity, what is the volume flow rate ?

$$\mathbf{Q = \frac{\Pi\ d^2}{4} x \frac{V}{B\ d} = 1.9\ cm^3/sec}$$

**Electrocardiography** (**ECG** ) is the process of recording the electrical activity of the heart over a period of time using electrodes placed on a patient's body. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle depolarizing during each heartbeat.

**Electricity Waves - Energy Travel over a Long Distance**

Electric force can transform into different types of energy waves, **such as** heat, radiation, radio and micro waves; and these energy waves can travel along distance. A changing magnetic field will induce a changing electric field and vice-versa, the two are linked. These changing fields form electromagnetic waves. Electromagnetic waves can travel not only through air and solid materials, but also through space. **The** human nervous system can create electric energy waves that can be measured with scientific instruments. The human body produces infra-red radiation that, with night vision equipment, **can** be seen from miles away.