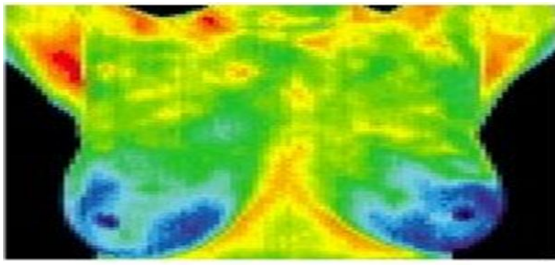
HEAT AND COLD IN MEDICINE
PART 2

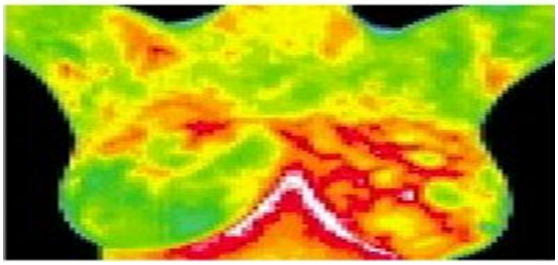
Thermograph uses

1-Cancer detection: Breast cancer could be characterized by an elevated skin temperature in the region of the cancer. The surface temperature above a tumor was typically about 1 °C higher than that above nearby normal tissue, and it was thought that this will be a good procedure for early breast cancer detection, as show in the figure below.

Normal breast

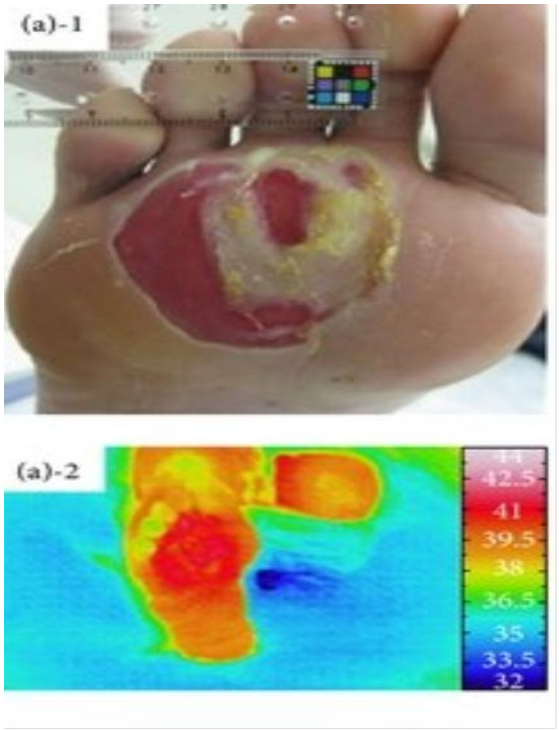


fibocystice



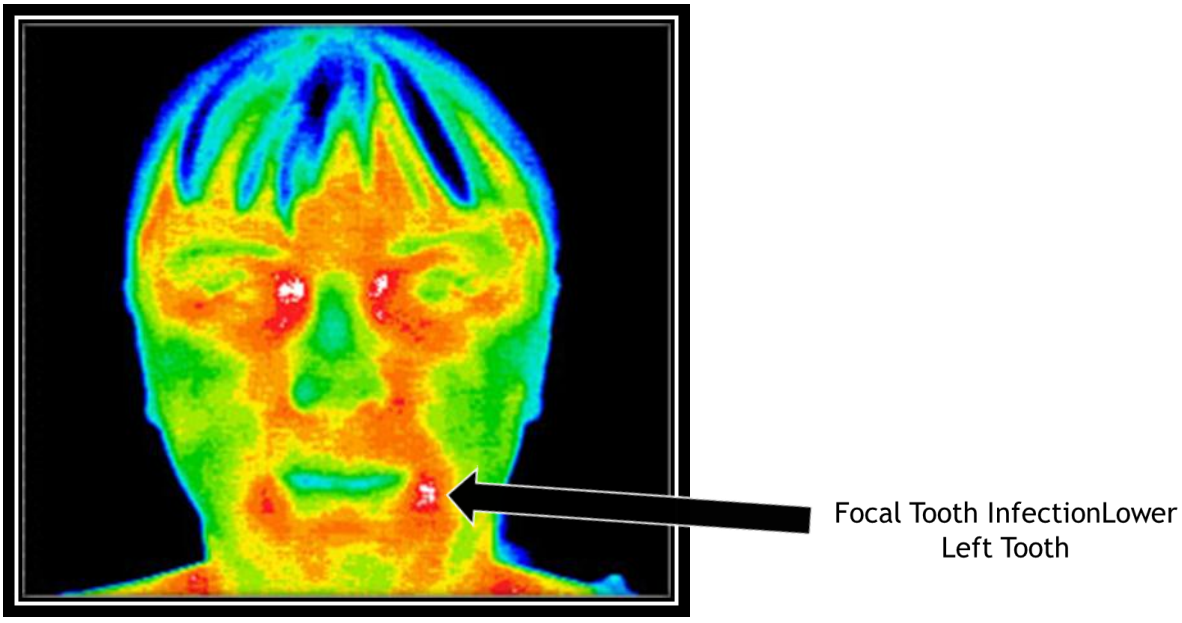
2-Thermograph used to study the **circulation** of blood in the head, differences in the blood supply between left and right sides can indicate circulatory problems. **In diabetic patients**, Thermograph had considerable success in reducing leg amputation in diabetic.

The blood supply in diabetic's leg is usually adequate, but if the tissues break down and an ulcer is formed, the need for blood in the leg may double. The circulation problems of the diabetic then become evident: the ulcer dose not heals and often becomes infected .With thermograph, the presence of a hot spot on the foot can be determined before an ulcer forms.



3-Dentistry :

Dentists recommend the use of medical thermograph in monitoring control in the inflammation process into oral cavity and reaction of the regional lymphatic nodes, maxillary joint disease and other chronic disease of the bones, nerves located in the maxilla facial area.



Heat therapy

The primary therapeutic effects take place in the heated area:

1-There is an increase in the metabolism resulting in a relaxation of the capillary system.

2-There is an increase in the blood flow, as blood moves into cool the heated area.

The physical methods of producing heat in the body:-

1-The conductive method

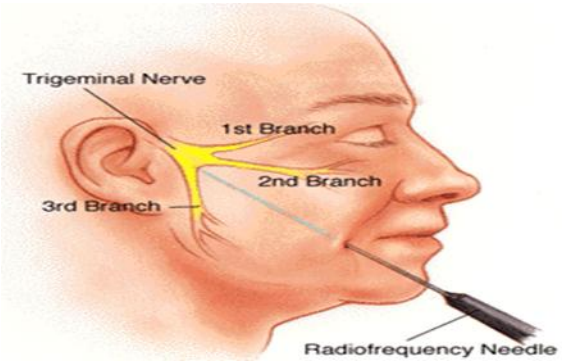
The conductive method is based on the physical fact that if two objects at different temperatures are place in contact, heat will be transfer by conduction from the warmer object to cooler one. The total heat transferred will depended upon the area of contact, the temperature difference, the time of contact, and the thermal conductivity of the materials. Hot baths, hot packs, electrical heating pads, and occasionally hot paraffin applied to the skin heat the body by conduction. Conduction heat transfer leads to local surface heating since the circulating blood effectively removes heat that penetrates deep into the tissue. Conduction heating is used in treating conductions such as arthritis, neuritis, contusions, sinusitis, and back pain.

2-Radiant (IR) heat:

Radiant heat is also used for surface heating of the body. This is the same form of heat we feel from the sun or from an open flame. Man-made sources of radiant heat are glowing wire coils and 250 W incandescent lamps. The IR wavelengths used are between 800-40,000nm (1nm=109m).The wave penetrate the skin about 3mm and increase the surface temperature .Excessive exposure causes reddening (erythematic) and sometimes swelling (edema).Very prolonged exposure cause browning or hardening of the skin. Radioactive heating is generally used for the same conditions as conductive heating, but it considered being more effective because the heat penetrated deeper.

3-Radiowave heating (Diathermy):

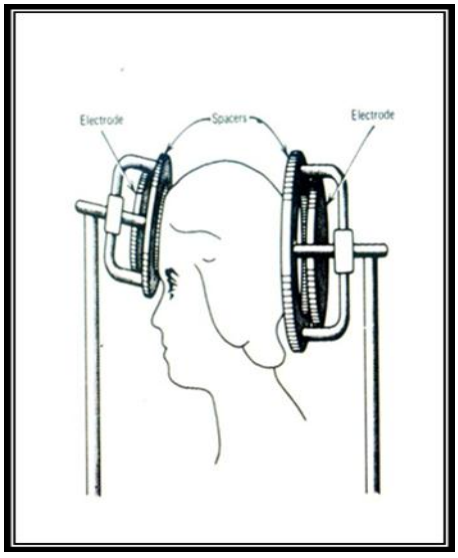
Short wave diathermy utilizes electromagnetic waves in the radio range(wavelength~ 10m),and **microwave diathermy** uses waves in the radar range (wavelength~ 12cm).Heat from diathermy penetrates deeper into the body than radiant and conductive heat. It is useful for internal heating and has been used in the treatment of inflammation of the skeleton, bursitis, and neuralgia.



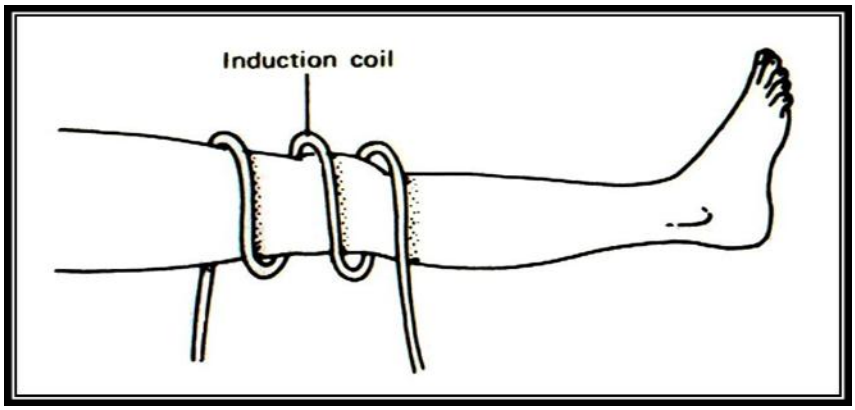
***Different methods are used for transferring the electromagnetic energy into the body in short wave diathermy*:**

a-By using capacitor plates: - the part of the body to be treated is placed between two metal plate-like electrodes energized by the high-frequency voltage. The body tissue between the plates acts like an electrolytic solution. The charged particles are attached to one plate and then the other depending upon the sign of the alternating voltage on the plates; this results in resistive (joule) heating.

Different body materials react differently to the waves, and this effect provides some selectively in treatments.



b-Magnetic induction method:- It is considered one of the methods that are used for transferring the electromagnetic energy into the body in short-wave diathermy. In this method, either a coil is placed around the body region to be treated or a "pancake" coil is placed near the part of the body. The alternating current in the coil results in an alternating magnetic field in the tissues. Consequently alternating (eddy) currents are induced, producing joule heating in the body region being treated. This method is used in relieving muscles spasms and degenerative joints disease.



Microwave diathermy:-

Microwave diathermy is another form of electromagnetic energy. These waves are produced in a special tube called a magnetron and then emitted from the applicator (antenna) which is placed at several inches from the region to be treated.

These waves penetrate deep into the tissues causing a temperature raised and deep heating.

Microwave diathermy is used in the treatment of fractures, strains, bursitis, injuries to tendons, and arthritis.

The frequency used is 900 MHz, which is found more effective than other frequencies in the therapy. It causes more uniform heating around bonny region.

4-Ultrasonic Wave

Ultrasonic wave are completely different from the electromagnetic wave just discussed; they produce mechanical motion like audible sound wave.

As the ultrasonic waves move through the body the particles in the tissues move back and forth produce heating in the tissues.

This method is useful for depositing heat in bones because they absorb ultrasound energy more effectively than dose soft tissues. Also it useful in relieving the tightness and scarring that often occur in joint disease. It greatly aids joints that have limited motion.

Cold in medicine

Cryogenics is the science and technology of producing and using very low temperatures.

The study of low-temperatures effects in biology and medicine is called *cryobiology*.

Low temperature can be produced by liquefying gases. It was succeeded to produce liquid air (-196 °C) in 1877 and liquid helium (-269°C) in 1908.For solid CO_2 it is (-79°C) and liquid nitrogen (-196°C).

The storage of cryogenic fluids has always been a problem. Most ordinary liquid-storage containers are unsatisfactory because they absorb a large amount of heat by conduction, convection, and radiation.

A significant improvement is the insulated container develops by James Dewar in 1892 and name after him. This container is made of glass or thin stainless steel to minimize conductive losses. It has a vacuum space to essentially eliminate convective losses, and the sides are silvered or polished so that radiation striking the surface is reflected rather than absorbed. The container resembles the familiar thermos bottle used to store hot and cold drinks.

Moderately low temperature were used successfully to cool down hamsters to (-5°C) freezing 50-60% of the water in their bodies, and reviving them. At present this technology excludes similar cooling for man, for short temperature reservation moderate low temperature was successful in some types of tissue blood and semen for long term

preservation very low temperature such as liquid nitrogen(-196 °C)which proved to be much better for preservation than solid CO2(-79°C).

For conventional blood storage it can be stored with anticoagulant at 4°C about 1% of the red blood cells hemolyze (break) each day so the blood will not be suitable for use after 21 day. For rare blood types should be stored for longer period, other procedure were used.

Blood can be preserved for very long periods of time if it frozen rapidly in liquid nitrogen (-196°C).

The rate of freezing is very important to revive the cell after thawing them. In addition to that some preservation material such as glycerol and dimethy sufoxide to improve cell survival. Sometime and especially in blood these additives can present a problem to remove them from the blood.

Cryosurgery

The cryosurgery, type of surgery which destroys abnormal cells by using extreme cold.

It has several advantages:-

1. Cause a little bleeding.
2. The volume of the tissue destroyed can be controlled.
3. Little pain because low temperature desensitize nerves.
4. Very short recovery.

cryosurgery use in

1- Some skin disease and small skin cancer.

2- Liver cancer, prostate cancer, lung cancer, oral cancer, cervical disorders and fibroma (benign excrescence of connective tissue) can be treated with cryosurgery.

Generally, all tumors that can be reached by the cryoprobes used during an operation are treatable. Although found to be effective, this method of treatment is only appropriate for use against localized disease, and solid tumors larger than 1 cm.

Tiny, diffuse metastases that often coincide with cancers are usually not affected by cryotherapy.

Cryosurgery works by taking advantage of the destructive force of freezing temperatures on cells. When their temperature sinks beyond a certain level ice crystals begin forming inside the cells and, because of their lower density, eventually tear apart those cells. Further harm to malignant growth will result once the blood vessels supplying the affected tissue begin to freeze.

3-eye surgery

a-In retinal detachment: a cooled tip is applied to the outside of the eyeball in the vicinity of the detachment a reaction occurs that acts in weld the retina to the wall of the eyeball

b- crysurgery extract of the lens, in this procedure the cold probe is touched to the front of the lens. The probe sticks to the lens making the lens easy to remove.