CRYOTHERAPY

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OBJECTIVES

- Define Cryotherapy.
- List different methods of cool transfer to body tissues.
- Explain the physiological effects of Cryotherapy.
- List indications, contraindications, and precautions of Cryotherapy.
- Identify different techniques of Cryotherapy application.

Cryotherapy or ice therapy is therapeutic use of local or general cold application for treating pathological lesions. This practice is as old as medicine itself.

Nowadays, local cold application may be applied by the use of various forms of ice or frozen gel packs, or by evaporation of volatile fluids from the skin.

Cryotherapy is applied to the skin surface but can decrease tissue temperature deep to the area of application, including intra articular areas.

Cooling body tissues can be achieved through;

Conductive cooling: a direct conduction of heat from the tissues of the body. It includes crushed ice packs, frozen gel packs, ice baths, wet iced towels, and ice cubes massage.

Convective cooling: using an electric fan to blow air over the skin for reduction of hyperthermia.

Evaporative cooling: use of volatile fluids for evaporation from the skin. When the volatile fluid evaporates from the skin, thermal energy is removed.

Fluids used are Ethyl chloride, Flurомethane, and Chlorofluoromethane.

TEMPERATURE CHANGES IN THE TISSUES DEPENDS ON

- Temperature difference between the coolant and the tissue.
- Thermal conductivity of tissues.
- Time length for which the cold is applied.
- Size of the area that is being cooled.

Physiological Effects of Cold

Cutaneous blood vessels

✓The initial haemostatic response to cooling is an attempt to preserve heat. It is accomplished by an initial vasoconstriction.

✓Vasoconstriction is caused by both direct and indirect mechanisms.

✓Activation of cold receptors directly stimulates the smooth muscles of the blood vessel walls to contract.

✓Cooling decreases the production and release of vasodilator mediators, such as histamine and prostaglandins, resulting in reduced vasodilatation.

✓Cooling also causes a reflex activation of sympathetic adrenergic neurons, resulting in cutaneous vasoconstriction.

✓A rteriovenous anastomoses will open to allow more blood flow to the skin.

✓Vasoconstriction is followed by vasodilatation, when cold is applied for longer periods of time or when the tissue temperature reaches less than 10 °C.

✓This phenomenon is known as cold-induce vasodilatation (CIVD) or hunting response

✓CIVD caused by local neurogenic axon reflex or local release of vasodilator hormones into the tissue or both.

✓CIVD may provide protection to the tissue from damage caused by prolonged cooling and relative ischemia.

✓The increased blood flow washes out this substance and the vessels constrict again thus continuous the cycle.

✓Vasodilatation follows with alternating episodes of constriction and dilatation.

Blood flow

✓Blood flow is reduced by cold through increasing blood viscosity in addition to vasoconstriction of blood vessels.

Metabolic rate

✓The metabolic rate is reduced by cooling according to Van't Hoff's low (the rate of any chemical action is increased by a temperature rise).

✓The actual change is about one-eight (13%) for each 1˚C.

Cellular activity

✓Chemical and biological processes of the cell slow down with decreasing temperature.

✓The membrane loses their selective permeability and the active pump is failed at lower temperature.

✓at zero temperature, the viscosity increases, and the cell volume is reduced as water leaks into interstitial space.

✓intravascular aggregation of platelets and RBCs with formation of occlusion masses in the vessels.

Neuromuscular system

Decreasing NCV of both sensory and motor nerves.

✓The first fibers affected by gradual cooling are the myelinated and eventually at very low temperatures the unmyelinated.

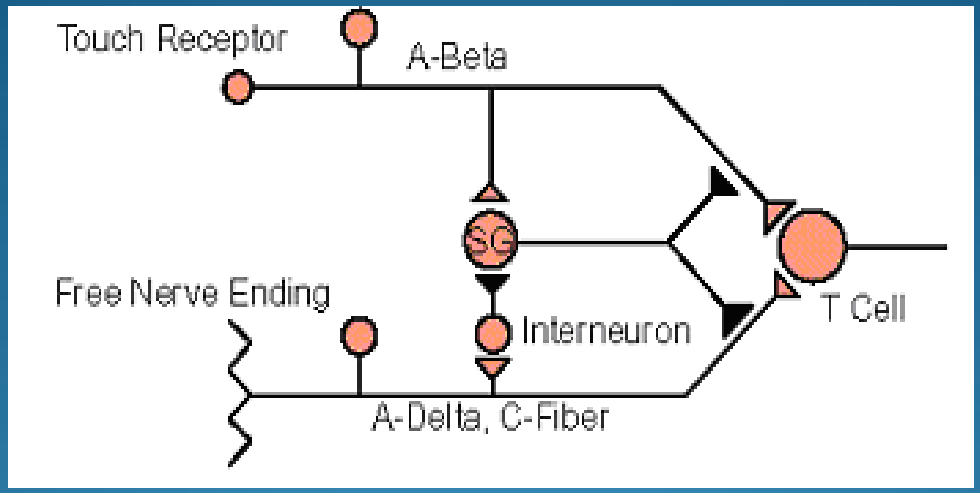
✓Delta fibers (small diameter, myelinated, pain fibers) demonstrate the greatest decrease in C.

Increase pain threshold, and decrease the sensation of pain through;

✓Counter-irritation via the gate control mechanism: Stimulation of the cutaneous cold receptors by cold may provide sufficient sensory input to block the transmission of painful stimuli.

✓Reduction of sensory nerve conduction velocity.

Gate control mechanism



✓Impulses transmitted through Aδ and C fiber inhibit the SGR, permitting passage of pain impulses and pain perception.

✓Impulses transmitted through Aβ fibers stimulate the (SGR) thus, inhibits synaptic transmission in the pathways of A-δ and C fibers

Muscle strength

Cryotherapy has been associated with both increases and decreases in muscle strength.

✓Brief cooling increase isometric muscle strength through facilitation of motor nerve excitability and an increased psychological motivation to performance.

✓prolonged cooling reduce muscle strength through reduction of blood flow, slowed motor nerve conduction, and increased joint or soft tissue stiffness.

Spasticity

✓Pathological state of increased muscle tone resulting from damage to the upper motor neurons.

✓The anterior horn cell lose the higher control of extrapyramidal system and fires spontaneously at an increased rate.

✓This results in a state of hypertonicity with hyperactivity of phasic and tonic stretch reflex due to loss of inhibitory mechanisms from the suppressor areas of the brain.

Cryotherapy can temporarily decrease spasticity via,

- ✓Decrease in gamma motor neuron activity as a reflex reaction to stimulation of cutaneous cold receptors.
- ✓Decrease in afferent spindle activity and sensitivity
- ✓Slowing of conduction in both the muscle and motor nerves.

Facilitation of muscle contraction

✓Brief application facilitate alpha motor neuron activity to produce a contraction in a flaccid muscle due to UMN dysfunction.

Indications of Cryotherapy

✓Control of inflammation

✓Relief of Pain

✓Reduction of edema and joint effusion.

✓Facilitation of motor control

✓Muscle spasm

✓Modification of spasticity

Control of Inflammation

acute inflammation

slowing down the rate of chemical reactions reduce the hotness, redness, edema, pain, and loss of function associated with this phase of tissue healing.

chronic inflammation

Cryotherapy relief pain and control minor acute or subacute inflammatory changes as occur from time to time with degenerative joint condition as osteoarthritis and chronic rheumatoid arthritis.

Control of edema and joint effusion

✓Edema is caused by extravasations of fluid into the interstitial space due to increased intravascular fluid pressure and increased capillary permeability.

✓Cryotherapy reduces the intravascular fluid pressure by reducing blood flow into the area via vasoconstriction and increased blood viscosity.

✓Also it controls increases in capillary permeability by reducing the release of vasoactive substances, such as histamine.

✓Compression and elevation reduce edema by driving extravascular fluid out of the swollen area into the venous and lymphatic drainage systems.

Relief of Pain

- ✓counterirritant through pain gate theory.
- ✓endorphins and enkephalns theory.
- ✓Slow or block the peripheral nerve conduction.
- ✓Elevation of pain threshold.
- ✓The indirect effect by elevating the under lying cause of the pain such as inflammation or edema.

Cryokinetics

✓a technique that combines the use of cold and exercise in the treatment of pathology or disease.

✓apply a cooling agent to the point of numbness (up to 20 minutes) after any injury to reduce the sensation of pain.

✓allow the patient to perform strengthening and stretching exercises for 3 to 5 minutes toward regaining range of motion (ROM) until the sensation of pain returns.

✓The cooling agent is then reapplied until analgesia is regained.

✓This sequence of cooling, exercise, and re-cooling is repeated approximately five times.

Cryostretch

✓is the application of a cooling agent before stretching to reduce muscle spasm and thus allow greater ROM with stretching.

Contraindications of Cryotherapy

- ✓Cold hypersensitivity or intolerance.
- ✓Cardiac disease or cerebrovascular insufficiency.
- ✓Peripheral vascular disease(e.g. Raynaud's disease or phenomenon).
- ✓Over a regenerating peripheral nerve
- ✓Over an open wound

Precautions of Cryotherapy

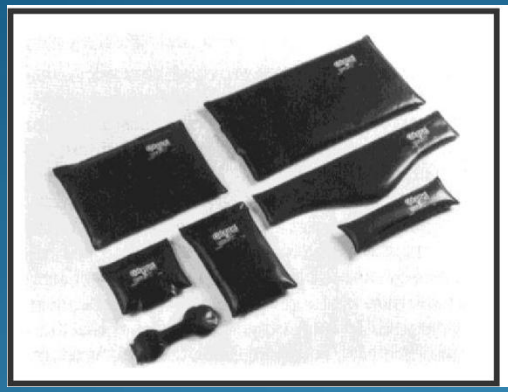
- ✓Over superficial nerves as lateral peroneal or redial nerve may cause nerve block.
- ✓Hypertension: cold can cause transient increases in systolic or diastolic blood pressure.
- ✓patients with poor sensation or poor mentation.
- ✓Very young and very old patients

Techniques of Application of Cryotherapy

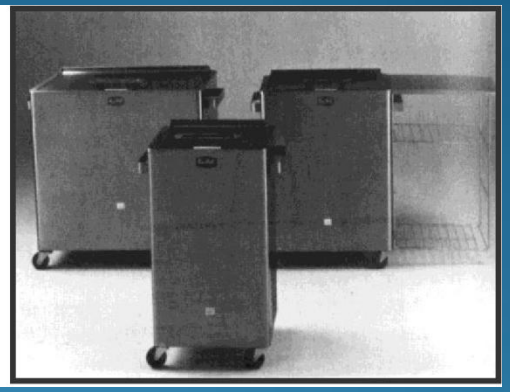
Different techniques according to the required effects.

- ✓Cold packs or ice packs.
- ✓Ice cups for ice massage.
- ✓Controlled cold compression units.
- ✓Vapocoolant sprays.
- ✓Ice water immersion, Cold whirlpool,

Cold Packs



Cold packs



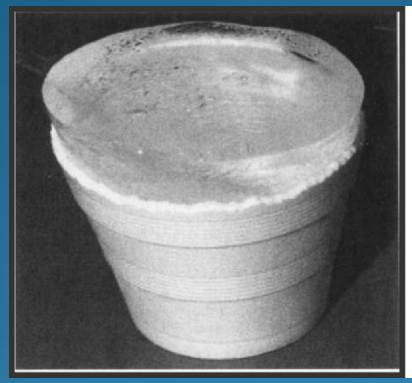
Cooling units

- ✓Composed of silica gel or a mixture of saline and gelatin covered with vinyl.
- ✓The gel is semisolid at between 0° and 5 ºC.
- ✓stored it in a specialized cooling unit or in a freezer at -5 °C .

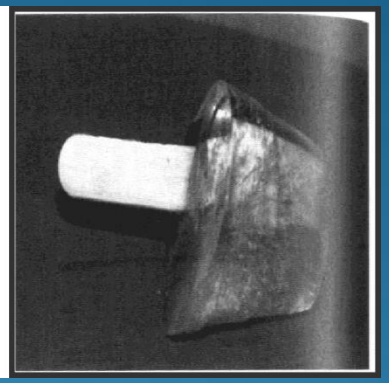
Ice packs

- ✓Crushed ice placed in a plastic bag.
- ✓Both cold packs and ice packs are applied in a similar manner.
- ✓Ice packs provide more aggressive cooling than cold packs

Ice Massage



Water popsicles



Ice cup

✓Ice massage may be applied for the local control of pain, inflammation, or edema.

✓Can also be used for facilitating the production of desired motor patterns in patients with impaired motor control.

Cold Compression Therapy

✓Cold compression units pump cold water and air into a sleeve wrapped around a patient's limb.

✓Most commonly used directly after surgery for the control of postoperative inflammation and edema.

Vapocoolant Sprays and Brief Icing

✓Ethyl chloride and Fluromethane have been used to achieve brief and rapid cutaneous cooling.

✓Rapid cutaneous cooling is generally used as a component of the treatment of trigger points.

✓Rapid cooling provide a counterirritant stimulus to cause a reflex reduction in motor neuron activity and thus a reduction in the resistance to stretch.

Cold whirlpool

whirlpool

Cold whirlpool


THANK YOU