

Physical Agent Modalities

Definition

- Modalities are physical agents that are used to produce therapeutic responses in tissue.
 - Cold
 - Heat
 - Sound
 - Electromagnetic waves
 - Electric currents
 - Water

- Adjunctive treatments rather than primary cure.

Cold (Cryotherapy)

Physiological Effects

■ Hemodynamic

- Immediate cutaneous vasoconstriction
- Delayed reactive vasodilatation
- Decreased acute inflammation

■ Neuromuscular

- Slowing of conduction velocity
- Increased maximal isometric strength
- Decreased muscle fatigue
- Temporarily reduced spasticity

Physiological Effects

- Joint and connective tissue
 - Increased joint stiffness
 - Decreased tendon extensibility
 - Decreased collagenase activity
- Miscellaneous (acute conditions)
 - Decreased pain
 - General relaxation

General uses of cryotherapy

- Acute musculoskeletal conditions (sprains, strains, tendinitis, tenosynovitis, bursitis, capsulitis, etc)
- Myofascial pain
- Following certain orthopedic surgeries
- Component of spasticity management
- Emergency treatment of minor burns

General precautions for use of cold

- Cold intolerance
- Cryotherapy induced neurapraxia/ axonotmesis
- Arterial insufficiency
- Impaired sensation
- Cognitive or communication deficits that preclude reporting of pain.
- Cryopathies
- Cryoglobulinemia
- Paroxysmal cold hemoglobinuria
- Cold hypersensitivity
- Raynaud's disease/ phenomenon

Cryotherapy agents

1. Cold packs



- **Hydrocollator packs:** Cooled in freezer to -12°C and applied over a moist towel.

- **Ice packs:** Easily used at home and best applied with elastic bandage or tape.

- Duration 20 to 30 min.
- skin is cooled immediately,
- sc tissue within mins &
- muscle at depth of 2 cm cooled by 5°C after 20 min.

Cryotherapy agents

2. Ice massage

- The direct application of ice to skin using gentle stroking motions
- Combines therapeutic effects of cooling with mechanical effects of massage
- Water is frozen in a paper cup, with ice being exposed by tearing the top rim of paper off as the ice melts.
- Used for localized symptoms and applied for 5 to 10 min per site.



Cryotherapy agents

3. Cryotherapy compression units

- Cuff or boot through which cold water is circulated and can be pneumatically compressed statically or serially
- distal to proximal pumping action.
- Combine beneficial effects of cryotherapy with advantages of pneumatic compression.
- Used primarily after acute musculoskeletal injury with soft tissue swelling, and after some surgical procedures.
- Typical temperatures of 7.2° C and pressures up to 60 mm Hg are used.



Cryotherapy agents

4. Cold water immersion

- Best suited for circumferential cooling of the limbs, localised burns
- 5 - 13° C.
- Often uncomfortable and poorly tolerated

HEAT

Physiological effects

Hemodynamic

- Increased blood flow
- Increased edema
- Increased bleeding
- Increased acute inflammation
- Decreased chronic inflammation

Neuromuscular

- Increased nerve conduction velocity

Physiological effects

Joint & connective tissue

- Increased tendon extensibility
- Increased collagenase activity
- Decreased joint stiffness

Miscellaneous (chronic conditions)

- Decreased pain
- General relaxation

General uses of heat

1. Musculoskeletal conditions (tendinitis, tenosynovitis, bursitis, capsulitis, etc)
2. Pain (neck, low back, myofascial, neuromas, postherpetic neuralgia, etc)
3. Arthritis
4. Contracture
5. Muscle relaxation
6. Chronic inflammation

General precautions for use of heat

- Acute trauma, inflammation
- Impaired circulation
- Bleeding diatheses
- Edema
- Large scars
- Impaired sensation
- Malignancy
- Cognitive or communication deficit that preclude reporting of pain.

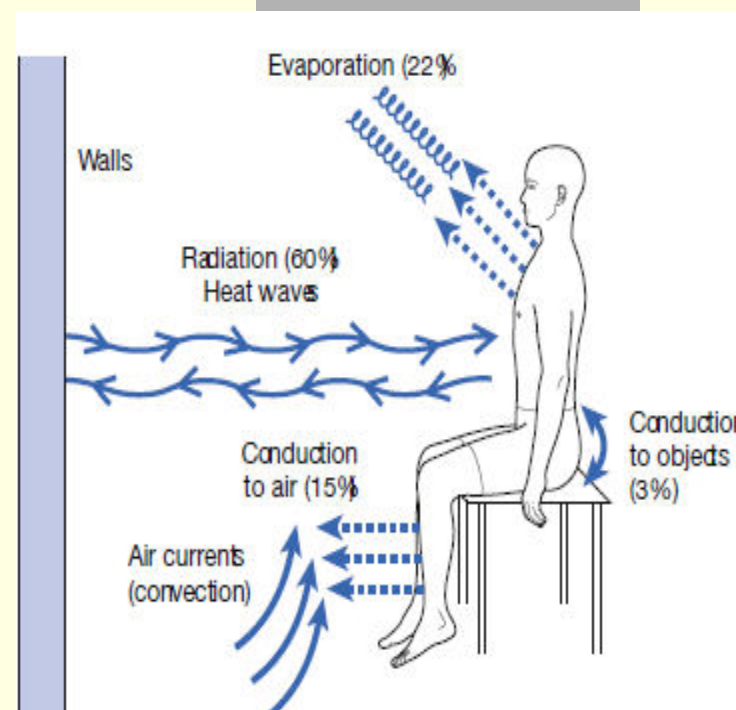
Classification of various types of heating

SUPERFICIAL HEAT

- | | |
|-------------------------------|--------------|
| 1. Hot packs and heating pads | (conduction) |
| 2. Paraffin wax baths | (conduction) |
| 3. Fluidotherapy | (convection) |
| 4. Whirlpool bath | (convection) |
| 5. Radiant heat | (radiation) |

DEEP HEAT

- | | |
|------------------------|--------------|
| 6. Ultrasound | (conversion) |
| 7. Shortwave diathermy | (conversion) |
| 8. Microwave diathermy | (conversion) |



Superficial heat

- Superficial heating agents achieve their maximum tissue temperature in skin and subcutaneous fat.
- Deeper tissue heating is limited by vasodilatation and insulating fat.
- Used in OA, RA, neck pain, LBP, muscle pain syndromes, and variety of musculoskeletal conditions.

Superficial heat

1. Hot packs

- Commercially available hot packs (Hydrocollator packs) contain silicon dioxide encased in canvas pack.
- They are immersed in tanks at 74.5 C and applied over several layers of insulating towels.
- Total treatment time is usually 30 min.
- In addition to general heat precautions, patient should not lie on the packs.
- They are among the more common causes of burn in physical modalities



Superficial heat



2. Heating pads

- Two types :
 - 1) electric heating pads** (control heat output by regulating current flow)
 - 2) circulating fluid pads** (control heat output thermostatically)
- Peak temperature of nearly 52° C achieved with electric heating pad set on lowest setting.
- In case of electric heating pads, potential of electric shock with moist toweling.
- Patient should not lie on heating pad, as it can lead to burns (Of particular concern in slender or cachectic patients)

Superficial heat



3. Paraffin wax bath

- Paraffin wax: Mineral - 6:1 or 7:1.
- 52.2° C to 54.4° C
- Methods of application are:
 - 1) **Dipping:** 7 to 12 dips followed by wrapping in plastic and towels or insulated mitts,
 - 2) **Immersion:** Several dips to form a thin glove of paraffin followed by immersion for 30 min. Produces greatest quantity and duration of temperature increase.
 - 3) **Brushing:** brushing on several coats of paraffin, followed by covering with towels.
 - More cumbersome.
 - Improves treatment compliance in children.
 - Useful for areas difficult to immerse.
- Open wounds and infected areas should be avoided.

Superficial heat

4. Radiant heat

- **Luminous infrared heat lamps** emit radiation in the near –infrared spectrum (wavelength 770 to 1500 nm) and **non-luminous infrared lamps** emit radiation in the far infrared spectrum (wavelength 1500 to 12500 nm)
- Infrared radiation produces heating by inducing molecular vibration.
- Preferable in patients who cannot tolerate the weight of hot packs.
- Caveats for radiant heat use: General heat precautions, light sensitivity, skin drying and dermal photoaging.

Deep Heat (Diathermy)

- Deep heat or diathermy, unlike superficial heat, affects the target tissues like muscle, tendon, ligament, bone without significant heating of skin and subcutaneous tissue.
- Therapeutic target temperature ranges from 40° C to 45° C.

Deep Heat

1. Ultrasound

- >20,000 Hz.
- Reverse piezoelectric effect.
- Most commonly **clinically used frequencies are in the range of 0.8 to 1.1 MHz**, although up to 3.0 MHz are used.
- Ultrasonic energy is absorbed by the tissues (esp. at interface) and is ultimately converted into heat via molecular vibrations, a phenomenon of conversion.



Deep Heat

- A **coupling agent** is used to prevent reflection of greater fraction of acoustic
- Commonly used are: Degassed water, mineral oils, encased silicon gel commercially available coupling gels .
- Temperatures of upto 46 C are achieved in deep tissues.
- Duration is generally 5 to 10 min per site
- Ideal for very deep heating e.g hip joint, in such cases superior to shortwave and microwave diathermy.

Deep Heat

Precautions for Ultrasound

1. General heat precautions
2. Near brain, eye, reproductive organs
3. Gravid or menstruating uterus
4. Near pacemaker near spine, laminectomy sites
5. Malignancy
6. Skeletal immaturity
7. Arthroplasties
8. Methylene methacrylate or high density polyethylene

Other Modalities



2. Phonophoresis

- Standard ultrasonic coupling gel is mixed with various chemical substances to produce phonophoresis coupling agent.
- Local analgesic gels, corticosteroids
- Anti-inflammatory effects of ultrasonic and corticosteroids act synergistically.

Deep Heat



3. Shortwave diathermy

- Oscillation of high frequency electrical and magnetic fields produces movement of ions, rotation of polar molecules and distortion of non-polar molecules, resulting in heat generation.
- Most commonly used frequency is 27.12 MHz & treatment time is 20-30 min
- Heating produced depends on type of shortwave unit, and on the water content and electrical properties of tissues.

Deep Heat

■ Precautions:

- General heat precautions
- Metal (jewelry, IUD's, surgical implants, deep brain stimulator and pacemaker which is absolute contraindication).
- Contact lenses (Potential for focal heating).
- Gravid or menstruating uterus
- Skeletal immaturity

Hydrotherapy

- External application of hot or cold water, in any form, for treatment of disease.
- Arthritis and variety of musculoskeletal conditions, and in cleansing and debridement of burns and other dermal injuries.

Whirlpool baths and Hubbard tanks

- Typically used for treatment of a limb or localized lesion.



Hydrotherapy

3. Contrast baths



- Consists of alternating immersion of the distal limbs in hot (42 - 45 C) ,then cold (8.5 – 12.5 C) water.
- 30 min treatment session are typical, beginning with 10 min immersion in hot, followed by alternating immersions of 1 min cold and 4 min hot, ending with cold immersion.
- Especially suited for rheumatological disease, neuropathic pain, other chronic pain syndromes like complex regional pain syndrome.

Other Modalities



Interferential current therapy (IFT)

- Periodic interference of two AC signals of slightly different frequency, results in a new wave with cyclic modulation of amplitude, due to cyclic constructive and destructive interference.
- IFT machines typically uses medium frequency currents of 4000 – 5000 Hz.
- Most machines use 2,4 or 6 applicators, which can be arranged in same plane (planar) as in lumbar area or in different planes (coplanar) as in the shoulder.
- Useful in variety of musculoskeletal conditions, neurological conditions and management of urinary incontinence.

Other Modalities

■ Precautions :

- near implanted stimulators (pacemakers, intrathecal pumps, spinal cord stimulators)
- near sympathetic ganglia or carotid sinus
- near open incision or abrasions
- near gravid uterus
- in the presence of venous thrombosis
- near SWD.

Factors to consider in Modality Selection

1. Target tissue
2. Depth of heating/cooling/therapeutic response desired
3. Intensity of heating or cooling desired
4. Body habitus (i.e amount of subcutaneous adipose)
5. Co-morbid conditions (e.g. malignancy, vascular disease, neuropathy ,etc)
6. Associated pt. specific features (e.g. metal implants, pacemaker, cold allergy etc)
7. Age (e.g. Open epiphysis)
8. Sex (e.g. pregnant female)

Thank you

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