



Therapeutic Heating Modalities

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Objectives

After studying this lecture, the students must be able to;

- ❖ Define and classify the physical agents modalities.
- ❖ Describe physical principle of thermal agents modalities
- ❖ Differentiate between methods of heat transfer.
- ❖ Understand the physiological effects of thermotherapy.
- ❖ Offer guidelines for use of therapeutic modalities include
 - ❖ Indications and contraindications of thermotherapy
 - ❖ Precautions and adverse effects of thermotherapy



Outlines

- Classification of physical agents modalities
- Methods of heat transfers
- Physiological effects of thermotherapy.
- Uses (indications) of thermotherapy.
- Contraindications of thermotherapy.
- Precautions & dangerous of thermotherapy



Physical Agents Modalities (PAMs)

- Physical agents modalities (PAMs) are external form energy (e.g. heat, cold, light, electricity) applied to the patients to assist in rehabilitation process. It can be used before, during or after a therapy session, to enhance the effects of other interventions.

PAMs classification

Electromagnetic

Radiation

Infrared radiation (IR),
Ultraviolet therapy (UV)
Low level Laser Therapy (LLLT),

Diathermy

Shortwave Diathermy (SWD)
Microwave Diathermy (MWD)

Acoustic energy

Ultrasound (US)
Extracorporeal Shock wave therapy (ESWT)

Electrical

TENS, HVPC, IFT,
Faradic stimulation,
DC stimulation

Mechanical

Manual and mechanical traction,
Pneumatic compression therapy



Thermotherapy

- Therapeutic application (uses) of heat
- Therapeutic heating modalities (Superficial and Deep) heating agents increase the skin temperature within the therapeutic range of 104°F to 113°F in order to provide physiological effects for therapeutic benefits.

Classification of thermotherapy modalities

Depths of penetration > 2cm



Microwave diathermy



Shortwave diathermy



ultrasound

Deep Heating modalities



Laser

Depths of penetration 0.5-2cm
Whirlpool,



Infrared



Superficial heating modalities



Hydrocollator, Hot packs



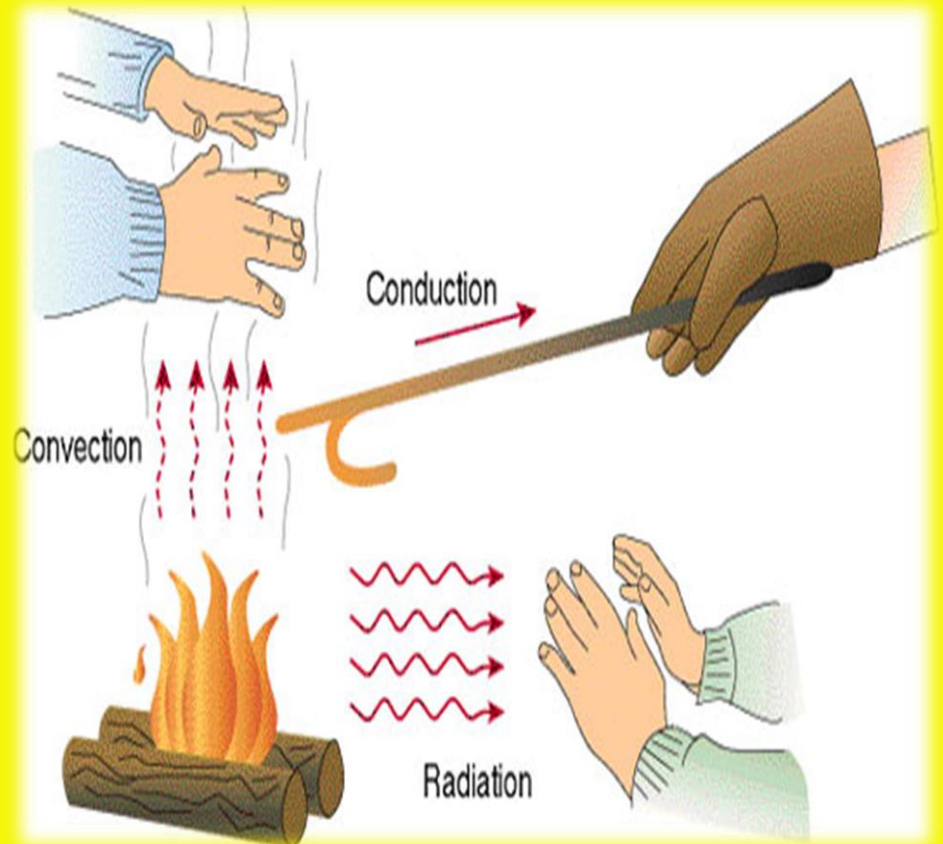
Paraffin wax



Fluidotherapy

Transferring heat (energy) to and from the body transfers

- Radiation
- Conduction
- Convection
- Conversion
- Evaporation



Transferring heat (energy) to and from the body transfers

Conduction

- is a direct transfer of energy between two objects in physical (direct) contact with each other.
- Ice packs
- Hot packs
- Paraffin
- Ultrasound

Radiation

- is a direct transfer of energy from higher temperature to lower temperature without the need for an intervening medium. No-contact is made.
- Shortwave diathermy
- Microwave Diathermy
- Laser
- Infrared & laser
- Ultraviolet therapy

Convection

- is a transfer of heat through direct contact between **circulating medium (air/ water)** and another material of different temperature .
- **Fluidotherapy**
- **Whirlpools**
- **Blood circulation**

Rate of energy transfer by conduction is dependent on

1. Temperature difference between two materials
2. Thermal conductivity
3. The total contact area
4. Tissue thickness



Transferring heat (energy) to and from the body transfers

Conversion

- is a conversion of **non-thermal** form of energy (**mechanical, electrical and / or chemical**) into heat.
 - Ultrasound
 - Shortwave diathermy

Evaporation

- heat is absorbed by the liquid on the skin surface and cools the skin as it turns into a gaseous state.
 - Vapocoolant sprays
 - Alcohol
 - Sweating

Transferring heat (energy) to and from the body transfers

Heat
transferring

Conduction

Radiation

Convection

Conversion

Evaporation

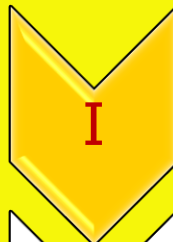


Factors Affecting Heat Energy Transfer

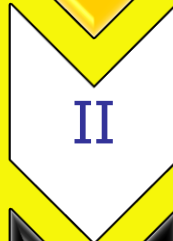


- 1) Density, thickness , and type of radiating tissues
- 2) Degrees of Reflection, Refraction, and Absorption
- 3) Law governing radiations (e.g. Grothaus-Draper, & Cosine law)
- 4) Temperature difference between two materials
- 5) Thermal conductivity
- 6) The total contact area
- 7) Intensity and size of radiation
- 8) Distance from radiation source
- 9) Duration of radiation

Bio-Physiological Response to Thermotherapy



- Hemodynamic effects



- Neuromuscular effect

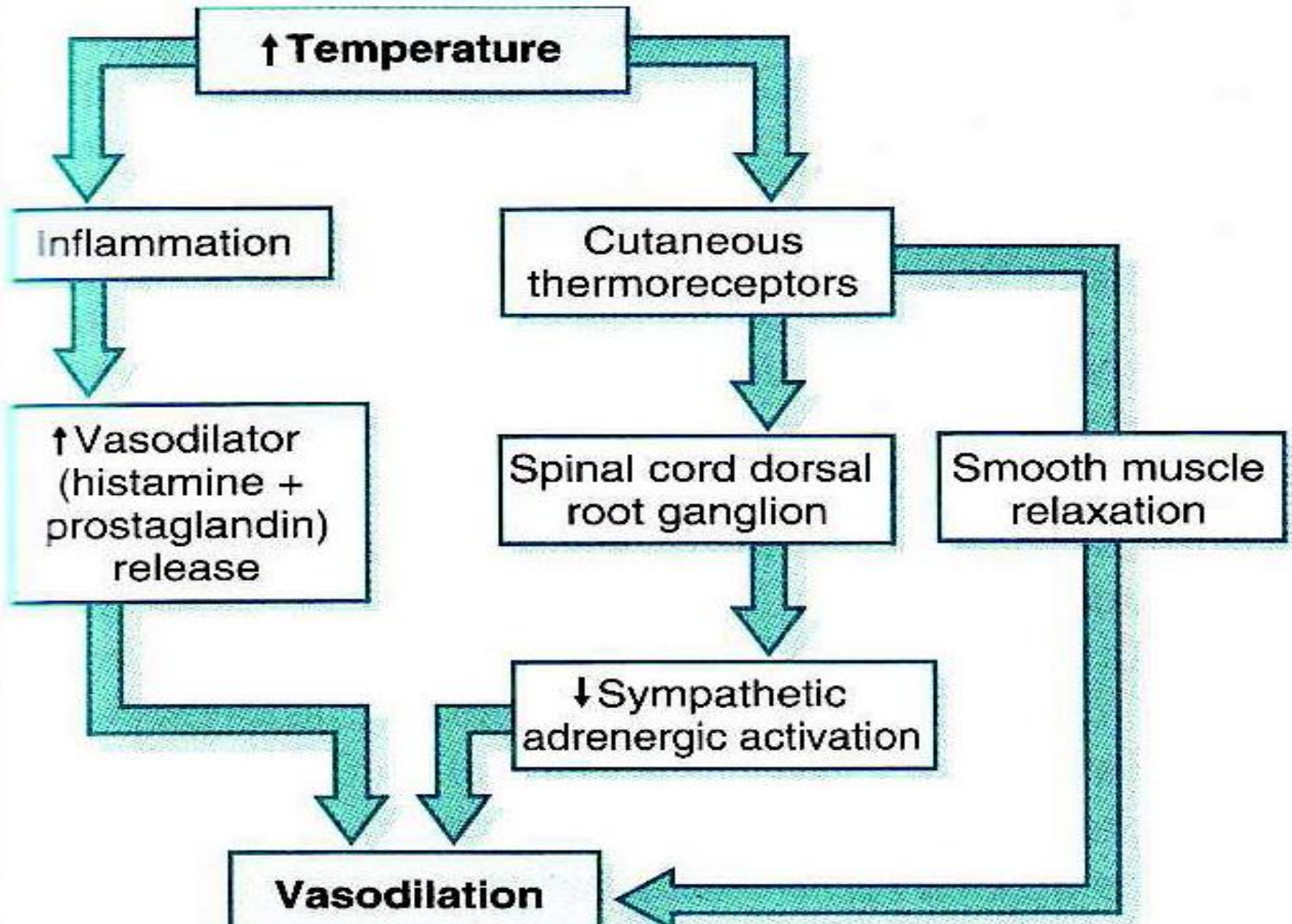


- Tissue Extensibility



- Metabolic effect

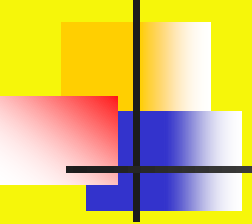
Hemodynamic Effects: Vasodilation



Cellular & Blood/Fluid Responses

- Cellular – For every 18°F (10°C) increase in skin temperature “the metabolic rate increased by factors of 2-3”
 - ↑ temperature → ↑ cell metabolism → ↑ O₂; cell waste ↑ excreted
 - ↑ temperature → blood hemoglobin releases O₂ (106°F = twice as much O₂ released)
 - ↑ temperature → (104°-113°F) plastic deformation of collagen-rich tissues occurs more easily
- Blood & Fluid Dynamics –
 - ↑ b. flow → ↑ edema, but ↑ b. flow removes wastes, etc.
 - Triggers release of bradykinin

II-Neuromuscular Effects

- 
-
1. Decreased pain and muscle spasm
 2. Increased pain threshold
 3. Increase nerve conduction velocity
 4. Decrease conduction latency (sensory & motor).
 5. Change muscle spindle firing rates

Changes in muscle strength

Muscle strength and endurance found to decrease for initial 30 minutes following heat application

Gradually recovers then increases for next 2 hours

Not really used therapeutically but should keep in mind if measuring muscle strength in therapy



III- Altered Tissue Extensibility

Increase extensibility of collagen tissues (tendon, ligament, capsule) at (40-45°C) resulting in

- ❖ Relaxation of tension,
- ❖ Increase length of soft tissue,
- ❖ Increase ROM

Superficial heat alone will NOT alter viscoelastic properties of tissue

■ Heat + Stretch

- Result = plastic elongation of deeper tissue such as (**tendons, ligaments, joint. capsule, fascia**).
- Factors important determining treatment strategies
 - Temperature elevation (40-45°C)
 - Time must be maintained for 5-10 minutes.
 - Stretch exercises

Physiological Effects of Heat Therapy

Increased

- 1- Local blood flow
- 2- Lymphatic drainage
- 3-Capillary permeability
- 4-Metabolic rate
- 5-Cellular oxidation
- 6-Flexibility of collagen tissues
- 7-Respiratory rate
- 8-Cardiac output
- 9-Pulse rate

(1-6)-----Local effects
(7-9)-----systemic effects

Decreased

- 1-Joint stiffness
- 2-Pain & muscle spasm
- 3-Muscle torque
- 4-Blood supply to internal organs
- 5-Blood pressure
- 6-Stroke volume

(1-3)----- Local effects
(4-6)----- systemic effects

Use of Thermotherapy



Indication: A condition(s) that could benefit from a specific therapeutic modality.



Contraindication: A condition(s) that could be adversely affected if a particular therapeutic modality is used.



Precautions:

Applied with special care or limitations.

“Relative contraindications”

Therapeutic Uses of Thermotherapy (Indications)



- Subacute or chronic inflammatory conditions
- Subacute or chronic pain and muscles spasm
- Limitation in ROM and joint contracture
- Hematoma resolution
- Before passive mobilization and exercise

Contraindications to uses of thermotherapy



Acute injuries

Recent or potential hemorrhage

Impaired circulation

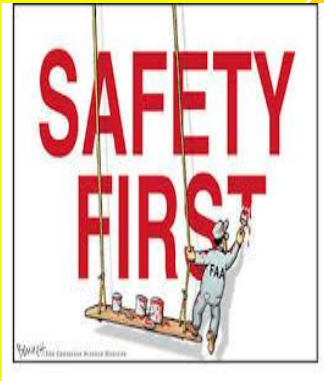
Poor thermal regulation (neuropathic
foot/hand)

Over or around neoplasms

Over or around infected area

Precautions to Thermotherapy

- ❖ Never apply heat directly to eyes or the genitals.
- ❖ Never heat the abdomen during pregnancy.
- ❖ Very young and very old patients.
- ❖ Mental retard patients.
- ❖ Cardiac insufficiency.
- ❖ areas with metal implants (higher thermal conductivity)
- ❖ Over area of topical anesthesia
- ❖ Dermatological anomalies.



Adverse Affects of Heat Applications

Burns:

- **Poor technique**
- **Patients' inability to dissipate or detect heat**
- **Treatment over areas of implanted metal or open wounds**



Bleeding: In acute trauma or hemophilia



Fainting: Due to potential peripheral superficial vasodilatation and decrease blood pressure .



MCQ- Questions

1-Hemodynamic - Neuromuscular - Metabolic

- a) Biophysiological Effects
 - b) Metabolic Effects
 - c) Neuromuscular Effects
 - d) Hemodynamic Effects
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2-Increases nerve conduction velocity - increases collagenous tissue extensibility - increases pain threshold - decreases muscular strength

- a) Neuromuscular Effects
- b) Metabolic Effects
- c) Biophysiological Effects
- d) Hemodynamic Effects

3-Hot packs - Fluidotherapy - Paraffin - Whirlpool - SW Diathermy - US

- a) Therapeutic Dosage
- b) Hemodynamic Effects
- c) Deep Heat Modalities
- d) Types of Thermal Agents