

Introduction to Physical Agents Part II: Thermotherapy

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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

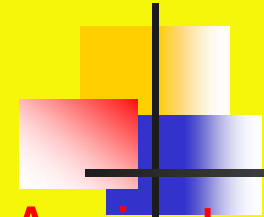
- Introduction and history of physical agents (PA)
- Classification of physical agents modalities
- Modes of heat transfers
- Physiological effects of thermotherapy.
- Therapeutic uses (indications) of thermotherapy.
- Contraindications of thermotherapy.
- Precautions & dangerous of thermotherapy



Physical Agents Modalities (PAMs)

- **Physical Agents Modalities (PAMs)** are external form of energy (e.g. heat, cold, light, electricity, electromagnetic, sound) applied to the patients to in the rehabilitation process to promote:
 - Pain and muscles spasm relief
 - Flexibility and range of motion
 - Wound healing
 - Muscular strength and endurance

History of physical agents



Ancient Rome and Greece used heat and water (steam rooms, hot & cool pools) to treat ailments



Late 19th Century Europe – natural hot springs

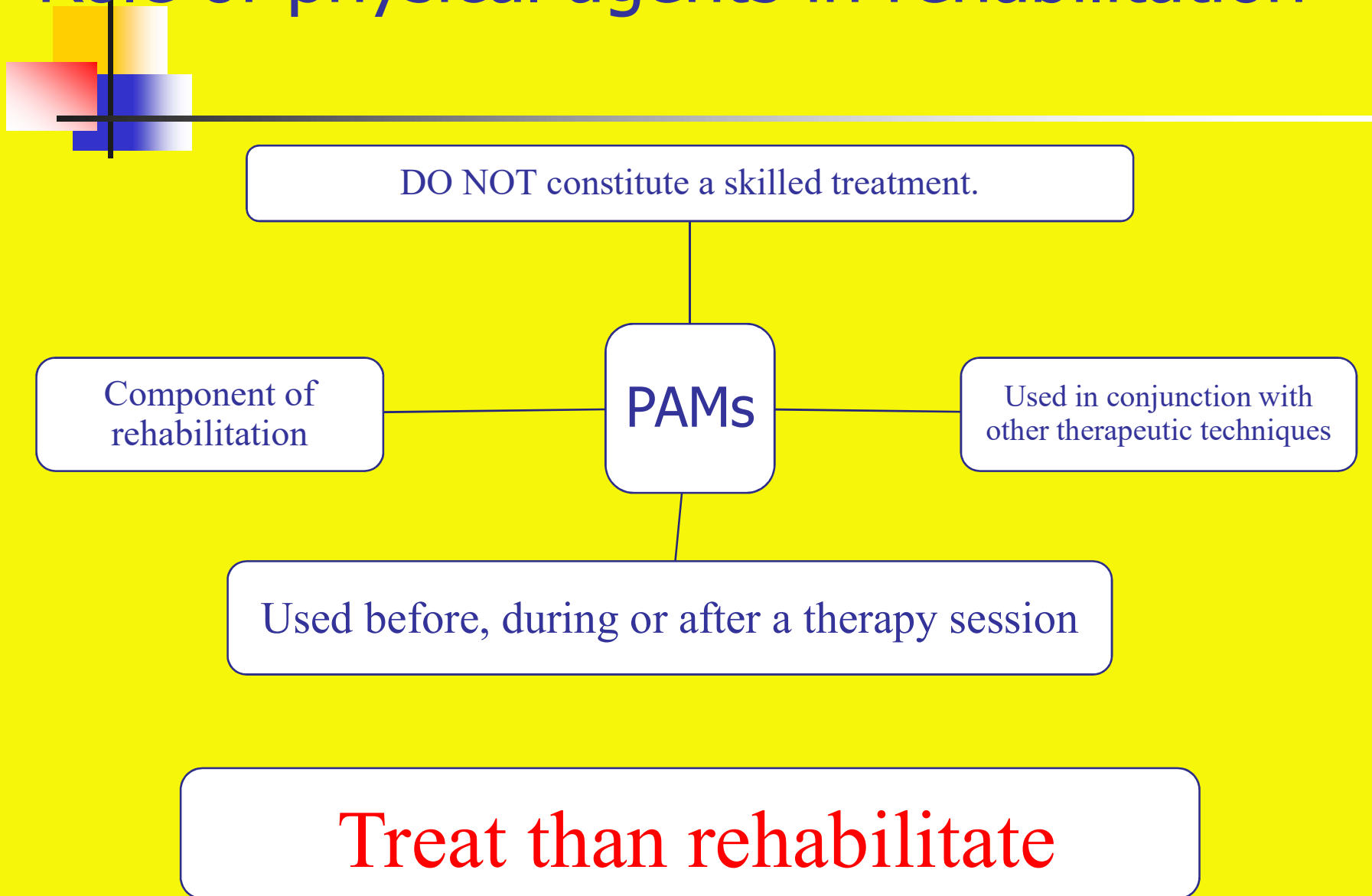
400 B.C. Torpedo fish were used to apply electrical shock to treat headache and arthritis.



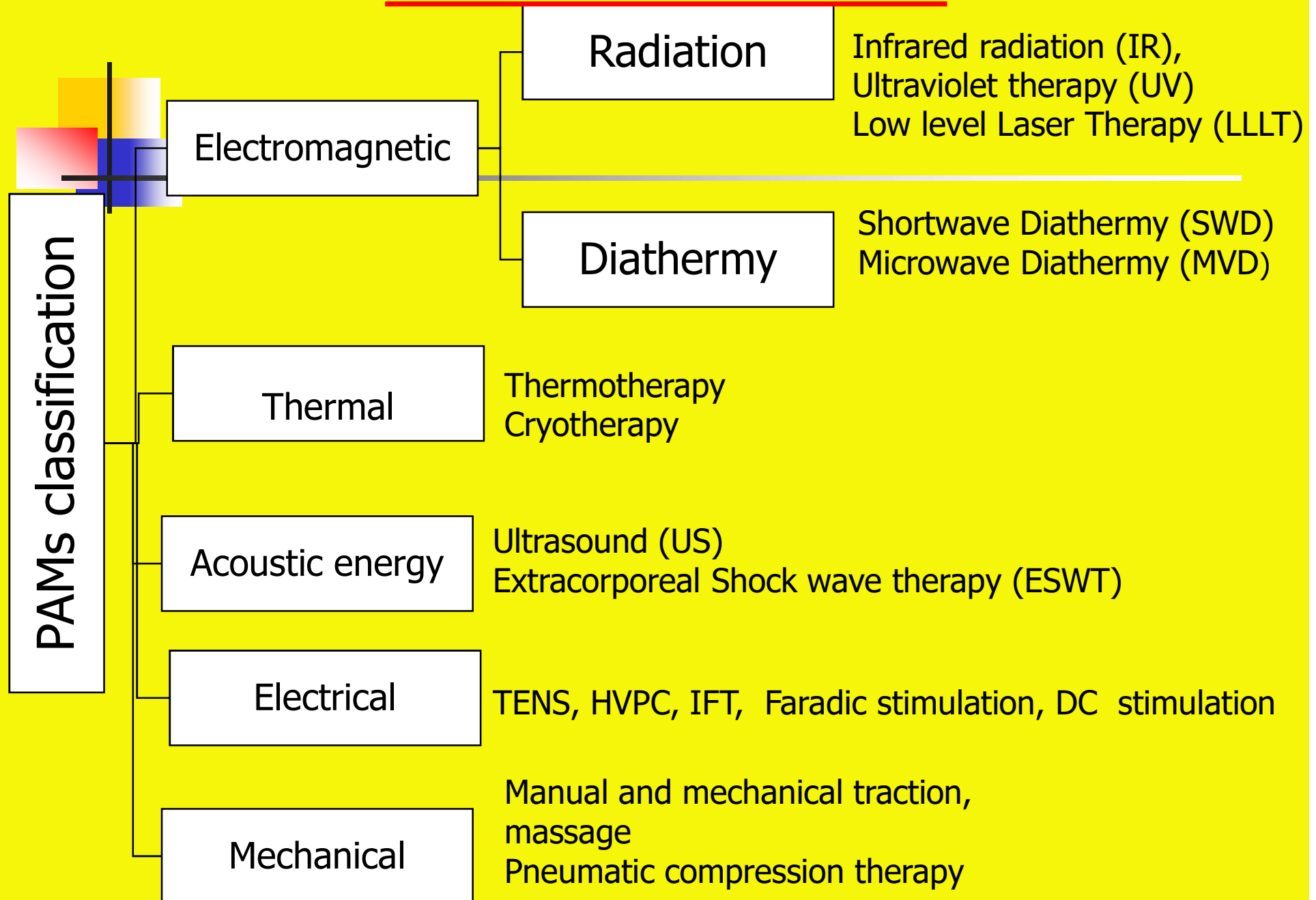
Sunlight was used to treat bone & joint diseases, dermatological problems & infection



Role of physical agents in rehabilitation

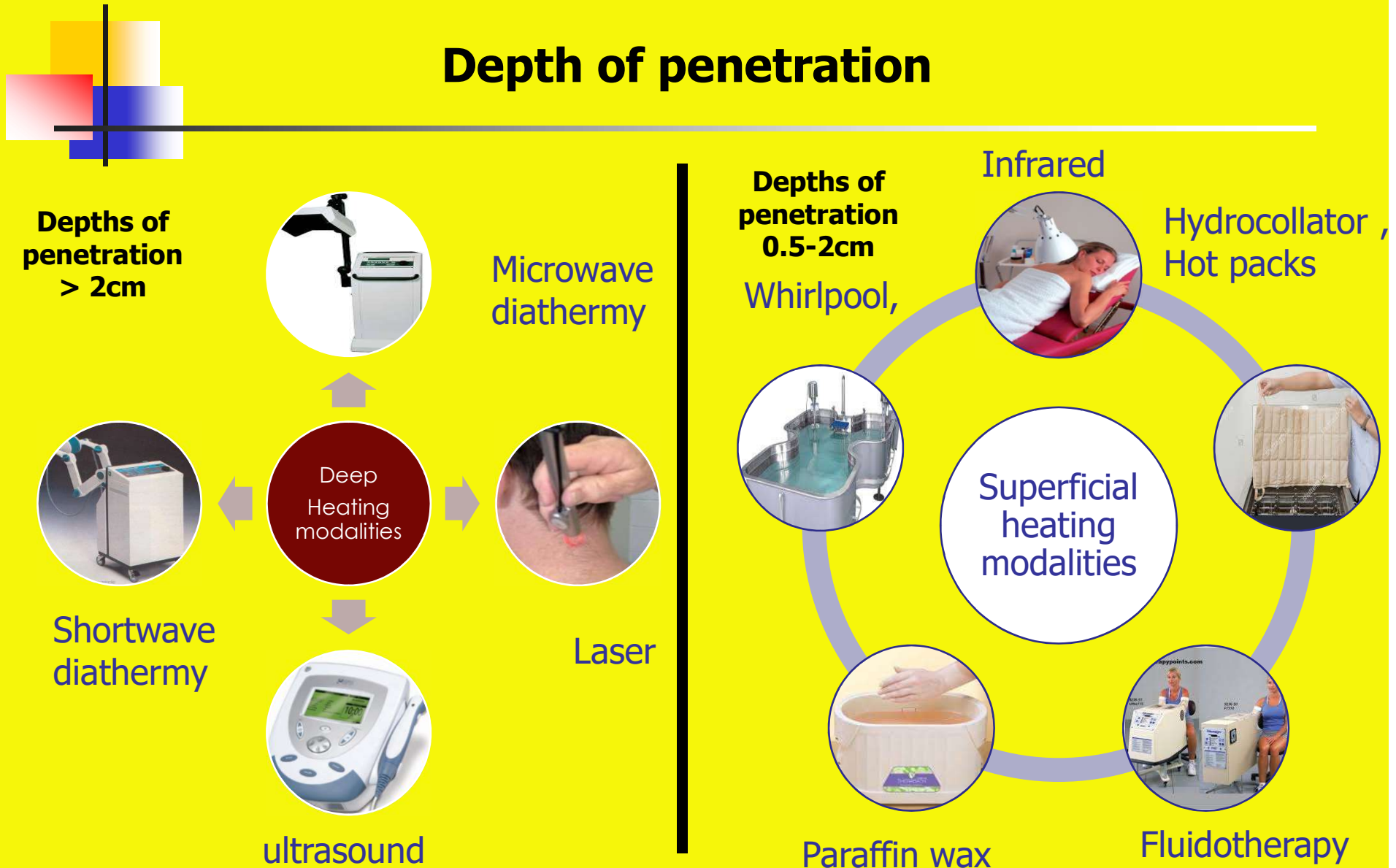


Classification of PAMs

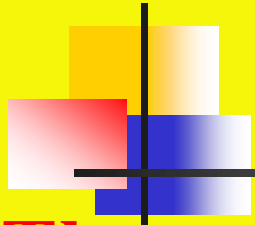


Classification of PAMs

Depth of penetration



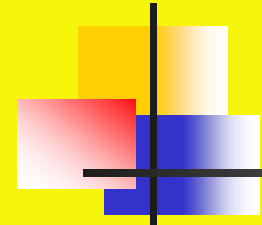
Thermal Agents



Thermal agents are types of **PAMs** that causes an increase or decrease in tissue temperature.

Thermotherapy is a application of heating modalities (**superficial/deep**) to increase the skin temperature within the therapeutic range (104 -113°F) to induce physiological effects for therapeutic benefits

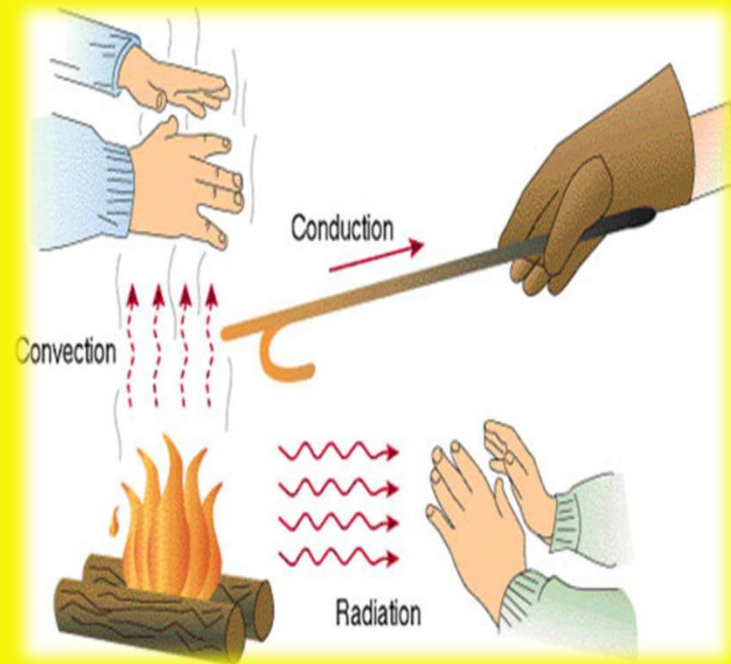
Modes of energy (Heat) transfer



Heat energy transfer from higher to lower concentration
Heat can be transferred to a body or from a body

Modes of heat transfer

- Radiation
- Conduction
- Convection
- Conversion
- Evaporation



Modes of energy (Heat) transfer

Conduction

is a direct transfer of energy (heat) between two objects in physical (direct) contact with each other.

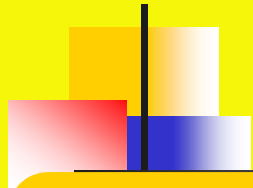
- Ice packs
- Hot packs
- Paraffin
- Ultrasound



Rate of energy (heat) transfer by conduction is dependent on

1. Temperature difference between materials
2. Thermal conductivity (Metal > water > bone + muscles > fat)
3. The total contact area
4. Tissue thickness

Modes of energy (Heat) transfer



Radiation

is a direct transfer of energy (heat) from higher temperature to lower temperature without the need for an intervening medium (**No-contact**).

- Shortwave diathermy
- Microwave Diathermy
- Laser
- Infrared & laser
- Ultraviolet therapy

Rate of energy (heat) transfer by radiation is dependent on

- 1) Density, thickness , and type of radiating tissues
- 2) Law governing radiations
- 3) Intensity and size of radiation
- 4) Distance from radiation source
- 5) Duration of radiation

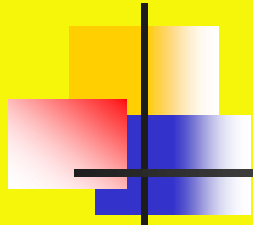
Modes of energy (Heat) transfer

Convection

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

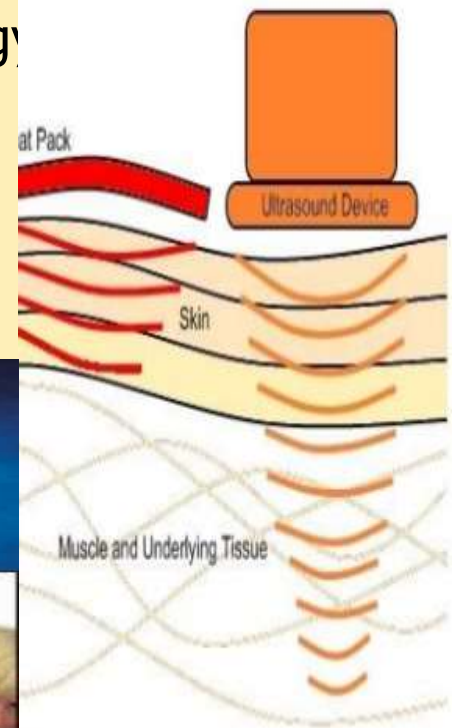
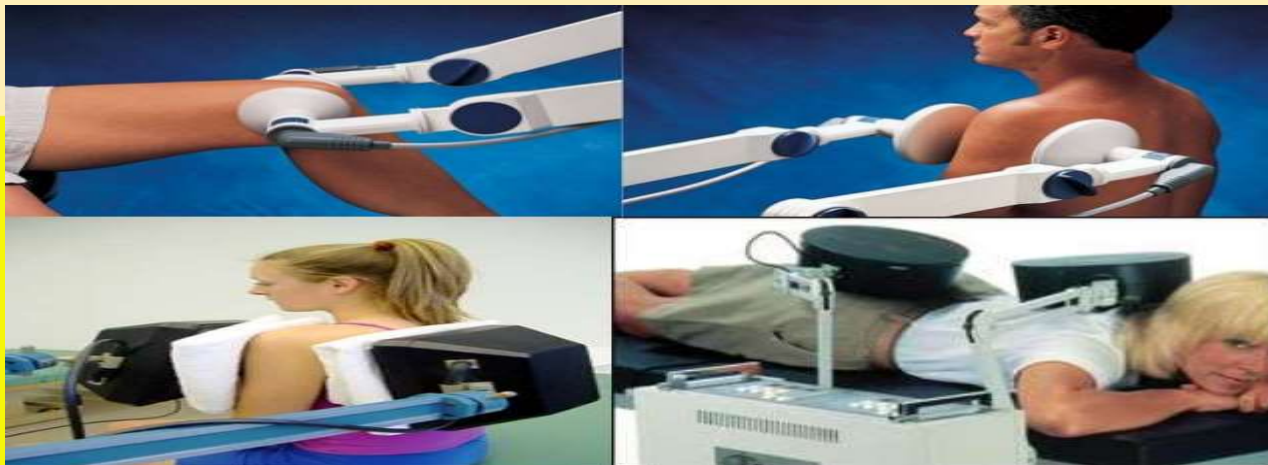


Modes of energy (Heat) transfer



Conversion

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



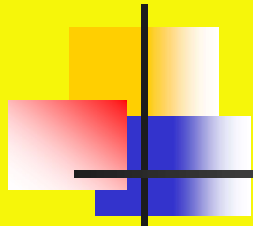
Modes of energy (Heat) transfer



Evaporation

- defined as the transformation from a liquid state to a gas state
- 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

Modes of energy (Heat) transfer



Heat
transferring

Conduction

Radiation

Convection

Conversion

Evaporation





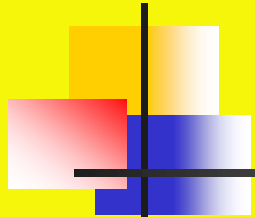
Non-thermal form of energy being converted into heat, => Ex: Mechanical, electrical or chemical energy; Diathermy, Ultrasound

- a) Conduction
- b) Conversion
- c) Convection
- d) Evaporation

Vapocoolant spray is a form of energy transfers by Radiation
True false

Adipose acts as insulator, thus slowing down temp change while
Muscle contains water has faster conduction of heat
True false

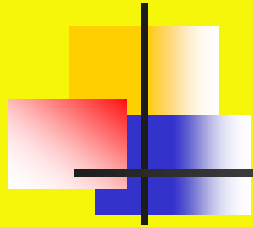
Effects of physical agents



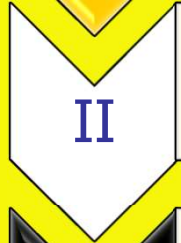
■ **Application (uses) of PAMs**

- Modulate pain
- Reduce or eliminate inflammation
- Increase rate of healing
- Modify muscle tone
- Increase connective tissue extensibility

Bio-Physiological Response (Effects) of Heat



- Hemodynamic effects



- Neuromuscular effect

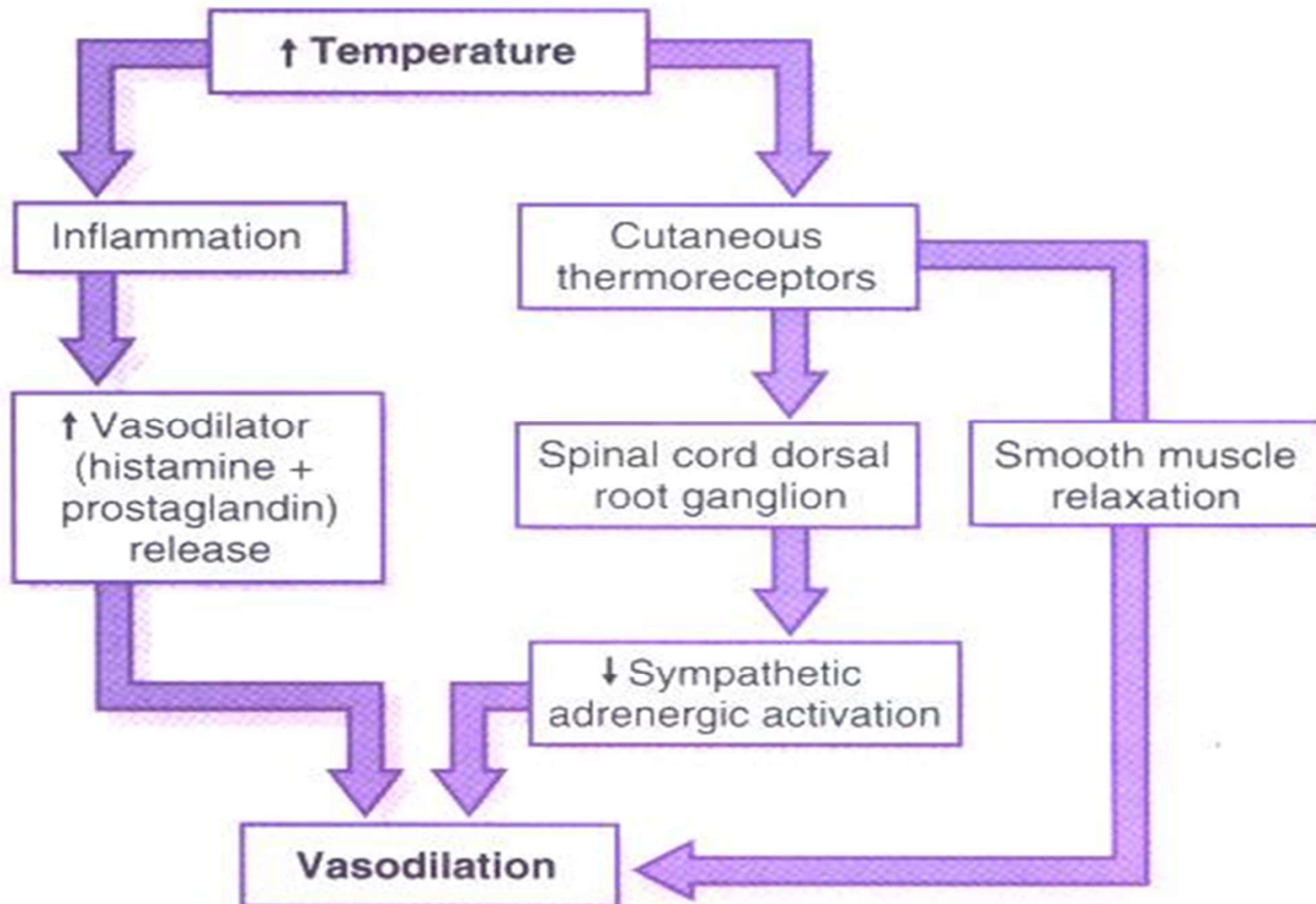


- Tissue Extensibility



- Metabolic effect

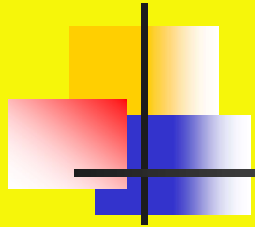
Hemodynamic Effects: Vasodilation



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. Change muscle spindle firing rates
4. Increase nerve conduction velocity
5. Decrease conduction latency (sensory & motor).

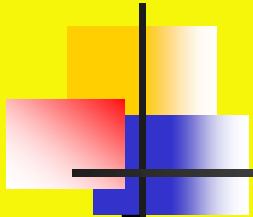
Changes in muscle strength

Muscle strength and endurance found to decrease for initial 30 minutes following heat application (**superficial/deep heating**)

Gradually recovers then increases for next 2 hours

Measuring muscle strength (before heat application Not after)

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

Local



Systemic

Increase

Local blood flow

Lymphatic drainage

Capillary permeability

Metabolic rate

Collagen extensibility

Decrease

Joint stiffness

Pain

Muscles spasm

Muscle torque

Increase

Respiratory rate

Cardiac output

Pulse rate

Decrease

Blood supply to internal organs

Blood pressure

Stroke volume

Considerations using Physical Agents



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:

A conditions in which therapeutic modalities is applied with special care or limitations.

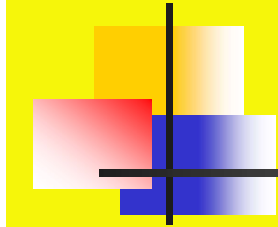


Therapeutic Uses of Thermotherapy (Indications)



- Subacute or chronic pain and muscles spasm
- Limitation in ROM and joint contracture
- Subacute or chronic inflammatory conditions
- Accelerate tissues healing
- Before passive mobilization and exercise

Contraindications for Thermotherapy



Acute injuries

Recent or potential hemorrhage

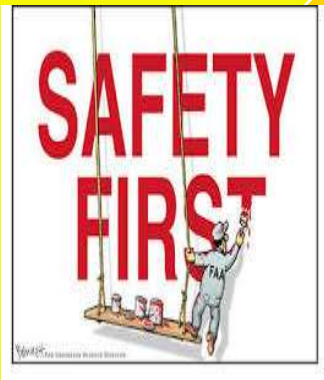
Impaired circulation

Poor thermal regulation

Over or around neoplasms (malignant tumor)

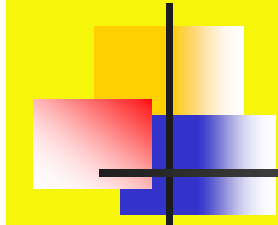
Over or around infected area

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

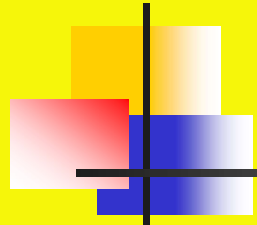


Fainting: peripheral superficial vasodilatation and decrease blood pressure .



How to Avoid ?

To select PAMs



- Correct diagnosis
- Pathological and physiological changes associated with the injury
- Understand the modalities effects, indications, and contraindications
- Match therapeutic goal with a modality that will help you achieve that goal

MCQ- Questions

1-Hemodynamic - Neuromuscular - Metabolic

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

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