SUPERFICAL HEATING AGENTS: (THERMOTHERAPY)

Principles of Heat Transfer

- Conduction – SURFACE TO SURFACE
  - Hot Pack, paraffin, ice
- Convection – MOVING air or water
  - Whirlpool, Fluidotherapy
- Conversion – NON-THERMAL ENERGY to THERMAL
  - Ultrasound, diathermy
- Evaporation – LIQUID TO VAPOR
  - Vapocoolant spray
- Radiation – NO MEDIUM: heat from radiation to cooler temperature
  - Infrared light

Effects:

- reduce pain
- increase tissue extensibility (↑ ROM, ↓ stiffness)
- increase circulation (vasodilation)
- accelerate healing
- decrease spasms (contraindicated for MS)
- increase metabolic rate

Contraindications:

- DVT
- recent cancer (may metastasize)
- venous insufficiency
- altered sensation
- do not apply to eyes
- recent hemorrhage

Precautions:

- not for acute injury
- pregnancy
- impaired circulation
- edema
- CV issues
- metal in area
- any topical creams applied
- open wounds

Applications:

- Superficial:
  - apply 15 to 20 min (6 to 8 layers)
  - paraffin: dip 3 to 5 times with fingers apart, wrap, elevate UE, leave on 10 to 15 min
  - Fluidotherapy: dry heating (corn cobs) that transfer heat by convection or by just moving around the body part leading to increased temperature. Temp at 100 to 118. Treat for 20 min.
THERMOTHERAPY APPLICATIONS:

- **Superficial Heating:**
  - Fluidotherapy: (Warm cellulose particles. Provides heat, skin desensitization and prevent edema. May be expensive.)
    - Put body part into unit before turning machine on.
    - Temperature set 111 – 125 F
    - Adjust to patient comfort
    - Treatment 20 min
  - Hot Packs: (Gel filled canvas, inexpensive, provides heat, pain relief and relaxation).
    - Requires monitoring to prevent burns.
    - Stored in hot water 158 – 167 degrees F
    - 6-8 layers of towels
    - Top of patient preferred, if lying on top, additional towels required
    - Skin checks every 5 min. Normal treatment time 20 min
  - Infrared Lamps: (Uses radiant heat.
    - Minimum penetration (1-3 mm)
    - Requires observation to prevent burns
    - 20 inches from source with moist towel over area treated
      - As distance decreased there is increased intensity
  - Paraffin: (Uses melted wax, contoured contact, easy, pleasant, and inexpensive)
    - Mixture 113 – 126 degrees F
    - 3 methods:
      - Dip-Wrap:
        - 6-10 dips, wrap with plastic and towel, 20 min
      - Dip-Immersion:
        - 6-10 dips, immersion x 20 min
      - Paint:
        - 6-10 layers, 20 min, for areas that cannot be dipped
THERMOTHERAPY APPLICATIONS:
- Deep Heating:
  - Diathermy: (Heats by conversion of high frequency EM waves into therapeutic heat)
    - Uses energy to produce vibration of molecules elevating tissue temperature.
    - Enhances soft-tissue healing:
      - Shortwave: In continuous or pulsed mode
        - Pulsed is nonthermal
        - Continuous is thermal
      - Most common frequency is 27.12 MHz
        - Capacitive Technique: (Plate to Plate)
          - Current between two transmission plates puts tissue in electrical circuit.
          - Oscillation of current oscillates ions and heats tissue.
          - Superficial, LOW FAT tissue
        - Inductive Technique: (Coil wrap or drum applicator)
          - Creates magnetic field perpendicular to the coil.
          - Eddy currents cause oscillation of ions and heats tissue
          - Deeper, Muscle and synovial fluid
  - Effects:
    - Increase temperature – Vasodilation - Increase metabolic rate – Increase collagen extensibility
    - ALTERED CELL MEMBRANE FUNCTION
    - INCREASED NERUV CONDUCTION VELOCITY
    - INCREASED EDEMA
  - Contraindications:
    - Pregnancy, IUD, Testes, Eyes, Pacemaker
    - Malignancy
    - Acute inflammation
    - MOIST WOUND DRESSING
  - Indications
    - Decreased collagen extensibility
    - Pain, Muscle guarding, DJD, Bursitis
    - Peripheral nerve regeneration
    - Chronic inflammation
  - Treatment Parameters
    - Remove all metal
    - Cover skin with dry towel
    - Patient should remain still
    - 15 – 30 min
THERMOTHERAPY APPLICATIONS:

- **Deep Heating: Ultrasound** (Common, depths to 5cm)
  
  - Uses sound to create tissue vibration to produce thermal and non-thermal effects.
  - Requires coupling agent (water or gel)

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<tr>
<th>Continuous: Thermal (Tissue heating)</th>
<th>Pulsed: Non-thermal</th>
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<tbody>
<tr>
<td>- 100% duty cycle</td>
<td>- 20% duty cycle = on 20% of time</td>
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<tr>
<td>- 1MHz deeper (up to 5cm)</td>
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</tr>
<tr>
<td>- 3MHz superficial (&lt;2cm)</td>
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**EFFECTS:**
- Increased collagen extensibility
- Decrease stiffness and spasm
- Pain reduction
- Increased blood flow

**EFFECTS:**
- Stim for regeneration/repair
- Increased macrophage
- Pain relief
- Increased blood flow and membrane permeability

**INDICATIONS:**
- Soft Tissue repair/Ulcer repair
- Contracture/fracture
- Trigger points

**INDICATIONS:**
- Scar tissue
- Pain/Muscle Spasm
- Plantar warts

**PARAMETERS**

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<th>Moving: Pulsed or Continuous</th>
<th>Stationary: Pulsed</th>
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<td>- Constant movement in Small circular movements or “Stripping” -2-4 times the size of the sound head</td>
<td>- 0.5 - 0.75 w/cm 20% duty cycle</td>
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**BNR:** Beam Nonuniformity Ratio:
- Ratio of high intensity to average intensity (There is some variation)
- Lower BNR favorable – Less Hot Spots
- BNR should be 2:1 to 6:1

**ERA:** Effective Radiating Area
- Area of transducer that produces US energy
- Always smaller than transducer head

**Acoustic Cavitation**
- Acoustic energy causes cavitation developing bubbles
- Two types:
  1. Stable: bubbles change size but do not burst. Leads to microstreaming
  2. Transient (unstable): bubbles implode.
    - Undesirable: Occurs at greater than 3W/cm

**Microstreaming:**
- Minute flow of fluid that is around bubbles that oscillate and pulsate

**Acoustic Streaming:**
- Consistent and circular flow of cell fluids from US
- Responsible for altering cellular activity and fluid transport

**Phonophoresis:**
- Using US to deliver medications transcutaneously
- Used with anti-inflammatory agents or analgesics
- Caution over injections

**Contraindications:**
- Eyes, pregnancy, heart, testes, Growing epiphyseal joints
- Cemented prosthetic joint
- Impaired circulation/Thrombophlebitis
- Malignancy
- Impaired circulation/Thrombophlebitis