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Thermal Therapy – Heat & Cold

Andrew Starsky, PhD, PT

Superficial (misleading) Heat

Hot packs
Paraffin
Fluidotherapy
Infrared lamp
Whirlpool
Thermotherapy

- Therapeutic range 104-113 degrees Fahrenheit (40-45 degrees Celsius)
- > 113 degrees Fahrenheit leads to catabolism (breakdown of macromolecules) and cell death

Energy Transfer

- **Conduction**: direct collision between molecules of two materials at different temperatures
- **Convection**: contact between circulating medium and another material at different temperatures
- **Radiation**: through the traveling of electromagnetic waves, across the air, from the warmer to the cooler substance or body
- **Evaporation**: transfer of heat from the body by conversion of a volatile liquid into a vapor when the liquid is applied to the skin (vapoocoolant)
- **Conversion**: changing from one form of energy to another (US)
Conduction

- Directly proportional to the following:
  - Temperature gradient between agent and skin surface
  - Duration of application
  - Thermal conductivity of the tissue
    - Skin > muscle > subcutaneous fat
    - Subcutaneous fat acts as a barrier - reduces transfer of heat to deeper tissues
  - Body weight - positioning
    - Body part resting on hot pack versus supporting hot pack
    - Resting creates higher pressure contact and decreases skin's ability to dissipate heat
  - Application method used (i.e. paraffin)

Conduction

- Inversely proportion to thickness of coupling medium
  - Add or remove towels with hot pack
  - Pre-warmed or moist towels compared with room-temp or dry towels will facilitate heat transfer
Hot Packs

- Introduced in 1950s
- Present in ~94% clinics
- Various sizes and shapes
- Hydrocollators
  - Water temp = 158°F - 168°F

continued

Starsky/OccupationalTherapy.com
Hot Packs

- Heat transfer via conduction
- Stored in hot water (158-168 degrees Fahrenheit)
- Requires coupling medium to avoid tissue damage
- Requires ~ 2 ½ hours to reheat between uses
- Issues with weight and AROM

Michlovitz and Nolan, 2005
Whirlpool

- Used in Greece from 500-300 BC
- Various sizes and shapes
Whirlpool

- Heat transfer via conduction and convection
- May adjust turbine to project water pressure toward or away from the involved area
- May perform therapeutic exercise
- Issues with contamination and costs associated with cleaning and heating water

Paraffin

- Introduce in early 1900s
- Present in ~60% of clinics
Paraffin

- Heat transfer via conduction
  - 1-2 centimeters
- Temperature 113°F- 122°F
  - Why is the temperature greater with paraffin than other thermal modalities?
    - Lower specific heat
    - Touch a steel and plastic surface on your chair
    - Steel feels colder- although both the plastic and steel are room temperature

Paraffin

- May be mixed with mineral oil to decrease melting point
  - from 129 to ~117 degrees Fahrenheit
- Good for contoured areas
- Issues with contamination if paraffin is reused- not recommended
  - May sterilize by setting heat to ~176 degrees Fahrenheit for a few hours/overnight
Methods for Applying Paraffin

- Continuous immersion with retention
  - 7 dip immersions
  - Continuous 30 min immersion in bath
  - 30 min period of retention outside the bath

- Continuous immersion
  - 7 dip immersions
  - Continuous 30 min immersion in bath

*** Continuous immersion produces greatest increase in cutaneous, subcutaneous and muscular temperature

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Methods for Applying Paraffin

- Dip immersion with wrapping (transient increase in skin temp)
  - 6-12 dip immersions then wrapped in layers
  - 30 min period of retention outside the bath

- Brushing with wrapping
  - 7-10 coating are brushed over treated area then wrapped in layers
Fluidotherapy

- Contains natural cellulose (ground up corn cobs) circulating in dry warm air
- May control heat and air flow
- Heated to around 130 degrees F
Fluidotherapy

- Heat transfer via convection
- Stimulates thermo and mechanoreceptors (heat & movement)
- Thermal effects + desensitizes hypersensitive tissue
- May help prevent edema ????
  - Limb in horizontal position vs. vertical position

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Box 4–6 Advantages and Disadvantages of Fluidotherapy

Adventages
1. Fluidotherapy is convenient and easy to administer.
2. Temperature of application can be controlled.
3. Agitation of dry particles can be controlled for comfort.
4. Variety of unit sizes allows for most body areas to be treated.
5. Allows for some active exercise to be carried out during intervention.
6. Fluidotherapy provides a dry, comfortable heat.
7. Fluidotherapy can be used for desensitization of hypersensitive hands/fingers or feet/toes.

Disadvantages
1. Fluidotherapy is a relatively expensive modality to purchase.
2. Some patients are intolerant to the enclosed container (claustrophobic feeling).
3. Some patients are intolerant to the dry materials used.
Fluidotherapy Disadvantages

- Expensive
- Cannot treat proximal joints
- Slippery due to spilling of particles
- Large unit

Infrared Lamp

- Present in 2-30% of clinics
- Emit electromagnetic radiation
  - Heat transfer occurs in electromagnetic spectrum (radiation)
  - Wavelengths between 780-1500 nm with peak intensity at 1000 nm

** Two recently published texts indicated that Infrared therapy is rarely used and “will not be discussed further.”
Infrared Lamp

- Tissue temperature proportional to radiation that penetrates tissue
  - Related to distance from source, angle, and skin color
  - Limited depth of penetration (1-3 mm)
- Avoid irradiation of the eyes: wear IR opaque goggles
- Use tape measure to record distance from source

Thermotherapy Effects
Thermotherapy Effects

- Hemodynamic effects
- Neuromuscular effects
- Metabolic effects
- Altered tissue extensibility

Hemodynamic Effects

- Vasodilation
- Increases blood flow
  - Improves healing and repair
  - Removes inflammatory compound that activate nociceptors
  - Studies regarding deep heating are mixed
    - Studies showing heating effects on “deep” muscle and joints used hands for assessment
**Hemodynamic Effects**

- Reflex vasodilation
  - Heat may trigger reflex activation of sympathetic cholinergic nerve fibers
  - Affects deeper tissue (not just superficial)
    - Greatest change in tissue temperature 1-2 centimeters

**Neuromuscular Effects**

* Mense, 1978 (cat study)

- Increase in temperature
  - Decreases firing rate of type II muscle spindle
    - excitatory to agonist muscle and inhibitor to antagonist muscle
  - Increases firing rate of type Ib fiber from Golgi tendon organs
    - inhibitory to agonist and excitatory to antagonist
  - Reduces alpha motor neurons
    - reduction in muscle spasm
    - reducing muscle spasm should reduce pain
Muscle spindle and Golgi tendon organ (GTOs)

Neuromuscular effects

- Changes nerve conduction velocity and firing rate
- Increases pain threshold
  - Decrease muscle spasm: decrease local ischemia and nociceptor activation
  - Inhibit gating effect on transmission of pain sensation at the spinal cord level via mechanical stimulation (gate control theory)
- Change in muscle strength
  - Muscle strength and endurance may decrease during the initial 30 minutes after heating
  - Changes in motor hand performance
**Metabolic effects (increases metabolic rate)**

- Increases enzymatic activity (102°F-109°F)
  - Begins to decrease at 111°F and stops completely at 122°F
- Increases oxygen uptake
- Increases cellular biochemical processes: accelerates healing
- May accelerate destruction of articular cartilage in patients with rheumatoid arthritis
  - Use caution in patients with acute inflammatory disorders; may contribute to inflammatory process

**Altered tissue extensibility (increases collagen extensibility)**

- Heated soft tissue
  - Maintains greater increase in length
  - Less force is required to increase length
  - Reduces risk of tissue tear
- May be difficult to achieve with superficial heat
  - Optimal at 104-113 degrees Fahrenheit for 5-10 minutes
When should you stretch when using heat?

Thermotherapy
Treatment/Indications

- Pain control
  - Decreasing muscle spasm (by decreasing ischemia)
  - Increasing blood flow removes waste products/inflammatory compounds that activate nociceptors
- Psychological aspects
- Increase ROM and decrease joint stiffness
- Tissue healing (not recommended during acute inflammatory stage)
- Psychological
HEAT

- Vasodilation
  - Increase cell metabolism
  - Increase blood flow
  - Promotes soft-tissue healing

- Increase thermoreceptor activity
  - Counter irritation effect
  - Decreases pain/promotes relaxation

- Decrease joint viscosity
  - Warming of intra-articular fluid
  - Reduces joint stiffness

Proposed sequences associated with thermotherapy

Application
**Application**

- Check for contraindications/precautions
- Visually inspection tissue before and after application
- Test skin for sensory heat discrimination
- Educate patient on goals of thermotherapy, expected sensation (i.e. mild warmth) and to ask for assistance if too hot (bell)
- Wear timer!

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**Application**

- Check patient periodically (5-10 min)
- ~20 min duration depending on patient (dx, history, tolerance…)
- Stop treatment if patient reports excessive heat or burning

- #1 lawsuit in P.T. due to hotpacks
Documenting Treatment

- Area
- Duration
- Position
- Co-treatments

Thermotherapy effects

- Vasodilation
  - Direct effect
  - Reflex vasodilation
    - Activates sympathetic cholinergic fibers, ACh released and activates cholinergic receptors on smooth muscle on blood vessels
Evidence for vasodilation


Erasala 1

- Temperature controlled heating pad
  - 38° C (100° F)
  - 40° C (104° F)
  - 42° C (108° F)
- 30 minute treatment to upper traps
- Measured blood flow at 18 different sites pre and post
Erasala 2

- Results
  - Vascularity changes up to 3 cm below skin
  - 38° C → 27%
  - 40° C → 77%
  - 42° C → 104%

What will this vasodilation do?

- More Oxygen to the tissues
- More nutrients to the tissues
- More “troops” to the injured tissues
  - Macrophages
  - Neutrophils
  - Fibroblasts
- Overall potentially speed the healing process
Lawsuits

- Source: Court TV, "Suit: Heating pad injured man's ability to provide wife with love," December 20, 2004.
- $450,000 in damages
- The mother of a 36-year-old man who died from a fentanyl overdose in 1994 won a verdict of $5 million against the manufacturer in an early Duragesic Patch lawsuit. The case was settled by a confidential agreement on appeal. Kurt Hophan had been prescribed a patch for pain from a back injury. He fell asleep with a heating pad and an electric blanket and never woke up. The heat of the pad and blanket were said to have caused the patch to release 100 times the prescribed dose of fentanyl.

Evidence of tissue extensibility

- 92 healthy volunteers
- Measured upper trap flexibility
- 5 groups
  - Stretch only
  - Heat + stretch
  - Cold + stretch
  - Heat and cold + stretch
  - No intervention
Lentell #2

- 3 treatments of 40 minutes over 5 days
- Follow up measurement 3 days after
- Significant improvement with heat + stretch
- Heat in stretched position

Thermal wraps
Evidence on thermal wraps


Abeln #2

- 76 adults with acute muscular LBP
- 4 treatments
  - Thermal wrap
  - Placebo wrap
  - Ibuprofen (400mg)
  - Oral placebo
- Wraps worn 8 hrs/night
Abeln #3

- subjective measures
  - pain relief
  - muscle stiffness

- objective
  - trunk range of motion
  - Roland Morris disability
  - sleep onset difficulty and sleep quality

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The Roland-Morris Low Back Pain and Disability Questionnaire

Patient name: ___________________________ File #: ___________________________ Date: ___________________________

Please read instructions. When your back hurts, you may find it difficult to do some of the things you normally do. Mark only the measures that describe you today:

- I stay at home most of the time because of my back.
- I change position frequently to try to get my back comfortable.
- I walk slower than usual because of my back.
- Because of my back, I am not doing any jobs that I usually do around the house.
- Because of my back, I take a handkerchief to dry my eyes.
- Because of my back, I feel driven to eat more often.
- Because of my back, I have to hold on to something to get out of an easy chair.
- Because of my back, I try to get other people to do things for me.
- I get dressed more slowly than usual because of my back.
- I only work for short periods of time because of my back.
- Because of my back, I try not to bend or bend down.
- I find it difficult to get one of a chair because of my back.
- My back is painful above all the time.
- I find it difficult to turn over in bed because of my back.
- My appetite is not very good because of my back.
- I have trouble sleeping on my side because of the pain in my back.
- I can only walk short distances because of my back pain.
- I sleep less well because of my back.
- Because of my back pain, I get dressed with the help of someone else.
- I am slower, for some of the day, because of my back.
- I need heavy pain around the house because of my back.
- Because of back pain, I am more irritable and less interested in things.
- Because of my back, I spend more money than usual.
- I stay in bed most of the time because of my back.

Instructions:

1. The person answered to yes a mark was to each appropriate statement.
2. The total number of marked statements are added by the clinician. Unlike the methods of the Oswestry Disability Questionnaire, Roland and Morris did not provide a description of the varying degrees of disability (e.g., 40% is severe disability).
3. Clinical improvement over time can be cited based on the analysis of overall questionnaire scores. For example, at the beginning of treatment, a patient’s score was 50 and, at the conclusion of treatment, the score was 25 (5 points of improvement; we would estimate an 80% [95% CI 100] of improvement).
Abeln #4

- Heat therapy compared to placebo provided significant increases in:
  - mean 3 day morning pain relief (2.75 vs. 1.45; \( p = 0.00005 \))
  - trunk range of motion (20 vs. 17 cm; \( p = 0.001 \)) and decreases in muscle stiffness (36.3 vs. 47.9; \( p = 0.0008 \))
  - disability (15% vs. 24%; \( p = 0.005 \)).
- These therapeutic benefits were evident both during the 3 day treatment period as well as during the 2 day follow-up period.

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Keep it hot

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~Pack Comparison- Hot~

- Hydrocollator
- Thermal Aid
- Gel pack
- Herb pack
- Rice pack
- Oat pack
- Barley pack

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Time Since Removal From Microwave

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Degrees
Contrast therapy

- Repeated immersion into cold, then hot
- 1 minute cold, 3-4 minutes hot
- Effects
  - Counterirritant
  - “pumping” action from blood vessel dilation and constriction
  - Activation of descending pain modulation

Contrast therapy evidence

- 16 healthy volunteers
- 20 minutes of contrast therapy
- Subcutaneous and intramuscular tissue temperatures were measured
- No significant temperature fluctuation in intramuscular region
Consensual heating

- Heat applied to regions of the spine will cause some reflex vasodilation at that myotomal level

- Examples
  - Hot pack to cervical region will cause vasodilation to UEs
  - Heat to lumbar region will cause vasodilation to Les

- Safer for people who cannot tolerate direct heating

Contraindications
Contraindications

- Acute injury or inflammation: edema, bleeding, may aggravate inflammatory reaction
- Open draining wound
- Thrombophlebitis: dislodge thrombus or blood clot
- Impaired sensation/mental cognition: burns
- Malignancy: may increase growth rate
- Pregnancy: avoid heating of the trunk or full body- may affect fetal development

Precautions

- Chronically inflamed joints
- Impaired circulation/ poor thermal regulation: burns
- Edema
- Cardiac insufficiency: may not tolerate increase in cardiac demand
- Metal implants: internal bleeding
- Over an superficial-closed or open wound: contamination, burns, breakdown immature scars
- Over areas where topical counterirritants have recently been applied: further vasodilation may promote burns
Literature Review

- Hot packs and static stretching
  - Mixed results (+ shoulder, - hamstrings)
- Rheumatoid arthritis
  - Mixed results (50/50)
- Burn contracture (+, type II)
- Traumatic hand injury (+, type II)
- Adhesive capsulitis (+, type II)
- Low back pain (+, type II)
- Trigger-point pain (+, type II)
- Spasm (+, type II)
- Neck and shoulder pain (+, type II)

Cryotherapy
Cryotherapy

- Not putting cold into the body
- Removing heat from body

Energy Transfer

- **Conduction**: direct collision between molecules of two materials at different temperatures
- **Convection**: contact between circulating medium and another material at different temperatures
- **Radiation**: through the traveling of electromagnetic waves, across the air, from the warmer to the cooler substance or body
- **Evaporation**: transfer of heat from the body by conversion of a volatile liquid into a vapor when the liquid is applied to the skin (vapoocoolant)
- **Conversion**: changing from one form of energy to another (US)
Energy Transfer - Conduction

- Conduction: direct collision between molecules of two materials at different temperatures
  - Transfer of heat from the body by the direct interaction of molecules in the (warm) body with those in a cool (cold) medium, which is dependent on:
    - Temperature difference between the two objects
    - Time of exposure
    - Thermal conductivity of the substance being cooled

Energy Transfer - Conduction

- Rate of heat transfer by conduction:
  - \[ \text{Area} \times K \times (T_1-T_2) / \text{thickness of tissue} \]
  - Area = bigger area then fast rate of exchange
  - K = conductivity coefficient = depends on tissue
    - Bone > Muscle > Fat
      - Bone has greater thermal conductivity
    - Want material between ice and person to be as conductive as possible
    - Use wet towel vs. dry towel (more of an insulator)
  - Temperature difference
Energy Transfer - Conduction

Energy Transfer - Conduction
Energy Transfer - Convection

Evaporation: transfer of heat from the body by conversion of a volatile liquid into a vapor when the liquid is applied to the skin.

Vapocoolant: low boiling point so exposure to air results in boiling and evaporates taking energy/heat away from the tissue.

- Transition from liquid to gas requires energy which is taken from the skin.
- Counter irritant.

Energy Transfer - Evaporation

- Evaporation: transfer of heat from the body by conversion of a volatile liquid into a vapor when the liquid is applied to the skin.
- Vapocoolant: low boiling point so exposure to air results in boiling and evaporates taking energy/heat away from the tissue.
  - Transition from liquid to gas requires energy which is taken from the skin.
  - Counter irritant.
Energy Transfer - Evaporation

- Vapocoolant spray generally lower skin surface temp to 59°F which causes little change in subcutaneous temp
- Superficial effects - no changes below epidermis
- Brief

Vapocoolants

- Ethyl chloride – explosive, flammable, highly toxic
- Fluoromethane – nonflammable, chemically stable, nontoxic, nonexplosive

Used to “spray and stretch”
Cold compression systems

- Continuous or manually intermittent flow of cold water
- Pressure/compression
- Cold water molecular activity
- No insulation
Energy Transfer Summary

<table>
<thead>
<tr>
<th>Methods of Energy Transfer with Cold Modalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction</td>
</tr>
<tr>
<td>Cold or ice packs</td>
</tr>
<tr>
<td>Ice massage</td>
</tr>
<tr>
<td>Vapocoolant sprays</td>
</tr>
<tr>
<td>Controlled-cold units</td>
</tr>
<tr>
<td>Cool whirlpool or cold baths</td>
</tr>
</tbody>
</table>

Michlovitz and Nolan, 2005

What factors influence the patient’s response to cold therapy?

- Hint: recall conduction equation
What factors influence the patient’s response to cold therapy?

- Temperature difference between cold stimulus and tissue
- Time of exposure
- Thermal conductivity of area being cooled
  - Bone > Muscle > Fat
  - Fat has lower thermal conductivity so it acts more like an insulator, providing resistance to heat transfer
- Type of cooling agent
- Total body surface area cooled

Cryotherapy Effects

- Hemodynamic
- Metabolic
- Neuromuscular
Cryotherapy Effects - Hemodynamics

- Vasoconstriction of cutaneous blood vessels
  - Decreases blood flow
  - Less leakage and less edema (think back to inflammation!)
- Reflex Vasoconstriction: cold triggers reflex activation of sympathetic adrenergic nerve fibers which leads to release of norepinephrine on the adrenergic receptors of smooth muscles surrounding blood vessels, causing reflex vasoconstriction
  - Results in vasoconstriction in deeper and more distal tissue

Cryotherapy Effects - Hemodynamics

- Edema control
  - Apply early (5-10 min) post-injury
  - Works best with compression
  - Not effective if edema caused by immobility or venous insufficiency
- Increase in blood viscosity
  - Think of honey when cold
  - Less bleeding in cold weather
Cryotherapy Effects - Metabolic

- Decreases metabolic rate
  - Reduces the potential for further cell death from secondary cell hypoxia
  - Acute traumatic injury results in poor oxygen supply and further cell death
  - Minimized by slowing metabolism
  - May help reduce destructive joint disease in arthritic conditions
- Decreases inflammatory process

Cryotherapy Effects - Neuromuscular

- Alters peripheral nerve activity
- Decreases sensory and motor conduction velocity...so what
- Be careful when applying ice over a superficial nerve
  - May cause nerve death
Cryotherapy Effects - Neuromuscular

- **Pain control**
  - Decrease nerve conduction velocity of A-delta and C fibers
  - May act as counter-irritant
  - Decreases edema
    - Less mechanical activation of nociceptors

- **Changes in muscle strength**
  - Short cold applications may increase muscle strength
    - Facilitates alpha motor neuron activity (Clendenin)
  - Example = person with poor dorsiflexion due to paralysis - swipe with ice - increase activity
Cryotherapy Effects - Neuromuscular

- Changes in muscle strength
  - Longer cold applications (i.e. immersion of limb in cold water X 30 min) may decrease muscle strength for up to one hour then increases in muscle strength for 1-3 hours
    - Reduced blood flow
    - Increase in viscous properties of muscle
  - Be careful with athletes who are returning to playing field

Cryotherapy Effects - Neuromuscular

- Decreases spasticity
  - Decreases gamma motor neuron activity
  - Cooling afferent spindles and GTO discharges are decreased which can persist up to 90 min
- Signs of reduced spasticity
  - Decrease amplitude of deep tendon reflexes
  - Decreased frequency and duration of clonus
    - Clonus - characterized by rapidly alternating muscular contraction and relaxation
  - Improved ability to participate in exercise program
  - May be able to stretch more
- Cannot always be accurately predicted
- Brainstorm: What type of patient would this benefit?
Adverse Effects

- Tissue death
- Frostbite
- Nerve damage

Indications

- Acute/subacute traumatic and postsurgical injuries (think back to inflammation)
- Pain
- Muscle spasm
- Spasticity disorders
- Post therapy/exercise
Ice packs applied over soft cast (Schaubel)

- Less splitting of casts (less swelling)
- Less inflammation (lower WBC counts)
- Fewer hematomas
- Lower narcotic levels (less pain)

RICE

- Rest, Ice, Compression, Elevation
- Acute traumatic injuries

MICE

- Motion (controlled), Ice, Compression, Elevation
Cryokinetics

- Cold + Exercise
- Restore motion by decrease muscle spasm, exercise-induced soreness, and pain
- Example
Myofascial Pain Syndrome

- Sxs= localized and referred pain, decreased ROM
- Characterized by myofascial trigger points
- Treatment includes spray and stretch over the trigger point
  - What if you don’t have spray and stretch?
  - What else could be used?

Spasticity Reduction

- Associated with UMN lesion
- Characterized by increased resistance to passive stretch, increased DTR and clonus
- Cold applied over hypertonic muscle for 10-30 min may reduce hypertonus (~ 90 min)
- Allows individual to perform functional activities with greater ease
  - Gait training
Guidelines

- Evaluate patient for cold hypersensitivity
  - Soak wash cloth in cold tap water
  - Wrap around wrist and hold 20 seconds
  - Once removed, skin should be mildly pink (HA release)
  - If blotchy, pink and white, or very white then likely have sensitivity to cold

Guidelines

- Administer treatment 10-30 min
  - Depends on method of application
  - Patient tolerance
  - Condition
  - Tissue type
  - Treatment purpose
- Cold application may mask pain- be careful when stretching or exercising
- May increase joint stiffness
Documentation

- Type of cold agent
- Duration
- Site
- Patient position
- Response: skin, pain, edema, motion

Types

- Commercial cold packs
- Ice massage
- Cold baths
- Vapocoolant spray
- Controlled cold-compression unit (cryocuff)
Commercial Cold Packs

- Stays cold 5-20 min
- Apply over a moist towel
- Be careful with chemically activated cold packs
  - Alkaline pH can burn if pack splits open

Ice Massage

- Water frozen in *paper* cup
- Apply to small area with overlapping strokes
- Use over muscle belly, tendon, bursa, trigger points before friction massage
- Patient will experience 4 stages: CBAN
  - Cold
  - Burning
  - Ache
  - Numbness
Cold Baths

- Immerse limb in water 55-64°F
- The lower the temp, the shorter the duration of immersion
- If immersing big area, more likely to have systemic effects

Vapocoolant sprays

- Ethyl chloride- volatile, flammable
- Fluoromethane- safe, non-flammable
Cryocuff

- Can adjust temp
- Sleeve is inflated intermittently to increase tissue pressure to force edema into lymphatics

Contraindications

- Always ask patient if they have ever had a sensitivity to cold!
- Cold urticaria- cold allergy- massive release of HA- wheals (white spots with red middle), face flushes, low blood pressure, high heart rate, syncope (loss of consciousness)
- Cryoglobulinemia- abnormal blood protein forms precipitate- ischemia/gangrene
  - Seen in RA, leukemia, lupus
  - May be idiopathic
Contraindications

- Raynauds disease - vasospastic disease
- Paroxysmal cold hemoglobinurias - release of hemoglobin in urine - rapid breakdown of blood cells occurs post cold application
  - May see blood in urine after cryotherapy
- Circulatory compromised areas
- Over regenerating nerves
- Circular insufficiency or peripheral vascular disease

Precautions

- Hypertensive patients
- Poor sensation
- Poor cognition
- Very young or very old
- Healing wounds
- Superficial nerves
- Cooling large areas
- Using wet medium
- Long duration
References


Questions?

- Thank you!

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