



Chapter 4 – Physiological Therapeutics

3

Therapeutic Ultrasound



Therapeutic Ultrasound

PHYSIOLOGIC EFFECTS OF ULTRASOUND

1. Increased collagen extensibility
2. Increased metabolism of edema and exudates
3. Increased pain threshold
4. Releases histamine
5. Increased nerve conduction velocities
6. Decreased joint stiffness
7. Decreased muscle spasm

These changes are the result of the chemical, biologic, mechanical, and thermal effects of the soundwaves.

Ultrasound is a deep heating modality. At an intramuscular depth of 3 cm, a 10-minute hot pack treatment yielded an increase of 0.8°C, whereas at this same depth, 1 MHz ultrasound has raised muscle temperature nearly 4°C in 10 minutes. At 1 cm below the fat surface, a 4-minute warm whirlpool (40.6°C) raised the temperature 1.1°C; however, at this same depth, 3 MHz ultrasound raised the temperature 4°C in 4 minutes. Non-thermal effects occur when pulsed ultrasound is applied. Non-thermal effects are useful for decreasing edema and promoting cellular repair.

INDICATIONS FOR USE

1. Soft tissue injuries
2. Chronic connective tissue and joint dysfunction
3. Osteoarthritis
4. Periarthritis (non septic)
5. Bursitis
6. Tensosynovitis
7. Tendonitis, bursitis, capsulitis
8. Myositis ossificans
9. Nerve entrapments
10. Plantar warts
11. Ganglia
12. Chronic sprains / strains
13. Muscle spasm

CONTRAINDICATIONS AND PRECAUTIONS

Contraindications

1. Cancerous lesions
2. Pregnant uterus
3. Over the spinal column / brain
4. Fractures
5. Growing epiphyseal junction
6. Metal implants
7. Eyes, heart, reproductive organs
8. Deep vein thrombosis
9. Tissue under therapy with radiation

Precautions

1. Bony prominences
2. Decreased sensitivity
3. Decreased circulation



SAFETY CONSIDERATIONS FOR THE ULTRASOUND HEAD

The crystal within the ultrasound head will only perform predictably and safely if it is not mishandled by the operator. If the soundhead is dropped, the manufacturer should be called to determine if the crystal has been damaged (possibly changing its output).

It is also essential that the ultrasound intensity NEVER be turned up before the soundhead is against a medium that will conduct the soundwaves. When the intensity is turned up without a transmission couplant, the soundwaves bounce back into the crystal, heating the head and risking the integrity of the crystal.

TECHNIQUES OF APPLICATION

Treatment area

The skin should be clean and dry before applying the coupling gel. The treatment area should be no more than twice the size of sound head.

Transmission media (couplant)

The higher the water conductive medium, the less the ultrasound energy is absorbed by the medium and the more energy is available to produce thermal effect. Less efficient mediums heat up, resulting in surface warmth to patient. In order of efficiency:

1. Water
2. Aqueous gel (conducts 96% of sound)
3. "Hydro" gel, (brand x), 68% of sound conducted
4. Mineral oil
5. Coupling lotion

Treatment time

Treatment time is generally between 5 and 10 minutes. Never treat over 15 minutes regardless of treatment area.

Frequency of treatment

Acute conditions may be treated using low intensity or pulsed ultrasound once or even twice daily for 6 to 8 days until acute symptoms such as pain and swelling subside. In chronic conditions, treatment may be done on alternating days. Ultrasound treatment should continue as long as there is improvement. If no improvement is noted following three or four treatments, ultrasound should be discontinued, or different parameters (i.e., duty cycle, frequency) employed. Typically recommended treatment times have ranged between 5 and 10 minutes in



length. The energy produced with 3 MHz ultrasound is absorbed three times faster than that produced from 1 MHz ultrasound.

Ultrasound treatments are similar to exercise session in that each session builds on the previous one. For most conditions and whenever possible, daily ultrasound treatments will provide the most benefits to the patient.

Penetration of ultrasound

Depth of penetration is dependent on the frequency of the US machine. The higher the frequency, the more superficial the treatment depth will be.

Continuous versus pulsed ultrasound

Continuous

This setting is indicated for subacute, chronic conditions with no active inflammation. Soundwaves are emitted continuously throughout the treatment. Because of the amount of friction created in the tissue, heat is created.

Pulsed

Pulsed ultrasound is beneficial in acute conditions, inflammatory responses, nerve entrapment and neuromas in scar tissue. Soundwave propagation is intermittent, retaining the mechanical effects of mild cavitation and micro massage without any thermal effects.

Methods of Soundwave Transmission

Direct Contact- When using the direct technique, the ultrasound head is put against the skin with only a thin layer of couplant (gel or lotion) in between. Considerations when using this technique are the amount of soft tissue over the bone in that area (“bony” areas may be better suited to indirect treatment, described below) and the size of the soundhead (large soundheads may require the indirect technique when treating a small area.)

Treatment time: 5 – 10 minutes

Mode of heat transfer: Conversion

Penetration: 4 – 6 cm

Application Procedure:

- Step 1: Apply a generous amount of coupling medium to clean dry skin
- Step 2: Move transducer in either a circular or stroking pattern
- Step 3: Turn intensity up to treatment level
- Step 4: Each circle / stroke should overlap the previous by ½
- Step 5: Treatment area limited to 2 times size of transducer
- Step 6: Slow and deliberate (moving the soundhead approximately 4 cm per second)
- Step 7: Transducer must stay in contact and in motion to avoid overheating of the transducer and damage to the crystal



Indirect - When putting the soundhead against the skin is not advisable or possible, the indirect technique may be used. The soundhead is held approximate 0.5 to 1.0 cm away from the skin, and the soundwaves are dispersed into a medium for this short distance, then into the tissue. This is suggested for irregular body parts and bony prominences with little soft tissue coverage, and for treating small areas with a large soundhead. There are two indirect techniques; underwater (immersion) or the balloon (bladder) technique.

Treatment time: 5 – 10 minutes

Mode of heat transfer: Conversion

Penetration: 4 – 6 cm

Intensity: Some clinicians choose to increase the intensity by .5 w/cm² they would use for the direct technique because of the greater dispersal of soundwaves into the medium.

Immersion Application Procedure:

- Step 1: Submerge part fully in tub of water (plastic, ceramic, rubber, or fiberglass)
- Step 2: Submerged ultrasound head and hold approximately 0.5 to 1 cm from the skin surface (intensity should be increased possibly as much as 50% to ensure effectiveness)
- Step 3: Move ultrasound head slowly over treatment area (if air bubbles accumulate on the soundhead or treatment area, they may be wiped away quickly)
- Step 4: Turn intensity up to treatment setting

NOTE: Most ultrasound machines are designed so the transducer can be safely placed underwater without risk of damage to the patient or machine. Check with the manufacturer if the machine capabilities are not known, particularly if the unit is old.

Bladder Application Procedure:

- Step 1: Fill balloon with water
- Step 2: Coat both sides of the balloon with coupling medium
- Step 3: Place balloon over treatment area
- Step 4: Place transducer over balloon
- Step 5: Increase power to desired intensity
- Step 6: Balloon and water will disperse and transmit sound waves to the underlying tissue

PREPARING THE PATIENT

It is important to remember that everyone's tolerance to heat is different, and thus ultrasound intensity should always be adjusted to patient tolerance. The patient should not feel warmth during the treatment. If the patient reports that the transducer feels hot at the skin surface, it is likely that the coupling medium is inadequate.

If the patient reports a deep aching sensation during the treatment, stop immediately. Periosteal burns may feel like a deep ache while the ultrasound is still on, and only later in the day will feel intensely painful.



POST-TREATMENT PROCEDURES

Immediately after treatment, the ultrasound head should be wiped off and returned to its bracket. Next, clean the coupling medium off the patient. The intensity level should be turned back to zero, so the intensity is not on when the machine is turned on for the next treatment. The patient should be questioned about any sensations they felt during or after the treatment and the response written in the patient's file.

COMMENT AND OPINIONS

As with any modality, patient education is key to patient compliance. This is especially important when using ultrasound, as the frequency of treatment plus the lack of sensation during pulsed ultrasound treatment may have patients questioning its benefits. If the patient's mindset is that nothing has been accomplished, this negative attitude toward the treatment works against the clinician's ability to help the patient heal.

References Consulted

Prentice, William E., *Therapeutic Modalities for Allied Health Professionals*, McGraw-Hill. 1998.

Jaskoviak, Paul A., Schafer, R.C., *Applied Physiotherapy*. The American Chiropractic Association. 1993.