Effect of Helium-Neon Laser on Musculoskeletal Trigger Points

Clinical trial, controlled. ?randomised

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Cold lasers have been proposed recently as a therapeutic tool for treating a wide variety of pathological conditions, including wounds, arthritis, orthopedic problems, and pain. These proposed therapeutic effects largely have been unsubstantiated by research. A randomized, double blind study was undertaken to ascertain the effect of a helium-neon (He-Ne) laser on the resistance of areas of skin overlying musculoskeletal trigger points. These areas usually demonstrate decreased skin resistance when compared with the surrounding tissue. Thirty patients with musculoskeletal trigger points were assigned randomly to either an experimental or a placebo group. In addition to standard physical therapy, each patient received three 15-second applications of a He-Ne laser or placebo "stimulation" from an identical unit that did not emit a laser. The results of a two-way analysis of covariance with one repeated measure showed a statistically significant increase ($p < .007$) in skin resistance. This increase in an abnormal skin resistance pattern may accompany the resolution of pathological conditions.

Key Words: *Electric stimulation, Lasers, Muscles, Pain, Physical therapy.*

The helium-neon (He-Ne) laser is a visible, monochromatic, red laser with a wavelength of 632.8 nm. This cold laser penetrates tissue without diverging to 0.8 mm and with some divergence to 10 to 15 mm.[1] It is, therefore, a superficial physical agent (more than 50% of the energy is absorbed by tissue located less than 1 cm below the skin surface). At therapeutic dosages for 15 to 20 seconds with a maximum intensity of 0.95 mW, the energy produced is about 14 to 29 mJ, which is substantially below the level that will produce tissue heating.[1]

Since 1970, He-Ne lasers have been marketed and sold to health care practitioners, and many claims have been made by the manufacturers concerning the healing capabilities of these lasers. One of these claims is that cold laser therapy (CLT) is useful in eliminating areas of increased muscle spasm termed trigger points. A trigger point is defined as a point that elicits referred pain on deep palpation and demonstrates a lowered skin resistance in comparison with that of the surrounding tissue.[2-4] The skin resistance method of determining sites of pathological conditions has been used in varying degrees since the mid-1930s.[5,6]

Areas of low skin resistance representing sympathetic hyperactivity have been found to correlate well with areas of pain described by the patient.[2-6] Furthermore, in at least one study in which skin resistance tests were used to localize the spinal level of a lesion and were repeated after surgical correction, the abnormally low skin resistance patterns were resolved.[5] The eastern European literature concerning CLT cited elsewhere[7-9] consists largely of uncontrolled, unsubstantiated, and equivocal findings similar to those made by the cold laser manufacturers.

In investigating the effects of He-Ne lasers, it is necessary to consider the nonthermal, metabolic consequences of low-power laser irradiation because this type of laser does not heat tissue.[1] Fork found that extremely short exposure to an argon laser (too brief to cause an increase in temperature) caused a change in the firing pattern of isolated abdominal ganglion cells in *Aplysia californica* (a marine mollusk).[10] Vizi et al observed an increase in the amount of acetylcholine released from Auerbach's plexus in the intestine of the guinea pig after a nonthermal dose of a ruby laser.[11] Walker suggested that this type of laser may affect serotonin metabolism, because a large increase in urinary excretion of 5-hydroxyindoleacetic acid was noted in patients who received laser treatment in a double blind study of pain relief using the He-Ne laser.[12] All of the above changes are attributable to nonthermal mechanisms because similar results were not produced by heating.

In two separate double blind studies of the effect of low-power laser irradiation (one, He-Ne and one, a slightly more powerful and deeper penetrating neodymium) on pain, 19 of 26 and 27 of 30 patients, respectively, experienced some measure of pain relief after treatment.[8,12]

The purpose of this study was to ascertain the effect of He-Ne laser irradiation on an objective measure, the abnormal skin resistance pattern that overlies musculoskeletal trigger

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Fig. 1. Laser probe and opaque shield.

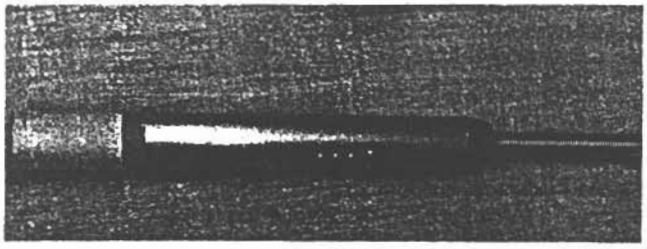

Fig. 2. Laser probe with tip obscured by the opaque shield.

points. A return to normal skin resistance may indicate the resolution of the pathological condition.[5] We hypothesized that CLT would not result in any statistically significant change in skin resistance.

METHOD

Instrumentation

The CLT instrument used in this study was the Dynatron 1120.* This instrument is classified by the US Food and Drug Administration's Bureau of Radiologic Health as a Class II laser product and a Class III medical device.[1,13] Class II laser products are limited to visible lasers that are safe for momentary viewing, but should not be stared into continuously unless the exposure is within recommended ocular exposure limits.[1] Class III medical devices include new or modified devices not substantially equivalent to any marketed before May 28, 1976.[13] Application of this laser over the eyes is potentially hazardous. The heads of the patients were not treated in our study, so this hazard was not a consideration. A placebo laser identical to the Dynatron 1120 (except that it did not emit a laser) also was used. Although Kleinkort and Foley reported dizziness and nausea in 2% of the patients they treated with the He-Ne laser, none of the patients in our study reported any side effects.[7]

The skin resistance measurements were taken using the dermometer of the Dynatron 1120. The same dermometer was used in all treatment sessions regardless of which machine was used for irradiation, and a standard protocol with specifically delineated methods was used. This dermometer measures the direct current resistance and reports it inversely in arbitrary units of 0 to 100. The lower numbers reported in our data correspond to increased skin resistance.

Subjects

All patients of the Comprehensive Pain Management Services and of the Philadelphia Institute for Physical Therapy who were being treated for musculoskeletal conditions an who exhibited trigger points in either the upper back, lowe back, or neck were asked to participate in the study. All o the patients who participated in the study were referred b their physicians and signed consent forms. The protocol wa approved by the Human Subjects Committee and Institu tional Review Board of Temple University. Thirty patient who agreed to participate were assigned randomly to th experimental group or to the placebo group. They ranged i age from 18 to 58 years; data were not kept regarding sex Three patients did not complete the study and their data hav been omitted.

Procedure

All patients subsequently received either CLT or a placeb treatment. Data were collected for three consecutive treat ments, and each session was separated by an interval of a least one and not more than three days.[7] Although the dura tion of treatment reported in the literature[7,12] and by W. Wu PhD, varies greatly from seconds to 30 minutes of continuou application, the methods reported by Kleinkort and Foley, Walker,[12] and Greathouse et al,[14] corresponding to 15 to 2 seconds of irradiation per square centimeter of tissue irradi ated, were used. The laser was set to deliver continuous energ at 0.95 mW (maximal intensity) for each 1-cm^2 trigger poin (14.25 mJ). The distance from the optical fiber tip to the ski surface was standardized at 0.5 mm using an opaque shiel that touched the skin surface but did not interfere with lase transmission (Fig. 1). Recommended distances range from (to 1 mm.[1,7]

All patients were told that the following steps would b performed during each experimental treatment: examinatio with a painless probe to find an area of decreased ski resistance, circling of the area at the time of the first treatmen with nontoxic indelible ink that would wear off within a week administration of 15 seconds of imperceptible CLT to th area, re-examination to check the posttreatment skin resist ance, and standardized physical therapy consisting of 2 minutes of conventional transcutaneous electrical nerv stimulation[15] and hot packs to complete the procedure.

Neither the physical therapists administering the treatmen nor the subjects were informed which unit was the placebo The optical fiber tip was covered by an opaque shield t prevent both the subject and the therapists from knowin whether the laser or the placebo was being used (Fig. 2).

No data were gathered to assess the effects of age or se differences. Additionally, no data were gathered concernin the effect of CLT on pain.

Data Analysis

Pretreatment and posttreatment skin resistance measure ments for each individual were recorded during each of th three treatment sessions. A two-way analysis of covarianc (ANCOVA) with one repeated measure and a covariate tha changed over trials was used. The independent variables wer treatment group (placebo or CLT) and trial (a repeated meas ure). Pretreatment skin resistance was used as a covariate The P2V subprogram of the BMDP (Biomedical Statistica Package) was used in all analyses. An alpha level of .01 wa used to determine statistical significance.

* Dynatronics, 270 W Crossroads Square, Salt Lake City, UT 84115.

RESULTS

Although the subjects were assigned randomly to the CLT and placebo groups, a difference appeared in their initial pretreatment skin resistance. The mean pretreatment skin resistance was 57.92 for the CLT group and 32.64 for the placebo group. The standard deviations were 8.76 for the CLT group and 12.51 for the placebo group. A t test for independent samples indicated a statistically significant difference at the outset ($t = 5.554$, $df = 22$, $p < .001$). Thus, posttreatment skin resistance was adjusted based on the initial differences using pretreatment skin resistance as a covariate.

The two-way ANCOVA with one repeated measure and one covariate is summarized in Table 1. As seen in Table 1, pretreatment skin resistance accounts for an appreciable amount of the variance in the dependent measure. Even after the effects of differences in pretreatment skin resistance are taken into account, however, there is a statistically significant difference in the posttreatment skin resistances of the CLT and placebo groups ($p < .007$).

The difference in resistance among subjects over trials was not statistically significant. For the period of treatment studied, we found little change in posttreatment skin resistance between treatments (Tab. 2).

TABLE 1
Effects of Group and Trial on Skin Resistance

Source of Variance	df	SS	MS	F	p
Group	1	806.39	806.39	8.69	.007
Pretreatment skin resistance (covariate)	1	3175.74	3175.74	34.22	.0001
Error	21	92.80			
Trial	2	118.89	59.44	1.35	NS
Trial and group	2	12.96	6.48	0.15	NS
Pretreatment skin resistance (covariate)	1	306.32	306.32	5.97	.01
Error	43	1889.76	43.94		

TABLE 2
Adjusted Group Means For Posttreatment Skin Resistance*

Treatment	Group	
	Laser (n = 13)	Placebo (n = 11)
1	30.94	42.23
2	34.66	44.51
3	34.29	43.55

* Standard deviations are unavailable for adjusted group means from the P2V subprogram of the BMDP.

DISCUSSION

The hypothesis that the He-Ne laser would have no effect on abnormal skin resistance patterns overlying musculoskeletal trigger points was not supported by the data. As stated previously, an increase in skin resistance has been shown to accompany the resolution of the pathological condition. The implication of this finding is that the He-Ne laser has some positive, therapeutic effect on the underlying musculoskeletal trigger points. This finding is important in that a short course of CLT now may be hypothesized to aid in the resolution of this type of musculoskeletal pathological condition.

This study indicates that application of the He-Ne cold laser resulted in an increase in the resistance of skin overlying musculoskeletal trigger points. One report has demonstrated that an increase in skin resistance accompanied the resolution of the underlying pathological condition.[5] The effect of CLT on the underlying pathological condition was not investigated in this study.

A short duration of laser stimulation was shown to produce notable results after only one treatment session. This type of treatment could be provided easily as an adjunct to standard physical therapy procedures for musculoskeletal trigger points without adding greatly to the time a therapist must spend with the patient.

Although a slight carry-over appeared from treatment to treatment in the experimental group, the increase in skin resistance over trials was not statistically significant (Tab. 1). That the resolution of persistent muscle spasm and trigger points often occurs after a short-duration application of cold[16] or a single injection of a local anesthetic is well-documented.[17] We maintain that a short-term alteration in the sympathetic activity as manifested by the change in skin resistance may produce a similar result. A minimum of three treatments has been suggested for assessing the efficacy of laser treatment, and a 10-session course has been recommended for those patients who seem to benefit from treatment.[7] The slight carry-over effect noted above possibly would have been augmented to the point of statistical significance had a 10-session paradigm been used. Further investigations of CLT on skin resistance with groups presenting more homogeneous initial skin resistances are needed.

Studies must be undertaken to address the question of whether pain relief results from use of CLT, whether the underlying pathological condition is affected by CLT, and what is the mechanism by which this occurs. We also can suggest studies to determine whether an incremental skin resistance change is attributable to a single 15-second dose of He-Ne laser irradiation and to describe a dose-response curve.

CONCLUSION

Measurement of skin resistance over musculoskeletal trigger points before and after three successive treatments of He-Ne laser irradiation displayed a significant increase in skin resistance after treatment. This restoration of skin resistance patterns to the level of the surrounding tissue may indicate the resolution of the pathological condition.

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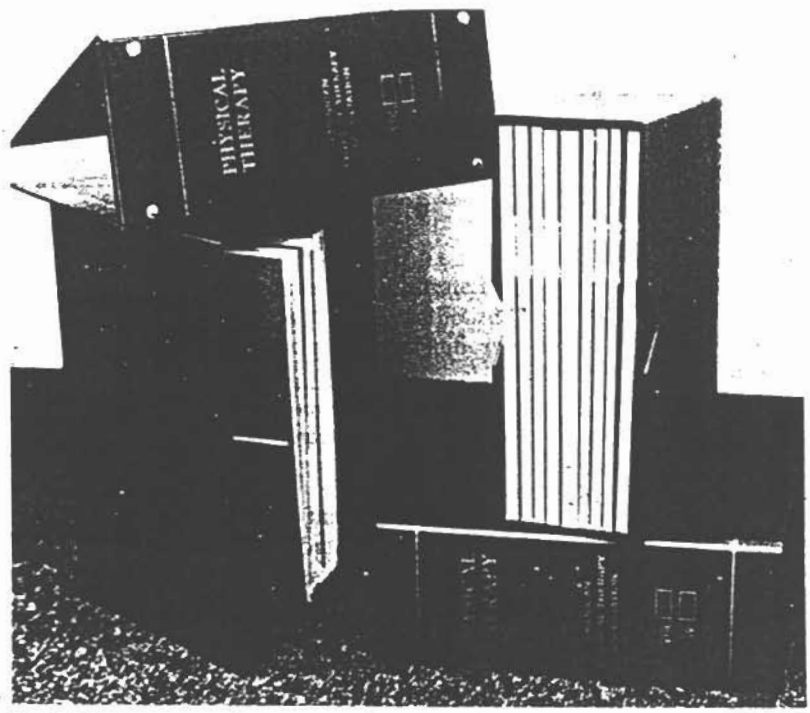

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