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Effect of Light Therapy Among Peripheral Neuropathy Patients

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Abstract

Peripheral Neuropathy (PN) is one of the most common disorders seen in general neurology. PN is characterized by a reduction/alteration in sensation, muscle weakness and chronic fatigue. Among PN with a definable cause, type 2 diabetes mellitus is the most common cause worldwide. Decreased foot sensitivity and pain due to diabetic PN (DPN) is one of the factors affecting walking ability and reduced quality of life. Infrared light therapy, a non-invasive FDA approved treatment, has shown to relieve pain. **Purpose:** The specific aim of this study was to determine the effect of a 5-week light therapy on feet sensitivity among patients with DPN. **Methods:** Nine individuals (age: 74 ± 8.68 years; five men and four women) with a physician's diagnosis of DPN were recruited from the Tyler metropolitan area. The infrared light therapy treatment was applied to the feet and legs of study participants, offered 3 times per week for 30 minutes per day, over 5 weeks. The light therapy intervention was performed using the Anodyne Therapy System (ATS) Model 480 (Anodyne Therapeutics LLC, Tampa, Florida). Plantar cutaneous pressure sensitivity was assessed using the 5.07 gauge Semmes-Weinstein monofilament (North Coast Medical, Inc.). The monofilament was applied to 5 sites on the plantar surface (i.e., the great and third toes, the first, third and fifth metatarsal). All testing was performed by the same technician. **Results:** The patients reported a significant increased sensation on the peripheral sensory tests. Indeed, the average number of sites with increased sensation increased following the 5 weeks of light therapy treatment. **Conclusions:** These findings demonstrate that infrared light therapy was capable of improving sensation in the feet of subjects with DPN.

Introduction

Peripheral Neuropathy (PN) is one of the most common disorders seen in general neurology, and foot numbness and pain is a frequent cause for referral for neurologic consultation (Gordon Smith & Robinson Singleton, 2006). Among PN with a definable cause, type 2 diabetes mellitus is the most common cause worldwide (Hughes, 2002). Foot pain due to diabetic PN (DPN) is one of the factors affecting walking ability. As a result, a large number of individuals with DPN suffer from a reduction in daily physical activity and reduced quality of life. PN tends to present itself in the most distal region of the extremities, such as the hands and feet. Most patients report a sense of numbness, tingling, or any other abnormal sensation in these areas. This loss of sensation can cause balance issues, which results in an increased risk for falls during daily activities. The incidence of falls within this population is more prevalent than the fall rate within the elderly population at large. Currently, there is no cure for peripheral nerve pain, only relief from the symptoms. Although thought to be irreversible, recent studies show a reversal in the symptoms of DPN using the Anodyne Therapy System (ATS). Interestingly, infrared light therapy, a non-invasive treatment and FDA cleared, has shown to reduce pain and increase local circulation (Leonard, Farooqi, & Myers, 2004; Prendergast, Miranda, & Sanchez, 2004).

Studies show that an estimated 15% of people over the age of 40 will show symptoms of PN at some point in their life, and of this population, 29% of the cases are due to type 2 diabetes mellitus. PN is a significant side effect of diabetes that has been shown to increase the risk of injury while decreasing the quality of life in diabetics.

Thus, the specific aim of this study was to determine the effect of a 5-week light therapy on feet sensitivity among patients with DPN. In addition, this study hopes to demonstrate that this therapy would help to improve the patient's quality of life.

Methods

Participants

Nine patients (age: 74 ± 8.68 years; five men and four women) with a physician's diagnosis of DPN were recruited from the Tyler metropolitan area. All participants signed informed consents prior to testing.

Program

The infrared light therapy treatment was applied to the feet and legs of study participants, offered 3 times per week for 30 minutes per day, over 5 weeks. The light therapy intervention was performed using the Anodyne Therapy System (ATS) Model 480 (Anodyne Therapeutics LLC, Tampa, Florida). Each ATS unit has eight flexible therapy pads (4 per limb). The flexible therapy pads will be placed in contact with each patient's skin during the treatment period as shown in Figure 1. Specifically, one therapy pad will be placed on the dorsal and one on the plantar aspect of the foot as well as one on the lateral and one on the medial aspect of both lower extremities, immediately above the ankle in each patient.

Assessments

Plantar cutaneous pressure sensitivity was assessed using the 5.07 gauge Semmes-Weinstein monofilament (North Coast Medical, Inc.). The monofilament exerts 10-g of force at the tip upon buckling and has been used in both clinical and research settings. The monofilament was applied to 5 sites on the plantar surface (i.e., the great and third toes, the first, third and fifth metatarsal) as shown in Figure 2. The participant indicated when he or she felt the fiber. All testing was performed by the same technician. Data was recorded as a "0" for no sensation, or a "1" if the monofilament was sensed.

Figure 1: Monochromatic Infrared Energy Unit

Figure 2: Monofilament Testing Sites

Monofilament Testing Technique

Using the sites indicated on Figure 2 the monofilament was applied perpendicular to the skin's surface. The monofilament wasn't applied on an ulcer site, callus, scar or necrotic tissue. The monofilament was applied using a smooth, not jabbing motion and enough force to cause the monofilament to bend or buckle into a C shape (Figure 3). The monofilament didn't slide across the skin or made repetitive contact with the skin. The total duration of the approach, skin contact and departure of the monofilament lasts approximately 1.5 seconds. Each site was tested three times. Patients were asked, "Do you feel the monofilament touch you - yes or no?" Data was recorded as a "0" for no sensation, or a "1" if the monofilament was sensed. The testing performed by an experienced technician.

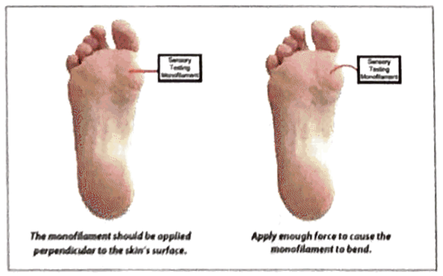

Figure 3: Monofilament Testing Technique

Results and Interpretation

Participant Characteristics

Variable	Baseline (mean ± SD)
Age (yr)	73.89 ± 8.68
Height (cm)	174.60 ± 11.82
Weight (kg)	95.88 ± 24.71
BMI ($kg \cdot m^{-2}$)	31.34 ± 6.97

All the patients completed the 5-week infrared light therapy protocol (i.e., 15 sessions in total). No adverse reactions to the treatment were reported. Forty four percent of the participants were women, and 56% men. The oldest participant was 82 years old, and the youngest was 56 years old. Forty four percent of the patients had a BMI greater than $30 kg \cdot m^{-2}$. Normally, patients who cannot reliably detect application of the 10-g monofilament to designated sites are considered to have lost protective sensation. Our findings indicated that our patients had an increased sensitivity on the peripheral sensory test following treatment. Indeed, the sites that yielded the greatest improvement in sensitivity were the great and third toes (~64% of participants reported increased sensitivity).

Interpretation

The ATS is a medical device consisting of a base power unit and therapy pads containing 60 near-infrared (890 nm) gallium aluminum arsinide diodes used to increase circulation by dilating arteries and veins. Indeed, the mechanism of action underlying pain relief associated with infrared therapy may be due, in part, to a combination of topical heat and an increased local release of nitric oxide (i.e., a potent vasodilator, Figure 4). Thus, improving blood flow in the feet of diabetic patients with peripheral neuropathy could help restore sensation and promote pain relief.

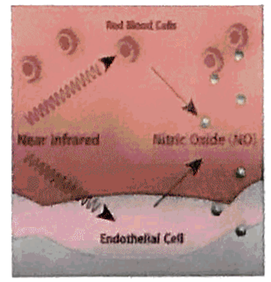

Figure 4: Nitric Oxide

Conclusions and Significance

These findings demonstrate that infrared light therapy promoted substantially improved foot sensation among patients with DPN. Clearly, the use of infrared light therapy in DPN patients can be likely to improve their functional ability and quality of life and simultaneously offer significant cost savings to the U.S. and international healthcare systems.

Significance

This findings are quiet relevant if we take in consideration that The Neuropathy Association estimates that there are now 15-18 million Americans with DPN due to the increasing prevalence of diabetes (The Neuropathy Association, 2013). The growing DPN statistic significantly raises the overall number of people with T2DM neuropathy in the U.S. Recent projections estimate by 2050, as many as one in every three American will have T2DM (Boyle, Thompson, Gregg, Barker, & Williamson, 2010). In Texas, there are a reported 10.6% adults with diabetes with no differences in race/ethnicity or sex. This is cause for concern, as Texas is higher than the national average with the incidence of diabetes.