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PHYSIOTHERAPY MANAGEMENT OF PAINFUL DIABETIC PERIPHERAL NEUROPATHY: A CRITICAL REVIEW OF TREATMENT METHODS FOR CLINICAL DECISION MAKING IN PRACTICE AND RESEARCH

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ABSTRACT

Objective: Diabetes is a global epidemic and one of the most leading complications of diabetes is peripheral neuropathy. Recent research and clinical practice focus is on symptomatic or painful diabetic peripheral neuropathy (PDPN). The objective of this paper was to review the physiotherapy management methods for symptomatic management in PDPN patients.

Methods: The therapeutic modalities reported in MEDLINE, EMBASE, SCOPUS, Ovid, CINAHL and Google Scholar were searched independently and 29 suitable trials were identified and reviewed. The selected studies were grouped under each treatment method and were described under exercise therapy, electrotherapy, actinotherapy and manual therapy in the review.

Results: The physiotherapy management of PDPN patients includes transcutaneous electrical nerve stimulation, pulsed electromagnetic energy, frequency-modulated electromagnetic neural stimulation, electrical stimulation, photon stimulation, monochromatic near-infrared (anodyne) light therapy, static magnetic fields, and acupuncture. One study studied combined efficacy of electrotherapy with pharmacotherapy in PDPN patients.

Conclusion: The review findings would facilitate clinicians, researchers and stakeholders to understand the established physiotherapy treatment options for symptomatic management of patients with painful diabetic peripheral neuropathy, and also rehabilitation clinicians and therapists to develop better treatment methods in the future.

Key words: physiotherapy, diabetic neuropathy, neuropathic pain, rehabilitation.

INTRODUCTION

Diabetic peripheral neuropathy (DPN) is a common complication estimated to

affect 30% to 50% of individuals with diabetes. Chronic sensorimotor distal symmetric polyneuropathy is the most common form of DPN. The prevalence of neuropathy in type 2 diabetes ranges

from 27% to 63% and from 14% to 70% in diabetes mellitus in general.⁴

The first description of “diabetic neuropathy as a presence of pain and paresthesiae in lower limbs” was done by Rollo in 1798.⁷ The consensus of opinion at the San Antonio conference on diabetic neuropathy was that diabetic neuropathy was “a descriptive term meaning a demonstrable disorder, either clinically evident or subclinical that occurs in a setting of diabetes mellitus without other causes of neuropathy. The neuropathic disorder includes manifestations in both somatic and/or autonomic parts of the nervous system.”

Diabetic peripheral neuropathic pain (DPNP) affects approximately 11% of patients with diabetic peripheral neuropathy (DPN). The most common type of neuropathy in DM is DPN, with up to 50% of patients experiencing some degree of painful symptoms and 10% to 20% having symptoms severe enough to warrant treatment.

World Confederation for Physical Therapy (WCPT) defines Physical Therapy as;

“... providing services to people and populations to develop, maintain and restore maximum movement and functional ability throughout the life-span. Physiotherapy includes the provision of services in circumstances where movement and function are threatened by the process of ageing or that of injury or disease. Full and functional movement are at the heart of what it means to be healthy ...Physiotherapy is concerned with identifying and maximising movement

potential, within the spheres of promotion, prevention, treatment and rehabilitation. Physiotherapy involves the interaction between physiotherapist, patients or clients, families and care givers, in a process of assessing movement potential and in establishing agreed upon goals and objectives using knowledge and skills unique to physiotherapists.” (Kumar, 2010).⁹

Physiotherapy for neuropathic pain in symptomatic patients with painful diabetic peripheral neuropathy (PDPN) include: modalities for pain relief like electrotherapy, actinotherapy, exercise therapy and manual therapy (Kumar and Jim, 2010).¹⁰ While electrotherapy includes electrical and thermal modalities, actinotherapy includes radiation modalities.¹¹

The aim of this systematic review was to identify and summarize the existing evidence on physiotherapy management in patients with PDPN through published studies to establish an evidence-informed clinical decision-making for clinical practice and research.

MATERIALS AND METHODS

Independent search was carried out by testers using a well-defined search strategy as follows; we searched the MEDLINE, EMBASE, SCOPUS, Ovid, CINAHL and Google Scholar databases using the key terms- pain AND diabetic AND neuropathy; management OR treatment OR physiotherapy OR rehabilitation; IN title OR abstract. A total of 242 studies were potentially identified by the authors. Studies published in English language on

effectiveness, efficacy, effects of physiotherapy treatment methods was included in our review; and studies on pharmacotherapy (118 studies); comparison of drugs (36 studies) or combined drug therapy (28 studies) with other treatments (32 studies) were excluded. A total of 29 studies were finally identified that were published from 1954 to 2010 and then considered for review. To avoid search bias, the testers performed independent searches and then disagreements were solved by consensus at various stages of the study.

Main findings of the review

The 29 included studies were grouped under nine treatment methods studied for their effectiveness in PDPN patient population which are descriptively reported below using a qualitative approach;

Electrotherapy

Pieber et al¹² in their MEDLINE search, reviewed 15 studies where the beneficial effects of prolonged use of transcutaneous electrical nerve stimulation was consistently shown in four studies. The effects of other modalities studied were insufficient enough to draw conclusions and/or recommendations.

Transcutaneous Electrical Nerve Stimulation- TENS:

One systematic review by Dubinsky and Miyasaki¹³ and one meta-analysis by Jin et al¹⁴ both concluded TENS therapy might be an effective and safe strategy in treatment of symptomatic DPN.

Two controlled clinical trials by Forst et al¹⁵ and Kumar and Marshall¹⁶ suggested TENS as a novel treatment modality for reducing pain and discomfort in patients with PDPN.

One quasi-experimental study by Moharic and Burger¹⁷ inferred that TENS did not alter C, A-delta nor A-beta fibre-mediated perception thresholds.

One case report by Somers and Somers¹⁸ presented a PDPN patient who was treated successfully by application of TENS to the low back region.

High frequency external muscle stimulation

Reichstein et al¹⁹ performed a pilot randomized controlled trial to compare the effects of high-frequency external muscle stimulation (HFEMS) with those of TENS in patients with symptomatic PDPN and found that HFEMS was more effective than TENS in relieving the symptoms of non-painful neuropathy and painful neuropathy.

Pulsed electrical stimulation

Oyibo et al²⁰ assessed the efficacy of pulsed-dose electrical stimulation (through stocking electrodes) in the treatment of 30 patients with painful diabetic neuropathy versus the control group and the authors found no evidence from their results that this treatment is more effective than control in the treatment of painful diabetic neuropathy.

Weight-bearing (walking) exercise intervention

LeMaster et al²¹ studied 79 patients with DM + PN who were randomly assigned to receive intervention components included leg strengthening and balance exercises; a graduated, self-monitored walking program (part 1); and motivational telephone calls every 2 weeks (part 2). Both groups received diabetic foot care education, regular foot care, and 8 sessions with a physical therapist. The authors found that promoting weight-bearing activity did not lead to significant increases in foot ulcers and they suggested that weight-bearing activity could be considered following adequate assessment and counseling of patients with DM + PN.

Vibrating insoles

Hijmans et al²² investigated the effects on standing balance of random vibrations applied to the plantar side of the feet by vibrating insoles in subjects with neuropathy and nondisabled subjects. In subjects with neuropathy, an interaction effect was found between vibration and an ADT for balance. No effects of vibration on balance were found in nondisabled subjects. The authors also found that vibrating insoles improved standing balance in subjects with neuropathy only when attention was distracted.

Plantar orthoses

Mohamed et al²³ determined the effect of Plastazote® and Aliplast®/Plastazote® orthoses in decreasing plantar pressures. One group wore custom Plastazote orthoses, the other, custom Aliplast/Plastazote

orthoses, for 3 months. The authors found that wearing custom-made orthoses reduced plantar pressures by increasing contact area. Plastazote alone and Aliplast/Plastazote were equally effective in decreasing pressures at time of fabrication, at 1 month after 9 of 16 pairs of orthoses were adjusted for wear, and after orthoses wear for an additional 2 months.

Frequency-modulated electromagnetic neural stimulation

Bosi et al²⁴ evaluated the efficacy of frequency-modulated electromagnetic neural stimulation (FREMS) on 31 patients with painful neuropathy in a randomised, double-blind, crossover study designed to compare the effects of FREMS with those of placebo. Furthermore, FREMS induced a significant increase in sensory tactile perception, as assessed by monofilament; a decrease in foot vibration perception threshold, as measured by a biothesiometer; and an increase in motor nerve conduction velocity. No significant changes were observed after placebo.

Photon stimulation

Swislocki et al²⁵ evaluated the effects of photon stimulation on pain intensity, pain relief, pain qualities, sensation and quality of life (QOL) in patients with painful diabetic peripheral neuropathy in their randomized, placebo-controlled trial. The authors did not find any differences in favor of the photon stimulation group in immediate post-treatment but significant decreases,

over time, were found in some pain quality scores, and significant improvements in sensation were found in patients who received the photon stimulation compared with placebo.

Monochromatic near Infrared (Anodyne) light therapy

Three controlled clinical trials by Leonard et al²⁶, Lavery et al²⁷ and Clift et al²⁸ determined the effect of monochromatic infrared energy (MIRE) in subjects with diabetic peripheral neuropathy and all the authors found that MIRE therapy was useful in subjects with diabetic peripheral neuropathy.

Li et al²⁹ performed a systematic review in MedLine, CINAHL, Cochrane Databases, and Physical Therapy on the efficacy of the anodyne therapy system (ATS) for treating patients with diabetic peripheral neuropathy. The results indicated efficacy for improving lower extremity sensation, balance, gait and decreasing fall risk, particularly if subjects have a relatively recent diabetic peripheral neuropathy onset (short duration).

DeLellis et al³⁰ examined the medical records of 1,047 patients with established peripheral neuropathy and showed that MIRE therapy was associated with significant clinical improvement in foot sensation in patients, with diabetic peripheral neuropathy.

Two quasi-experimental studies by Kochman et al³¹ and Kochman³² examined the effectiveness of MIRE therapy and they prove it to be effective.

Static magnetic field therapy

Weintraub et al³³ did a large multicenter trial of 375 PDPN patients in a randomized, placebo-controlled parallel-group study where the patients were given either multipolar static magnetic (450G) shoe insoles or unmagnetized placebo insoles for 4 months. The authors reported statistically significant changes in pain scores, and improvements were also noted in nerve conduction studies and quantitative sensory testing measures. Best analgesic benefits were observed at 3rd and 4th month duration in the active group compared to the placebo.

Percutaneous electrical nerve stimulation (PENS)

Hamz et al³⁴ evaluated 50 patients with PDPN who were randomly assigned to receive active PENS (needles with electrical stimulation at an alternating frequency of 15 and 30 Hz) and sham (needles only) treatments for 3 weeks. The authors concluded that PENS was a useful non-pharmacological therapeutic modality for treating diabetic neuropathic pain.

Low-Level Laser Therapy

Zinman et al³⁵ conducted a randomized double-blind sham-controlled clinical trial of low intensity laser therapy (LLLT) in 50 patients. After a 4-weeks intervention, the LLLT group had statistically insignificant changes in self-reported pain and had no effects on Toronto clinical neuropathy score, nerve conduction studies, sympathetic skin response or quantitative sensory testing.

Massage therapy

Finch et al³⁶ reported immediate effects of 80 min of single-session of massage therapy to lower limbs on plantar foot pressure variability, and foot contact time in their one patient with PDPN. The treatment involved myofascial techniques, passive stretching, trigger point treatment and mobilization of the joints of the lower limb distal to the knee. Additionally, preparatory hydrotherapy was also applied. The massage therapy intervention utilized by the authors increased the variability of pressure below the hallux of a participant with diabetic neuropathy, and also affected gait positively in terms of velocity and fluidity.

Acupuncture

Though acupuncture is a part of Chinese Medicine, two trials, one by Abuaisha et al³⁷ and other by Ahn et al³⁸ both found therapy to be effective.

Pulsed electromagnetic field therapy

Graak et al³⁹ carried out a study to evaluate the effects of low-power, low-frequency pulsed electromagnetic field (PEMF) of two doses- 600 and 800 Hz on 30 subjects for 30 min for 12 consecutive days versus a control group of standard medical care and they found significant improvements in pain and motor nerve conduction parameters and the authors concluded that PEMF could be used as an adjunct in reducing neuropathic pain as well as retarding the progression of neuropathy in a short span of time.

Combined electrotherapy and drug therapy

Kumar et al⁴⁰ evaluated the efficacy of combining TENS with amitriptyline in their PDPN patients and they found it to be effective than individual treatment with the drug.

DISCUSSION

This review was a clinically and scientifically applicable of its kind for use both by clinicians and researchers involved with patients of painful diabetic peripheral neuropathy. Some of the potential limitations of this review were the lack of meta-analysis and quality scoring of the included studies. We included studies of all designs leading to heterogeneity not only in interventions, outcome assessment and follow-up, but also in analysis and effect size. We also reviewed only studies in English and this might have missed some other important studies. Though a large volume of literature on management of PDPN patients is on pharmacotherapy⁴¹, future research could be on developing a comprehensive management involving other treatment methods as effective adjuncts like neurodynamic mobilization⁴² in patients with painful diabetic peripheral neuropathy. The magnitude of tissue changes in chronic painful diabetic peripheral neuropathy shifts to mechanical from neurophysiological.⁴³ Mechanical changes were earlier observed in neural tissues and neurodynamic interventions like nerve sliders and nerve massage were extensively studied for peripheral neuropathic pain symptoms.⁴⁴ The

effectiveness of physical and manual (neurodynamic) treatment methods could also be evaluated using standardized multifaceted clinical assessment scales⁴⁵ to study the wholistic impact on pain, activity limitation, clinical examination findings and psychosocial issues. Further good quality controlled clinical trials on comparison between the physiotherapy modalities and also with standard care of glycemic control and lifestyle modification are necessary to derive valid conclusions.

CONCLUSION

Physiotherapy treatment methods of electrotherapy for symptomatic relief were studied widely and Monochromatic near infra-red energy and transcutaneous electrical nerve stimulation was shown to be effective in high quality studies. Further research on other treatment methods such as manual therapy and exercise therapy are indicated.

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Figure-1: Schematic diagram showing physiotherapy treatment methods studied in patients with painful diabetic peripheral neuropathy

