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Research Article

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Efficacy of Foot Bath Vs. Contrast Bath in subjects with Diabetic foot

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Abstract

Objective

To compare the effects of foot bath and contrast bath in subjects with diabetic foot.

Background of the study

Diabetic foot is a common chronic complication of diabetic peripheral neuropathy. Feet are the main target of sensitive and motor complications due to pathophysiology of neuropathy. The study focuses on the effectiveness of foot bath and contrast bath in subjects with diabetic foot for improvement of sensory and motor stimulation.

Methodology

30 subjects were selected based on selection criteria with the age group of 50 to 60 years who are diagnosed and undergoing medication for past 10 to 15 years of type II Diabetes. Subjects having diabetic ulcer, cardiac problems, neurological problems, undiagnosed and not medicated, were excluded. Patient consent was obtained by explaining the project procedure. Group A receives foot bath (41˚C) with bed nail board for a period of 4 weeks (5days/week) for 15 minutes. Group B receives contrast bath (hot water for 6minutes at 44˚C and cold water for 4minutes at -2˚C) with passive stretching for a period of 4 weeks (5days/week) for 15 minutes. Outcome measures are MNSI and MTCNS.

Result

Result of the study shows that both foot bath with bed nail board and contrast bath with passive stretching is effective in increasing sensation of foot. However contrast bath, passive stretching is more effective than foot bath with bed nail board in improving the sensation of foot.

Keywords: Foot bath, contrast bath, diabetic foot, Michigan neuropathy screening instrument, Modified Toronto clinical neuropathy scoring.

Introduction

Diabetes mellitus is a common chronic metabolic disease. The long term complications of this disease involve the eye, kidney, nerve and blood vessels. Diabetes mellitus leads to vascular endothelial damage. Therefore, blood flow decreases in these patients as compared to healthy individuals. The impairment of the autonomic nervous system because of damage to the neurons, synapses, sensory receptors and blood vessels is another complication of diabetes mellitus. The nutrition of body tissues is provided by blood flow, and so the damage of blood vessels has a serious impact on different organs [1].

Diabetes mellitus is a complex, chronic illness requiring continuous medical care with multi factorial risk reduction strategies beyond glycaemic control. .Diabetes mellitus is a chronic multisystem disease related to abnormal insulin production, impaired insulin utilization or both. The prevalence of diabetes for all age groups worldwide was estimated to be 2.8% in 2000 and may reach 4.4% in 2030. Majority of the people with diabetes around 382 million are aged between 40 and 59, 80% of them live in low- and middle-income countries[2].

Diabetic neuropathy (DN) is a common disorder and is defined as signs and symptoms of peripheral nerve dysfunction in a patient with diabetes mellitus (DM) in whom other causes of peripheral nerve dysfunction have been excluded. There is a higher prevalence of DM in India (4.3%) compared with the West (1%–2%). Probably Asian Indians are more prone for insulin resistance and cardiovascular mortality. The incidence of DN in India is not well known but in a study from South India 19.1% type II diabetic patients had peripheral neuropathy. DN is one of the commonest causes of peripheral neuropathy. It accounts for hospitalization more frequently than other complications of diabetes and also is the most frequent cause of non-traumatic amputation [3].

About 10% of diabetic patients experience persistent pain. Pain in DN can be spontaneous or stimulus induced, severe or intractable. DN pain is typically worse at night and can be described as burning, pins and needles, shooting, aching, jabbing, sharp, cramping, tingling, cold, or allodynia. Some patients develop predominantly small fiber neuropathy manifesting with pain and paraesthesia early in the course of diabetes that may be associated with insulin therapy (insulin neuritis)[2,3].

Diabetic peripheral neuropathy is a common chronic complication of diabetes mellitus that has been very challenging for clinicians for a long time.DPN affects up to 50% of people with diabetes and usually starts with lesions on peripheral sensitive nerves and progress to motor and autonomic nrves.it causes progressive loss of vibratory,thermal,tactile and proprioceptive sensitives.th feet are the main target of most of the sensitive and motor complication to which individuals with diabetes are exposed[2,4].

Diabetic foot problems are a common occurrence throughout the world, resulting in major economic consequences for patients, their families and society, Because foot ulcers are most likely to be of neuropathic origin, they are eminently preventable in the developing countries that will experience the greatest increase in the prevalence of type 2 diabetes in the next 20 years[5].

Aquatic therapy is a common treatment modality used to address the complexity of patients with neurological disorders with the goal to achieve optimal functional independence. The physical properties of hydrodynamics, such as buoyancy, viscosity and thermodynamics, appear to benefit mobility in populations with disabilities. Although aquatic therapy continues to be widely utilized in neuro rehabilitation [6].

Foot bath is a supportive care technique for DM patients; foot bathing was more effective than foot massage on skin temperature, grade of neurotoxicity, and quality of life. Footbath for recovering from fatigue, easing of neuralgia and

muscle-ache, removing stiffness in the neck and shoulders by increasing the circulation of blood, maintaining health, recovering from nervousness and remedying various diseases. Footbath for recovering from fatigue, easing of neuralgia and muscle-ache, removing stiffness in the neck and shoulders by increasing the circulation of blood, maintaining health, recovering from nervousness and remedying various diseases [7].

Contrast bath is a treatment is used as alternative heat and cold water on a target limb [1,3]. The alternative temperature of the water leads to increase in blood flow and vascular pumping. Reduction of pain, stiffness, oedema and increase in mobility are the effects of contrast bath [1,4]. Various methods for the application of contrast bath are mentioned in the literature, according to change of time, temperature and total treatment duration [4].

Contrast bath as an alternative heat and cold enhances skin circulation and leads to more vasodilatation than warm bath alone [8,9]. This treatment can increase superficial blood flow, but its effects at the intramuscular level are not obvious [5, 8]. It seems that this treatment is useful for patients with circulatory deficiency such as diabetes mellitus [4].

In clinical treatment, CWT is conducted in a range between 37°C to 43°C for hot baths and cold baths of 12°C to 15°C which theoretically alternates the area between vasoconstriction and vasodilatation. CWT was sufficient for skin temperature to react in this fluctuation and that the significant fluctuations in subcutaneous temperatures signify the peripheral circulation of the skin caused by contrast therapy [10].

The Michigan Neuropathy Screening Instrument (MNSI) is used widely for the evaluation of distal symmetrical peripheral neuropathy in diabetes. The MNSI includes two separate assessments, a 15-item self-administered questionnaire that is scored by summing abnormal responses, and a lower extremity examination that includes inspection and assessment of vibratory sensation and ankle reflexes and is scored by assigning points for abnormal findings [11].

Positive responses and abnormal physical examination findings were recorded in the questionnaire form. In the questionnaire form risk of neuropathy was accepted to increase with higher number of positive responses. Diabetic peripheral neuropathy was diagnosed in patients with a physical examination score ≥2.5.In this study MNSI was accepted as a diagnostic test according to ADA recommendations [11].

The Toronto Clinical Neuropathy Score can be used to measure changes in such early DSP pathophysiology because of its content validity, and the demonstration of criterion validity against the morphological criteria of sural nerve fibre density for DSP , and of construct validity against nerve conduction velocities and nerve conduction amplitudes. The TCNS has been preferred in some clinical Trials owing to its ease of use, acceptability by patients, its ability to classify the severity of DSP and its representation of the clinical changes associated with the progression of DSP Inherent in these attributes, the TCNS has sufficient reliability and reproducibility as an instrument to document and monitor DSP in the clinical setting [12].

A bed nail board was invented in 1986, which was moulded of a resilient material and consists of an upper surface and a non-slip lower surface. The mat in its preferred embodiment is moulded in one-piece of a resilient plastic material. The mat has a lower non-slip surface and an upper surface that includes a multiplicity of cone shaped protrusions. The protrusions are designed to apply an optimized pressure point contact to the body. On the top surface is also located protrusion-free sections that allow a mat user to selectively exclude specific areas of the foot from being subjected to acupressure [13].

With respect to neurological, stretching muscle increases the discharge of muscle spindles.' The reflex response to a transient stretch has been shown to increase the stiffness of muscle considerably in both isolated preparations and

in vivo muscle testing. The stiffness of the musculotendinous tissues will thus also be determined by the level of muscle activation. As muscle activation increases, the contractile elements stiffen, and at maximum isometric tension, contractile element stiffness can be of a similar magnitude to that of the tendon [14].

Methodology

48 subjects were selected based on selection criteria with the age group of 50 to 60 years who are diagnosed and undergoing medication for past 10 to 15 years of type 2 Diabetes. Subjects having diabetic ulcer, cardiac problems, neurological problems, undiagnosed and not medicated, were excluded. Patient consent was obtained by explaining the project procedure and the effect of foot bath and contrast bath. The MNSI is widely used for evaluation of diabetic sensorimotor polyneuropathy. It includes 2 components A-self questionnaire & B- lower extremity examination. Component A has 15 self-administered question in(yes or no) format with 1&0 scoring, respectively. Subjects who scored above 6 are proceeded with next level of examination i.e., component B which has ankle reflex, vibration &perception, inspection & monofilament examination with maximum scoring of 10 points for bilateral foot. Subjects scored between 2.5 -5 is mild,5-7.5 is moderate,7.5-10 is severe. MTCNS, it has 2 components A-symptom score which is a subjective assessment with maximum scoring of 18 points & B- sensory scoring which objective examination with maximum scoring of 15 points for bilateral foot. Subjects scored between 9-14 is mild,15-25 is moderate, 26-33 is severe. Pre-test was done using Michigan neuropathy screening instrument, Modified Toronto clinical neuropathy scoring as an outcome measures, proceeded with treatment protocol.

Procedure

30 subjects were selected and divided equally into two groups based on simple random sampling method. Group A received foot bath (41◦c) with bed nail board for a period of 4 weeks (5days/week) for 15 minutes per session. Group B received contrast bath (hot water for 6minutes at 44◦c and cold water for 4minutes at -2◦c) with passive stretching for a period of 4 weeks (5days/week) for 15 minutes per session. After the cessation of the treatment protocol post-test was done using the same outcome measures. Statistics was done based on data collected in SPSS software version 24.

Result

Table-1 Comparison of MNSI scoring between group A and group B in pre and post test

#MNSI	#Group - A		#Group - B		t - Test	df	Significance
	Mean	S.D	Mean	S.D			
Pre test	4.1	1.01	4.3	1.12	6.649	28	0.526
Post test	3.56	0.92	3.28	0.97	5.018	28	0.0003**

Group –A Footbath and bed nail board Group-B contrast bath and passive stretching

Graph 1

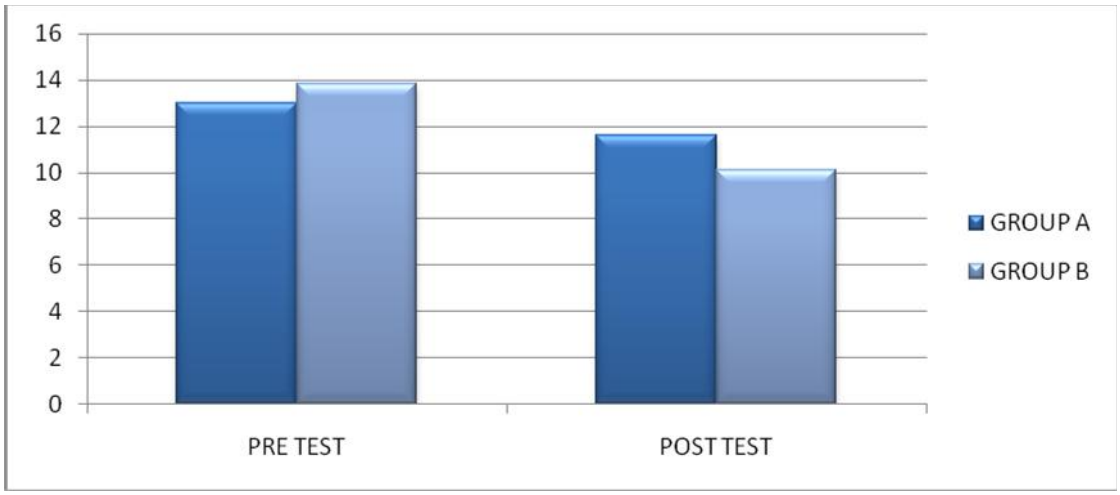
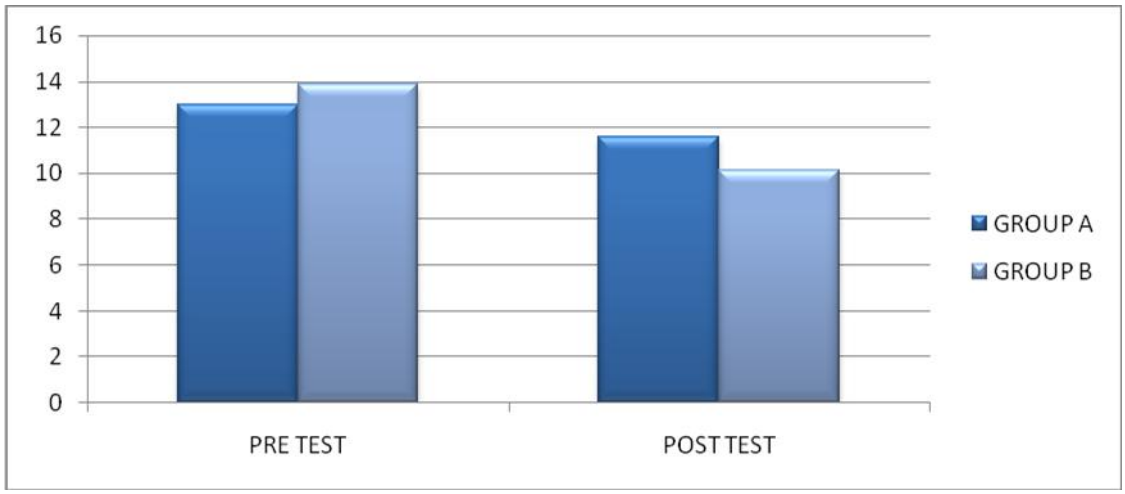


Table-2 Comparison of MTCNS scoring between group A and group B in pre and post test

#MTCNS	#Group - A		#Group – B		t - Test	df	Significance
	Mean	S.D	Mean	S.D			
Pre test	13	2.52	13.86	1.12	1.147	28	0.273
Post test	11.6	1.95	10.13	1.82	3.213	28	0.0006***

Group –A footbath and bed nail board Group-B contrast bath and passive stretching

Graph 2



From the data analysis, on comparing Group A and Group B who underwent foot bath and contrast bath obtained the mean difference of (0.54) & (1.02) in MNSI & (1.4) & (3.73) in MTCNS respectively.

Group A and Group B reveals that t value & p value of MNSI is (2.486) & (3.933), (0.0021) & (0.0007) and t value & p value of MTCNS is (2.332) & (5.017), (0.0027) & (0.0002) respectively. Both group shows p value is ≤0.001 but Group B shows more significant than group A. Hence the study accepts the alternative hypothesis and rejects null hypothesis.

Discussion

The principal finding of the study was that contrast bath and passive stretching was more effective than foot bath in subjects with diabetic foot as measured by Michigan neuropathy screening instruments (MNSI) and Modified Toronto clinical neuropathy scoring system (MTCNS).

There are several possible mechanism that could explain why contrast bath and passive stretching increases sensation of foot. **Jessica Marsh, (2014) to** know the effectiveness of contrast bath among clients with sprains and strains in the ankle and foot at a massage centre, Halifax, Canada. Investigator did contrast bath alternatively using hot water with 36-38 degrees C(3minutes) and cold water with 4-21 degrees C(10 seconds to 1 minute) for 3 cycles, always ending with cold. The study result reported that there was a reduction in the level of pain in the ankle and foot[17].

The quasi experimental study conducted by **Gormans JM et al (2011)** to assess the effectiveness of hydrotherapy among 20 diabetes mellitus clients with foot pain who were admitted in a medical ward were randomly selected. Foot immersion was done in hot water for 3 minutes and cold water for 30 seconds, alternating for 3 cycles. The study finding revealed that there was reduction in foot pain which was noticed by using numerical pain scale[18].

Donna E. Breger Stanton et al (2012) conducted a systematic review among 28 clinical research articles on contrast bath from 1938 onwards in which10 met the inclusive criteria set by the authors to know the effectiveness of contrast bath on diagnosis of rheumatoid arthritis and diabetes, to note the physiological temperature variations on blood flow, temperature of subcutaneous, intramuscular, the influence of room temperature, pain and age. The definitive conclusions was made that the contrast bath increases superficial blood flow and skin temperature in foot which relieves pain[19].

An experimental study conducted by **Nick Grantham (2008)** to know the effectiveness of contrast bath among 60 clients with diabetes foot attending foot clinic at china. They took 30 minutes for each client to provide the intervention. The temperature of the hot water was 35-40 degree C for 3-4 minutes and cold water was 35 10-15 degree C for 3-4 times. They concluded the study as contrast bath stimulates the nervous system since brain receives and recognizes various information (hot and cold), hence it reduces pain due to temperature variations[20].

Fiscus et al (2005) identified that heat or warm water therapy as well as CWT has been implicated with increased blood flow, where cold water had no effect on blood flow. However, studies conducted with diabetic patients, whose blood flow was reduced up to 50% to that of their control group, showed that CWT had little to no effect on superficial blood flow[21].

Linda Fehrs (2009) conducted an experimental study to assess the effectiveness of contrast bath on 20 diabetic neuropathy pain among diabetic clients attending a massage centre at US. Hot bath was administered at 100-115 degree and a cold bath in a range of 40-65 degrees for half an hour. The study result showed that there was reduction in pain level. The study was concluded that heat can help to relax aching while cold reduces inflammation and inhibits pain[22].

There are statistically significant improvements in the sensation of diabetic foot for both of these groups. table-1 within MNSI there is statistically highly significant difference between the pretest (4.1) and posttest (3.56) values within group-A(p=0.0012) (***- $P \leq 0.001$)and the pretest (4.3) and posttest (3.28) values within group-B (p=0.000) (***- $P \leq 0.001$)in the post test means Table-2 within MTCNS there is statistically highly significant difference between the pretest (13) and posttest (11.6) values within group-A (p=0.002) (***- $P \leq 0.001$)and the pretest (13.86) and posttest (10.13) values within group-B(p=0.000) (***- $P \leq 0.001$).

In between group analysis it was found that the group which underwent contrast bath and passive stretching showed more increase in sensation of diabetic foot as compared to the group which received foot bath and bed nail board.

Conclusion

Conclusion of the study shows that both foot bath with bed nail board and contrast bath with passive stretching is effective in increasing sensation of foot. However contrast bath, with passive stretching is more effective than foot bath with bed nail board in improving the sensation of foot in type II diabetes.

It can be used as simple and cost effective treatment program in improving sensation in diabetic neuropathic patients. it is noninvasive and non-pharmatic treatment with no side effects and also used for relaxation.

This may help the patient to improve their quality of life by improving sensation when performing activities of daily living.

Authors contribution

Dr. V. Pavithralochani participated in the design of the study and performed the statistical analysis, where Jaiganesh. G, Nurun Dhasbika. J, Divya. K, Meena. R contributed to draft the manuscript and data collection work.

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