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Research Article

Effectiveness Of Buerger-Allen Exercise on Lower Extremity Perfusion and Peripheral Neuropathy Symptoms Among Patients with Diabetes Mellitus Admitted in Medical Wards of SMVMCH

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Abstract:

Introduction: Diabetes mellitus is associated with vascular and neurological complications of the lower extremities. Peripheral arterial disease and peripheral neuropathy can impair circulation, produce sensory symptoms and increase the risk of diabetic foot complications. **Aim:** To determine the effectiveness of Buerger-Allen exercise on lower extremity perfusion and peripheral neuropathy symptoms among patients with diabetes mellitus. **Methods:** A quantitative approach and quasi-experimental one-group pre-test and post-test design were adopted. The study included 30 patients with diabetes mellitus admitted in the medical wards of Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), Puducherry. A random (lottery) sampling technique was reported. Lower extremity perfusion was assessed using an Ankle Brachial Index (ABI)-based assessment scale and peripheral neuropathy symptoms using the Michigan Neuropathy Screening Instrument (MNSI). Buerger-Allen exercise was administered and pre-test and post-test scores were compared using paired t-test. **Results:** After the intervention, mean lower extremity perfusion score decreased from 45.90 ± 3.078 to 26.57 ± 1.960 , with a mean difference of 19.33 and paired $t = 32.564$ ($p = 0.000$). All patients were at high risk of peripheral neuropathy before and after the intervention. The mean peripheral neuropathy symptom score decreased from 8.90 ± 1.094 to 7.00 ± 0.695 , with a mean difference of 1.900 and paired $t = 8.576$ ($p < 0.000$). Occupation was significantly associated with lower extremity perfusion ($\chi^2 = 8.210$, $p = 0.016$). **Conclusion:** Buerger-Allen exercise was effective in improving lower extremity perfusion and reducing peripheral neuropathy symptom scores among patients with diabetes mellitus.

Keywords: Buerger-Allen exercise; diabetes mellitus; lower extremity perfusion; peripheral neuropathy; Ankle Brachial Index.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose resulting from inadequate insulin production, impaired insulin action, or both. Persistent hyperglycaemia can damage blood vessels and nerves and may result in serious complications affecting the lower extremities.

Peripheral arterial disease is an important vascular complication of diabetes mellitus. It is characterized by narrowing or blockage of peripheral arteries, commonly affecting the lower limbs. Diabetes increases the risk of peripheral arterial disease and may accelerate its development. Reduced arterial flow can contribute to ischemic symptoms, delayed wound healing, ulceration, gangrene and amputation.

Peripheral neuropathy is another important complication of diabetes. Sensory loss, numbness, tingling, burning pain and reduced perception of injury may make foot problems difficult to recognize. The coexistence of diabetes, peripheral arterial disease and neuropathy can substantially increase the risk of non-healing ulcers and limb loss.

Buerger-Allen exercise is a postural exercise designed to improve lower extremity circulation through gravity-assisted changes in vascular filling. The exercise consists of elevation, dependency and horizontal phases. In the elevation phase, the legs are raised; in the dependency phase, the legs are lowered; and in the horizontal phase, the

AIM

Because Buerger-Allen exercise is simple, low-cost and can be incorporated into nursing care, the present study was undertaken to assess its effectiveness on lower extremity perfusion and peripheral neuropathy symptoms among patients with diabetes mellitus admitted to SMVMCH.

NEED FOR THE STUDY

Diabetes mellitus is an increasing global and national health problem, with vascular and neurological complications contributing substantially to morbidity. Peripheral arterial disease may remain unrecognized until advanced stages, particularly when peripheral neuropathy blunts pain perception. Early assessment of lower extremity perfusion and neuropathy is therefore important for preventing diabetic foot complications. The study document reports that Buerger-Allen exercise may improve collateral circulation and lower extremity perfusion through postural changes and muscle activity. Previous studies cited in the dissertation have reported significant improvements in peripheral circulation and foot perfusion following Buerger-Allen exercise. These findings provided the basis for evaluating the exercise among patients with diabetes mellitus in the selected hospital setting.

AIM

To determine the effectiveness of Buerger-Allen exercise in improving lower extremity perfusion and reducing peripheral neuropathy symptoms among patients with diabetes mellitus.

MATERIAL AND METHODS

A quantitative research approach with a quasi-experimental one-group pre-test and post-test design was adopted to assess the effectiveness of Buerger-Allen exercise on lower extremity perfusion and peripheral neuropathy symptoms among 30 patients with diabetes mellitus in the medical wards of Sri Manakula Vinayagar Medical College and Hospital, Puducherry. Patients aged 35–70 years with diabetes for more than five years and symptoms such as tingling and numbness were selected using reported random (lottery) sampling. Data were collected using a demographic tool, a 12-item lower extremity perfusion assessment, and the Michigan Neuropathy Screening Instrument. Buerger-Allen exercise involved elevation, dependency, and horizontal positioning of the legs, repeated 3–5 times per session. Pre-test and post-test assessments were conducted following ethical approval, informed consent, and daily administration of the exercise. Frequency and percentage were used for demographic variables, while paired t-test was used to compare pre- and post-test scores and chi-square test to assess associations with demographic variables, with $p < 0.05$ considered statistically significant.

RESULT

Table 1.1 shows that 76.7% of the patients were aged 40–70 years and 23.3% were above 40 years; none were aged 18–20 years. Females constituted 63.3% and males 36.7%. Regarding education, 60% had primary school education, 36.7% had higher secondary education and 3.3% had no formal education. More than half of the patients were daily wage workers/labourers (53.3%), followed by business workers (30%) and housewives (16.7%). Half had 3–5 family members, 43.3% had 5–7 members and 6.7% had more than seven members.

Table 1.2 shows that all patients had Type 2 diabetes mellitus (100%). Regarding duration of diabetes, 80% were categorized under years, 16.7% under months and 3.3% under all the above. All participants were reported as vegetarian. Alcohol consumption was reported by 36.7%, while 63.3% did not consume alcohol. Smoking was reported by 20%, while 80% were non-smokers.

Table 2 shows that during the pre-test, 83.3% of patients had severe impairment/poor lower extremity perfusion and 16.7% had moderate impairment. Following Buerger-Allen exercise, all patients (100%) were classified under moderate impairment, with none remaining in the severe impairment category.

Table 3 shows that all patients (100%) were categorized as having a high risk of peripheral neuropathy during both pre-test and post-test. No participant was classified as low risk in either assessment.

Table 4 demonstrates a reduction in the mean lower extremity perfusion score from 45.90 ± 3.078 in the pre-test to 26.57 ± 1.960 in the post-test. The mean difference was 19.33, with a paired t-value of 32.564 and $p = 0.000$, indicating a statistically significant improvement following Buerger-Allen exercise.

Table 5 shows that the mean peripheral neuropathy symptom score decreased from 8.90 ± 1.094 in the pre-test to 7.00 ± 0.695 in the post-test. The mean difference was 1.900, with a paired t-value of 8.576 and $p < 0.000$, indicating a statistically significant reduction in peripheral neuropathy symptoms.

Table 6 shows that occupation was significantly associated with lower extremity perfusion ($\chi^2 = 8.210$, $p = 0.016$). Table 7 shows that association with peripheral neuropathy symptoms could not be determined because all participants were categorized as high risk during the pre-test and there

RECOMMENDATION

The present study demonstrated that Buerger-Allen exercise improved lower extremity perfusion among patients with diabetes mellitus. The proportion of patients with severe impairment/poor perfusion decreased from 83.3% before the intervention to none after the intervention, while all patients were classified as having moderate impairment at post-test. The significant reduction in the mean perfusion score further supports the effectiveness of the exercise.

These findings are consistent with Thakur and Sharma (2019), who reported significant improvement in peripheral circulation following Buerger-Allen exercise among patients with diabetes mellitus. Similar improvement in foot perfusion was reported by Srivastava, John and Reddy (2021), who found a significant increase in perfusion following the intervention. The findings are also supported by El Sayed et al. (2021), who reported significant changes in lower extremity perfusion following Buerger-Allen exercise, and by Jenyfer Renu Margret and Tamilselvi (2021), who found significant improvement in lower extremity perfusion measured using ankle-brachial pressure index.

The present study also showed a significant reduction in peripheral neuropathy symptom scores after Buerger-Allen exercise. However, the categorical risk classification remained high for all participants. This indicates that although symptom scores improved, the intervention period did not produce a change sufficient to shift participants from the high-risk category to the low-risk category.

The findings are in agreement with the study by Radhika and Tamilselvi (2020), which reported that Buerger-Allen exercise improved lower extremity perfusion and reduced peripheral neuropathy symptoms among patients with Type 2 diabetes mellitus. Recent evidence cited in the dissertation, including studies by Bobina Gregory and Smitha Paul (2025), also reported significant improvement in lower extremity perfusion after Buerger-Allen exercise. Occupation was significantly associated with lower extremity perfusion in the present study. This suggests that occupational characteristics may influence the distribution of perfusion impairment among patients with diabetes mellitus. No association could be determined for peripheral neuropathy symptoms because all participants were classified in the same high-risk category at pre-test.

CONCLUSION

The study concluded that Buerger-Allen exercise was effective in improving lower extremity perfusion and reducing peripheral neuropathy symptom scores among patients with diabetes mellitus. A marked shift from severe to moderate perfusion impairment was observed after the intervention, and mean peripheral neuropathy symptom scores decreased significantly. Although the overall neuropathy risk category remained high, the reduction in symptom scores indicates beneficial change following the exercise.

RECOMMENDATION

- Similar studies may be conducted with larger and more diverse samples of patients with diabetes mellitus.
- Studies may be conducted in different hospital settings and community settings.

LIMITATION

- The study included only 30 patients.
- The study was conducted in the medical wards of one selected hospital.

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Table 1. Frequency and Percentage Distribution of Demographic Variables of Patients with Diabetes Mellitus (N = 30)

S.No.	Variable	Category	f	%
1	Age	18–20 years	0	0.0
		40–70 years	23	76.7
		Above 40 years	7	23.3
2	Gender	Male	11	36.7
		Female	19	63.3
3	Education	No formal education	1	3.3
		Primary school	18	60.0
		Higher Secondary school	11	36.7
4	Occupation	House wife	5	16.7
		Business	9	30.0
		Daily wage worker/ Labourer	16	53.3
5	Number of family members	3–5	15	50.0
		5–7	13	43.3
		More than 7	2	6.7

S.No.	Variable	Category	f	%
6	Type of diabetes mellitus	Type 1	0	0.0
		Type 2	30	100.0
		Gestational diabetes mellitus	0	0.0
7	Duration of diabetes	Years	24	80.0
		Months	5	16.7
		All the above	1	3.3
8	Diet pattern	Vegetarian	30	100.0
		Non-vegetarian	0	0.0
		All the above	0	0.0
9	Habit of alcoholism	Yes	11	36.7
		No	19	63.3
10	Habit of smoking	Yes	6	20.0
		No	24	80.0

Table 2. Frequency and Percentage Distribution of Level of Lower Extremity Perfusion Among Patients with Diabetes Mellitus (N = 30)

Level	Pre-test f (%)	Post-test f (%)
Mild or no perfusion symptoms	0 (0.0)	0 (0.0)
Moderate impairment	5 (16.7)	30 (100.0)
Severe impairment / poor perfusion	25 (83.3)	0 (0.0)

Table 3. Frequency and Percentage Distribution of Level of Peripheral Neuropathy Symptoms Among Patients with Diabetes Mellitus (N = 30)

Risk level	Pre-test f (%)	Post-test f (%)
Low risk of neuropathy	0 (0.0)	0 (0.0)
High risk of neuropathy	30 (100.0)	30 (100.0)

Table 4. Comparison of Mean Lower Extremity Perfusion Scores Between Pre-test and Post-test (N = 30)

Variable	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean difference	Paired t	p-value
Lower extremity perfusion	45.90 $\pm$ 3.078	26.57 $\pm$ 1.960	19.33	32.564	0.000

Table 5. Comparison of Mean Peripheral Neuropathy Symptom Scores Between Pre-test and Post-test (N = 30)

Variable	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean difference	Paired t	p-value
Peripheral neuropathy symptoms	8.90 $\pm$ 1.094	7.00 $\pm$ 0.695	1.900	8.576	<0.000

Table 6. Significant Association Between Lower Extremity Perfusion and Selected Demographic Variable (N = 30)

Variable	χ^2	df	p-value	Interpretation
Occupation	8.210	2	0.016	Significant

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