Effect of Buerger Allen Exercise on Lower Extremity Perfusion Among Patients with Diabetes Mellitus - Randomized Clinical Trial

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Abstract

An experimental study was undertaken to assess the effectiveness of Buerger Allen exercise on lower extremity perfusion among patients with diabetes mellitus. Conceptual framework used in this study was based on modified Daniel Stuffle Beam's CIPP evaluation model. Consecutive sampling technique was used to select 30 Type- II diabetes mellitus patients (15 patients each in experimental and control group). The study was conducted in medicine unit of Pradyumna Bal Memorial Hospital. In experimental group samples were subjected to Buerger Allen exercise whereas in control group no intervention was given. Ankle Brachial Index was used to assess the lower extremity perfusion. Statistical value revealed that on post-intervention the mean lower extremity perfusion in right leg in experimental group was 0.84 which is higher than the mean lower extremity perfusion of control group 0.65 with p value 0.000 which is extremely significant at p≤0.001 level of significance. The mean lower extremity perfusion in left leg in experimental group was 0.84 which is higher than the mean lower extremity perfusion of control group 0.67 with p value 0.000 which is extremely significant at p≤0.001 level of significance. The study concluded that Buerger Allen exercise is a non-invasive cost effective method to improve the lower extremity perfusion.

As per the report of International Diabetes Federation (IDF), India is looming epidemic of diabetes, and known as the diabetes capital of the world. India has highest number of 50.8 million people suffering from diabetes mellitus (DM), followed by China (43.2 million) and US (26.8 million). More over 3.2 million deaths are due to DM. IDF estimated that more than 382 million people worldwide had diabetes as of 2013, and this number is projected to increase to 592 million by the year 2035. Odisha has 4.2 million diabetic patients against the country's 70 million.

Diabetes mellitus is a group of metabolic disorders characterised by hyperglycemia and microvascular, macrovascular and neuropathic complications. Type 2 DM is the commonest form of diabetes constituting 90 percent the diabetes population. It contributes significantly and independently to the development of peripheral arterial disease which impacts heavily upon the public health system. The acute and chronic complications of diabetes is the major cause of hospital admission. Studies suggest that Asian patients had more evidence of micro and macro vascular complication. The prevalence of micro and macro vascular complications is higher in Asians (66.4%) than in European populations (44.2%).

According to the World Health Organisation (WHO) report, India today leads the world with 32 million diabetic patients and this number is projected to increase to 79.4 million by the year 2030. Surveys indicate that diabetes now affects a staggering 10-16 percent of urban and 5-8 percent of rural population in India and Odisha has 4.2 million diabetic patients.

As per the "Healthy People Programme" prevention of problems of diabetic foot are the major goal. Peripheral neuropathy contributes to diabetic foot complications and the possibility of ulceration of lower extremities in the diabetic patients is approximately 15-59 times more than in the non-diabetic individuals. Around 45-70 percent of diabetic traumatic amputations result from diabetic peripheral neuropathy.

Khurda (of which the state capital Bhubaneshwar is a part) and Cuttack are among top 20 districts with high prevalence raised blood sugar level (>150 mg/

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dl), a marker of diabetes, among 284 districts of nine states, which were part of the latest clinical, anthropometric and bio-chemical (CAB) survey conducted by the Registrar General of India. As a reflection of growing burden non-communicable diseases, 14 of the 30 districts in the state figure in the list of top 100 districts for high blood sugar level, which is second highest after 29 districts of Uttar Pradesh. Experts say, it is reflection of changing lifestyle and unhealthy eating habits.

The dramatic growth in PAD is already a major public health challenge due to loss of mobility, diminished quality of life, and the significantly increased risk of heart attack and stroke.

Objectives

The objectives of the study were:

1. To assess the effectiveness of Buerger Allen exercise on lower extremity perfusion among patients with diabetes mellitus in experimental group.
2. To compare the lower extremity perfusion among patient with diabetes mellitus from pre-test and post-test level in experimental and control group.

Hypothesis

H_1: There is a significant difference between the pre-test and post-test score of lower extremity perfusion among patient with diabetes mellitus.

Review of Literature

In a quasi-experimental study with pre-test post-test design to determine the effectiveness of Buerger-Allen exercise on level of lower extremity perfusion among type 2 diabetes mellitus patients in experimental group, non-probability convenient sampling technique was used. A total of 60 admitted patients participated in the study. The study showed a significant improvement in the level of lower limb perfusion in experimental group after Buerger Allen exercise than in the control group among patient with type 2 diabetes mellitus at ($p<0.001$). This indicates that Buerger Allen Exercise is a simple non-pharmacological and effective method for the management of lower limb perfusion among the patient with type 2 diabetes mellitus.

In an experimental study to determine the cost effectiveness of exercise training to improve claudication, symptoms in peripheral arterial disease were compared. The effectiveness was assessed at three and six months' exercise programme. Initially first three months PTA was more effective than exercise rehabilitation but after six months the exercise was more effective than PTA and cost effective also. The study concluded that exercise rehabilitation for claudication treatment has implications for future PVD care.

In a study to investigate the level of lower extremity perfusion among patient with type 2 diabetes and assess the effect of Buerger-Allen Exercise to improve lower extremity perfusion among patients with type 2 diabetes mellitus admitted at tertiary hospital, India, subjects in experimental group underwent intervention of Buerger-Allen exercise under supervision twice a day for 5 days and in control group, subjects were under regular treatment. Demographic data and ankle brachial index scale was used to assess the lower extremity blood circulation. In experimental and control group 24 (80%), 15 (50%) had lower extremity arterial disease and 6 (20%), 15 (50%) were in border line. In experimental group, there was a significant difference between the pre-test mean value of 0.922 with SD 0.0562 and post-test mean value 0.980 with SD 0.0407 which projects that t value 9.108 was significant at the level of $p<0.05$. The study concluded that Buerger-Allen exercise is effective in improving the lower extremity.

Methodology

Randomised controlled trial design was undertaken to evaluate the effectiveness of Buerger Allen exercise on lower extremity perfusion. Consecutive sampling technique was used to select 30 type-2 diabetes mellitus patient (15 patients each in experimental and control group). The study was conducted in medicine unit (male and female unit) of Pradyumna Bal Memorial Hospital. In experimental group samples were performed Buerger Allen exercise where in control group no intervention given. An Ankle Brachial Index was used to assess the lower extremity perfusion.

Results

Demographic characteristics (Tables 1-3)

Age: Most of the patients with diabetes mellitus were in age group in between 41-50 years, in experimental group 46.66 percent, in control group 53.33 percent. Gender: Majority of them were male, in experimental group male were 66.67 percent, in control group male were 66.67 percent. Education: Most of them were secondary, experimental group – 40 percent, in control group graduates 33.33 percent. Type of family: Majority belonged to nuclear family (experimental group 93.33%, control group 73.33%). Occupation: Most of them were employee (experimental group 40%, control group 40%). Fam-

Table 1: Frequency and percentage distribution of study sample according to age (N=30, 15+15)

Characteristics	Control group (n = 15)		Experimental group (n = 15)	
	f	%	f	%
Age (years)				
31-40	0	0	3	20
41-50	7	46.66	8	53.33
51-60	6	40	4	26.66
61 and above	2	13.33	0	0

Table 2: Frequency and percentage distribution of study sample according to gender (N=30, 15+15)

Characteristics	Control group (n= 15)		Experimental group (n=15)	
	f	%	f	%
Gender				
Male	10	66.67	10	66.67
Female	5	33.33	5	33.33

Table 3: Frequency and percentage distribution of samples according to educational qualification (N=30, 15+15)

Characteristics	Control group (n =15)		Experimental group (n=15)	
	f	%	f	%
Education				
Primary education	3	20	5	33.33
Secondary education	6	40	5	33.33
Graduate	6	40	3	20
Post graduate	0	0	0	0
Illiterate	0	0	2	13.33

ily income: Most were having family income in between Rs. 15001-20000/- (experimental group 33.33%, control group 33.33%). Smoking habit: Most of them were smoker (experimental group between 6-10 years 40 percent, in control group above 10 years 46.66%). Duration of disease condition: Most of the patients' duration of disease condition was 1 year and above, in experimental group 100 percent, in control group 100 percent. Exercise pattern: Most of them had irregular exercise pattern (in experimental group 93.33% control group 86.67%). Type of work: Most of them were doing sedentary type of work (experimental group 66.67%, control group 60%).

Comparison of lower extremity perfusion scores between control and experimental group (Tables 4-7, Figs 1-4)

In the comparison of right side lower extremity perfusion scores of pre-intervention and post-intervention in control group and experimental group, on pre-intervention in experimental group the mean lower extremity perfusion of right leg was 0.65, SD 0.05 and after intervention the mean score was 0.84, SD 0.05 with p value 0.000 which is statistically extremely significant at p≤0.001 level of significance. In pre-intervention in control group the mean lower extremity perfusion in right leg was 0.65, SD 0.07 and in post-intervention it was 0.65, SD 0.06 with p value 0.384 which is statistically not significant at p≤0.001 level of significance.

In the comparison of left side lower extremity perfusion scores of pre-intervention and post-intervention in control group and experimental group, on of pre-intervention in experimental group the mean lower extremity perfusion of left leg was 0.65, SD 0.08 and after intervention the mean score was 0.84, SD 0.08 with p value 0.000 which is statistically extremely significant at p≤0.001 level of significance. In control group the mean lower extremity perfusion in left leg in pre-intervention was 0.667, SD 0.06 and in post-intervention it was 0.67, SD 0.06 with p value 1.000 which is statistically not significant at p≤0.001 level of significance.

In the comparison of pre-test lower extremity perfusion scores in control group and experimental group, during pre-intervention the mean lower extremity perfusion in right leg in experimental group was 0.65, which is equal to the mean of control group 0.65, with p value 1.000 which is not significant at

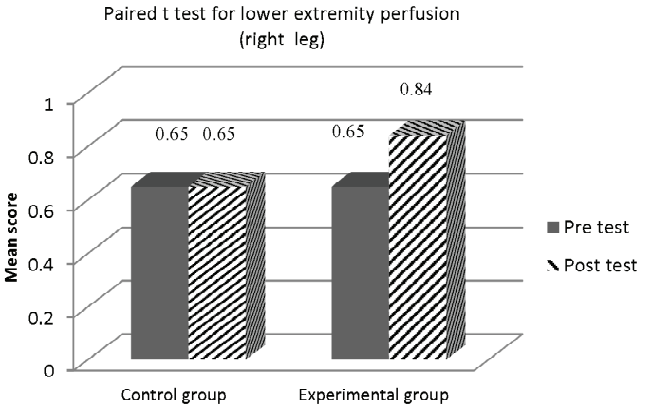

Fig 1: Right lower extremity perfusion scores in pre-intervention and post-intervention in control group and experimental group.

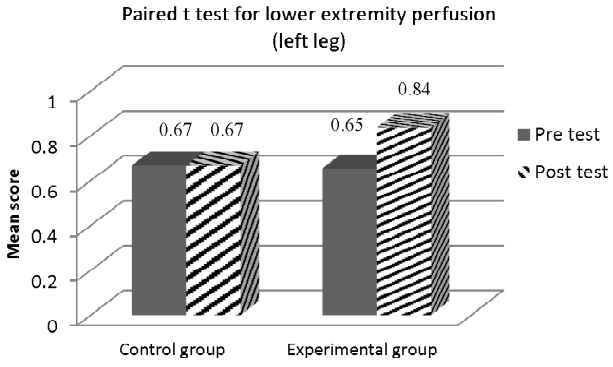

Fig 2: Left lower extremity perfusion scores in pre-intervention and post-intervention in control group and experimental group.

Table 4: Difference of right lower extremity perfusion scores in pre-intervention and post-intervention in control group and experimental group Paired t-test, N=30 (15+15)

Right – ABI	Pre-intervention	Post-intervention	p value	Inference
Control group (Mean ± SD) (n=15)	0.65 ± 0 .07	0.65 ± 0.06	0.384	Not significant
Experimental group (Mean ± SD) (n=15)	0.65 ± 0.05	0.84 ± 0.05	0.000	Extremely significant

p≤0.001

Table 5: Difference of left side lower extremity perfusion score from pre-intervention and post-intervention in control and experimental group. Paired t test; N=30 (15+15)

Left – ABI	Pre-test	Post-test	p value	Inference
Control group (Mean ± SD) (n=15)	0.67 ± 0.06	0.67 ± 0.06	1.000	Not significant
Experimental group (Mean ± SD) (n=15)	0.65 ± 0.08	0.84 ± 0.08	0.000	Extremely significant

p≤0.001

Table 6: Comparison of lower extremity perfusion score in pre-intervention of experimental and control group Unpaired t test with equal variance: N=30 (15+15)

Pre- Intervention	Control group (n=15)	Experimental group (n=15)	p value	Inference
Right – ABI (Mean ± SD)	0.65 ± 0.07	0.65 ± 0.05	1.000	Not significant
Left – ABI (Mean ± SD)	0.67 ± 0.06	0.65 ± 0.07	0.630	Not significant

p≤0.001

Table 7: Comparison of lower extremity perfusion scores in post-intervention of experimental and control group unpaired t test with equal variance: N=30 (15+15)

Post-Intervention	Control group (n=15)	Experimental group (n=15)	p value	Inference
Right Leg – ABI (Mean ± SD)	0.65 ± 0.06	0.84 ± 0.05	0.000	Extremely significant
Left Leg – ABI (Mean ± SD)	0.67 ± 0.06	0.84 ± 0.08	0.000	Extremely significant

p≤0.001

p≤0.001 level of significance. The mean lower extremity perfusion in left leg in experimental group is 0.65 which is lower than the mean of control group 0.67 with p value 0.630 which is not significant at p≤0.001 level of significance.

In the comparison of post-intervention lower extremity perfusion scores in control group and experimental group during post-intervention the mean lower extremity perfusion in right leg in experimental group is 0.84 which was higher than the mean lower extremity perfusion of control group 0.65 with p value 0.000 which was extremely significant at p≤0.001 level of significance. The mean lower extremity perfusion in left leg in experimental group is 0.84 which is higher than the mean lower extremity perfusion of control group 0.67 with p value 0.000 which was extremely significant at p≤0.001 level of significance.

This study finding revealed that there is a significant difference between the pre-intervention and post-intervention score of lower extremity perfusion among patients with diabetes mellitus. So, the null hypothesis was rejected and the research hypothesis was accepted. There was a significant difference between the pre-test and post-test score of lower extremity perfusion among patient with diabetes mellitus in experimental group. The use of Buerger Allen exercise is effective in improving the foot perfusion in terms of ABI score, reducing the capillary refill time. Therefore, Buerger Allen exercise is effective exercise to improve the foot perfusion of diabetes mellitus patients.

Homogeneity between experimental and control group with selected socio-demographic and clinical variables

Age: The mean age among the experimental group was 48.73 years, lower than the control group (54.33 years), this difference is statistically significant, with SD 5.65 the p value is 0.0175. Family income: The mean family income among experimental group (Rs.17133.3) was lower than the mean income of control group (Rs. 17333.3), this difference is statistically not significant, with SD 5627.3 and p value 0.921. Smoking habit: The mean smoking duration of experimental group (12.2 years) was greater than the mean smoking duration of the control group (10.2 years), this difference is statistically not significant, with SD 2.57 and p value 0.230. Duration of disease condition: The mean duration of disease condition in the experimental group (5.26 years) was lower than the mean of control group (6.86 years), this difference was statistically not significant, with SD 3.54 and p value 0.203.

Implications for Nursing Practice

Buerger-Allen exercise can be introduced as a stimulating mode of intervention by the nurses for promoting peripheral circulation among the patients suffering from varicose vein; it can be incorporated into routine nursing intervention. Buerger-Allen can be given for patients admitted in medical ward. This exercise will help to reduce the circulatory complication among diabetes mellitus patient.

Nursing education: Nurse educator can encourage students to conduct health teaching sessions on vari-

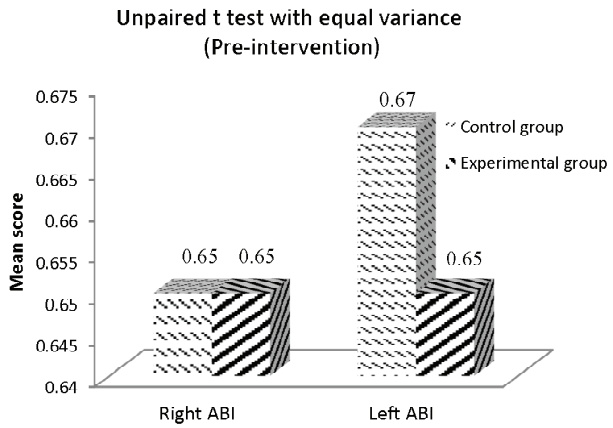

Fig 3: Lower extremity perfusion score in pre-intervention of experimental and control group.

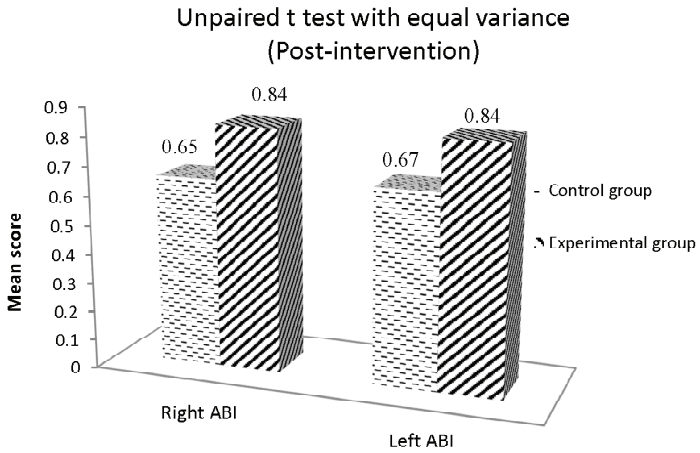

Fig 4: Lower extremity perfusion scores in post-intervention of experimental and control group.

ous exercise methods. Staff development programme need to be arranged, so that the nurse educators can encourage the students to provide various exercise to the patients.

Nursing administration: Nursing administrator can organise in-service education programmes for staff nurses regarding Buerger-Allen exercise. Arrangements can be made for the practice of Buerger-Allen exercise in hospital, so that the staff nurses can provide calm, quiet, clean and safe environment to the patients for the practice.

Nursing research: Research should focus on other non-pharmacological interventions to improve the peripheral circulation. The findings should be disseminated through conferences, seminars and publications in professional, national and international journals.

Recommendations

On the basis of findings of the study, following recommendations could made for further study.

- A similar study could be conducted with varicose vein disease patients to find out the effectiveness of the peripheral circulation.
- A comparative study can be to evaluate the effectiveness of Buerger-Allen exercise between the diabetes mellitus patient and varicose vein.
- A study can be conducted (a) with large sample size to generalise the results of the study; (b) to find out the various innovative methods to improve the level of peripheral circulation.

Conclusion

The study concluded that the Buerger Allen exercise is a non–invasive cost effective method to improve the foot perfusion in terms of ABI score and reduce the capillary refill time. Therefore, Buerger Allen Exercise is an effective exercise to improve the foot perfusion of diabetes mellitus patients.

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