EFFECTIVENESS OF ACTIVE ANKLE EXERCISE ON PREVENTION OF DEEP VEIN THROMBOSIS IN BEDRIDDEN PATIENTS

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DOI: 10.5281/zenodo.11399586

Abstract

Introduction: The clinical conditions of bedridden patients are most closely associated with deep vein thrombosis. Prevention with appropriate detection and prophylaxis of deep vein thrombosis is an essential indicator of the quality of care. The aim of the study to evaluate the effectiveness of active ankle exercise in preventing deep vein thrombosis. **Methods:** An experimental research design was adopted to conduct the study with 30 bedridden patients who met the inclusion criteria and were assigned on to experimental group (n=15) and control group (n=15) by simple random sampling technique. Active ankle exercise was administered to the experimental group for 7 days with 5 cycles in the morning and 5 cycles in the evening. The control group received routine hospital care services. The study's primary outcome was risk of deep vein thrombosis, measured by modified Well's Probability Scale impairment scale before the intervention and at the end of the intervention. **Results:** Within-group analysis, paired t test showed a significant improvement comparing the modified well's score before (6.93±0.91) and after (4.80±0.56) the intervention in the experimental group (p<0.001). Between-group analysis, experimental and control group post-test mean score of modified well's score before (4.80±0.56 & 7.03±0.43) showed significant difference (p<0.001). **Conclusion:** The study findings concluded that active ankle exercise effectively prevents deep vein thrombosis among bedridden patients. Hence this interventional strategy may include the prevention of DVT protocol in the hospital and may be taught to the caregivers of bedridden patients as part of home care management

Keywords: Active Ankle Exercise, Bedridden Patients, Deep Vein Thrombosis, Exercise, Deep Vein Thrombosis Prophylaxis.

INTRODUCTION

Deep vein thrombosis (DVT) is a significant public health concern. It occurs when a thrombus forms in one or more deep veins, usually in the legs, which can cause leg pain or swelling. DVT can be serious when a thrombus breaks or travels along the circulation, leading to pulmonary embolism. Deep venous thrombosis (DVT) and pulmonary embolism, collectively called Venous thromboembolism (VTE), which is a major preventable cause of morbidity and mortality [1], occurs with an incidence of approximately 1 per 1000 annually in adult populations [2]. The contributing Virchow's triad for thrombosis formation is venous stasis, vascular injury, and hypercoagulability, of which venous stasis is the most influential factor. Still, stasis alone is not sufficient to cause clot formation [3]. The presence of venous stasis and vascular injury or hypercoagulability dramatically increases the risk of the formation of a thrombus [4].

The clinical conditions of bedridden patients with cancer or those in the early postoperative period following orthopaedic, gynaecological, or major surgery, pregnancy, congestive heart failure, varicose veins, obesity, advancing age, and a history of DVT are most closely associated with DVT [5]. Thrombosis is also related to poor quality of life, mainly when post-thrombotic syndrome develops [6, 7]. DVT is also has been chosen as an essential indicator of the quality of care and pay attention to prevention with appropriate detection and prophylaxis [8]. The American College of Chest Physicians, American Academy of Orthopaedic Surgeons, and Japanese Circulation Society have developed clinical practice guidelines for mechanical and pharmacological VTE prophylaxis [9-15]. Because Pharmacological prophylaxis causes severe bleeding risk among patients at risk of bleeding, mechanical prophylaxis must be implemented [16–17]. Mechanical prophylaxis involves using graduated compression stockings, intermittent pneumatic compression, and venous foot pumps to improve blood flow in the leg's deep veins and ease venous insufficiency symptoms. Active leg movement is a recommended mechanical VTE prophylaxis method [15,18-19]. Combined ankle movement improves venous velocity in the lower extremities more effectively than single ankle movement [19]. Ankle joint movement is integral to the activation of the calf muscle pump [20], which is the most significant [21], and also suggested that impaired calf muscle function is a causative factor in chronic venous diseases [22]. Exercise also increases cardiac output, attenuating sympathetic vasoconstriction by contracting skeletal muscle in the lower extremities, which enhances blood flow to the muscles and also reduces pressure on the ankle joint [23,24]. Hence, the present study hypothesized that active ankle exercise would prevent the risk of deep vein thrombosis among bedridden patients, thereby reducing the financial cost of hospitalization.

METHODOLOGY

True experimental design was adopted to conduct the study at Saveetha Medical College and Hospital after obtaining formal permission from the hospital authority. Thirty bedridden patients were selected for the study by using a simple random sampling technique. Experimental group (n=15) were selected from I unit of male & female medical, surgical and orthopaedic wards and the control group (n=15) were selected from II unit of male & female medical, surgical and orthopaedic wards. The samples who included in the study were patients with age above 20 years, both gender, immobilized for more than one week, meeting the WELL'S score of low to moderate risk of deep vein thrombosis and were willing to participate in the study. The patients with ankle fracture and dislocation, on treatment of anticoagulant, foot ulcer, cognitive impairment and undergoing any other exercise were excluded from the study. The investigators explained the purpose of the study to the participants in their regional language and clarified the doubt. Obtained written informed consent from the participants after assuring confidentiality. Baseline information was collected using a structured questionnaire in the interview method. A pre-test assessment was done using a modified Well's Probability Scale for both groups. Modified Well score comprised of 8 criteria. The criteria are localized tenderness along the distribution of deep veins; swollen entire leg; unilateral calf swelling of greater than 3 cm; unilateral pitting edema; superficial collateral vein, throbbing or cramping pain in 1 leg (rarely both legs), usually in the calf or thigh; warm skin around the painful area and red or darkened skin around the painful area. Each criterion has one point. The scoring was given and based on the clinical signs and symptoms. The Modified Well's score was

ISSN 1462 2815

interpreted as 0: low probability, 1 to 2 points: Moderate probability, and 3 to 8 points: high probability. The experimental group received the active ankle exercise for 7 days at the bedside on one to one basis. The exercise consists of sequence of 20-degree dorsal flexion, 30- degree varus flextion, 40-degree plantar flexion, 30-degree valgus flexion and repeated the sequence for 2 minutes. It was administered 10 cycles per day, in which 5 cycles in the morning and 5 cycles in evening. The participants were observed for progress and any untoward effects during an intervention. The control group received routine care at the hospital. Post-test was conducted using the same tool at the end of seventh day for both experimental and control groups. The ethical principles were adhered to protect the rights of the samples and maintained confidentiality throughout the study. The data were tabulated and analyzed by descriptive and inferential statistical methods using SPSS statistical package. The baseline information was described as frequency and percentage. The effectiveness of intervention within the group and between the group was calculated by paired t-test and unpaired t-test. The probability of $p<0.05$ or less was taken as statistically significant.

RESULTS

Table 1: Background information of Bedridden Patients

Demographic Variables	Experimental Group Frequency (%)	Control Group Frequency (%)
Age in Years		
25 to 35	1 (6.7%)	3 (20%)
36 to 40	4 (26.7%)	3 (20%)
41 to 50	2 (13.3%)	2 (13.3%)
More than 51	8 (53.3%)	7 (46.7%)
Gender		
Male	11 (73.3%)	10 (66.7%)
Female	4 (26.7%)	5 (33.3%)
Occupation		
Sedentary worker	7 (46.7%)	4 (26.7%)
Moderate worker	3 (20%)	2(13.3%)
Heavy Worker	5(33.3%)	9 (60%)
Standing Hours per Day		
2 to 4	1(6.7%)	1(6.7%)
4 to 6	2 (13.3%)	3 (20%)
7 to 8	6 (40%)	6 (40%)
More than 8 hrs	6 (40%)	5 (33.3%)
Body Mass Index		
Underweight	1 (6.7%)	1(6.7%)
Normal	11(73.3%)	9 (60.0%)
Overweight	2 (13.3%)	3 (20.0%)
Obese	1 (6.7%)	2(13.3%)
Types of Food		
Vegetarian	0	1 (6.7%)
Non-vegetarian	15 (100%)	14 (93.3%)
Type of co-morbidity		
Hypertension	2 (13.3%)	2(13.3%)
Diabetic Mellitus	-	1 (6.7%)
Hypertension & Diabetes Mellitus	4 (26.7%)	1 (6.7%)
Others	9 (60%)	11(73.3%)

Table 1 shows that approximately 50% were in the age group of more than 50 years, and most participants (70%) were male and had normal BMI. Regarding occupation, 40-60% ranged from mild work to heavy work with a standing of 7-8 hours per day, and 100% were non-vegetarian and had some morbidity conditions.

Table 2: Comparison of Modified Well's Score

Modified Well's Score	Low Probability (0)		Moderate Probability (1–3)		High Probability (4-8)	
	No.	%	No.	%	No.	%
Experimental Group						
Pre-test	-	-	12	80	3	20
Post-test	7	26.7	8	73.3	-	-
Control Group						
Pre-test	-	-	11	73.4	4	26.6
Post-test	3	20	10	66.7	2	13.3

Table 2 presents the Modified Well's Score in terms of frequency and percentage. Out of 15 samples in the experimental group, in the pretest 12(80%) had moderate probability, 3(20%) had high probability of getting DVT, whereas in post-test, the percentage of low and moderate probability of occurrence of DVT is 26.7% and 73.3% and none of them had high probability. In control group pre-test, out of 15 samples

Table 3: Within Group Analysis of Experimental and Control Group

Parameter	Group	Mean ± SD	Paired 't' test
Modified Well's Score	Control Pre test	7.23±0.62	t = 0.972 p = 0.18 NS
	Control Post test	7.03±0.43	
	Experimental Pre test	6.93±0.91	t=58.66 p=0.0001 S***
	Experimental Post test	4.80±0.56	

***p<0.001, S – Significant, NS – Not Significant

Within group analysis, Paired t-tests compared the experimental group's pre-test and post-test levels of modified well's Score. The experimental group pre-test and post-test mean and standard deviation was 6.93±0.91 and 4.80±0.56. The calculated value of t = 58.66 was statistically highly significant at a p<0.001 level as depicted in Table 3).

Table 4: Between Group Analysis

Modified Well's Score	Experimental Group		Control Group		Mean Difference	Student Independent 't' test
	Mean	S.D	Mean	S.D		
Pretest	6.93	0.91	7.23	0.62	0.3	t=0.917 p=0.367 N.S
Post Test	4.80	0.56	7.03	0.43	2.23	t=13.147 p=0.0001 S***

***p<0.001, S – Significant, N.S – Not Significant

In between group analysis, the post-test mean and standard deviation of modified well's score in the experimental and control group was 4.80±0.56 and 7.03±0.43. The result demonstrated that the calculated independent 't-test value of t = 13.147 was statistically highly significant at p<0.001as shown in Table 4. Whereas, there was no statistical significant difference between the experimental and control group pre-test.

DISCUSSION

Deep vein thrombosis is one of the complications of being bedridden. DVT and its related complications are fatal and life-threatening. Early detection and prevention of DVT by systematic management is essential in clinical practice in the decision-making of thromboembolism prophylaxis among bedridden patients. The present study intensively screened the DVT and analyzed the effect of active ankle exercise on preventing DVT. The current study found that more than 70% of the participants had a moderate to high probability of developing DVT. Amongst 70% of the participants, the majority were lower extremity and hip fractures, postoperative patients including major abdominal and orthopedic surgery, and critically ill. The finding also demonstrates that active ankle exercise is statistically significant in preventing DVT.

This finding is consistent with the study findings of Zhe Wang et al. proved that active ankle movement is effective in preventing the formation of DVT after lower limb surgery by enhancing the maximum venous outflow and venous capacity and alleviating the swelling [25]. Kenta Tanaka et al. also proposed that the leg exercise protocol may serve as a new DVT prevention tool as it increases vessel diameter and venous blood flow of lower legs [26]. Similarly, Ye Li et al. also found that active ankle movements maximize the maximum venous outflow (MVO) and maximum venous capacity (MVC), which prevents the formation of lower-extremity DVT after orthopedic surgery and helps to quicken postoperative recovery [27]. The present study lacks in measuring blood rheology, which provides strong scientific evidence for the study. Similarly, Rohit Prasad V observed the compliance of active ankle pump exercises from the first postoperative day onwards and found good adherence among post-orthopedic hip surgery patients [28]. The current study also found a cent percent compliance among bedridden patients.

Furthermore, Arun Thachil et al. demonstrated with bedside ankle active exercise monitoring device among the post-surgical geriatric population. They found that the device is significantly effective in preventing DVT and suggested that it could also be used for bedridden risk groups [29]. Concordantly, Yukiyo Shimizu et al. also proved that novel leg exercise of slow speeds and combined motion effectively improves flow volume, thereby preventing thromboembolism in postoperative and bedridden patients [30]. Kanami Kobayashi et al., suggested that in-bed leg exercise may be included along with other mechanical thromboprophylaxis of compression stockings and intermittent pneumatic compression devices for the prevention of symptomatic venous thromboembolism among patients with bedridden spinal disease [31].

Multiple studies have drawn conclusions from post-orthopedic surgery populations; nevertheless, specific studies on bedridden patients have small numbers on other particular conditions. Though the present study significantly prevents DVT, few recommendations were made to conduct further studies. A similar study may be conducted with large samples, compared with matching exercises, and intervened in the same intervention for patients with complaints of DVT by measuring blood rheology for a better understanding of scientific evidence and includes this strategy in policies and procedures regarding thromboprophylaxis.

CONCLUSION

The study findings concluded that active ankle exercise effectively prevents deep vein thrombosis among bedridden patients. Hence this interventional strategy may include the prevention of DVT protocol in the hospital and may be taught to the caregivers of bedridden patients as part of home care management. However, this research recommends replicating with larger sample sizes to design the intervention and generalize findings.

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