

# The Effect of Training and Use of Graduated Compression Stockings in Surgery Patients

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## Abstract

**Introduction:** The risk of developing deep vein thrombosis is very high among the surgery patients if appropriate precautions are not taken. Graduated compression stockings, that are used to prevent deep vein thrombosis, may threaten patient's safety if they are not used properly. This study was carried out to examine the use of graduated compression stockings in surgery patients and the effect of training given about deep vein thrombosis in a cross sectional and semi-experimental design.

**Methods:** The study was conducted in General Surgery, Brain Surgery and Urology Clinics of a Healthcare Practice and Research Center located in the western Black Sea region between February 2017 and February 2018. Sample of the study was composed of a total of 166 patients who were assigned to both groups randomly. Patients in Group I were given training about deep vein thrombosis during preoperative period; and patients included in Group II were provided routine nursing care in the clinics. The use of graduated compression stockings by the patients and the problems they experienced were evaluated within the first 48 hours following surgery. Descriptive tests, the Kolmogorov Smirnov test, Independent-samples t test, Mann Whitney U test, Pearson, Yates and Fisher exact chi-square tests and McNemar test were used for statistical analyses.

**Results:** The risk of deep vein thrombosis was found to be comparable between both patient groups during preoperative assessment. It was determined that all of the patients who were given training about deep vein thrombosis used graduated compression stockings, and 33.7% of the patients who got routine care did not know how to use them. The problems of itching ( $p=0.729$ ) and sweating ( $p=0.225$ ) were found to be experienced by both groups. It was also observed that graduated compression stockings slid downwards ( $p=0.001$ ) and redness ( $p=0.001$ ) occurred in the patients group who got routine care.

**Conclusion:** The training provided by the nurses had a positive effect on the adjustment to the use of graduated compression stockings among the patients who underwent surgical intervention. Providing training to the patients is suggested to be crucial in order to provide an efficient and reliable care to the surgery patients who are under risk for deep vein thrombosis, and it is important not to neglect it.

**Keywords:** Venous Thrombosis, Stockings, Patient Education, Nursing Care

## Introduction

Deep vein thrombosis (DVT) is a disease characterized by the generation of thrombus in deep veins of the body. Venous thromboembolism (VTE), that appears as DVT and pulmonary embolism (PE), is an

important health problem which is commonly observed in the world and presents high morbidity and mortality rates (1,2). Although DVT is a preventable cause of death, it is responsible for nearly 10% of hospital deaths. It has been reported that DVT diagnoses were

made for approximately 600.000 patients who admitted to the hospitals in America each year; and PE developed in 50.000 to 200.000 of these patients (2). When DVT develops, it causes death among the patients by causing PE during acute period; and causes a significant impairment in the life quality of the patients due to chronic pulmonary hypertension, post-thrombotic syndrome and repeated venous thromboembolies during chronic period (3, 4). The risk for DVT increases under the circumstances such as advanced age, sedentary lifestyle, a previous history of DVT, cancer treatment, obesity, varicosis, cardiac failure, surgical intervention, inflammatory intestinal disorder and pregnancy. Besides, the type and duration of surgical procedure, anesthesia method and the duration of immobility following the operation are among the other circumstances that significantly increase the risk for DVT (4,5). Pharmacological and non-pharmacological methods are used to prevent DVT. These methods aim to prevent the generation of thrombus, to decrease complications of emboli, to restore clinical picture and to prevent recurrence (5,6). Standard heparin, low molecular weight heparins, fondaparinux and varfarin are included among pharmacological methods. Nonpharmacological methods include standing at early postoperative period, foot elevation, lower extremity active range of motion (ROM) exercises, intermittent pneumatic compression device, active-passive movements, provision of hydration and graduated compression stockings (5-7). It is recommended to use graduated compression stockings for surgery patients who are at moderate and high risk besides pharmacological therapy (2,7). Graduated compression stockings (GCS) decrease vascular pressure by narrowing vessel diameter; and besides, they prevent venous stasis and thrombus by increasing venous return (8,9). The efficiency of GCS in treatment depends on the pressure they apply on the legs. The pressures of the stockings were designed as the highest on the ankle, as low on calf and as the lowest on femur in

order to aid bloodstream dynamics more. Thus, bloodstream is directed from upside down by applying pressure on the ankle more than calf and on the calf more than femur (10,11). Patient compliance is very important to enhance efficiency in DVT prophylaxis. Promotion of compliance is parallel with the patient's awareness. All healthcare professionals including particularly nurses have significant responsibilities in patient's training. It has been shown that compliances of the patients to treatment and care were increased when they were provided training by the nurses (12). The awareness of the patients regarding DVT symptoms and signs was found to be enhanced; and participation of the patient for protective methods was provided through training (13). It was also observed that training of the patients and their families by the nurses regarding DVT symptoms and signs, risk factors, protective measures, arrangements that may be made for lifestyle, the purpose of using GCS and situations to be considered during the use of GCS was important for decreasing mortality and morbidity (7,13). The aim of this study was to evaluate the effect of training given for DVT and use of graduated compression stockings in surgery patients.

## Methods

This was a cross-sectional and semi-experimental study. This study was carried out in General Surgery, Brain Surgery and Urology Clinics of a Health Practice and Research Center located in Western Black Sea Region between February 2017 and February 2018. In these clinics, a nurse was providing care to a mean of 7 to 11 patients. Patients were hospitalized one day before the surgery for planned operations. All patients, who underwent big and small surgical interventions in the clinic, were provided to use over-the-knee stockings until they reached to their mobility level before the operation. The sample size required for the study was found to be 166 patients at minimum including an effect size of 0.4, a test power of 82% and a

confidence interval of 95% for two independent samples. Therefore, sample group included 166 patients who were selected by weighted stratified random sampling based on the clinics. The first patient who assigned to the sample group was determined by lot using simple random method. Then, patients were classified as Group I who underwent DVT training (n=83) and Group II who got routine care (n=83). The criteria for inclusion in the study were as follows: being over 18 years old, speaking and understanding Turkish, accepting voluntarily to participate in the research, being hospitalized at least 24 hours before surgery, when hospitalized for at least two days after surgery and patients who have sustained the use of graduated compression stockings during operation and after surgery. The criteria for exclusion in the study were as follows: don't speaking and understanding Turkish, no voluntary participation in the research, no hospitalization before surgery, no hospitalization for at least two days after surgery and patients who do not wear graduated compression stockings during and after surgery. Personal information form, which was developed by the researchers, and Results Form for the Use of GCS were used to collect data. Personal information form was composed of information regarding sociodemographic characteristics of the patients and for determining DVT risk. Postoperative GCS use of the patients, their thoughts about this subject, the problems they experienced and the level of their satisfaction were assessed by Results Form for the Use of GCS. Patients included in Group I were given information about DVT and protective methods through a training brochure that was prepared in the morning of preoperative day 1. Leg circumference measurements were made; and a suitable size of over-the-knee GCS were given to the patients. Lower extremity active range of motion (ROM) exercises and use of stockings were demonstrated in practice. Trainings were given individually and lasted for an average of 25-30 minutes for each patient. Patients included in Group II were

given over-the-knee GCS by the nurses working in the clinic through routine clinical practice. Skin control was made among the patients in both groups by taking off graduated compression stockings within the first 48 hours following the surgery; and existing problems were recorded. Practices of the patients during GCS use were evaluated. Necessary precautions (such as fixing the curls of GCS) were taken in order to prevent a possible damage to the patients if there were some misapplications observed. IBM SPSS statistics for Windows version 19.0 was used for statistical analysis. Descriptive statistics and their conformity to normal distribution were assessed by the Kolmogorov Smirnov test. Mann Whitney U test, Independent-samples t test, Pearson, Yates and Fisher exact chi-square tests were used to compare groups. All statistical analyses were accepted as significant with a p value below 0.05 and within a confidence interval of 95%.

## Results

Regarding descriptive characteristics of the patients in Group I and Group II, mean age was 58.72±12.62 and 59.40±13.23 years old; 50.6% and 55% were women; 65.1% and 63.9% were elementary school graduates; 49.4% and 50.6% were housewives; 43.4% and 39.8% were overweight; 66.3% and 59% were hospitalized in general surgery department; 56.6% and 65.1% were not smoking; 81.9% and 77.1% had a previous history of cancer; 73.5% and 62.7% did not have an appearance of varicose vein and 63.9% and 60.2% had a chronic disease, respectively. Both groups showed similar characteristics in terms of patient characteristics and risk factors according to the Chi-Square tests ( $p>0.05$ ) (Table 1). Within the first 48 hours during postoperative period, knowledge, thoughts and experiences of the patients regarding the use of GCS were evaluated. Accordingly, it was determined that all of the patients in Group I knew the purpose of using GCS and how to use them properly whereas 96.4% of the patients in Group II used

them as a requirement for surgery and 33.7% did not know how to use them. The difference between the groups was found to be statistically significant according to the Chi-Square tests ( $p < 0.05$ ). The most common problems experienced were determined as wearing GCS among 44.6% and 47% and taking them off among 20.5% and 21.7% in Group I and Group II, respectively (Table 2). Patient compliance and their satisfaction states were evaluated for the use of GCS. While it was determined that all patients in group I wore GCS by an appropriate technique, did skin control, took care not to curl them and placed heel region properly, it was observed in Group II that only 1.2% of the patients wore them by an appropriate technique, none of them did skin control, 98.8% did not take care not to curl them and 55.4% did not place heel region properly. When satisfaction levels of the patients regarding GCS were evaluated (by scoring between 0-10), the scores were found to be  $9.13 \pm 0.69$  in Group I and  $6.80 \pm 1.01$  in Group II. The difference between the groups was determined to be statistically significant according to the independent-samples t test ( $p < 0.05$ ). (Table 3). When the problems experienced by the patients within the first 48 hours following operation were evaluated, the most common problems were found to be burning in 57.8% and 32.5%; itching in 26.5% and 28.9%; redness in 1.2% and 63.9%; sliding of GCS downwards in 2.4% and 51.8%; and sweating in 32.5% and 22.9% for Group I and II, respectively. The feeling of burning was found to be experienced more significantly in Group I whereas redness and sliding of GCS downwards were found to be significant in Group II according to the Chi-Square tests ( $p < 0.05$ ). Tourniquet effect was not observed in both groups (Table 4).

### Discussion

DVT is a preventable cause of death that is frequently observed in hospitalized patients. Its incidence increases after 45 years old; and it is more commonly seen among men compared to women at advanced ages (3). In this study, it was determined that sex ratios

were similar; but, mean age of the patients created risk for DVT. Many factors generate risk for the development of DVT. The most common risk factors are surgical interventions, individual and/or familial history of VTE, obesity and smoking, history of cancer, appearance of varicose vein and chronic diseases (5,14,15). The presence of a high percentage of patients having a chronic disease and a history of cancer besides the surgical intervention indicated a high risk for DVT in this study and showed the necessity of implementing protective measures carefully. Using GCS, that are used for decreasing DVT risk, is the most often preferred method after the application of anticoagulant medications. GCS increase bloodstream in deep veins by canalizing the flow of blood in the superficial veins towards deep veins (16,17). In a previous study, it was reported that GCS reduced the rate of DVT by 60% when used alone, and provided efficiency up to 85% when used in combination with a pharmacological or nonpharmacological method (7). Nurses have very important roles and responsibilities in the application of GCS safely. Patient training is the leading one among these responsibilities. In a study performed, it was indicated that most of the patients using GCS did not know how to use them and they needed knowledge especially regarding taking the stockings off (13). In the study by Ozkan *et al.*, it was determined that 40% of the patients did not know the purpose of using GCS; and this ratio was found to be 20% in the study by Winslow *et al.* (9,18). When patients were trained by the nurses, it was revealed that 80% of the patients expressed the purpose of using GCS properly (18). In this study, it was observed that all of the patients in Group I, which was given training, knew the purpose and way of wearing GCS; and 66.3% of the patients in Group II considered the purpose of wearing GCS as a requirement for operation and only 33.7% knew how to use them. It was determined that training made a significant contribution for knowledge and use of GCS as desired. GCS

Table 1. Patient Characteristics

Characteristics		GROUP I		GROUP II		Chi-Square Test	P
		DVT training		Routine care			
		n	%	n	%		
<b>Age group</b>	18-40 years	7	8.4	8	9.6	$\chi^2=1.658^*$	0.64
	41-60 years	38	45.8	35	42.2		
	61-75 years	31	37.3	28	33.7		
	76 years and older	7	8.4	12	14.5		
<b>Sex</b>	Women	42	50.6	46	55.4	$\chi^2=0.387^*$	0.53
	Men	41	49.4	37	44.6		
<b>Education level</b>	Illiterate	6	7.2	2	2.4	$\chi^2=3.706^*$	0.44
	Literate	1	1.2	3	3.6		
	Elementary school	54	65.1	53	63.9		
	Secondary school	20	24.1	24	28.9		
	Higher education	2	2.4	1	1.2		
<b>Occupation</b>	Retired	33	39.8	31	37.3	$\chi^2=3.741^*$	0.44
	Housewife	41	49.4	42	50.6		
	Officer	2	2.4	2	2.4		
	Worker	1	1.2	5	6		
	Freelance	6	7.2	3	3.6		
<b>Classification of BMI</b>	Underweight	2	2.4	2	2.4	$\chi^2=0.880^*$	0.92
	Normal weight	22	26.5	24	28.9		
	Overweight	36	43.4	33	39.8		
	Obese	16	19.3	14	16.9		
	Over obese	7	8.4	10	12.0		
<b>Surgical clinics</b>	General surgery	55	66.3	49	59.0	$\chi^2=1.004^*$	0.60
	Brain surgery	15	18.1	17	20.5		
	Urology	13	15.7	17	20.5		
<b>State of smoking</b>	Yes	5	6	8	9.6	$\chi^2=3.101^*$	0.21
	No	47	56.6	54	65.1		
	Quitted (before 3 weeks at least)	31	37.3	21	25.3		
<b>History of cancer</b>	Yes	68	81.9	64	77.1	Yates Chi-Square Test	0.56
	No	15	18.1	19	22.9		
<b>Familial history of DVT/PE</b>	Yes	-	-	2	2.4	Fisher's Exact Test	0.49
	No	83	100	81	97.6		
<b>Appearance of varicose vein</b>	Yes	22	26.5	31	37.3	$\chi^2=2.245^*$	0.13
	No	61	73.5	52	62.7		
<b>Presence of a chronic disease</b>	Yes	53	63.9	50	60.2	$\chi^2=0.230^*$	0.63
	No	30	36.1	33	39.8		

**Table 2.** Comparison of Knowledge, Thoughts and Experiences of the Patients

Characteristics	GROUP I DVT training		GROUP II Routine care		Chi-Square Test	p
	n	%	n	%		
<b>State of knowing the purpose of wearing GCS</b>						
Yes	83	100	55	66.3	Yates Chi-Square Test	0.01
No	-	-	28	33.7		
<b>Thoughts regarding the purpose of wearing GCS</b>						
Maintaining blood flow	67	80.7	1	1.8	$\chi^2=129.96^*$	0.001
Preventing blood clots	16	19.3	1	1.8		
Requirement for operation	-	-	53	96.4		
<b>State of knowing how to use GCS</b>						
Yes	83	100	28	33.7	Yates Chi-Square Test	0.001
No	-	-	55	66.3		
<b>State of experiencing an adverse situation during GCS use</b>						
Yes	37	44.6	39	47	Yates Chi-Square Test	0.856
No	46	55.4	44	53		
<b>Difficulty in wearing</b>						
Yes	37	44.6	39	47	$\chi^2=0.097^*$	0.755
No	46	55.4	44	53		
<b>Difficulty in taking off</b>						
Yes	17	20.5	18	21.7	Yates Ki-Kare Test	1
No	66	79.5	65	78.3		

**Table 3.** Compliance and Satisfaction of Patients regarding GCS use

Characteristics	GROUP I DVT training		GROUP II Routine care		Chi-Square Test/ Independent-samples t test	P
	n	%	n	%		
<b>Wearing by an appropriate technique</b>						
Yes	83	100	1	1.2	Yates Chi-Square Test	0.001
No	-	-	82	98.8		
<b>Doing skin control</b>						
Yes	83	100	-	-	Yates Chi-Square Test	0.001
No	-	-	83	100		
<b>Taking care on curling</b>						
Yes	83	100	1	1.2	Yates Chi-Square Test	0.001
No	-	-	82	98.8		
<b>Placing heel region properly</b>						
Yes	83	100	37	44.6	Yates Chi-Square Test	0.001
No	-	-	46	55.4		
<b>Satisfaction on GCS use</b>						
	<b>X±SD</b>		<b>X±SD</b>		$Z=-10.623$	0.001
	9.13±0.69 Min:7 Max:10		6.80±1.01 Min:4 Max:9			

**Table 4.** Problems experienced by the patients regarding the use of graduated compression stockings within the first 48 hours following operation

Characteristics	GROUP I DVT training		GROUP II Routine care		Chi-Square Test	P
	n	%	n	%		
	<b>Burning</b>	Yes	48	57.8		
	No	35	42.2	56	67.5	
<b>Itching</b>	Yes	22	26.5	24	28.9	$\chi^2=0.120^*$ 0.729
	No	61	73.5	59	71.1	
<b>Redness</b>	Yes	1	1.2	53	63.9	Yates Chi-Square Test 0.001
	No	82	98.8	30	36.1	
<b>Sliding of GCS down</b>	Yes	2	2.4	43	51.8	Yates Chi-Square Test 0.001
	No	81	97.6	40	48.2	
<b>Sweating</b>	Yes	27	32.5	19	22.9	Yates Chi-Square Test 0.225
	No	56	67.5	64	77.1	
<b>Tourniquet effect</b>	Yes	-	-	-	-	Fisher's Exact Test 1
	No	83	100	83	100	

function by a pressure at varying degrees starting from ankle to its endpoint. The highest pressure is on the ankle and this pressure decreases upwards. This pressure difference causes a difficulty in the use of GCS by the patients (7,17). At the end of this study, difficulties were observed in wearing and taking off GCS in both groups at similar rates. It is highly important to wear GCS properly, not to curl them, to make daily skin control and to identify right size (19). The necessity of following GCS use and helping about their proper use was introduced as an A level evidence in evidence-based studies (17). In the study by Ozkan *et al.*, it was found that 82.7% of the patients did not make skin control, 1.3% did not place heel properly and 48% did not care about curling of the stockings (18). In this study, it was observed that all of the patients in Group I used GCS properly at the end of

training given. On the contrary, it was determined that almost all of the patients in Group II, which was provided care in accordance with clinical routine practices, did not use GCS properly. In this respect, it was concluded that training given to the patients was effective. Problems such as improper size of GCS, development of edema and curling of the stockings downwards create a contraindicated situation for the patient. This situation causes tourniquet effect and results in skin injury; and compromises effective use of the stockings. It has been reported that over-the-knee GCS limited patient toleration and comfort; and patient compliance has been reported to be poor for that reason (20). Due to the synthetic and slippery nature of GCS, they can slip downwards (21). In this study, it was determined that the feeling of burning was significantly more among the patients who got

training about DVT within the first 48 hours following operation; and it was determined that redness and sliding of GCS downwards were significantly higher in the patient group that underwent routine care. At the end of the study which was performed by Winslov *et al.*, it was stated that 26% of the patients were made to wear oversize GCS; and the most common problems experienced were sliding of the stockings downwards as rolling, generation of a pressure as creating a circle on the skin and their loose nature (9). The prevalence of GCS-derived pressure sores that were generated on the extremities of the patients, who were hospitalized in surgical intensive care, was reported to be 31% (22). In the previous studies, it was found that itching was very common among the patients using GCS; and as a result of this, these patients did not want to use them and took them off (18, 23). In the study by Yilmaz *et al.*, 11.5% of the patients were found to have complaints associated with sweating of the legs due to GCS (24). It has been also indicated that over-the-knee GCS resulted in a folding on popliteal fossa by sliding downwards during their use; and due to the tourniquet effect they created, both venous and arterial blood pressures might have been affected adversely (21, 22). At the end of evaluation made within the first 48 hours following operation in this study, it was found that itching and sweating were detected among the patients at varying ratios from 19% to 27%; but no tourniquet effect was observed. Participation of the patients in care activities and provision of their compliance are highly important in the maintenance of effective healthcare. Training is an essential instrument in providing patient compliance (25, 26). Geerts *et al.* have concluded that GCS application could not be made effectively during routine practice; and Xu *et al.* have concluded that healthcare professionals had positive attitudes towards GCS use in clinical practice, but their knowledge and behaviors were inadequate (5, 27). In another study, it was emphasized that nurses had a better knowledge level regarding

GCS use; therefore, they would be more effective in instructing patients (13). In this study, it was determined that patients who got training about DVT used GCS more consciously; and their satisfaction level was significantly higher. The results of this study reflect only a 48-hour post-operative time. There is a need for studies showing longer postoperative follow-up. The results are limited to the institution in which the study is conducted and cannot be interpreted in general.

### Conclusions

It was determined that compliance and satisfaction for GCS use were high in the patient group which got training about DVT during preoperative period. Patient training, that is one of the roles and responsibilities of the nurses, can be used effectively in surgery patients in order to prevent DVT. Patient compliance regarding GCS use can be provided more easily in this way. Awareness of all healthcare professionals, particularly nurses, on the use of GCS in preventing DVT should be enhanced. Due to high pressure nature of GCS, patients may experience problems such as itching and sweating. It is required to conduct studies on new textile products in order to minimize these problems.

### Ethical issues

Ethics approval for the study was obtained from non-Interventional Clinical Research Ethics Committee of Kocaeli University (Date:05.10.2016; No: 2016/16.4). A written authorization was taken from Head Physician of Health Practice and Research Center. Patients were provided instructions about the aim and process of the study; and they gave written informed consents based on a voluntary basis.

### Authors' contributions

Study conception and design: EK, AŞ; Data collection: AŞ; Data analysis and interpretation: AŞ, EK; Drafting of the article:

AŞ, EK Critical revision of the article: EK, AŞ.

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