

ORIGINAL PAPER**Investigate of Eligibility Usage of Graduated Compression Stockings****Elif Dirimese, MSc. RN**

Department of Surgery Nursing, School of Nursing Ege University; Bornova, İzmir, Turkey

Meryem Yavuz, PhD. RN

Department of Surgery Nursing, School of Nursing Ege University; Bornova, İzmir, Turkey

Birgül Nurulke, MSc

Department of Surgery Nursing, School of Nursing Ege University; Bornova, İzmir, Turkey

Corresponding Author: Elif Dirimese Department of Surgery Nursing, School of Nursing Ege University; Bornova, İzmir, Turkey 35100 **Email:** elifim67@gmail.com**Abstract****Background:** Venous Thromboembolism is common cause of morbidity and mortality. Graduated compression stockings to reduce venous thromboembolism is one of the most frequently applied methods. Graduated compression stockings unless there are contraindications safely when used correctly.**Objective:** This study examined appropriateness of use of graduated compression stockings.**Methodology:** The study was run in the University Hospital and Clinics of Urology and Orthopedics. Sample of the study 114 patients were enrolled. A questionnaire developed by researchers in data collection were used. Analysis of data, number, percentage, chi-square test was performed.**Results:** The patients of 77.5% graduated compression stockings for the use of compressed information from the health team, 58.8% of showed they know how to use graduated compression stockings. The patients of 29.8% experienced difficulty was the use of graduated compression stockings.

The patients of 96.5% the stocking size was appropriate, 92.1% of the patients worn correctly, 30.7% of the patients took off the stockings daily and examined the skin, 21.9% experienced wrinkling and gliding of the stocking, 19.3 % experienced a curling up of stocking, which created a tourniquet effect. 32.5 % experienced heat increase in both legs, 30.7% experienced itching, 11.4% experienced sensitiveness, 8.8% experienced erythema and numbness.

Conclusion: As a result of this study is the appropriate use of graduated pressure stockings, but because of deficiencies in patient education were experiencing some problems.**Key Words:** Venous Thrombosis, compression stockings, venous thromboembolism**Introduction**

Venous Thromboembolism (VTE) that is manifested as Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) represents a significant cause of death and is internationally known as a silent killer (Autar 2009). VTE and its complications are a common cause of morbidity and mortality in the United States (AHRQ 2003). Within hospitals, PE is the third leading cause of death and the number one cause of preventable mortality in hospitalized patients (Gilpin 2007) Researchers have estimated

that the average annual incidence of isolated DVT is 50 per 100,000 people and for PE, with or without DVT, the incidence is 70 per 100,000 (AHRQ 2003). Deep vein thrombosis is itself a distressing but often avoidable condition that leads to long-term complications such as the postthrombotic syndrome and chronic leg ulcers in a large proportion of patients who have proximal vein thrombosis (Anderson and Audet 1998). The International Consensus Statement stated that approximately 25% of patients who have in the past suffered from deep

vein thrombosis would later in life develop the debilitating condition of venous leg ulceration. They estimated that the annual costs of the treating venous leg ulcers in the UK were in the region of £400 million (House of Commons Health Committee 2005)

Prevention of venous thromboembolism (VTE), a combination of DVT and PE, is more effective than treatment and is an important aspect of patient care before, during, and after surgery (AORN 2010). Without thromboprophylaxis, the incidence of objectively confirmed, hospital-acquired DVT is approximately 10 to 40% among medical or general surgical patients and 40 to 60% following major orthopedic surgery (Geerts *et al.* 2008).

Virchow's triad describes the three main causative factors in DVT formation: endothelial damage, hypercoagulability, and venous stasis. The following conditions all can contribute to these causative factors and result in DVT (AORN 2010, Autar 2009). The goal of prophylaxis in patients with risk factors for DVT is to prevent both its occurrence and its consequences, mainly pulmonary emboli and post-phlebotic syndrome. (AORN 2010).

Multiple healthcare organizations such as the National Quality Forum, the Joint Commission on Accreditation of Healthcare Organizations, and the Agency for Healthcare Research and Quality have now identified VTE as a preventable condition in hospitalized patients; therefore, it is necessary that formal risk assessment be conducted as a first step, followed by the initiation of timely prophylaxis to improve patient safety (AHRQ 2008, ICSI, 2008, Flink *et al.* 2002). Surgical patients with at least 24 hours before and after surgery to prevent DVT appropriate preventive methods should be applied (Michota 2007).

Preventative treatments can include early ambulation, graduated compression stockings, pneumatic compression devices, anticoagulants, and blood-thinner drugs, such as low-molecular-weight heparin, unfractionated heparin, and warfarin sodium (Gilpin 2007; AHRQ 2008).

Background

Graduated compression stockings to reduce post-operative deep vein thrombosis and pulmonary embolism in hospitalized patients is one of the most frequently applied methods. Graduated compression stockings attempt to prevent DVT by affecting the three aetiological factors, venous stasis, vessel injury and coagulation. External compression reduces the cross sectional area of the limb and increases the

velocity of blood flow in both superficial and deep veins.

This increased velocity of blood reduces venous stasis and decreases the risk of thrombus formation by reducing venous wall distension, local contact time, and the concentration of coagulation reactants. External compression also improves venous valve function, reducing stasis of blood in the cusps (Autar 2009; Best practice 2001; Walker and Lamont 2008). Graduated pressure refers to the application of varying degrees of pressure, with pressure greatest at the ankle and decreasing proximally. The stocking compression profile should be equivalent to the Sigel Profile, and approximately 18 mmHg at the ankle, 14 mmHg at the mid-calf and 8 mmHg at the upper thigh (Autar 2007). This pressure interval improves venous return and reduces venous stasis (Autar 2009). The products are inexpensive and re-use of graduated compression stockings. Unless there are contraindications safely when used correctly (Amaragiri and Lees 2000; Morrison 2006).

A Cochrane review found that graduated graduated compression stockings were effective in reducing rates of DVT for general medical and surgical patients whether they were used alone or in addition to other DVT prophylaxis. In nine studies comparing graduated compression stockings with no prophylaxis, rates of DVT were reduced from 27% to 13%, and in seven studies the addition of the stockings to background prophylaxis further reduced DVT rates from 15% to 2%. (Amaragiri and Lees 2000)

The evidence-based practice information sheet from the Joanna Briggs Institute (2008) includes the following recommendations for managing patients with graduated compression stockings:

1. Measure and fit graduated compression stockings according to the manufacturer's recommendation.
2. Document leg measurements and stocking size to serve as a baseline.
3. Review leg measurements regularly to avoid complications resulting from leg swelling that causes excessive pressure from the stockings.
4. Remove the stockings at least once a day to perform skin care and assess the skin.
5. Check stockings regularly to ensure correct usage and that there is no restriction of perfusion.
6. Check neurovascular status regularly using the inspection window in the toes of the stockings.
7. Monitor patients when they're sitting up to ensure that the stockings are not acting as a tourniquet.

8. Educate the patient on the purpose and correct application and fit of the stockings and on proper care of the skin.

9. Educate health care workers to ensure proper usage of the stockings.

Healthcare professionals should give patients verbal and written information, before surgery, about the risks of DVT and the effectiveness of prophylaxis. (Autar 2007) Health care professionals can implement several prophylactic measures, both pharmacological and nonpharmacological, in the prevention of VTE. Preoperative measures include the patient's use of graduated compression stockings and their continued use until the patient is discharged. Patients using graduated compression stockings should be shown how to wear them correctly by healthcare professionals trained in the use of that product. Stocking use should be monitored and assistance provided if they are not being worn correctly. Healthcare professionals should encourage patients to mobilize as soon as possible after surgery (Joanna Briggs Institute 2008; Morrison 2006).

Fortunately, pharmacologic and nonpharmacologic methods to prevent DVT are safe, effective, cost-effective, and advocated by authoritative guidelines. Yet, despite the reality that hospitalized medical and surgical patients routinely have multiple risk factors for VTE, making the risk for VTE nearly universal among inpatients, large prospective studies continue to demonstrate that these preventive methods are significantly underutilized. (AHRQ 2008) Perioperative or primary prophylactic therapy in patients with risk factors for DVT or PE involves their prevention, if possible. If preventive measures are unsuccessful, the goal is to reduce the consequences of DVT or PE. Use the results of studies on the graduated compression stockings are not available in Turkey. Graduated compression stockings are used to understand why the patients, to know how to use the right to use, evaluate the status and satisfaction is very important to know their difficulties. The results of this study, the prevention of DVT for patients and health care team in the future, training programs will shed light on the use of graduated compression stockings.

The purposes of the current study were to investigate of eligibility usage of graduated compression stockings, in hospitalized postoperative patients.

Methods

Date and Place of the Research: The study was run in the urology and orthopaedics' units of a university hospital, between the dates March 2010 and January 2011.

The Sample of the Research: The sample of the study consisted of 114 patients over 18 ages who wore graduated compression stockings after an operation and were willing to participate to the research.

Tool Used for Collecting the Data: In this research, a survey form which was prepared according to the associated medical literature by the researchers was used to obtain the data. In the survey, the patients' demographic features, their use of stockings, a control list in which the use of stockings were assessed and neurovascular condition assessment all takes a part. By the questions asked to the patients, we got acknowledged about why the patient was using the graduated compression stockings, if he/she knew how to use it, the problems they face while using it and their contentment with it. In the control list that had been effectuated it was checked if the stockings was convenient for the patient, if there was any gliding, wrinkle or curling up and whether the patient knew how to perform a skin assessment of not. In the neurovascular assessment it was checked separately for each leg that whether there was any pain, oedema, heat, sensitiveness, erythema, change of colour, pulse, capillary storage, sensation and movement. The survey was consisted of 31 questions in total.

Evaluation of the Data: The data was evaluated by using SPSS 16.00 program. In the statistical analysis, number and chi-square tests were used.

Ethical Explanation: In order to run the study, a scientific ethical permission was gained from a local committee of ethics (B.30.2 EGE.0.82.00.00/21-299), and a written permission (B.30.2 EGE.0.82.00.00/522) was gained from the university hospital where the study was carried out.

An verbal informed consent was taken from the patients participating to the study, after explaining the purpose of the study to them.

Results

When the demographic properties of the patients were inspected, it was found that 32.5% (n=37) of them were female, 67.2 % (n=77) were male, 40.4 % (n=46) were primary school graduates and 37.7 % (n=43) were retired. The mean value for the ages of the patients were 57.93 ± 13.24 (min: 22 max:88).

Table 1. Patient and study characteristics

Descriptor	N	%
Gender		
Male	77	67.5
Female	37	32.5
Education		
Illiterate	6	5.3
Literate	14	12.3
Primary education	46	40.4
Secondary education	30	26.3
Higher education	18	15.8
Occupation		
Retired	43	37.7
Housewife	27	23.7
Office holder	14	12.3
Worker	14	12.3
Unanswered	14	12.3
Self-employed	2	1.8
Clinics		
Urology clinic	86	75.4
Orthopaedics clinic	28	24.6
Type of operation		
Closed urologic operations	50	43.9
Open urologic operations	36	31.6
Knee surgeries	18	15.8
Hip surgeries	10	8.8
Stocking type		
Knee-lenght	59	51.8
Thigh-lenght	55	48.2
Total	114	100.0

It was found that 75.4 % of the patients (n=86) were in the urology clinic of the hospital, and 24.6 % of the patients (n=28) were in the orthopaedics clinic of the hospital. When the surgical operations applied to the patients were investigated, it was found that 43.9 % (n=50) were closed urologic operations, 31.6 % (n=36) were open urologic operations, 15.8% (n=18) were knee surgeries and 8.8% (n=10) were hip surgeries. It was found that 51.8 % of the patients (n=59) wore knee lenght stockings, 48.2 % of the patients (n=55) wore thigh lenght stockings (Table 1).

When the contentment status of the patients about the use of the graduated compression stockings were investigated, it was seen that 72.5 % (n=83) were content with it, on the other hand, 27.1 % (n= 31) were not content with it (Table 2).

When the graduated compression stockings use was evaluated, it was seen that in 96.5 % (n= 110) of the patients the stocking size was When the knowledge and behaviour of the patients towards the graduated compression stockings were investigated, it was seen that 36% (n=41) knew why they needed to use it; 46.9 % (n=69) got that knowledge from the doctors and 30.6 % (n=45) got it from the nurses.

It was found that 29.8 % (n=34) of the patients had hardships about using the stockings, and that hardship was faced while appropriate, 92.1% (n=105) of the patients wore the stockings right, 71.1% (n=81) wore it at least two hours before the surgery, in 80.7% (n=92) it was made sure that the stocking stayed put on the patients legs, 30.7 % of the patients (n=35) took off the stockings daily and examined the skin, 21.9 % (n=25) experienced wrinkling and gliding of the stocking, 19.3 % (n=22) experienced a curling up of stocking, which created a tourniquet effect (Table 3).

The legs of the patients were evaluated for the findings that are important to watch while using the graduated compression stockings. According to that, it was found that; average of pain existence in right leg was 1.23±1.80 , in left leg it was 1.28±1.93 (1-10 numeric scale); 32.5 % (n=37) experienced heat increase in both legs, 30.7% (n=35) experienced itching, 14.9% (n=17) experienced oedema, 11.4% (n=13) experienced sensitiveness, 8.8% (n=10) experienced erythema and numbness, 3.5% (n=4) experienced change of colour and 2.6% (n=3) experienced disruption in tissue integrity (Table 4). There wasn't any limitations in the patients' pulse, capillary storage, sensation and movement.

In the groups separated according to the type of the surgery, it was seen that in the knee surgery group, the percentage of wearing the graduated compression stockings at least two hours before the surgery ($X^2=58.14$, $p=0.00$) and the percentage of keeping the stockings on during the surgery ($X^2=89.88$, $p=0.00$) was statistically less than the percentages of the other groups.

Table 2. Patient Responses Used For Graduated Compression Stockings

Patient Responses	N	%
Knowledge of the purpose of the stockings		
Knowing	41	36.0
Unknowning	37	32.5
Partial knowing	36	31.5
The necessity of knowing how to use +		
Knowing	67	58.8
Unknowning	14	12.3
Partial knowing	33	28.9
Sources of information *		
Doctor	69	46.9
Nurse	45	30.6
Booklet	15	10.3
Nowhere	11	7.5
Family, friends	4	2.7
Another patients	2	1.4
TV, newspaper	1	0.6
Difficulty in use +		
Yes	34	29.8
No	80	70.2
What about the difficulty experienced *		
Wearing	26	66.7
Remove	7	17.9
Movement restrictions	6	15.4
Satisfaction with stockings +		
Satisfaction	83	72.8
Dissatisfaction	31	27.1

+N=114 patient

* More than one response allowed.

In the open urologic operation group, wrinkling and gliding percentage of the stocking ($X^2=14.58$, $p=0.00$) and the percentage for curling up and creating a tourniquet effect ($X^2=13.34$, $p=0.00$) was higher than the percentages of the other groups, in a statistically meaningful way.

No difference was detected among the groups in fitness of the size of the stocking to the patient ($p=0.9$), wearing the stocking right ($p=0.08$), taking off the stocking daily and performing a skin assessment ($p=0.08$).

It was seen that no statistical difference existed among fitness of the size to the patient according to the stocking length ($p=1$), the correct wear of the stocking ($p=0.77$), wearing the stocking at least two hours before the surgery ($p=0.97$), keeping the stockings on during the surgery ($p=0.23$), taking the stockings off daily and performing skin assessment ($p=0.32$), wrinkling and gliding of the stocking ($p=0.09$), curling up and creating a tourniquet effect ($p=0.13$).

It was detected that no statistical difference existed in heat ($p=0.59$), itching ($p=0.67$), oedema ($p=0.63$), sensitiveness ($p=0.25$), erythema ($p=0.38$), change in colour ($p=0.24$), numbness ($p=0.24$), disruption in tissue integrity ($p=0.52$) in accordance to the stocking length.

Table 3. Evaluation of the Use Graduated Compression Stockings

Conditions	Yes		No	
	N	%	N	%
Correct size	110	96.5	4	3.5
Correct usage	105	92.1	9	7.9
During the operation to use stockings	92	80.7	22	19.3
Wearing 2 hours before surgery	81	71.1	33	28.9
Routine skin inspection	35	30.7	79	69.3
Wrinkling, gliding	25	21.9	89	78.1
Curling, tourniquet effect	22	19.3	92	80.7

Table 4. Use of Graduated Compression Stockings Patient Outcomes Assessed

Evaluation criteria	Yes		No	
	N	%	N	%
Heat	37	32.5	77	67.5
Itching	35	30.7	79	69.3
Oedema	17	14.9	97	85.1
Sensitiveness	13	11.4	101	88.6
Skin redness	10	8.8	104	91.2
Numbness	10	8.	104	91.2
Change of colour	4	3.5	110	96.5
Skin damage	3	2.6	111	97.4

Discussion

It was seen that the majority of the patients participating to the research did not sufficiently know why they should wear graduated compression stockings in order to prevent DVT, and almost half of them did not know how to use it. It was detected in the literature that, patients knew that thrombus may occur because of immobilisation but their knowledge about DVT and precautions to take against it are limited (Sage *et al.* 2008), 20% of the patients (n=120) did not know why they should wear stockings (Winslow *et al.* 2008) and in a different study carried out with 80 surgery patients, it was seen that not all the patients received a written inform and 70% did not received any information on graduated compression stockings use (Miller 2011).

In preventing deep venous thrombosis, patient adjustment is utterly important in using mechanic methods such as graduated compression stockings use effectively. Patient education is needed for an effective adjustment. Findings of the study are important for showing the need of patients to receive an education upon this subject.

It was detected that most of the patients received the education on how to use graduated compression stockings from the health personnel. In literature, it was shown that the information sources of the patients were mostly media and their families (Sage *et al.* 2008). However, it's the responsibility of the

health personnel to educate patients about maintenance of health and prevention from diseases (Kaya 2009).As a result of this study, we see that the majority of patients receive the education on this subject from the health personnel, but, when evaluated together with the other findings from the study, the level of the education is not as high as intended to be.

In literature, it's pointed out that, although the crew saw the health education the primary responsibility, they did not feel sufficiently equipped, could not plan patient education systematically and the institutional work and support were lacking (Kaya 2009).

It was seen that 29.8% of the patients had difficulties at using the stockings, and most of that hardship was faced when wearing it. An ideal graduated compression stockings has less elasticity on the ankle part of the stocking (Ozbayrak and Kavusturan 2009). It's been thought that the hardship that patients face while wearing the sock is caused by this structural characteristic. It appears that patients need to be helped while wearing the stockings, and feedback should be provided to the supplying companies so that research will be done on producing stockings with different techniques. We think that the level of satisfaction of the patients will rise once these attempts are applied.

It was detected that almost all of the patients had a fitting stocking size and that they wore it correctly. Though it was seen in the institution in which the study had been on going that fitting size of graduated compression stockings was chosen for the patients and the patients were informed about how to use them, when we search the literature on this issue, we see that 29%(Winslow *et al.* 2008) -38.75 % (Miller 2011) of the patients lying in the hospital after an operation does not use the graduated compression stockings right, 26% (Winslow *et al.* 2008) - 29% (Miller 2011) of the patients uses a wrong size of stockings, and most of the patients does not think that thigh-high stockings are comfortable (Winslow *et al.* 2008).

It was seen that, in the knee-surgery group, no stockings was worn at least 2 hours before the surgery and the stockings were not on during the surgery. It was found that the reasons for why the patients did not wear it at least 2 hours before the surgery needs to be investigated. An awareness of the fact that during the operations upon an extremity, graduated compression stockings should be worn on the other extremity too, should be raised among the staff.

It was seen that gliding, wrinkling and causing a tourniquet effect is experienced more in the patient group who had open urologic surgery. It was thought that patients who had a closed urologic operation will have a better score on dealing with the problems caused by the gliding of the stocking by themselves, as they get back to their daily life activities more easily and that patients who had a hip & knee surgery would face gliding and wrinkling problems less, as they have much more limited movement ability.

It was detected that most of the patients did not remove the stockings daily and perform a skin control. But, in the literature concerned, it's pointed that 29% (Miller 2011) of the patients using an graduated compression stockings performed a skin check every day.

When we controlled the patients' legs, in respect to the findings-to-be-careful-about, we saw that pain in both of the legs were minimal; heat rise and tickling is found wildly; oedema, sensitiveness, erythema, numbness, colour change and loss of tissue integrity is found rarely. It's thought that heat rise and tickling could be due to the synthetic nature and the weaving characteristics of the stocking. It's found that more research into the possible reasons for oedema, sensitiveness, erythema, numbness, colour change and loss of tissue integrity is needed. In literature, the importance of record keeping and the need of educating the health personnel and care-givers and for preventing DVT's is emphasised. The education should include topics like; symptoms and findings on DVT, taking the stocking off and performing skin check every day in order to use the stockings correct, the signs of the diseases that may appear on the skin if the stocking is badly used, skin care, hygiene, the neuromuscular assessment for detecting a possible arterial failure early (SMH 2008). For the patients' safety, it's utterly important to keep well records and keep the DVT education curriculum wide.

According to the results of a study done with 80 patients, for 82.7% of the patients no records were kept of the DVT risk assessment, the leg –measuring results and the stocking size was not recorded for any of the patients (Miller 2011).

Conclusion

As a result of this study, it is seen that the majority of the patients get the information about using graduated compression stockings in order to prevent DVT, from the health personnel, but despite that, had a limited knowledge about how or why to use it.

It was also detected that patients had hardships about using graduated compression stockings.

In prevention of deep venous thrombosis, patient education and is essential for ensuring patient safety and maintaining it. The results of this study revealed the need for patient education for the prevention of DVT.

In order to be able to provide this education, we advise adoption of institutional policies so that the health personnel can decide correctly and provide high quality care, establishing record forms, running clinical guidelines about this subject, using written material on education, keeping the educational sources available for the health personnel, patients and care-givers and also running applications which would raise the awareness of the health personnel and monitoring the results of it.

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