Biomedical & Pharmacology Journal Vol. **8**(1), 67-76 (2015)

The Comparison of Incidence Deep Vein Thrombosis for Three Mechanical Methods of Graduated Compression Stockings (GCS),Intermittent Pneumatic Compression (IPC) and Elastic Bandage in Intensive Care Units

MARYAM MOSLEHI[1], NASROLLAH ALIMOHAMMADI*[2], AHMAD REZA YAZDANNICK[3] and SAID ABBASI[4]

[1]Students Research Center, School of Nursing and Midwifery, Isfahan University of Medical Sciences.
[2]Assistant Professor of Nursing and midwifery faculty, Research center of Nursing and midwifery care, Isfahan University of Medical Sciences, Esfahan, Iran.
[3]Critical Care Department, Nursing and Midwifery Faculty, Nursing and Midwifery Research Center.
[4]Department of Anesthesiology, school of medicine,Isfahan University of Medical Sciences, Isfahan, Iran.

DOI: http://dx.doi.org/10.13005/bpj/583

(Received: February 14, 2015; accepted: March 03, 2015)

ABSTRACT

Due to the nature of the subject and objectives of present study regarding the comparison of incidence of deep vein thrombosis in three mechanical care methods, the present study is descriptive one of retrospective type in which the files of threes groups of patients receiving three types of care (i.e. graduated compression stockings, intermittent pneumatic compression and elastic bandage) who satisfied the pre-defined requirements were included in the present study. Then, the incidence of deep vein thrombosis was studied based on the specifications of intended units and risk factors of thrombosis. The incidence of deep vein thrombosis of the three preventive methods showed no statistically significant difference in three preventive methods when compared with each other (P=1.2). In sum, the total incidence of this disorder is 1.2 percent for the three groups. The results of present study show that mechanical prevention, either alone or with medicinal methods, can effectively decrease the incidence of deep vein thrombosis for patients of intensive care units.

Key words: Deep Vein Thrombosis (DVT), Intermittent pneumatic compression (IPC), Graduated Compression Stockings (GCS), Elastic Bandage, Intensive Care Unit (ICU)

INTRODUCTION

The patents in intensive care units might experience deep vein thrombosis as a result of disease and numerous other factors such as immobilization, surgery, trauma, malignancy, chemotherapy, neurological diseases associated with anesthesia, central venous catheters or pacemaker, varicose, thrombosis, of superficial blood vessels, increasing age, previous thromboembolism, prolonged hospitalization before coming to the hospital's intensive care unit, mechanical ventilation, use of paralyzing drugs, emergency surgeries and failure to take preventive coagulation drugs[1]. Deep vein thrombosis is relatively common and its prevalence for all patients of the hospital and those patients in intensive care units were respectively estimated to be 25[2-3] and 28-32 percent[4]. If this disorder is prevented, its incidence reduces to 3-15 percent[5]. In Iran, the incidence of thrombosis in intensive care units as denoted in some studies[6] was reported to be 48.5 percent while in neurosurgical units, it was 20 percent[7].

Deep vein thrombosis and in general, vein thrombosis constitute the third common cause of vascular disease after myocardial infarction,

ischemic stroke[2]. This disorder leads to numerous consequences the most critical of which is pulmonary embolism. The results of a study on the intensive care unit of one of the hospitals located in Tehran show that of 339 patients, 4.1 percent had deep vein thrombosis.

In addition to pulmonary thromboembolism, deep vein thrombosis might lead to increase of hospitalization duration[8], relapse, post-thrombotic syndrome , movement disorder, in ability, disruption of quality of living[9], huge costs due to need for diagnostic tests, specialized treatment and hospitalization[10]. Fatigue and physical and mental irritation caused by thrombosis could lead to post-thrombotic syndrome which is one of the significant factors affecting the quality of life among the patients[9].

This is while prediction can be regarded as a safe and cost-effective method which is most commonly done through anticoagulants such as low-dose heparin, heparin with low molecular weight and oral anticoagulants as well as mechanical devices such intermittent pneumatic compression and graduated compression stockings[12].

Of course, the medicinal preventive methods such as heparin lead to bleeding, injection site reactions and drug interactions[13]. As a result, American College of Physicians (ACP) recommends mechanical methods if usage of anticoagulants is prohibited.

Based on performance, mechanical methods are categorized into static and dynamic types. The static method consists of graduated compression stocking and compression bandages and it prevents the blood stasis[15, 16].

Of the advantages of graduated compression stockings, one could point to low prices, ease of use, lack of need for distinctive and specialized technique, national-scale availability, lack of additional accessories and posing no limitations on patients. The disadvantage of using this method is its lower effect upon prevention of deep vein thrombosis compared with other mechanic-dynamic methods, pressure on skin, increase in the risk of cutaneous infections, skin reactions, feeling of heat in the place where stockings are used and irritation[6]. This method can be used either alone or with other medicinal methods for different patients[1].

Another mechanical method is using intermittent pneumatic compression which generates alternating pressure in different zones of the leg, increases of blood current and inhibits blood stasis of leg to reduce the risk of thrombosis[17]. This method is recommended for high-risk patients which faces limitations in taking anticoagulants. Regarding the advantages of this method compared with graduated compression stockings, one could mention more proper effects, less irritation and lack of skin reactions among the patients[10] but it has disadvantages such as need for training and expertise for applying on all areas of the body[18].

Based on the evidence of previous studies, graduated compression stockings and intermittent pneumatic compression are regarded as suitable techniques of preventing deep vein thrombosis. However and to authors' best knowledge, no previous study was found which represents the superiority of one of these compression devices for prevention and personal preferences, ease of use and support of companies were all determining factors in this regard[19].

Due to the fact the superiority of these methods over each other is subjected to doubts, especially when accompanied with a medicinal method, the present study aims to compare the incidence of deep vein thrombosis when these methods are utilized.

METHODOLOGY

The present study is a retrospective descriptive-analytical one in which the records of three groups of patients in the intensive care unit of Al-Zahra Hospital of Isfahan from March 21, 2013 to March 20, 2014 which received ant-thrombosis cares of intermittent pneumatic compression, graduated compression stockings and elastic bandage, were analyzed and compared. In this regard, 115 samples were in group of intermittent

pneumatic compression, 67 samples were in group of graduated compression stockings and among 1805 patients who received elastic bandaging, 144 ones were selected through systematic random method. All patients used the mechanical methods at least three days weekly.

In the present study, the inclusion criteria were age of higher than 17 and hospitalization in intensive care unit for more than 3 days. The records of patients were collected through flow sheet and nursing reports, medical orders, surgical and laboratory records and computerized information of medical documents. The data collection instrument in the present study consisted of two parts. The first part was a checklist developed by the researchers which included personal and clinical information codified based on review of the associated literature. After developing the checklist, it was reviewed in a panel of ten experts including faculty members, nurses and doctors of intensive care unit in regard to content validity. The personal and clinical information included age, sex as well as clinical data such as weight and preventive method. Risk factors before entry into ICU such as expected duration of hospitalization in ICU, mechanical ventilation, immobilization, surgery in the past 4 weeks, tumors, central venous catheters, and its location, existence of cat down syndrome and platelet count, information regarding taking anticoagulants such as heparin, enoxaparin, warfarin, clopidogrel, information regarding method of diagnosing thrombosis including Doppler ultrasound, increased rigidity and heat around the affected swollen leg, the time of manifesting symptoms of thrombosis and mortality were also recorded.

The second instrument included the standard questionnaire of acute physiology score (SAPS II). Data collection through this instrument is relatively simple and easy so that it can be filled in less than five minutes and no sample of arterial and venous blood is needed [11]. 24 hours after admission to the ICU, the measurement has been completed and resulted in an integer point score between 0 and 163 and a predicted mortality between 0% and 100%. No new score can be calculated during the stay. If a patient is discharged from the ICU and readmitted, a new SAPS II score can be calculated. The SAPS II includes only 17 variables: 12 physiology variables, age, and type of admission (scheduled surgical, unscheduled surgical, or medical), and three underlying disease. The parameters are:age, heart rate, systolic blood pressure, temperature, Glasgow coma scale,mechanicalventilation or CPAP,FiO2 urine output, blood urea nitrogen,sodium, potassiumbicarbonate, bilirubin, white blood cell, chronic diseases and type of admission.

Following filling the questionnaires in, the information were added to SPSS Software (Version.20) and then, they were analyzed.

RESULTS

The findings of present study are shown in table (1). The results showed that there was not any statistically significant difference among the three groups in regard to sex, age, history of hypertension, immobilization, malignancy, mortality, incidence of deep vein thrombosis and its location ($P>0.05$). Of all patients included in the present study, 73.3 percent were male and 26.7 were female. The mean age of sampled patients was 54 year and their mean weight was 76 kg. In regard to background problems, hypertension had the highest incidence (27.8 percent), all patients in the three groups were immobile (100 percent) and frequency of malignancy among the three groups was 20.8 percent. In addition, the frequencies of catheters, mortality and deep vein thrombosis were respectively 22.7, 32 and 1.22 percent.

Among the three groups, there were significant differences in regard to initial diagnosis on entry to ICU, mean score of simplified acute physiology score (SAPS II), estimated percentage of mortality, duration of hospitalization before entry to ICU, referred location, underlying problems, central venous catheters, platelet count above 450 thousand, surgery in past 4 weeks, duration of using mechanical devices of preventing thrombosis and use of anticoagulants as shown in statistical tests ($P<0.05$; table.1). The frequency distribution of initial diagnosis shows that 32.07 percent of patients were hospitalized due to diagnosis of trauma and 26.1 percent of hospitalized patients were diagnosed to have neurological and neurosurgical diseases.

Table 1.Comparison of Three Treatment Groups of Intermittent Pneumatic Compression, Elastic Bandage and Graduated Compression Stockings based on Factors with Highest Risk

Risk Factors	Risk Factors	Intermittent Pneumatic Compression		Graduated Compression Stockings		Elastic Bandage		P-value
		No	Per	No	Per	No	Per	
Initial Diagnosis	Neurological and Neurosurgery Disease	27	25	10	15.2	46	31.9	0.001
	Trauma	16	14.8	22	33.3	64	44.4	
Referential Location	Emergency Unit	41	43.6	11	19	60	43.2	0.001
	Operating Room	25	26.6	28	48.3	59	42.4	
Underlying Problems	Stroke	4	3.5	0	0	15	10.4	0.004
	Smoking Cigarette	16	13.9	3	4.5	2	1.4	0.001
ICU Risk Factors	CVC	42	36.5	20	29.9	15	10.4	0.001
	Surgery in Past Four Weeks	76	66.1	58	86.6	110	76.4	0.008
	Platelet Count of Higher than 45 Thousand	1	0.9	3	4.5	0	0	0.028
Anticoagulant		Heparin	57.4	Heparin	21.2	Heparin	22.2	0.001
SAPS II		35.96	20.63	33.33	11.34	29.3	17.47	0.22
Estimated Percentage of Mortality		27.07	29.74	21.94	23.3	17.77	23.11	0.02
Duration of Hospitalization before Reception in ICU		3.53	4.15	11.77	32.7	3.56	4.6	0.003

Among these patients, compression-bandage group (44.4 percent) and compression-stocking group (33.3 percent) had the highest level of trauma diagnosis and in the group receiving anti-thrombosis treatment throughintermittent pneumatic compression, the highest level of diagnosing neurological and neurosurgical diseases (31.9 percent) was observed. In regard to simplified acute physiology score (SAPS II), the groups treated with intermittent pneumatic compression, graduated compression stockings and compression bandage had respective means of 35.96, 33.33 and 29.3 percent. The SAPS II values show that the simplified acute physiology score (SAPS II) for the group receiving treatment throughintermittent pneumatic compression (39.56) is higher than the other two groups and the mean value of these three groups was 32.86. The frequency distribution of referential origin of patents received in intensive care unit was not identical (p=0.001). The highest frequency for groups receiving elastic bandaging and Intermittent pneumatic compression was from the emergency unit but for the group of graduated compression stockings, it was from the operating room. The analysis of frequency distribution of underlying problems (i.e. hypertension, hyperlipidemia, history of addiction, heart failure, joint replacement, fractures, previous DVT and pulmonary embolism showed that there were statically significant differences among the three groups in regard to background of stroke and smoking cigarette (P<0.05).

In regard to three facilitating factors of developing thrombosis, the results showed that central venous catheters (p=0.001), surgery in past 4 weeks (p=0.008) and platelet count above 450 thousand (p=0.028), there were significant difference among the three groups (table.1). The highest frequency of central venous catheters was associated with the group receiving treatment through intermittent pneumatic compression (36.5 percent), the highest number of surgery was associated with the group receiving treatment through elastic bandaging (76.4 percent) and the highest level of platelet count was associated with the group receiving treatment through graduated compression stocking (4.5 percent). The values of frequency distribution of anticoagulants among the three groups receiving antithrombotic treatment of graduated compression stockings, intermittent pneumatic compression and elastic bandaging showed significant differences among them. The most common drug used for the three groups was heparin. In the group with intermittent pneumatic compression, its usage was 57.4 percent higher than the other three groups. The frequency distribution of duration of mechanical prevention method for the three groups showed that although mean duration of hospitalization and mean duration of mechanical ventilation showed no significant difference among them but the duration of using means of mechanical prevention is significantly different (p=0.002) so that mean duration of intermittent pneumatic compression is minimum (9.29 percent) while that of compression bandaging is the most (17.44 percent). Despite of the above differences among the groups, the three groups had no difference with each other from view point of developing thrombosis. At last, 4 out of 326 patients had deep vein thrombosis. Among these 4 patients, 1 patient was in the group of intermittent pneumatic compression (0.86 percent), 1 patient was in the group of graduated compression stocking (1.49 percent) and 2 patients were in the group of elastic bandaging (1.38 percent) (table.3).

Table2. Frequency Distribution of DVT Incidence of Three Treatment Groups of Intermittent Pneumatic Compression, Graduated Compression Stockings and Elastic Bandage

Variable	Intermittent pneumatic compression		Graduate compression Stockings		Elastic Bandage		Total	P-Value	
	No.	Per.	No.	Per.	No.	Per.	No.	Per	1
Updated Value	1	0.86	1	1.49	2	1.38	4	1.22	

Table 3.1.Demographic Characteristics (Quantitate Variables) of DVT Patients in Three Treatment Groups of Intermittent Pneumatic Compression, Graduated Compression Stockings and Elastic Bandage

Prevention Type	Age	Weight	Duration of Using Mechanical Means	SAPS II Score	Estimated Percentage of Mortality	Duration of Hospitalization before ICU	Duration of Mechanical Ventilation	Thrombosis Development Duration	Duration of Hospitalization in ICU(Day)
Intermittent Pneumatic Compression	28	-	13	56	59.8	1	14	31	14
Graduated Compression Stockings	57	63	19	41	26.6	9	10	5	19
Elastic Bandage 1	81	100	70	52	50.7	5	54	15	70
Elastic Bandage 2	68	77	10	40	24.7	12	11	10	11
Mean	58.5	80	28	47.3	40.5	5.2	22.3	15.3	28.5

Table 3.2. Demographic Characteristics (Qualitative Variables) of DVT Patients in Three Treatment Groups of Intermittent Pneumatic Compression, Graduated Compression Stockings and Elastic Bandage

Means Type	Sex	Initial Diagnosis	Risk Factors	Referential	Immobility Location	Surgery	CVC	Anticoagulant	Mortality
Intermittent Pneumatic Compression	Male	Trauma	Smoking-Addiction	Emergency	Yes	Yes	Subclavian	Subcutaneous Heparin	No
Graduated Compression Stockings	Female	Neurological Injury (Brain Tumor)	-	Emergency	Yes	Yes	Jugular	Warfarin	No
Elastic Bandage 1	Male	Trauma	Heart Failure, Diabetes-Fracture of the Lower Limb	Emergency	Yes	Yes	Subclavian	Subcutaneous Heparin and Clopidogrel	No
Elastic Bandage 2	Male	Trauma	Hypertension – Record of Stroke	Operating Room	Yes	Yes	Subclavian	Intravenous Heparin	Yes

In table (3), the clinical and demographic characteristics of the patients are shown. From statistical viewpoint, the low prevalence of deep vein thrombosis made determination of risk factors of this disorder implausible. From clinical perspective, the average age, weight, SAPS II score, estimated percentage of mortality, duration of hospitalization in intensive care units and duration of mechanical ventilation as well as initial diagnosis of trauma, reference from emergency unit, surgery and existence of central venous catheters in DVT patient were totally different from all other patients (table.4).

DISCUSSION AND CONCLUSION

Because the frequency value of developing deep vein thrombosis for all patients was 1.2 percent, the three groups treated with intermittent pneumatic compression, graduated compression stockings and elastic bandage were not statistically different in regard to level of developing thrombosis. Due to the fact that the incidence of thrombosis in the group treated with intermittent pneumatic compression was 0.78 percent but it had higher SAPS II score and higher rate of using central venous catheter, these two factors are regarded as risk factors behind developing thrombosis. Therefore, one could conclude that intermittent pneumatic compression is more effective than other methods.

The obtain incidence in the present study was less than other reported values in studies. A study by Arabi et.al[23] on comparison of mechanical methods reported DVT incidence to be 7.1 percent. In a study by Boodi, this value was reported to be 11.9 percent before the develope training program and 4.5 percent following it. In the meta-analysis by Limpus, Chaboyer, McDonald and Thalib[15], the incidence of thrombosis was reported to range from 11 to 56 percent without proper preventive measures.If medicinal prevention is used to deal with thrombosis, the incidence of thrombosis was 7.4-40 percent while the application of mechanical prevention methods, the incidence of thrombosis was 0-33 percent. In the review study by Morris and Woodcock[17], the incidence of thrombosis in a group of patients with graduated compression stockings was 5.9 percent but it was 2.9 percent for a group that used intermittent pneumatic compression. This difference in the levels of incidence might be due

Table 4. Comparison of Demographic and Clinical Characteristics (Quantitative Variables) of DVT Patients Compared with Total Patients in Three Treatment Groups of Intermittent Pneumatic Compression, Graduated Compression Stockings and Elastic Bandage

Variable	Mean Age	Mean Weight	Estimated Mortality	SAPS II	ICU Hospitalization Duration	Duration of Mechanical Ventilation	Duration of Hospitalization	Duration of Using Preventive Means
Group of Patients								
DVT Patients (4)	58.5	80	40.45	47.25	5.8	22.5	28.5	28
All Patients (326)	53	76	22.23	32.86	6.3	11.8	15	6.5

Table 5. Comparison of Demographic and Clinical Characteristics (Qualitative Variables) of DVT Patients Compared with Total Patients in Three Treatment Groups of Intermittent Pneumatic Compression, Graduated Compression Stockings and Elastic Bandage

Variable	Initial Diagnosis	Referential Location	CVC	Immobility	Surgery	Mortality
Group of Patients						
DVT Patients (4)	Trauma (75 %)	Emergency ward (75 %)	100%	100%	100%	25%
All Patients (326)	Trauma (32%)	Emergency ward (50%) Operating Room (50%)	22.7%	100%	75%	32%

to clinical characteristics of the studied population, preventive methods and diagnostic procedures. The present study was retrospective and for patients with clinical symptoms, DVT was diagnosed through Doppler ultrasound. Doppler ultrasound is a non-invasive and simple method of DVT diagnosis the sensitivity of which is 95 percent. In the cases which DVT symptoms are developed in legs, the sensitivity of Doppler ultrasound is 75 percent. The representation of clinical symptoms depends on involvement of leg veins and if one of the few leg veins are involved or the blood flow of leg veins is not disrupted, these clinical symptoms do not develop[3]. In majority of analysis of patients included in the sample, diagnostic tests were done to examine thrombosis. In a study by Cook et.al[4], all sampled patients had two weekly Doppler ultrasound tests in a two-week study to diagnose DVT. In traumatic patients with higher risk of thrombosis, an ultrasound of higher sensitivity compared with Doppler ultrasound was used and incidence of DVT in patients using mechanical prevention methods was reported to be 33 percent. In another study in 2001, Cook studied the incidence of DVT among all ICU patients between the fourth and seventh day through Doppler ultrasound. The incidence of thrombosis in that study was reported to be 12 percent[5]. In a study by Kochack et.al, diagnosis of DVT in patients with verified symptoms was done through Doppler ultrasound which showed an incidence rate of 4.1 percent.

It seems that low incidence rate of the present study might be due to lack of diagnostic tests for patients without associated symptoms. In other studies, all patients with and without DVT symptoms were screened despite of the fact that diagnostic examination of DVT through Doppler ultrasound is not recommended for all patients. Goodacre et.al[24] did a review study of 22 papers and found out that the evidence properly supports clinical prediction methods for estimation of developing thrombosis, especially Wells' Criteria for DVT.

The incidence of thromboembolism in Asian population is another noteworthy point of past few years. Some studies emphasize the effectives of ethnicity on incidence of thrombosis so that development of DVT in patients hospitalized in intensive care units is reportedly less[13, 14]. At last, the higher incidence of developing DVT is associated with lower quality of hospital caring measures. However, there is no study on standardizing the screening procedure and there are some practical difference between clinicians and hospitals in this regard. As a result, the incidence rates of thrombosis are different and in centers in which ultrasound is used for screening, higher rates of DVT were reported. Due to the fact that the mortality rate of present study was similar to other ones, the results of present study show that mechanical prevention methods and their accompaniment with medicinal prevention methods can effectively reduce the incidence of DVT in ICU patients.

The mean age of sampled patients was 58. 5 years and their mean weight was 80 kg which is higher than equivalent quantities for all hospital patients. The increase of age and weight represents risk factors the effectiveness of which upon DVT were verified in different studies[18].

The mean value of simplified acute physiology score (SAPS II) in DVT patients was 47.25 which was significantly higher than all patients of the hospital (32.86). Due to the fact that some factors associated with acuteness of DVT such as higher age, mechanical ventilation and surgery are risk factors of thrombosis, it is recommended that when patients represent more significant symptoms of DVT and they are received in ICU, examination of patients in regard to DVT symptoms should be done with more precision. Central venous catheter is one of the factors associated with thrombosis so all four DVT-positive patients had CVC thrombosis. Of these four cases, three were subclavian and one was jugular. Some believe that development of DVT in patients with subclavian CVC is due to higher damages of these catheters during placement which are often without symptoms [25]. In general, the factors associated with DVTs in the present study were similar to other ones so that other studies with mechanistic approach to DVT regarded factors such as surgery, trauma, venous catheter, prolonged inactivity, malignancy and obesity as influential upon it[26].

Based on the obtained results in the

present study, one could state that mechanical prevention, without attention to its type, accompanied by medicinal prevention can effectively reduce DVT in ICU. As a result, using mechanical prevention method for ICU patients is recommended.

ACKNOWLEDGMENT

The authors express their gratitude for the vice president of Department of Research and Technology of Isfahan University of Medical Sciences due to financial project which is based on a M.S Dissertation (No. 393307). The authors also thank the personnel of medical records of Al-Zahra Hospital for their cooperation.

REFERENCES

1. Sachdeva, A., Dalton M., Amaragiri S.V., Lees T. Elastic compression stockings for prevention of deep vein thrombosis. The *Cochrane Database System Rev*. 7(7) (2010).
2. Barer D., Intermittent pneumatic compression in patients with stroke,*Lancet*. **382**(9903):1481-1482 (2013).
3. Zhang C., Zeng W., Zhou H., Zheng B.X., Cheng J.C., Li X.Y., The efficacy of intermittent pneumatic compression in the prevention of venous thromboembolism in medical critically ill patients. *Zhongguo Wei Zhong Bing Ji Jiu Yi Xue.,* **23**(9): 563-5 (2011).
4. Elpern, E., Killeen K., Patel G., Senecal P, A., The application of intermittent pneumatic compression devices for thromboprophylaxis, an observational study found frequent errors in the application of these mechanicaldevices in ICUs. *Am J Nurs*, **113**(4): 30-36 (2013).
5. Shakori, P., Tarzamni, M., Ansarin, Kh., Ghafari, M., Findings of Doppler ultrasound of bottom limb veins and pulmonary isotope scan of patients suspected of pulmonary emboli, Journal of Ardebil University of Medical Sciences, **8**(3): 85-107 (2009).
6. Molahossein, K, R., Nikoobakht, M., The frequency assessment of deep vein thrombosis and its associated risk factors in patients undergoing neurosurgical procedures, *Razi Journal of Medical Sciences,* (2010).
7. Raskob, G, E., Silverstein, R., Bratzler, D, W.,Heit, J, A &White, R, H. (). Surveillance for deep vein thrombosis and pulmonary embolism, recommendations from a national workshop. *American Journal of Preventive Medicine*, **38**(4):S502-S9 (2010).
8. Alikhan, R.,Cohen, A,T.,Combe, S., Samama, M, M., Desjardins L., Risk factors for venous thromboembolism in hospitalized patients with acute medical illness, analysis of the MEDENOX Study. *Archives of Internal Medicine*, **164**(9): 963-968 (2004).
9. Ashrani, A, A., Heit, J, A.,Incidence and cost burden of post-thrombotic syndrome. *Journal of Thrombosis and Thrombolysis*, **28**(4): 465-76 (2009).
10. Cundiff, D, K., Anticoagulation therapy for venous thromboembolism. *Medscape General Medicine*, **6**(3) (2004).
11. Lukas, P, S.,Krummenacher, R., Biasiutti, F, D., Begré, S.,Znoj, H.,Von Känel, R.,Association of fatigue and psychological distress with quality of life in patients with a previous venous thromboembolic event. Thromb Haemost, **102**(6): 1219-1226 (2009).
12. Tapson, V, F., Decousus, H., Pini, M., Chong, B, H., Froehlich, J, B., Monreal M., Venous thromboembolism prophylaxis in acutely Ill hospitalized medical patients, Findings from the International Medical Prevention Registry on Venous Thromboembolism. *CHEST Journal*, **132**(3): 936-945 (2007).
13. Douketis, J, D., Berger, P, B., Dunn, A, S., Jaffer, A, K., Spyropoulos, A, C., Becker R.C., The perioperative management of antithrombotic therapy, American College of Chest Physicians, Evidence-Based Clinical Practice Guidelines,*CHEST Journal*, **133**(6): 299S-339S (2008).
14. Hirsh, J., Guyatt, G., Albers, G,W.,Harrington, R., Schunemann, H, J.,Antithrombotic and thrombolytic therapy, American College of

Chest Physicians Evidence-Based Clinical Practice Guidelines. *CHEST Journal*, **133**(6): 110S-2S (2008).

15. Limpus, A., Chaboyer, W., McDonald, E., Thalib, L.,Mechanical thromboprophylaxis in critically ill patients, a systematic review and meta-analysis. *American Journal of Critical Care*, **15**(4): 402-12 (2006).
16. Eppsteiner, R, W., Shin, J, J., Johnson, J., van Dam, R, M., Mechanical compression versus subcutaneous heparin therapy in postoperative and post-trauma patients, a systematic review and meta-analysis. *World journal of Surgery*, **34**(1): 10-19 (2010).
17. Morris, R, J., Woodcock, J, P., Intermittent pneumatic compression or graduated compression stockings for deep vein thrombosis prophylaxis,a systematic review of direct clinical comparisons. *Annals of Surgery*, **251**(3): 393-396 (2010).
18. Francis, C, W., Prophylaxis for thromboembolism in hospitalized medical patients. *New England Journal of Medicine*, **356**(14): 1438-44 (2007).
19. Caprini, J, A., Risk assessment as a guide for the prevention of the many faces of venous thromboembolism. *The American Journal of Surgery*, **199**(1): S3-S10 (2010).
20. Cecchi, A., Boddi, M., Ciapetti, M., Barbani, F., Bonizzoli, M., Parodo, J.,Deep venous thrombosis in ICU patients, exploring the submerged part of the iceberg by an expanded intra-ICU ultrasound surveillance program. *Critical Care,* **15**(Suppl. 1):20 (2011).
21. Alizadeh, A., Hassanian-Moghaddam, H., Shadnia, S., Zamani, N., Mehrpour, O.,SAPS II and APACHE II and Prediction of the Mortality and Later Development of Complications in Poisoned Patients Admitted to Intensive Care Unit. *Basic and clinical pharmacology & Toxicology.,* 2014.
22. Lucena, J, F., Alegre, F., Martinez-Urbistondo, D., Landecho, M, F., Huerta, A., García-Mouriz, A., Performance ofSAPS II and SAPS 3 in Intermediate Care. *PloS one.* **8**(10):e77229 (2013).
23. Arabi, Y, M., Khedr, M., Dara, S,I., Dhar, G, S., Bhat, S,A., Tamim, H, M.,Use of intermittent pneumatic compression and not graduated compression stockings is associated with lower incident VTE in critically ill patients, a multiple propensity scores adjusted analysis. *Chest*. **144**(1): 152-9 (2013).
24. Sampson, F. C., Goodacre, S. W., Thomas, S. M., van Beek, E. J., The accuracy of MRI in diagnosis of suspected deep vein thrombosis: systematic review and meta-analysis. *European radiology*, **17**(1): 175-181 (2007).
25. Gentile, A., Petit, L., Masson, F., Cottenceau, V., Bertrand-Barat, J., Freyburger, G., Sztark, F., Subclavian central venous catheter-related thrombosis in trauma patients, incidence, risk factors and influence of polyurethane type. *Critical Care*, **17**(3): R103 (2013).
26. Reitsma, P. H., Versteeg, H. H., Middeldorp, S., Mechanistic view of risk factors for venous thromboembolism.*Arteriosclerosis, thrombosis, and vascular biology.*, **32**(3): 563-568 (2012).