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ORIGINAL RESEARCH

To assess the implementation of Deep Venous Thrombosis (DVT) prophylaxis in patients admitted to the surgical critical care unit: A cross-sectional study

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ABSTRACT
Background: Venous thromboembolism (VTE) is a medical disorder characterised by the development of blood clots in the deep veins, particularly in the lower leg veins. This leads to the restriction of blood flow, which in turn produces symptoms such as pain, swelling, and discoloration. **Aims and objectives:** To assess the implementation of deep venous thrombosis (DVT) prophylaxis in patients admitted to the surgical critical care unit.
Material and methods: A grand total of 70 patients were enlisted. A total of 15 patients were treated with mechanical prophylaxis alone, 23 patients were treated with pharmacotherapy only, and 32 patients received combined mechanical and pharmaceutical treatment. This research included patients hospitalised in the Surgical Intensive Care Unit (SICU) who were between the ages of 18 and 68 and stayed in the unit for at least 2 days. Only patients who were stable in terms of their blood circulation and had all routine medical tests within normal ranges were included. The incidence of haemorrhage was similar across the groups, with a p-value of 0.15, which indicates that the difference was not statistically significant.
Results: The number of male participants was 48, accounting for 68.57% of the total, while the number of female participants was 22, accounting for 31.43%. The average age of the patients was 51.85 ± 4.55 years. The mechanical prophylaxis had the greatest occurrence of deep vein thrombosis (DVT); however, the difference was not statistically significant. The average dosages of enoxaparin administered in the pharmacotherapy-only group and the combined mechanical therapy and pharmacotherapy group were 64.52±5.69 mg/day and 43.22±4.33 mg/day, respectively. The average dosages of enoxaparin were 43.11±4.85 mg/day for those using stockings and 43.34±3.98 mg/day for those using SCDs. In the group receiving both mechanical and pharmacological prevention, 16 patients (50%) used SCDs and 16 (50%) used DVT stockings. In the group receiving just mechanical treatment, 11 patients (73.33%) used DVT stockings, and 5 patients (26.67%) used SCDs.
Conclusion: It has been shown that a combination of mechanical and pharmacological interventions is linked to a decreased occurrence of DVT. The total dosage of medications administered as pharmacotherapy was lower in individuals who received dual treatments compared to those who received pharmacotherapy alone.
Keywords: DVT, prophylaxis, surgical critical care unit.

Introduction

Venous thromboembolism (VTE) is a medical disorder characterised by the development of blood clots in the deep veins, particularly in the lower leg veins. This leads to the restriction of blood flow, which in turn produces symptoms such as pain, swelling, and discoloration.[1] Embolism, namely pulmonary embolism, is the most frequent consequence of venous thrombosis, characterised by the movement of these clots into other blood vessels. Research indicates that 50% of individuals who are admitted to the hospital are susceptible to thromboembolism.[2] The incidence of venous thromboembolism in individuals who do not receive any prophylaxis varies from 10% to 80%.[3,4]Research has shown that the incidence of VTE is higher in individuals who are hospitalised compared to those in the community.[5] Deep vein thrombosis (DVT) is common in ICUs, especially in Western nations. Asian nations have a somewhat lower prevalence in comparison. The research conducted in Thai surgical ICU patients revealed a DVT incidence rate of 3.6%, which is similar to the findings of a study conducted in Tehran, where the incidence rate of DVT in ICU patients was 3.5%.[6] Longer duration of stay in the intensive care unit (ICU) and advanced age are two distinct risk factors associated with the development of DVT. Further research was carried out on Chinese cancer patients who were hospitalised in the ICU with the aim of identifying VTE. The study showed a low occurrence of VTE.[7]The prevalence of VTE was 37.2% among patients diagnosed with sepsis and septic shock, as reported in reference.[8] Research has

demonstrated similar outcomes in teenagers.[9]The efficacy of thrombo-prophylaxis is shown in its ability to decrease the incidence of thromboembolism in both medical and surgical patients. Nevertheless, it specifically reduces the death rate in surgical patients while having little or no effect on the mortality rate among medical patients.[8]Thromboprophylaxis may be classified into two types: primary and secondary. Primary prophylaxis refers to the preventive measures taken to avoid the development of deep vein thrombosis (DVT). This includes the use of pharmacologic therapies such as unfractionated heparin (UFH), low molecular weight heparin (LMWH), fondaparinux, or mechanical therapies such as pneumatic and graduated compression stockings.[10] Secondary prophylaxis entails the prompt identification and treatment of venous thrombosis. The selection of the main prophylaxis strategy is based on criteria such as the likelihood of thrombosis and haemorrhage, the characteristics of the sickness, the institution's policies, financial considerations, and personal preferences. These criteria aid in categorising patients into low, moderate, and high-risk groups, each requiring a distinct preventive approach. Furthermore, the length of preventive therapy varies across patients based on their risk categorization. These patients are at an increased risk of developing DVT while staying in the ICU due to many causes, including recent surgery, extended periods of immobility, infection, and vascular damage caused by indwelling central venous catheters or other invasive procedures. Effectively managing VTE prophylaxis in critically ill patients requires finding a balance between reducing the occurrence of DVT and PE while avoiding the potential for severe bleeding.[11]

Aims and objectives: To assess the implementation of deep venous thrombosis (DVT) prophylaxis in patients admitted to the surgical critical care unit.

Material and methods

A prospective cross-sectional, randomised, double-blinded study was undertaken on 70 adult patients admitted to the surgical critical care unit. The present study has been carried out in the Department of Anaesthesia, Nalanda Medical College and Hospital, Patna, Bihar, India, in collaboration with the Critical Care Department, Big Apollo Spectra Hospital, Patna, Bihar. The Institutional Ethics Committee granted ethical approval beforehand. The patients provided their informed consent. The study was carried out over a one-year period, from January 2023 to December 2023. Data such as name, age, etc. was recorded. If the patients were unable to provide informed consent owing to an altered state of consciousness, permission was obtained from their accompanying individuals. The objective of the research was to evaluate the strategies used for preventing deep vein thrombosis (DVT) and to compare the occurrence of DVT among the various methods used in the Surgical Intensive Care Unit (SICU). A grand total of 70 patients were enlisted. A total of 15 patients were treated with mechanical prophylaxis alone, 23 patients were treated with pharmacotherapy only, and 32 patients received combined mechanical and pharmaceutical treatment. The patients were categorised into several groups based on the judgement of the treating intensivist and surgeon, taking into consideration the need for medication, mechanical treatment, or both. As a result, the group sizes were unequal. This research included patients hospitalised in the Surgical Intensive Care Unit (SICU) who were between the ages of 18 and 68 and stayed in the unit for at least 2 days. Only patients who were stable in terms of their blood circulation and had all routine medical tests within normal ranges were included. Patients who were not taking any medication that might affect their blood clotting capacity and who provided informed permission were also included. The research excluded patients with significant neurological, cardiac, respiratory, metabolic, renal, or hepatic conditions that potentially impact their coagulation profile. Additionally, patients who had a confirmed DVT or PE prior to or within 48 hours of admission to the ICU were also excluded.

Methodology

Patients were evaluated on a daily basis to determine the occurrence of DVT, the kind of preventive medication administered, and any potential consequences. Patients were regularly monitored until either 28 days elapsed or they were discharged from the ICU, whichever occurred later. The method of DVT prevention administered (mechanical, pharmacological, or both) was recorded. Mechanical prophylaxis included the use of DVT stockings with an inflation pressure of 30–40 mmHg or the use of SCD with an inflation pressure of 50–120 mmHg for a minimum of 18–20 hours each day. The pharmacological treatment was the administration of low-molecular-weight heparin at a dosage of 30–40 mg subcutaneously every 12 hours. Low molecular weight heparin (LMWH), namely enoxaparin, is the commonly used pharmacological preventive treatment in the majority of hospitals. No patients received unfractionated heparin in the trial.

Statistical analysis

Using SPSS version 22.0 (IBM Corp., 2016), statistical analysis was performed on the obtained data. The statistical analysis included the evaluation of quantitative data using an unpaired Student's t-test, while qualitative data was evaluated using a Chi-square test. The p-value was deemed statistically significant when it reached a threshold of 0.05 with a confidence level of 95%.

Results

The number of male participants was 48, accounting for 68.57% of the total, while the number of female participants was 22, accounting for 31.43%. The average age of the patients was 51.85 ± 4.55 years. The mechanical prophylaxis had the greatest occurrence of deep vein thrombosis (DVT); however, the difference was not statistically significant. The use of combined intervention was the prevailing method employed for prophylaxis, as shown in Tables 1 and 2.

Table 1: Socio-demographic characteristics of the patients

characteristics	category	Total Number of patients (n=70)	Percentage	P value
Gender	Male	48	68.57	0.11
	Female	22	31.43	
Age (years)	below 25	5	7.14	0.15
	25-35	9	12.86	
	35-45	12	10	
	45-55	34	48.57	
	55-65	7	10	
	Above 65	3	4.29	
Mean Age in years		51.85±4.55		

Figure 1: Gender wise distribution of study patients

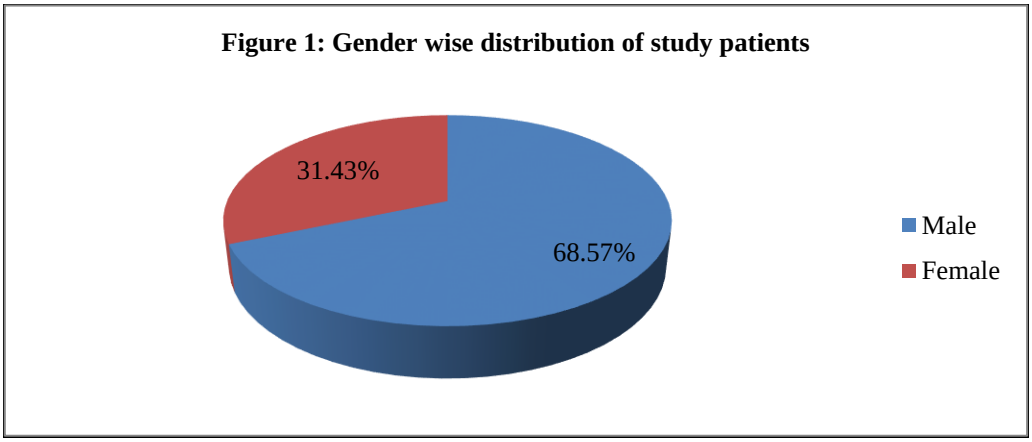

Table 2: Type of intervention and incidence of DVT

Intervention	Type of prophylaxis		Incidence of DVT		p-value
	Number	Percentage	Number	Percentage	
Mechanical prophylaxis alone	15	21.43	3	20	0.19
Pharmacotherapy alone	23	32.86	2	8.70	0.09
Both mechanical and pharmacotherapy	32	45.71	1	3.13	0.11

Table 3: Type of intervention and incidence of haemorrhage

Type of prophylaxis	Number of patients (n=70)	Incidence of hemorrhage	Percentage	P value
Mechanical prophylaxis alone	15	0	0	0.15
Pharmacotherapy alone	23	3	13.04	
Both Mechanical and Pharmacotherapy	32	1	3.13	

The incidence of haemorrhage was similar across the groups, with a p-value of 0.15, which indicates that the difference was not statistically significant. This information can be seen in Table 3.

Table 4: Mean dose/day of pharmacotherapy

Low molecular weight heparin (Enoxaparin)	Dose(mg/day)		P value
	Mean	SD	
Pharmacotherapy alone	64.52	5.69	0.001
Both Mechanical and Pharmacotherapy	43.22	4.33	
Both Mechanical and Pharmacotherapy stockings	43.11	4.85	
Both Mechanical and Pharmacotherapy sequential compression devices	43.34	3.98	

The average dosages of enoxaparin administered in the pharmacotherapy-only group and the combined mechanical therapy and pharmacotherapy group were 64.52±5.69 mg/day and 43.22±4.33 mg/day, respectively. The doses in the pharmacotherapy-only group were substantially higher ($p<0.001$) compared to the combined group. It is important to mention that in the dual prophylaxis group, 16 patients used stockings, while 16 patients used SCDs for mechanical prophylaxis. The average dosages of enoxaparin were 43.11±4.85 mg/day for those using stockings and 43.34±3.98 mg/day for those using SCDs, as shown in Table 4.

Table 5: Type of mechanical therapy

Type of mechanical therapy	Patients with mechanical and pharmacotherapy		Patients with mechanical therapy alone		P value
	Number	Percentage	Number	Percentage	
DVT stockings	16	50	11	73.33	0.11
Sequential compression devices	16	50	4	26.67	
Total	32	100	15	100	

In the group receiving both mechanical and pharmacological prevention, 16 patients (50%) used SCDs and 16 (50%) used DVT stockings. In the group receiving just mechanical treatment, 11 patients (73.33%) used DVT stockings and 5 patients (26.67%) used SCDs, as shown in Table 5.

Discussion

Deep vein thrombosis (DVT) refers to the development or existence of a blood clot in the deep veins, often seen in the lower limbs and seldom in the upper limbs. When a blood clot blocks the pulmonary artery or its branches, it leads to the formation of a PE. This usually happens when a clot from the deep veins of the legs travels and becomes stuck in the pulmonary artery. PE occurs in around one-third of individuals with DVT. Therefore, by taking measures to avoid DVT, the occurrence of a severe and potentially fatal disease known as PE is greatly reduced.[11] Hoyt DB and Swegle JR[12] proposed that implementing active preventive measures, maintaining a high level of suspicion, and promptly diagnosing and treating DVT are crucial in reducing the rates of illness and death in patients admitted to the SICU.Harris LM et al.[13] observed that screening of patients in the SICU is recommended due to the significant occurrence of silent illness. In their study, they discovered that 7.5% of the 294 patients admitted to the SICU had an asymptomatic disease. Typically, an equilibrium between the substances that promote blood clotting and those that prevent it keeps the production of blood clots inside blood vessels in check. The presence of one or more variables that make up the trinity of Virchow (venous stasis, endothelial damage, and hypercoagulability) may lead to the development of DVT. Inpatients are susceptible to venous stasis, and when combined with other conditions, their chance of developing DVT is heightened. Consequently, this elevates the likelihood of PE. The prophylaxis of DVT involves treatments that specifically address either the reduced blood flow in the veins or the increased tendency of blood to clot (hypercoagulability) in the vascular system. The total occurrence rate of DVT was 3.13% (1 out of 32 patients) for patients who received both mechanical and medication. In contrast, it was 8.70% (2 out of 23) for patients who received pharmacotherapy alone and 20% (3 out of 15) for patients who had mechanical interventions. Research conducted by Kumar A et al.[14] observed that the occurrence of DVT was 0.8% among patients admitted to SICUs who received prophylaxis. Research conducted by Miri M. et al.[15] observed an incidence rate of 3.5% among patients in the intensive care unit. The occurrence of bleeding was most frequent in the group receiving just pharmacotherapy (n = 3 out of 23; 13.04%). None of the patients who underwent mechanical intervention had a bleeding episode, whereas one patient in the group receiving both pharmacotherapy and mechanical intervention (n = 1 out of 32) had a bleeding event. The total dosage of medications administered for pharmacotherapy was lower in individuals who received both therapies compared to those who received pharmacotherapy alone. This accounts for the lower occurrence of hemorrhagic symptoms in the combination

treatment group compared to the group receiving just medication. Fraisse F. et al.[16] observed a greater occurrence of bleeding in individuals who were administered medication for DVT prevention compared to those who did not get any pharmacotherapy. Cook DJ and Crowther MA[17] propose the use of appropriate DVT prophylaxis to mitigate the occurrence of DVT in high-risk individuals while considering the potential danger of bleeding. A comprehensive review conducted by Kakkos SK et al.[18] found that the incidence of DVT was 4.10% in the intermittent IPC group. However, in the combined group that received both IPC and pharmacotherapy, the incidence decreased to 2.19%. This indicates a favourable decrease in the occurrence of DVT in the combined group. Furthermore, the use of anticoagulants in the IPC treatment regimen resulted in a higher likelihood of experiencing bleeding as compared to using IPC alone. However, it is essential to frequently assess patients hospitalised in the Surgical Intensive Care Unit (SICU) for the occurrence of DVT. Dagadakiet al.[19] proposed the regular use of ultrasonography to evaluate the peripheral venous system in patients in the critical care unit as a means of detecting deep vein thrombosis.

Limitations of the study: The study had a restricted sample size; hence, the conclusions cannot be generalised to include all patient groups. Only patients classified as American Society of Anesthesiologists (ASA) Grade III were included. The study assessed adult patients while excluding individuals over the age of 68 and those with significant co-morbidities. These factors could potentially distort the results of the study by increasing the risk of bleeding and thromboembolic complications, introducing a bias.

Conclusion

It has been shown that a combination of mechanical and pharmacological interventions is linked to a decreased incidence of DVT. The total dosage of medications administered as pharmacotherapy was lower in individuals who received dual treatments compared to those who received pharmacotherapy alone. According to this research, the combination of pharmacotherapy and pressure stockings is an optimal treatment for preventing DVT.

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