

Thromboprophylaxis & DVT in Surgical Practice: Role of Caprini Score

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Abstract

Background: Deep Vein Thrombosis (DVT) is a major source of morbidity and mortality among patients undergoing prolonged surgery. Most of post-operative DVT can be prevented by simple preoperative thromboprophylaxis after assessing the risk of patient. Caprini risk scoring is a simple preoperative risk assessment tool for predicting DVT in surgical patients. This study was undertaken to assess prediction of DVT in postoperative patient using Caprini score and effect of thromboprophylaxis in preventing postoperative DVT in high risk individuals. **Materials and methods:** A total of 150 patients admitted in various surgical specialties undergoing prolonged surgical procedures of more than two hours were included in the study. All patients were assessed using Caprini scoring and comparison between patients given preoperative thromboprophylaxis and those who did not receive prophylaxis has been done. **Result:** 21 out of 26 patients who developed DVT were in the age group 40-80 years. 92 patients (61.3%) had co morbidities, the most common being diabetes mellitus in 55 (36.7%) and coronary artery disease (CAD) had a significant correlation with DVT. Malignancies (17.3%) and PIVD (14%) were the most commonly encountered diagnosis. Swelling and pain in the lower limbs were the only symptoms in 61.5% of DVT patients. 12 patients (46%) had both breathlessness and swelling of legs which showed significant correlation to DVT ($p < 0.001$). Thromboprophylaxis was significantly beneficial in preventing DVT post operatively in patients, with a significant p value of 0.006. Patients with Caprini score of more than 8 (mean 8.8) had high prediction to develop DVT than patients with score of less than 6 (mean 6.8). Thromboprophylaxis given to patients with Caprini score of more than 8 had a higher chance of preventing post op DVT. Caprini score of more than 5.5 has a sensitivity of 94.9% and specificity of 47.3% in predicting DVT. **Conclusion:** Patients having a Caprini score of more than 8 have a high risk of development of post-operative DVT. Preoperative thromboprophylaxis in high risk patients has shown to reduce incidence of DVT.

Keywords: Thromboprophylaxis, DVT, Caprini Score, Risk scoring, Prolonged surgery

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I. Introduction

Venous thromboembolism (VTE), which includes pulmonary embolism (PE) and deep venous thrombosis (DVT), (1) is a major source of morbidity and mortality among hospitalized patients. The incidence of VTE in general population is 67 per 100 000 population per year (2) and the cumulative lifetime incidence is to the tune of 2 to 5%. (3) Population studies have suggested that the overall age and gender adjusted annual incidence of DVT in the general population is 0.5–1 per 1000. (4) The critically ill are at higher risk of developing VTE than other patients. (5) Understanding the natural history of venous thrombosis is important for optimal management of this condition. Common signs and symptoms of DVT include pain or tenderness, swelling, warmth, redness or discoloration, and distention of surface veins. Signs and symptoms alone are not sufficiently sensitive or specific to make a diagnosis, but when considered in conjunction with known risk factors can help determine the likelihood of DVT.

Accurate and timely diagnosis of DVT is necessary as untreated DVT can result in thromboembolic disease whereas misdiagnosis is associated with bleeding due to the treatment with anticoagulants. (6) Diagnosis of DVT is made by varying combinations of history, physical examination, clinical probability score, blood test for D-dimer, and compression ultrasonography. Colour Doppler Ultrasound (CDUS) is still the initial approach in the diagnosis of DVT in many centres. It is a reliable and accurate diagnostic test to confirm or rule out DVT. Numerous studies demonstrate that a combination of a clinical probability assessment (e.g., Caprini score, Wells score), D-dimer, and CDUS might be a reliable means of excluding suspected DVT and guiding treatment decisions. It has been proved in recent investigations that D-dimer measurement has a high negative predictive

value in ruling out DVT (almost 99%) and is highly sensitive but not specific. A combination of pretest probability with a D-dimer test has been proved to be effective.(7)

The outcome of DVT may vary from patient to patient. One of the most feared complications of DVT is, as mentioned previously, pulmonary embolism (PE), which carries a significant mortality rate. An estimated 10% of in-hospital deaths are caused due to PE,(3) whereas 50% of those diagnosed as having DVT develop the long-term sequelae of post thrombotic syndrome.(4) Another complication following DVT is venous insufficiency, seen in up to 60% patients.(6) The clinical signs and symptoms of venous thrombosis are non-specific, only occurring in up to 50% of patients while sensitivity and specificity of screening tests to detect disease in asymptomatic patients is low.(2)

The concept of a weighted risk stratification tool for VTE has been championed by Joseph Caprini since the early 1990s. The Caprini risk score is a risk assessment tool for the occurrence of venous thromboembolism among surgical patients. The Caprini risk score includes 20 variables and it is derived from a prospective study of 538 general surgery patients. The incidence of VTE increased in a linear fashion with increasing Caprini score (1). The Caprini score can identify a 10- to 15-fold variation in VTE risk among the overall surgical population and can effectively be used to identify those at very low risk (<1% at 30 or 60 days) and high risk (>10% at 30 or 60 days).

Despite American College of Chest Physicians Guidelines on Prevention of Venous Thromboembolism (ACCP) (9th edition) to consider extended post discharge thromboprophylaxis in patients deemed to be at high risk, there appears to be a relatively low rate of utilization of post-discharge thromboprophylaxis in current clinical practice.(8) This study, hence was undertaken to determine the importance of Caprini score in risk stratification as a tool for prevention of DVT, and also, to prove the benefits of thromboprophylaxis to prevent post-surgical DVT.

II. Materials and Methods

A prospective observational study was carried out in a secondary as well as tertiary care hospital at New Delhi from June 2015 to June 2017. A total of 150 patients who were admitted to surgical, orthopedic and gynaecological wards of the two hospitals who were undergoing major surgical intervention were included in the study. Patients undergoing prolonged (>2hours) and difficult surgery with prolonged immobilization and an expected postoperative stay in hospital of at least 5 days were included in the study. Patients with old history of bleeding disorders, past history of major surgeries and DVT, non-surgically acquired DVT, treatment with oral anticoagulants or dextran within 14 days prior to admission and pregnancy were excluded from the study.

Pre-operative risk prediction for all patients were carried out using Caprini score and the sample population was divided in to two groups – Group A: those who received thromboprophylaxis and Group B: those who did not receive any thromboprophylaxis. All patients in high risk group underwent Colour Doppler post operatively for the assessment of DVT. Pre-operative risk prediction done using Caprini score was correlated to clinical outcome. A comparison between Group A and B was done after 2 weeks to see for outcome of thromboprophylaxis. IPSS scoring system was applied on all these patients using scoring sheets. Data was analyzed using graphs and Chi square testing and the statistical analysis was done using SPSS .

III. Results

Out of 150 patients included in the study, the most commonly affected were between the age group of 61-80 years (54.7%) with a mean age of 58.96 years [Figure 1]. 104 were males and 46 were females.

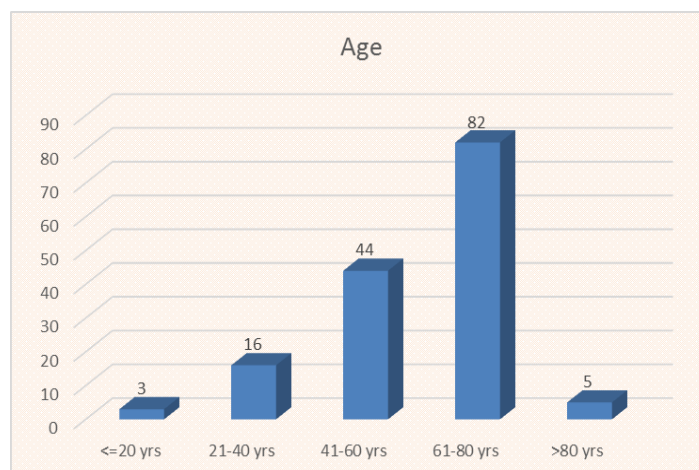


Figure 1: Demographic data

92 patients (61.3%) had co morbidities, the most common being diabetes mellitus in 55 (36.7%). Coronary artery disease (CAD) had a significant correlation with DVT with p value of 0.001. No similar correlation was found between DVT and diabetes mellitus (p value <0.3). [Table 1]

Co morbidities		DVT	No DVT	Total	Pearson Chi-Square	p-value
DM	Absent	19	76	95	1.286	0.257
	Present	7	48	55		
HTN	Absent	16	82	98	0.2	0.655
	Present	10	42	52		
CAD	Present	15	106	121	10.645	0.001
	Absent	11	18	29		
Obesity	Absent	23	112	135	0.083	0.774
	Present	3	12	15		
Others	Absent	25	122	147	0.547	0.46
	Present	1	2	3		
Total		26	124	150		

Table 1: Comorbidity Profile

Of the 150 patients enrolled in study, malignancies (17.3%) and PIVD (14%) were the most commonly encountered diagnosis and it was found that there was no significant correlation between diagnosis and development of DVT. [Table 2]

Diagnosis	Frequency	%	DVT	No DVT	Total	Pearson Chi-Square	p-value
PIVD	21	14	2	19	21	13.914	0.125
RTA	4	2.7	2	2	4		
Severe Head Injury	4	2.7	2	2	4		
Carcinoma	26	17.3	3	23	26		
Vertebral Fracture	6	4	3	3	6		
B/L TKR	14	9.3	1	13	14		
Fracture femur	9	6	1	8	9		
GBM	8	5.3	2	6	8		
Others	58	38.7	10	48	58		
Total	150	100	26	124	150		

Table 2: Correlation of diagnosis and DVT

Among 26 patients who developed DVT, 16 (61.5%) had swelling and pain in the lower limbs as the only symptoms and 12 patients (46%) had both breathlessness and swelling of legs which showed significant correlation to DVT (p<0.001). [Table 3]

Clinical Features	DVT	No DVT	Total	Pearson Chi-Square	p-value
None	0	122	122	138.8	<0.001
Swelling and pain LL	14	2	16		
Breathlessness	12	0	12		
Total	26	124	150		

Table 3: Correlation of clinical features with DVT

With regards to thromboprophylaxis, 59 (39.3%) belonged to Group A (received prophylaxis) while Group B (without prophylaxis) included 91 patients (60.7%). Of patients in Group A, 77% received only pharmacological prophylaxis while 22% received pharmacological as well as mechanical prophylaxis.

Out of 59 patients in Group A, only 4 developed DVT, while out of 91 patients in Group B, 22 developed DVT. Thromboprophylaxis hence was significantly beneficial in preventing DVT post operatively in patients, with a significant p value of 0.006.

[Table 4 and Figure 2]

Thromboprophylaxis	DVT	No DVT	Total	Pearson Chi-Square	p-value
YES	4	55	59	7.56	0.006
NO	22	69	91		
Total	26	124	150		

Table 4: Correlation between thromboprophylaxis and DVT

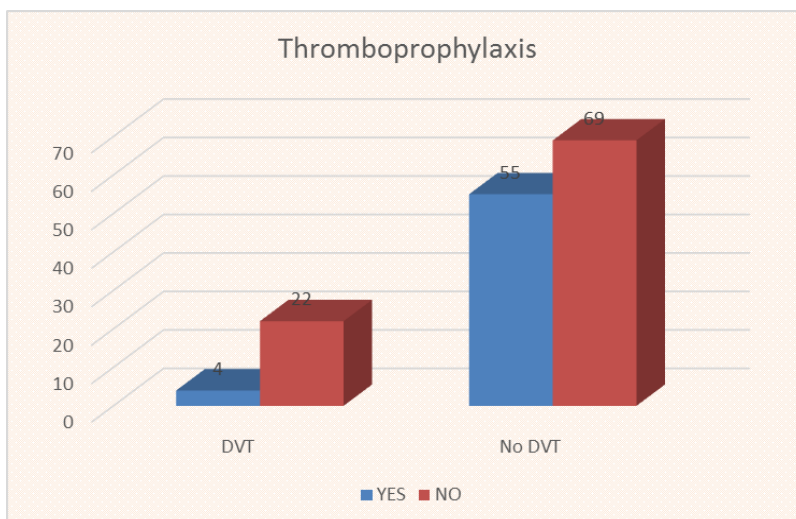


Figure 2: Correlation between thromboprophylaxis and DVT

Caprini scoring was applied to all 150 patients. In our study it was seen that patients with score of more than 8 (mean 8.8) had high prediction to develop DVT than patients with score of less than 6 (mean 6.8). Study also showed that prophylaxis given to patients with Caprini score of more than 8 has a higher chance of preventing post op DVT with a significant p value of 0.001.

Caprini score	DVT	N	Mean	Std. Deviation	t-value	p-value
	DVT	26	8.808	2.281	3.452	0.001
	No DVT	124	6.807	2.764		

Table 5: Correlation of DVT to Caprini score

Caprini score	Thromboprophylaxis	N	Mean	Std. Deviation	t-value	p-value
	YES	59	8.63	2.41	5.754	0.001
	NO	91	6.20	2.60		

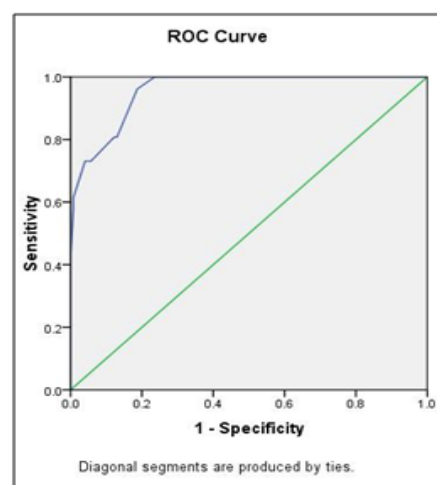
Table 6: Correlation of Caprini score and effect of thromboprophylaxis

In this study area under curve has shown that a Caprini score of more than 5.5 has a sensitivity of 94.9% and specificity of 47.3% in predicting DVT.

Coordinates of the Curve		
Test Result Variable(s): Caprini score		
Positive if Greater Than or Equal To ^a	Sensitivity	1 - Specificity
1	1	1
2.5	1	0.978
3.5	1	0.868
4.5	0.983	0.714
5.5	0.949	0.527
6.5	0.746	0.341
7.5	0.678	0.297
8.5	0.458	0.209
9.5	0.339	0.132
10.5	0.254	0.077
11.5	0.119	0.022
12.5	0.051	0.022
13.5	0.034	0.011
14.5	0.017	0
16	0	0

The test result variable(s): Caprini score has at least one tie between the positive actual state group and the negative actual state group.

a. The smallest cutoff value is the minimum observed test value minus 1, and the largest cutoff value is the maximum observed test value plus 1. All the other cutoff values are the averages of two consecutive ordered observed test values.



IV. Discussion

This was a study aimed at determining risk prediction of DVT using Caprini score and effect of preoperative DVT prophylaxis in preventing post-operative DVT. Very few studies have been done in the past comparing preoperative risk prediction of DVT using Caprini score. Apprehension exist among surgeons concerning preoperative thromboprophylaxis with regards to the risk of intra-operative bleeding. However, there are many studies which have proved the contrary and the benefit of preoperative prophylaxis outweighs its disadvantages.

In this study 150 patients undergoing prolonged surgical procedure (>2hours) were selected. 46 (30%) patients were females, and 104 (70%) were males. 21 out of 26 patients who developed DVT were in the age group 40-80 yrs. This was comparable to study by M Nordstrom et al in 1987 in which mean age for DVT was 66 years.(9) Other studies showed a mean age of 65.5 ± 16 years and 51- 64 years and with a male preponderance.(10,11)

92 patients had comorbidities which accounts for 61.33% of the study population. Among these, the most common was diabetes mellitus accounting for 36% of the cases, though this was not statistically significant. In our study a significant correlation was found between coronary artery diseases and development of DVT with a significant p value of < 0.001 . This study was comparable to a study by Fredrick A Anderson et al which showed coronary artery diseases as a risk factor for development of DVT.(12) Since carotid plaques represent a marker of arterial disease elsewhere in the circulation, atherosclerosis can also induce venous thrombosis, This in turn, suggests the existence of a link between arterial and venous disorders.(13)

Patients who required prolonged immobilization postsurgery and patients in whom DVT prophylaxis was not given had a higher risk of developing DVT. In our center department of Orthopedics which was giving prophylaxis to all high risk patients had DVT rates to the tune of only 5.2% of patients. Study by D.Warwick et al had shown DVT in only 5.2% of orthopedic patients in whom pre-operative thromboprophylaxis was given. (14) Malignancy, another prothrombotic state which predisposes to DVT had a 11.3% chance of developing DVT without any preoperative prophylaxis. Though effect of chemotherapy on oncological patients was not taken into consideration in this study. This incidence is comparable to study by Lee AY et al. Cancer and its treatments are well-recognized risk factors for venous thromboembolism (VTE).(15)

In our study 04 patients had pulmonary thromboembolism post DVT which accounts for 2.6%. This can be compared to Hassan et al, the 5-year cumulative incidence of recurrent venous thromboembolic events was 21.5% (95% confidence interval [CI], 17.7%-25.4%) after a first DVT and 27.9% (95% CI, 19.7%-36.1%) after a second DVT. The 5-year cumulative incidence of fatal pulmonary embolism was 2.6% (95% CI, 1.1%-4.1%) after a first DVT.(16)

It was found that 14 patients out of 26 (53.8 %) who developed DVT had presented with leg pain and swelling, while rest of patients had associated breathlessness. It showed a significant p value of < 0.001 . This was comparable to study by J west et al in which a study which included 5997 patients showed leg swelling to be present in 40% of patients, others being dyspnea (10%), leg pain (10%), tachypnoea (5%). (17)

Out of 59 patients who received prophylaxis, only 4 developed DVT (6%) whereas in 91 patients who did not receive any prophylaxis 22 went on to develop DVT (24.1%). In our study it was found that certain departments such as orthopedics where patient were being given preoperative prophylaxis, a decrease in incidence of DVT was noted. Incidence of DVT dropped to 5.2% in those who received prophylaxis vis-à-vis those who were not given prophylaxis (27.7%). This can be compared to study by Agnelli G et al in which routine use of thromboprophylaxis is recommended in surgical patients who are >40 years of age or undergoing major general procedures. (18) Compared with no prophylaxis, both subcutaneous, low-dose unfractionated heparin (LDUH) and low-molecular-weight heparin (LMWH) have been shown to reduce the risk of VTE in these patients by at least 60%.(19,20)

In our study total of 71(47.3%) patients had a Caprini score of more than 8, out of which 22 patients developed DVT (30.9%). Our study shows that Caprini score of more than 8 has a high chance of developing DVT with a significant p value of < 0.001 while score less than 6 has reduced probability of DVT. This was comparable to study by Pannucci et al, among patients with Caprini score >8 , 16.3% have a postoperative VTE when chemoprophylaxis was not provided.(21) Other studies by Christopher J P et al (21) and Obi et al, (1) had similar conclusions.

Patients in whom Caprini score was more than 8 were given prophylaxis. This showed a significant p value of <0.001 . Area under curve showed that Caprini score of more than 5.5 had a 94% sensitivity and 52 % specificity in predicting DVT.

Caprini Score

1 Point	2 Points	3 Points	5 Points
- Age 41–60 years	- Age 61–74 years	- Age 75 years	- Stroke (<1 mo)
- Minor surgery	- Arthroscopic surgery	- Family history of VTE	- Elective arthroplasty
- Swollen legs	- Major open surgery (>45 minutes)		- Hip, pelvis, or leg fracture
- Varicose veins	- Laparoscopic surgery (>45 minutes)		- Acute spinal cord injury (<1 month)
- Pregnancy or postpartum	- Malignancy		
- History of unexplained or recurrent Spontaneous abortion	- Confined to bed (>72 hours)		
- Oral contraceptives or hormone Replacement therapy	- Immobilizing plaster cast		
- Sepsis (<1 month)	- Central venous access		
- Serious lung disease, including Pneumonia (<1 month)			
- Abnormal pulmonary function			
- History of inflammatory bowel disease			
- Medical patient at bed rest			

V. Conclusion

Preoperative risk assessment using Caprini score was found to have a high DVT predictability in all surgical patients. Those with a Caprini score of more than 8 have a higher risk of development of post operative DVT. In our study it has been seen that preoperative DVT prophylaxis in high risk patients can reduce the incidence of DVT. From this study it can be concluded that all patients undergoing surgery in all departments should be assessed using Caprini score preoperatively and patients in high risk group should be given thromboprophylaxis according to institutional recommendations. It was also found that asymptomatic DVT exists and all surgical patients should be risk assessed prior to surgery and appropriate DVT prophylaxis should be initiated in high risk patients.

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