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Original Research Article

INCIDENCE AND DETERMINANTS OF DEEP VENOUS THROMBOSIS IN SURGICAL ICU PATIENTS

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Abstract

Introduction: Deep venous thrombosis (DVT) is a major cause of morbidity and mortality among critically ill surgical ICU patients, driven by factors such as prolonged immobility, invasive procedures, and age. Although DVT prophylaxis is widely implemented, cases persist, particularly in high-risk populations. Despite global awareness, limited data exist on DVT incidence in Indian surgical ICUs. This study aims to determine the incidence of DVT and identify its key determinants in surgical ICU patients.

Materials & Methods: This prospective observational study was conducted from January to June 2023 in a surgical ICU at a tertiary hospital in Gujarat. Patients aged ≥18 with ICU stays longer than 48 hours were included, excluding those with pre-existing DVT or contraindications to anticoagulation. Demographic and clinical data, including APACHE IV and DVT risk scores, were collected.

Results: There was 18.0% incidence of DVT among surgical ICU patients. Key risk factors included advanced age, prolonged immobility, and presence of central venous catheters, obesity, previous DVT, coagulation disorders, and extended ICU stays.

Conclusion: DVT risk assessment using a standardized risk score should be conducted for all surgical ICU patients, with particular attention to high-risk groups, such as the elderly, those with prolonged immobility, and those with central venous catheters. Evidence-based prophylaxis, including the use of LMWH, should be prioritized for patients with additional risk factors, such as obesity, previous DVT, or coagulation disorders.

Keywords: Central Venous Catheters, Deep Venous Thrombosis (DVT), Immobility, Risk factors, Surgical ICU

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

INTRODUCTION

Deep Venous Thrombosis (DVT) is a significant cause of morbidity and mortality among critically ill patients, especially those in surgical ICUs. Several factors such as prolonged immobility, invasive procedures, and underlying medical conditions contribute to the increased risk of DVT in these patients. Studies have shown that critically ill surgical patients are at a particularly high risk of DVT, often resulting in complications such as pulmonary embolism and prolonged ICU stays.[1]

In surgical ICUs, factors like age, mechanical ventilation, and the use of central venous catheters have been identified as significant determinants of DVT.[2] Despite global recognition of these risks, data on the incidence of DVT in surgical ICUs in India remain limited, which underscores the importance of region-specific studies to understand the unique risk factors in this population. Furthermore, tools like the APACHE IV score have been shown to correlate with DVT risk and adverse outcomes, making them crucial for assessing and managing these patients.[3,4]

DVT prophylaxis, including pharmacological agents like low-molecular-weight heparin (LMWH) and mechanical methods, has become an essential component of ICU care. Yet, despite these measures, DVT cases continue to be reported in surgical ICUs, suggesting the need for more targeted interventions and individualized patient assessment protocols.[5] (Previous research highlights that the effectiveness of DVT prophylaxis can vary significantly based on individual patient risk factors and ICU practices, underscoring the need to explore the determinants and risk profiles specific to Indian ICU patients to enhance patient outcomes and reduce thrombotic complications.[1,4] This study aims to determine the incidence of DVT and identify key determinants in surgical ICU patients.

MATERIALS AND METHODS

This prospective observational study was conducted at the Surgical ICU of tertiary care hospital, Gujarat from January 2023 to June 2023. This study was approved by the Institutional Ethics Committee, and informed consent was obtained from all patients.

Inclusion Criteria: All patients admitted to the surgical ICU during the study periods who were ≥18 years of age with a length of ICU stay longer than 48 hours were included.

Exclusion Criteria: Patients with pre-existing DVT, those with contraindications to anticoagulation therapy, or those who were discharged or transferred before the study's completion were excluded.

Data Collection: Demographic data, clinical characteristics, and surgical details were collected on admission. The following variables were noted: age, gender, history of prolonged immobility, obesity, previous DVT, history of varicose veins, abnormal coagulation disorders, thrombocytopenia, and use of pharmacological prophylaxis. The APACHE IV score and DVT risk scores were calculated on admission. The type of surgery and the use of central venous catheters (CVC) were also recorded.

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

DVT Diagnosis: DVT was diagnosed using duplex ultrasonography performed within 48 hours of ICU admission and again before ICU discharge for all patients. A positive diagnosis of DVT was defined by the presence of thrombus on ultrasonography.

Statistical Analysis: Data were collected using a pre-designed proforma and analyzed with Epi Info version 7.1.4.0. Continuous data were expressed as mean ± SD, and categorical data as frequency and percentage. Chi-square tests and independent t-tests were used to assess the association between DVT and various risk factors. A p-value <0.05 was considered statistically significant.

RESULTS

During the study period, a total of 200 patients were admitted to the surgical ICU. Among them, 36 patients developed DVT, indicating an incidence rate of 18.0% for DVT in this population of surgical ICU patients.

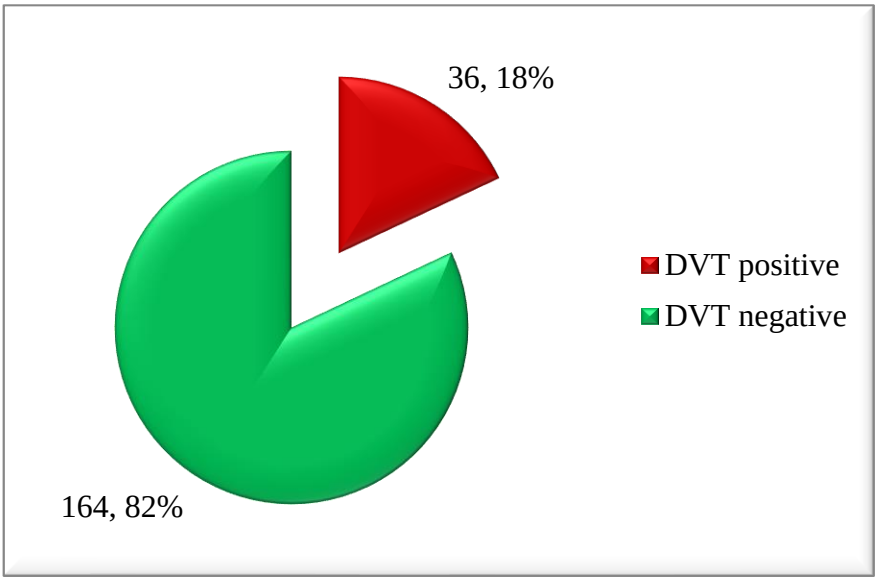

Figure 1: Incidence of DVT among surgical ICU

Demographics and Clinical history: The mean age was higher in the DVT-positive group (66.2 ± 12.3 years) compared to the DVT-negative group (59.2 ± 11.2 years, p – 0.01). The APACHE IV score was notably higher in DVT-positive patients (61.1 ± 12.1) than in DVT-negative patients (44.0 ± 10.8, p -0.03). DVT risk scores were also elevated in DVT-positive patients (4.5 ± 1.2 vs. 3.1 ± 1.0), showing a strong statistical association (p < 0.001).

Risk Factors: DVT-positive patients had a higher incidence of prolonged immobility (55.6%) and CVC presence (58.3%) compared to the DVT-negative group (31.7% and 30.5%, respectively), with p-values of 0.01 and 0.003, respectively. Obesity, history of DVT, varicose veins, and coagulation disorders were significantly more prevalent in DVT-positive patients, indicating a strong association with DVT.

Outcomes and Complications: DVT-positive patients showed a higher rate of pulmonary embolism (19.4%) and recurrence of DVT (11.1%), with significant p-values (<0.001). The length of ICU stay was notably longer in DVT-positive patients (15.1 ± 5.58 days vs. 8.32 ± 3.98 days), with a p-value of <0.001.

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

Treatment: DVT-positive patients were more likely to have received mechanical prophylaxis (80.6%) compared to DVT-negative patients (61.6%), with a p-value of 0.02. The mean ventilator days were higher in the DVT-positive group (7.27 ± 3.54) than in the DVT-negative group (3.25 ± 2.16), also showing a significant association ($p < 0.001$).

Table 1: Comparison of demographic profile and risk Factors between DVT positive and DVT negative ICU patients in surgical ICU

Demographic profile	DVT Positive (n=36)	DVT Negative (n=164)	Total (n=200)	p-value
Age (years, Mean ± SD)	66.2 ± 12.3	59.2 ± 11.2	61.2 ± 11.23	**0.01**
Gender				
Male	22 (61.1%)	98 (59.8%)	120 (60%)	0.87
Female	14 (38.9%)	66 (40.2%)	80 (40%)	
Risk Factors				
Prolonged immobility	20 (55.6%)	52 (31.7%)	72 (36.0%)	**0.01**
CVC (Central Venous Catheter)	21 (58.3%)	50 (30.5%)	130 (65%)	**0.003**
Obesity	15 (37.5%)	25 (15.6%)	40 (20.0%)	**0.005**
H/O DVT (%)	8 (22.2%)	10 (6.1%)	18 (9.0%)	
H/O varicose vein	7 (19.4%)	6 (3.7%)	13 (6.5%)	**<0.001**
H/O abnormal coagulation disorder	9 (25.0%)	13 (7.9%)	22 (11%)	**0.001**
H/O thrombocytopenia	11 (30.6%)	9 (5.5%)	20 (10.0%)	0.19
H/O pharmacological prophylaxis	9 (25.0%)	5 (3.1%)	150 (75%)	0.07
DVT risk score	4.5 ± 1.2	3.1 ± 1.0	3.4 ± 1.1	**<0.001**
APACHE IV score	61.1 ± 12.1	44.0 ± 10.8	40.50 ± 10.22	**0.03**
Major surgery	30 (75.0%)	92 (56.1%)	122 (61.0%)	**0.004**
Type of Surgery				
Orthopedic	20 (50.0%)	60 (37.5%)	80 (40.0%)	0.15
Abdominal	10 (25.0%)	50 (31.3%)	60 (30.0%)	
Cardiothoracic	8 (20.0%)	32 (20.0%)	40 (20.0%)	
Neurosurgery	2 (5.0%)	18 (11.3%)	20 (10.0%)	

Table 2: Comparison of outcome and treatment between DVT positive and DVT negative ICU patients in surgical ICU Setting

Outcomes	DVT Positive (n=36)	DVT Negative (n=164)	Total (n=200)	p-value
Pulmonary embolism	7 (19.4%)	3 (1.8%)	10 (5%)	**<0.001**
ICU mortality	9 (25.0%)	7 (4.2%)	15 (7.5%)	0.32
Length of ICU stay (days, Mean ± SD)	15.1 ± 5.58	8.32 ± 3.98	10.3 ± 4.21	**<0.001**
Treatment and Prophylaxis				
LMWH	31 (86.1%)	114 (69.5%)	145 (72.5%)	0.06
Vasopressors	18 (50%)	82 (50%)	100 (50%)	1.00
Inotropes	13 (36.1%)	57 (34.8%)	70 (35%)	0.88
Ventilator day (Mean ± SD)	7.27 ± 3.54	3.25 ± 2.16	4.98 ± 2.51	**<0.001**
Mechanical prophylaxis	29 (80.6%)	101 (61.6%)	130 (65%)	**0.02**
No prophylaxis	2 (5.6%)	18 (11%)	20 (10%)	0.32
Complications				
Bleeding due to anticoagulation	3 (8.3%)	5 (3.0%)	8 (4%)	0.15
Recurrence of DVT	4 (11.1%)	1 (0.6%)	5 (2.5%)	**<0.001**

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

DISCUSSION

DVT may be silent clinically because thrombus that does not cause a net venous outflow obstruction is often asymptomatic and hence remains undiagnosed or even if symptomatic, the clinical signs are nonspecific like; pain, edema, and tenderness. In ICU patients' edema is universally present due to hypoalbuminemia, right-sided heart failure, fluid overload, hepatic, renal insufficiency, or due to surgery.[6]

Incidence

The incidence of DVT among surgical ICU patients in our study was found to be 18.0%. This rate is consistent with the wide variability in DVT incidence reported across different studies. For instance, Jaff et al.[7] reported a higher incidence of 25%, while Wilasrusmee et al.[8] observed a lower rate of 10%. Similarly, Agarwal et al.[9] documented an incidence of 5.0%, significantly lower than our findings. Other studies have shown an even broader range, with incidences between 25–32%.[10] These differences in incidence rates can be attributed to various factors, including patient demographics, ICU protocols, anticoagulation practices, and differing criteria for DVT diagnosis.

Risk factors

In our study, several factors were identified as significant contributors to the risk of DVT among surgical ICU patients. Advanced age (66.2 ± 12.3 years) emerged as a prominent risk factor, consistent with findings from Wilasrusmee et al.[8], who reported a similar mean age of 64.0 ± 12.8 years among their ICU patients. Increased age is often associated with decreased venous elasticity and reduced mobility, both of which contribute to DVT risk.

The APACHE IV score (61.1 ± 12.1) and elevated DVT risk scores (4.5 ± 1.2) also correlated strongly with DVT incidence in our study, indicating that patients with greater severity of illness are more vulnerable to thrombotic events.

Prolonged immobility was present in 55.6% of our DVT cases, aligning closely with findings from Agarwal et al.[9], who found immobilization as a significant risk factor in 34.0% of patients. Extended ICU stays (7.27 ± 3.54 days) in our cohort also contributed to DVT risk, as immobilization is typically longer among these patients, increasing the likelihood of stasis and thrombosis. The presence of a central venous catheter (CVC) in 58.3% of our cases corroborates similar rates observed by Agarwal et al.[9] (34.8%), highlighting that venous instrumentation increases DVT risk, potentially due to endothelial injury and venous stasis.

Obesity (37.5%), a history of DVT (22.0%), varicose veins (19.4%), and coagulation disorders (25.0%) were additional factors associated with increased DVT risk in our study. These factors are recognized for their contributions to venous stasis and hypercoagulability.

Comparatively, Agarwal et al.[9] also noted that a previous history of DVT (8.0%) significantly increased risk. Mechanical prophylaxis was applied in 80.6% of our cases, while the use of low-molecular-weight heparin (LMWH), identified as the most common prophylactic measure by Agarwal et al.[9] (78%), was less frequently used in our cohort.

Kumar et al.[6] also found that high APACHE IV score ($p = 0.029$), high DVT risk score ($P = 0.026$) use of vasopressors ($P = 0.023$), central venous catheter (CVC) ($P < 0.01$), and prolonged ICU stay ($P < 0.01$) were associated with DVT.

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 10, 2024

CONCLUSION

This study identified 18.0% incidence of deep venous thrombosis (DVT) among surgical ICU patients, with elevated APACHE IV and DVT risk scores associated with higher risk. Key risk factors included advanced age, prolonged immobility, presence of central venous catheters, obesity, previous DVT, coagulation disorders, and extended ICU stays. These findings highlight the critical need for targeted DVT prevention strategies in high-risk surgical ICU patients to reduce complications and optimize ICU resources. Implementing evidence-based prophylactic measures is essential to effectively lower DVT incidence in this vulnerable population.

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