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Incidence of Deep Vein Thrombosis and Associated Factors Among Intensive Care Unit Patients at Dhulikhel Hospital : A Prospective Cross-Sectional Study

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ABSTRACT

Introduction: Deep vein thrombosis (DVT) is a common yet preventable complication in ICU patients. Several factors leads to its development including prolonged immobilization, high disease severity scores such as APACHE II, sepsis, septic shock and invasive procedure as central line placement . Diagnosing DVT in ICU is challenging because clinical symptoms are often non specific and insensitive. Many cases of DVT remains clinically silent, yet this clinical condition can progress to life threatening complication as pulmonary embolism.

Objectives: To evaluate the incidence of deep vein thrombosis (DVT) among ICU admitted patients and identify its associated factors.

Methodology: We conducted a prospective cross-sectional study on 59 ICU patients. The data included demographics, comorbidities, operative procedures, D-dimer levels, thrombo-prophylaxis, lower limb ultrasound and doppler findings.

Results: The incidence of DVT among ICU patients was 5.1% (3/59; 95% CI: 1.1%-14.2%) , with all cases occurring despite pharmacological thromboprophylaxis. Elevated D-dimer (>0.5 mcg/mL) was observed in two-thirds of DVT cases,however no significant association was found between D-dimer levels and DVT incidence. Common comorbidities included sepsis (63%), pneumonia (27.1%), and Chronic obstructive disease (25%). Twenty two percent of patients underwent operative procedures of whom one developed DVT. A higher prevalence of DVT was observed in older age groups (12.5% in patients over 75 years) and females (11.1%). Smoking, blood transfusion and sepsis were clinically relevant factors, consistent with global risk profiles.

Conclusion: The incidence of DVT among ICU patients admitted to Dhulikhel Hospital was 5.1%. Close monitoring of critically ill patients, combined with target screening strategies and individualized risk assessment, can help to improve early detection and prevention of DVT.

Introduction

Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), is a significant medical complication in critically ill intensive care unit (ICU) patients, associated with increased morbidity and mortality.[1,2] Several factors, including older age, smoking, obesity, major surgery, immobility, pregnancy, cesarean delivery,blood transfusion, malignancy, and infection leads to increased risk of venous thromboembolism.[3,4] Most ICU patient have at least one major risk factor for venous thromboembolism.[5]

The incidence of DVT is higher in critically ill patients due to prolonged immobilization, sepsis, mechanical ventilation, invasive procedures such as

Central line placement and recent vascular injury or surgery.[6] The risk of developing a DVT can be as high as 81% in critically ill patients without thromboprophylaxis and around 44% even with thromboprophylaxis.[7]

Diagnosing DVT in ICU is very challenging because clinical symptoms are often non specific and insensitive making it difficult to rely solely on physical signs.[8,9] A retrospective study involving ICU patient screened for DVT using color flow Doppler ultrasound estimated an incidence of 33%.[10] Similarly, cross sectional study involving medical and surgical ICU patients reported that approximately 10% of patients already had DVT on ICU admission.[11,12]

Several earlier studies have suggested a lower susceptibility and incidence of VTE in the Asian population.[13] However, recent studies show a similar rate of VTE after major surgery and in medical patients among Asian population compared to the Western populations.[14]

In Nepal, there is minimal data currently available regarding the prevalence of deep vein thrombosis among ICU admitted patients. There are very few publications on DVT prophylaxis methods being adopted in Nepal, and it remains unclear whether standardized protocols for DVT prophylaxis are followed in the country.[15] This aim of this study is to find the incidence of DVT and to identify its associated risk factors among patients admitted to our ICU.

Methodology

This hospital-based, prospective, cross-sectional study conducted at a single center, the ICU of Dhulikhel Hospital. It included all patients admitted to the ICU of Dhulikhel Hospital after receiving approval from the Institutional Review Committee (IRC-KUSMS Approval No. 193/24).

A total of 59 patients of age more than 18 years and admitted to the ICU for more than 3 days were included in the study. Patients with known cases of DVT or pulmonary embolism, patients under anticoagulants and those who refused to give consent were excluded from study. The sample size was calculated by using the following formula:

$n = (Z^2 \times p \times (1-p)) / e^2$

$= 1.962 \times 0.1 \times 0.9 / 0.08^2$

$= 55$

Where,

n = minimum required sample size

Z = 1.96 at 95% Confidence Interval (CI)

p = prevalence taken from a previous study, 10%[2]

e = margin of error, 8%

After collecting demographic and clinical data, including D dimer (> 0.5 mcg/ml) two well-trained doctors performed ultrasonography of the bilateral lower limb. Compression venous ultrasonography was first performed within 72 hours of patient enrollment. Proximal DVT was diagnosed by venous ultrasonography using real time B mode on Mindray M5 diagnostic ultrasound system with 7.5 mHZ and 10 mHZ linear transducer probe. The patient was positioned with each leg externally rotated at hip and slightly flexed at the knee. The probe was transversely placed on the proximal femoral triangle starting near the inguinal ligament, so that the common femoral vein and artery could be visualized. Firm compression and pressure release were applied to the vein with the operator sliding the probe distally to follow great saphenous vein and the bifurcation of the common femoral vein. Then probe was moved distally to popliteal fossa to scan the popliteal vein and its bifurcation. The common iliac vein and external iliac vein were scanned with a 10mHZ probe. A study was considered positive if complete venous compressibility was absent.[16] Then positive studies were confirmed by a vascular surgeon who performed both compression and the doppler assessment for all patients. DVT involving the femoral or popliteal vein was defined as proximal DVT. Additionally echocardiography was performed to assess for right atrial and right ventricular dilatation, impaired left ventricular diastolic filling with leftward displacement of the interventricular septum and thrombus presence in pulmonary artery.[17]

All statistical analyses were performed using SPSS version 26. Continuous variables were expressed as mean and standard deviation for normally distributed data or median and inter-quartile range for non normally distributed data. Categorical variables were summarized as count and percentages. Fisher's exact test was applied to assess associations between variables. A p-value of <0.05 was considered statistically significant throughout the study.

Results

There were 59 patients included in the study, of whom three patients (5.1%, 95% CI:1.1%-14.2%) were diagnosed with deep vein thrombosis . The age of patients in our study ranged from 18 to 91 years, with mean age of 51.86 ± 21.04 years (Table 1).The mean age of patients with DVT was 71 ±10.15 years compared to 50.84± 21.03 years in those without DVT. This study included 32 male and 27 female. There is no statistically significant association between gender category and DVT occurrence (Table 1). Although overweight individuals had the highest DVT prevalence (9.09%), but there was no statistically significant correlation between BMI categories and DVT risk (Table 1).

Table 1: Patient demographics and characteristics:

Age Group	Number of Patients N=59	DVT Cases	Cumulative Incidence of DVT (%)	p-value
18–40 years	19	0	0%	0.55
41–60 years	19	1	5.26%	
61–75 years	13	1	7.69%	
>75 years	8	1	12.50%	
Gender				
Male	32	0	0%	0.25
Female	27	3	11.11%	
BMI Category				
Underweight (<18.5)	4	0	0%	0.72
Normal (18.5- 24.9)	23	1	4.35%	
Overweight (25-30)	22	2	9.09%	

The most common comorbidities among ICU patients were sepsis 37 (63%), Community acquired pneumonia and Hospital acquired pneumonia 16 (27.1%), COPD 15 (25%), and fractures 9 (15%) (Fig 1). Among 13 patients who underwent operative procedures, one patient developed DVT post-operatively (Fig 2). Operative durations ranged from 15 minutes to 10 hours, with a mean duration of 3.2 hours. No cases of DVT were observed in longer procedures (e.g., 6–10 hours), however the sample size is too small to establish any definitive conclusion.

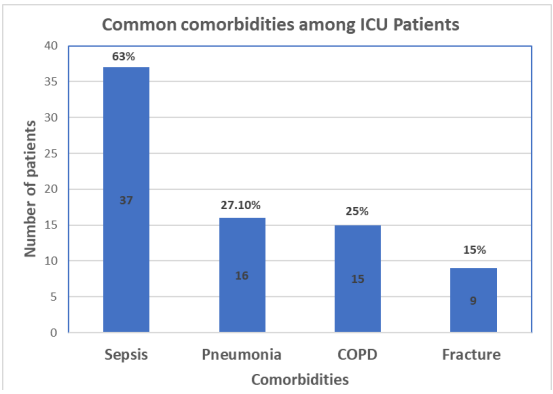

Figure 1: Common comorbidities among ICU patients

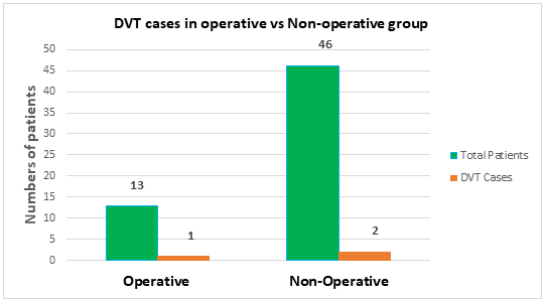

Figure 2: Relationship Between Operative Procedures and DVT

Of the 59 patients included in the study , 28 (47.5%) were smokers, with pack years ranging from 2 to 50 and average of 14.3 years (Table 2). The prevalence of DVT was slightly higher among smoker (7.14%) compared to non-smokers (3.23%). However, this difference was not statistically significant (Table 2) . All patients diagnosed with DVT had elevated D Dimer levels (8.8 mcg/ml,3.5mcg/ml and 1.51 mcg/ml) still no significant association was found between D-dimer levels and DVT prevalence in our study. The statistical power to detect such association was limited by small sample size (Table 3). Among the three patients who developed DVT, one patient had undergone hemicraniectomy for right hippocampal hemorrhage and received enoxaparin starting on the 3rd postoperative day. Doppler ultrasonography revealed a thrombus in the left common femoral vein. The other two patients, both with underlying coagulopathy, received thromboprophylaxis with Enoxaparin 60mg starting on Day two. In these cases, Doppler scans showed thrombus in the left popliteal vein. Most of patients in the study received thromboprophylaxis, primarily with Enoxaparin. A few patients were treated with other anticoagulants like Apixaban, Heparin or Rivaroxaban. Thromboprophylaxis was initiated within the first days of ICU admission, with duration varying from 2 to 8 days.

Table 2: Relation between smoking and DVT

Category	Total Patients N=59	DVT Cases	Cumulative Incidence (%)	p-value
Smokers	28	2	7.14%	0.58
Non-smokers	31	1	3.23%	

Table 3: Relation between d-dimer level and DVT

D-dimer Category	Total Patients N= 59	DVT Cases	Cumulative Incidence (%)	p-value
Normal (<0.5 mcg/ml)	14	1	7.14%	0.56
High (>0.5 mcg/ml)	45	2	4.44%	

Discussion

Venous thromboembolism including deep vein thrombosis and pulmonary embolism has become a significant concern in ICU setting worldwide, highlighting the need for effective prevention strategies. In our ICU patients the incidence of DVT was 5.1% which was similar to the global prevalence of 5–15% as observed in a large meta-analysis involving 27,344 individuals admitted to ICU worldwide.[18] However the incidence of DVT in our study was lower than that reported in Chinese(19%) and Caucasian populations (28–32%) without thromboprophylaxis.[19,20,21] This discrepancy may be because of genetic factors particularly the higher prevalence of thrombotic mutation like factor V Leiden in the Caucasian populations. The relatively lower incidence observed in this study can be attributed to smaller propotion of post operative patients, early mobilization strategy and routine use of thromboprophylaxis in the ICU. Despite lower incidence, ICU acquired DVT remains clinically significant due

to risk of pulmonary embolism and long term disability such as post- thrombotic syndrome, emphasizing the need for ongoing vigilance and screening.[9] This study reflects similar global trends where factors like age and smoking are considered as important contributors to DVT in critically ill patients (Table1, Table 4).[22] Our study identified acute clinical conditions, particularly pneumonia and septic shock were significant risk factors for DVT. These conditions trigger inflammatory and hemodynamic changes during severe infections that result in a hypercoagulable state. This observation is consistent with previous study from China and Europe reporting higher DVT rates among patients with severe infections and systemic inflammatory responses.[23,24] Sepsis promotes a procoagulant state through mechanisms such as dysregulated coagulation, fibrinolysis suppression, platelet activation, and endothelial dysfunction thereby increasing the likelihood of thrombotic events.[25] Therefore enhanced monitoring and targeted treatment strategies should be prioritized for the high risk population.

International guidelines emphasize individualized risk assessment to guide the choice of prophylaxis.[14] Low Molecular Weight Heparin is preffered over unfractionated heparin for its superior pharmacokinetics and lower heparin-induced thrombocytopenia (HIT).[26] Mechanical methods such as graduated compression stockings (GCS) and intermittent pneumatic compression (IPC) devices remain integral components, especially in patients at high risk of bleeding.[27] In our ICU we routinely implement both pharmacological and mechanical prophylactic strategies.

D-dimer testing has less specificity in ICU patients, as level elevated due to overlapping conditions like infection, inflammation, or trauma.[28] The incidence of elevated D-dimer levels observed in non-DVT group was 73.2% indicating that elevated d-dimer is insufficient to diagnose thrombosis in ICU patients (Table-5). Similar finding have been reported in COVID-19 ICU cohorts, where D-dimer elevation reflects cytokine-induced coagulation activation, leading to microthrombosis and endothelial injury.[29] Thus, in ICU settings, the diagnostic specificity of D-dimer is low, and its primarily utility lies more in monitoring inflammation and coagulopathy than confirming DVT. We used D dimer as a screening tool, with definitive diagnosis confirmed by using non invasive compression ultrasound, which is readily available at the bedside that alings with WHO recommendations for ICUs with limited resources.[16] Duplex and color Doppler ultrasonography offer improved sensitivity and specificity when performed by experienced operator.[30] However operator dependency and variable interpretation emphasize the need to integrate imaging findings with clinical judgment. The choice of diagnostic modality should consider sensitivity, availability of resources , and urgency of clinical decision-making. Routine risk stratification,use of both mechanical and pharmacological prophylaxis are effective in reducing DVT incidence in high risk ICU population.

Conclusion

In this prospective cross-sectional study conducted in the ICU of Dhulikhel Hospital, the incidence of deep vein thrombosis (DVT) was found to be 5.1%. This finding highlights the importance of continuous vigilance, risk stratification, and multi-modal prophylactic strategies. The low number of DVT cases in our study limits statistical power to detect significant associations but the clinical patterns such as higher rates among septic, older or female patients remain consistent with global . Future research should focus on multi-center studies with larger sample sizes and longer follow-up periods to validate these findings and develop risk-adapted VTE prevention protocols suitable for Nepalese critical care settings.

Limitation

This is a single centre design so the findings can not be generalized to other settings. The incidence of DVT in our study population was low leading to a small number of outcome events. This limits the use of inferential statistical methods to detect significant associations between associated factors and occurrence of DVT .

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Conflict of Interest: None

Financial Disclosure None

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