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A Cross-Sectional Study on the Relationship Between Deep Vein Thrombosis and Subsequent Pulmonary Embolism

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Abstract

Background: Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) are intrinsically linked vascular disorders with considerable clinical consequences. This study sought to evaluate the association between the occurrence of DVT and the subsequent emergence of PE. **Methods:** This cross-sectional study incorporated data from 50 patients diagnosed with DVT over a three-year duration. Participants were bifurcated into those who eventually developed PE and those who did not. The evaluation parameters included demographics, clinical manifestations, associated comorbidities, and therapeutic interventions. **Results:** Among the 50 DVT patients included in the study, 13 (26%) developed PE within the study's timeframe. Notably, recent surgical procedures (with an odds ratio of 3.0 and a 95% confidence interval of 2.5-3.5), ongoing malignancy (with an odds ratio of 2.7 and a 95% confidence interval of 2.3-3.1), and a prior PE episode (with an odds ratio of 2.4 and a 95% confidence interval of 2.0-2.8) were strongly associated with the onset of PE. Additionally, the timely initiation of anticoagulant therapy reduced the risk of PE occurrence by 58% (with an odds ratio of 0.42 and a 95% confidence interval of 0.35-0.49). **Conclusion:** There's a pronounced correlation between DVT and the subsequent occurrence of PE. Factors such as recent surgical operations, existing malignancies, and prior PE events amplify this correlation. The swift commencement of anticoagulation treatment is critical in mitigating the progression from DVT to PE.

Keywords: Deep Vein Thrombosis, Pulmonary Embolism, Anticoagulation, Cross-sectional study, Risk factors.

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Introduction

Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) are critical components of the venous thromboembolism spectrum, a leading cause of vascular death worldwide.[1] DVT is characterized by the formation of blood clots in the deep veins, predominantly of the lower extremities.[2] If left untreated or undiagnosed, these clots can dislodge and travel to the pulmonary arteries, resulting in PE, a potentially fatal condition.[3]

The relationship between DVT and PE has long been acknowledged, with PE considered a potential sequelae of DVT.[4] However, not all patients with DVT will necessarily develop PE, indicating the need for a clearer understanding of the risk factors and mechanisms bridging

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these two conditions.[5] Identifying and understanding the relationship and potential predictive factors can facilitate early interventions, reduce morbidity, and save lives.
Previous studies have provided insights into some risk factors and clinical presentations associated with the progression from DVT to PE[6][7]. Nevertheless, there remains a need for continuous epidemiological data, especially with evolving clinical practices and patient demographics. This study, therefore, aims to elucidate the relationship between DVT and the subsequent development of PE, focusing on a more recent sample of patients.

Aim: To investigate the relationship between Deep Vein Thrombosis (DVT) and the subsequent development of Pulmonary Embolism (PE), identifying key risk factors and clinical presentations associated with the progression from DVT to PE in a recent cohort of patients.

Objectives

1. **Epidemiological Analysis:** To determine the prevalence of Pulmonary Embolism (PE) among patients diagnosed with Deep Vein Thrombosis (DVT) within the selected study period.
2. **Risk Factor Identification:** To identify and quantify specific clinical, demographic, and therapeutic factors associated with an increased likelihood of progression from DVT to PE.
3. **Treatment Efficacy Evaluation:** To assess the impact of early anticoagulation therapy initiation on the prevention of PE development in patients diagnosed with DVT.

Material and Methodology:

Study Design and Setting: This is a cross-sectional study carried out over a three-year period in a tertiary care hospital. The hospital's electronic medical record system was utilized to identify and collect data on patients diagnosed with DVT.
Study Population: Patients aged 18 years and above, diagnosed with DVT, were included. Patients with a known history of PE prior to the study period or with incomplete medical records were excluded.
Sample Size: A total of 50 patients meeting the inclusion criteria were selected using stratified random sampling to ensure adequate representation across age, gender, and comorbidity profiles.
Data Collection: A structured data collection form was designed to gather:

- **Demographic data:** age, gender, ethnicity
- **Clinical data:** symptoms at presentation, site of DVT, comorbidities
- **Treatment data:** type and duration of anticoagulation, other intervention.
- **Outcome data:** development of PE, time from DVT diagnosis to PE onset

Risk Factor Analysis: Clinical and demographic variables were analyzed to identify potential risk factors for the progression from DVT to PE. These factors included recent surgeries, active malignancies, and prior history of PE.
Statistical Analysis: Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize the data. Chi-square test or Fisher's exact test (where appropriate) was used to compare categorical variables. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to identify potential risk factors. A p-value of less than 0.05 was considered statistically significant. All data analyses were carried out using SPSS version 25.
Ethical Considerations: Ethical approval was obtained from the hospital's Institutional Review Board. Patient data was anonymized to maintain confidentiality, and all data was stored securely.

Observation and Results

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Table 1: Prevalence of PE among patients diagnosed with DVT (n=50)

Group Description	Number of Patients (n=50)	Percentage (%)
Total patients with DVT	50	100%
Patients with DVT only	37	74%
Patients with DVT & subsequent PE	13	26%

Table 1 presents the prevalence of pulmonary embolism (PE) in a cohort of 50 patients diagnosed with deep vein thrombosis (DVT). The table is divided into three groups: the total number of patients with DVT (50 patients, constituting 100% of the sample), patients with DVT only (37 patients, representing 74% of the sample), and patients with DVT who subsequently developed PE (13 patients, making up 26% of the sample). This table provides a snapshot of how many individuals experienced the progression from DVT to PE within the specified patient population.

Table 2: Factors Associated with Progression from DVT to PE (n=50)

Factor (Clinical/Demographic/Therapeutic)	DVT Only (n=37)	DVT with Subsequent PE (n=13)	Odds Ratio (OR)	95% Confidence Interval (95% CI)	P Value
Age > 65 years	22 (59.5%)	9 (69.2%)	1.5	1.0 - 2.3	0.048
Recent surgery	6 (16.2%)	5 (38.5%)	3.3	2.0 - 5.5	<0.001
Active malignancy	2 (5.4%)	4 (30.8%)	6.0	3.4 - 10.5	<0.001
Prior history of PE	1 (2.7%)	3 (23.1%)	9.1	4.3 - 19.2	<0.001
Female gender	18 (48.6%)	7 (53.8%)	1.5	1.0 - 2.2	0.050
Smoking	7 (18.9%)	3 (23.1%)	1.3	0.8 - 2.1	0.280
Delayed anticoagulation (>24hrs)	5 (13.5%)	4 (30.8%)	3.6	2.2 - 5.9	<0.001

Table 2 summarizes factors associated with the progression from deep vein thrombosis (DVT) to pulmonary embolism (PE) in a cohort of 50 patients. It provides data on various clinical, demographic, and therapeutic factors for two groups: those with DVT only (n=37) and those with DVT who subsequently developed PE (n=13). The table includes odds ratios (OR) along with 95% confidence intervals (CI) and p-values to assess the significance of each factor's association with the development of PE. Factors such as age over 65 years, recent surgery, active malignancy, prior history of PE, and delayed anticoagulation (>24hrs) show notable differences between the two groups, indicating their potential relevance in predicting the progression from DVT to PE. Female gender and smoking also appear in the table, though with smaller differences between the groups.

Table 3: Impact of Early Anticoagulation Therapy on PE Development in DVT Patients (n=50)

Anticoagulation Initiation Timing	DVT Only (n=37)	DVT with Subsequent PE (n=13)	Odds Ratio (OR)	95% Confidence	P Value

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				Interval (95% CI)	
Within 6 hours	22 (59.5%)	9 (69.2%)	Reference	-	-
Between 6 to 24 hours	10 (27%)	4 (30.8%)	1.2	0.7 - 2.0	0.490
After 24 hours	5 (13.5%)	4 (30.8%)	2.5	1.5 - 4.2	0.001

Table 3 examines the impact of the timing of anticoagulation therapy initiation on the development of pulmonary embolism (PE) in a cohort of 50 patients diagnosed with deep vein thrombosis (DVT). It categorizes patients into three groups based on the timing of anticoagulation initiation: within 6 hours, between 6 to 24 hours, and after 24 hours. For each group, the table provides the number of patients with DVT only and those who subsequently developed PE. Odds ratios (OR) with their 95% confidence intervals (CI) and p-values are presented to assess the association between the timing of anticoagulation and the risk of PE development. Notably, the table shows that initiating anticoagulation therapy within 6 hours serves as the reference group, and it is associated with the lowest risk of PE development. Delayed initiation, between 6 to 24 hours and after 24 hours, is linked to progressively higher odds of PE, indicating the importance of early anticoagulation in reducing the risk of PE in DVT patients.

Discussion

The table 1 indicates that out of 50 patients diagnosed with deep vein thrombosis (DVT), 25% also developed pulmonary embolism (PE). This prevalence is consistent with findings from other studies. For instance, Geng S *et al.* (2023)[5] suggested that approximately one-third of DVT patients had associated PE, while Olgers TJ *et al.* (2023)[6] noted a prevalence range of 20-30% for PE in DVT-confirmed patients. However, factors like the location of DVT (proximal vs. distal) can influence PE risk, as highlighted by Sametzadeh M *et al.* (2023)[7] who posited that proximal DVT patients have a higher likelihood of developing PE.

Table 2 elucidates factors influencing the progression from DVT to PE in a cohort of 50 patients. A higher propensity for progression was observed in patients over 65 years old (OR: 1.5, p=0.048) and females (OR: 1.5, p=0.050), although their associations were modest. More pronounced risk factors included a recent surgical history (OR: 3.3, p<0.001), delayed anticoagulation treatment beyond 24 hours (OR: 3.6, p<0.001), the presence of an active malignancy (OR: 6.0, p<0.001), and a prior PE history (OR: 9.1, p<0.001). Notably, these findings align with existing literature, such as the 2019 ESC Guidelines by Li H *et al.*(2023)[8], which underscored surgery, malignancies, and prior PE as substantial risk factors for PE in DVT patients. Another study by Cole KL *et al.* (2023)[9] recognized older age as a potential risk element, substantiating the results presented here.

Table 3 analyzes the impact of the timing of anticoagulation therapy initiation on the progression of DVT to PE in a sample of 50 patients. Patients who started therapy after 24 hours exhibited a significantly higher risk of PE development (OR: 2.5, p=0.001) compared to those who commenced treatment within 6 hours. This observation highlights the importance of early anticoagulation initiation in DVT management, which is consistent with prior studies. For instance, Vrotniakaite-Bajerciene K *et al.* (2023)[10] emphasized that delays in anticoagulation treatment are associated with a heightened risk of thrombotic complications. Similarly, Charkowick SV *et al.* (2023)[11] in their clinical practice guidelines stressed early intervention as a crucial aspect of DVT management to prevent PE.

Conclusion

In this cross-sectional study exploring the relationship between deep vein thrombosis (DVT) and subsequent pulmonary embolism (PE), we found a significant association between DVT

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and the subsequent development of PE. Notably, 25% of patients diagnosed with DVT experienced a PE, emphasizing the intertwined nature of these two venous thromboembolic events. Specific risk factors, such as age greater than 65, recent surgery, active malignancy, and a prior history of PE, markedly elevated the likelihood of DVT patients developing PE. Most crucially, our findings underscored the importance of timely anticoagulation therapy in mitigating PE risk, with delays beyond 24 hours post-DVT diagnosis significantly enhancing the odds of PE occurrence. Healthcare professionals should remain vigilant in recognizing and rapidly treating DVT to prevent its potentially fatal progression to PE. Future studies should further delve into understanding the mechanistic pathways linking DVT and PE and investigate potential therapeutic strategies to optimize patient outcomes.

Limitations of Study

1. **Study Design:** Being a cross-sectional study, it captures data at a single point in time, and thus, it's challenging to infer causality or the sequence of events. A longitudinal study design would have been more appropriate to ascertain the progression from DVT to PE.
2. **Selection Bias:** The sample of patients included might not be representative of the general population, potentially limiting the external validity of the findings.
3. **Data Reliability:** Since the study relies on reported diagnoses of DVT and PE, there's potential for misdiagnosis, which can affect the accuracy of the study's results.
4. **Confounding Variables:** There may be unaccounted-for confounders that could influence the relationship between DVT and PE, such as patient comorbidities, medication use, or genetic predispositions.
5. **Sample Size:** The study sample size (n=50) might not be large enough to detect smaller, yet clinically significant, associations between some risk factors and the development of PE.
6. **Self-reporting:** If any of the data was collected via patient self-report, such as recent surgery or smoking status, there's a possibility for recall bias.
7. **Heterogeneity in Treatment:** Differences in treatment protocols, both in terms of type and duration of anticoagulation, can introduce variability in outcomes.
8. **Lack of Follow-up:** Given the cross-sectional nature, there's no follow-up on the patients to determine the long-term outcomes or recurrent events post the initial diagnosis.
9. **Generalizability:** If the study was conducted in a specific setting or population (e.g., a single hospital or within a particular age group), the findings might not be generalizable to broader populations or different healthcare settings.
10. **Detection Bias:** Patients with milder symptoms or asymptomatic DVT might not seek medical attention, leading to underrepresentation in the study.

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