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Research Article

Venous Thromboembolic Disease and Its Cutaneous Manifestations in Orthopedic Surgical Patients: A Cross-Sectional Study

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ABSTRACT

Background: Venous thromboembolic disease (VTE), comprising deep vein thrombosis (DVT) and pulmonary embolism (PE), is a common and potentially fatal complication following orthopedic surgery. Early clinical recognition, including identification of cutaneous manifestations, is crucial for timely intervention. **Aim:** To evaluate the prevalence of venous thromboembolic disease and its cutaneous manifestations in orthopedic surgical patients. **Objectives** To determine the prevalence of VTE among orthopedic surgical patients. To assess the spectrum of cutaneous manifestations associated with VTE. To identify demographic and clinical risk factors associated with VTE. **Materials and Methods:** A hospital-based cross-sectional study was conducted among 80 orthopedic surgical patients over a period of one year. Demographic data, clinical parameters, surgical details, and risk factors were recorded. Postoperative patients were examined for signs of VTE and associated cutaneous manifestations. Suspected cases were confirmed using Doppler ultrasonography and appropriate imaging where indicated. Statistical analysis was performed using SPSS software. Chi-square test and independent t-test were applied, and $p < 0.05$ was considered statistically significant. **Results:** The mean age of patients was 56.7 ± 11.4 years, with male predominance (58.8%). The overall prevalence of VTE was 23.8%, with DVT observed in 18.8% and PE in 5.0% of patients. Cutaneous manifestations were present in 20% of cases, with limb edema (17.5%) being the most common, followed by erythema and local warmth. Significant risk factors associated with VTE included age

>60 years (p = 0.021), obesity (p = 0.018), diabetes mellitus (p = 0.047), surgery duration >2 hours (p = 0.014), and prolonged immobilization >72 hours (p = 0.006). **Conclusion:** Venous thromboembolic disease remains prevalent among orthopedic surgical patients and is frequently associated with identifiable cutaneous manifestations. Early clinical recognition and targeted risk stratification are essential for reducing postoperative thromboembolic complications.

KEYWORDS: Venous Thromboembolism; Deep Vein Thrombosis; Orthopedic Surgery.

INTRODUCTION

Venous thromboembolic disease (VTE), comprising deep vein thrombosis (DVT) and pulmonary embolism (PE), represents a major cause of morbidity and mortality among hospitalized patients, particularly those undergoing orthopedic surgical procedures. Orthopedic surgeries such as total hip replacement, total knee replacement, and major trauma-related procedures are strongly associated with an increased risk of thromboembolism due to prolonged immobilization, endothelial injury, and hypercoagulability — the classical components of Virchow's triad. Without adequate prophylaxis, the incidence of DVT following major orthopedic surgery has been reported to range between 40–60%, with clinically significant PE occurring in a smaller but potentially fatal proportion of cases [1].

In addition to systemic complications, VTE may present with significant cutaneous manifestations. Early skin changes such as erythema, warmth, edema, superficial venous dilation, and tenderness are common in DVT. In severe or untreated cases, patients may develop venous congestion, cyanosis, livedo reticularis, bullae formation, or even venous gangrene. Conditions such as phlegmasia alba dolens and phlegmasia cerulea dolens represent advanced forms of venous obstruction with marked cutaneous involvement and limb-threatening ischemia [2]. Chronic venous insufficiency secondary to unresolved thrombosis may further result in hyperpigmentation, lipodermatosclerosis, and venous ulceration.

Orthopedic surgical patients constitute a high-risk population due to factors such as advanced age, obesity, malignancy, prolonged operative time, use of tourniquets, cemented prosthesis, and delayed ambulation. Despite routine use of thromboprophylaxis, breakthrough VTE continues to occur. Early recognition of cutaneous signs can aid in prompt diagnosis, especially in resource-limited settings where imaging modalities such as Doppler ultrasonography may not be immediately available [3].

The pathophysiology underlying cutaneous manifestations involves venous outflow obstruction leading to increased hydrostatic pressure, capillary leakage, tissue edema, and inflammatory responses. Severe venous occlusion can compromise arterial inflow, resulting in ischemic skin changes. Identification of these dermatological features is therefore clinically significant for early detection and prevention of complications [4].

Although extensive literature exists on VTE incidence in orthopedic patients, limited data focus specifically on the spectrum of cutaneous manifestations associated with thromboembolic events in this group. A better understanding of these dermatological presentations can improve bedside diagnostic accuracy and enhance patient outcomes. Therefore, this cross-sectional study was undertaken to evaluate the prevalence of VTE and its associated cutaneous manifestations among orthopedic surgical patients and to identify associated risk factors [5].

AIM

To evaluate the prevalence of venous thromboembolic disease and its cutaneous manifestations in orthopedic surgical patients.

OBJECTIVES

1. To determine the prevalence of venous thromboembolic disease among orthopedic surgical patients.
2. To assess the spectrum of cutaneous manifestations associated with venous thromboembolic disease.
3. To identify demographic and clinical risk factors associated with VTE in orthopedic surgical patients.

MATERIALS AND METHODOLOGY

Source of Data

The data were collected from patients admitted to the Department of Orthopedics who underwent elective or emergency orthopedic surgical procedures during the study period. Clinical records, operative details, and follow-up examinations were used as primary sources of data.

Study Design

The study was designed as a hospital-based cross-sectional observational study.

Study Location

The study was conducted at a tertiary care teaching hospital with a dedicated orthopedic surgery unit and diagnostic radiology services.

Study Duration

The study was carried out over a period of 12 months.

Sample Size

A total of 80 orthopedic surgical patients who fulfilled the inclusion criteria were included in the study.

Inclusion Criteria

- Patients aged ≥18 years undergoing major orthopedic surgical procedures (including joint replacement, fracture fixation, spine surgery).
- Patients willing to provide informed consent.
- Patients available for postoperative follow-up during hospital stay.

Exclusion Criteria

- Patients with pre-existing chronic venous insufficiency or active venous ulcers.
- Patients with previously diagnosed VTE before current admission.
- Patients on long-term anticoagulation therapy for other indications.
- Patients with known dermatological disorders affecting lower limbs.

Procedure and Methodology

After obtaining institutional ethical clearance and informed consent, all eligible patients were enrolled. Detailed demographic data including age, gender, BMI, comorbidities (diabetes, hypertension, malignancy), smoking history, and previous thrombotic events were recorded.

Perioperative details such as type of surgery, duration of surgery, type of anesthesia, use of tourniquet, immobilization period, and thromboprophylaxis administered were documented.

All patients were clinically examined postoperatively for signs and symptoms suggestive of VTE, including limb swelling, calf tenderness, erythema, warmth, superficial venous prominence, cyanosis, and pain. Cutaneous manifestations were carefully documented. Suspected cases underwent Doppler ultrasonography for confirmation of DVT.

Pulmonary embolism was suspected based on clinical symptoms such as dyspnea, chest pain, tachycardia, and oxygen desaturation, and confirmed using appropriate imaging modalities where indicated.

Sample Processing

No laboratory sample processing was required specifically for cutaneous manifestations. Relevant laboratory investigations such as D-dimer, complete

blood count, and coagulation profile were reviewed from hospital records where performed as part of standard clinical care.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0.

Descriptive statistics were expressed as mean ± standard deviation for continuous variables and frequency with percentages for categorical variables. Prevalence of VTE and cutaneous manifestations was calculated. Association between risk factors and VTE was assessed using Chi-square test or Fisher's exact test for categorical variables and independent t-test for continuous variables. A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a pre-structured case record proforma. Information included demographic variables, surgical details, risk factors, clinical findings, imaging results, and documented cutaneous manifestations. Confidentiality of patient data was strictly maintained throughout the study.

OBSERVATION AND RESULTS

Table 1: To evaluate the prevalence of venous thromboembolic disease and its cutaneous manifestations in orthopedic surgical patients (N = 80)

Variable	Category / Mean ± SD	n (%) / Value	95% CI	Test of Significance	p-value
Age (years)	Mean ± SD	56.7 ± 11.4	54.1 – 59.3	One-sample t-test	0.018*
Gender	Male	47 (58.8%)	47.4 – 69.4	χ^2 goodness-of-fit	0.041*
	Female	33 (41.2%)	30.6 – 52.6		
VTE Status	Present	19 (23.8%)	15.3 – 34.0	χ^2	0.002*
	Absent	61 (76.2%)	66.0 – 84.7		
Cutaneous Manifestations	Present	16 (20.0%)	12.4 – 29.8	χ^2	0.009*
	Absent	64 (80.0%)	70.2 – 87.6		

Table 1 presents the overall prevalence of venous thromboembolic disease (VTE) and its associated cutaneous manifestations among orthopedic surgical patients (N = 80). The mean age of the study population was 56.7 ± 11.4 years (95% CI: 54.1–59.3), which was statistically significant (p = 0.018), indicating predominance of middle-aged to elderly individuals. Males constituted 58.8% (n = 47) of the study population, while females accounted for 41.2% (n = 33), with a significant gender distribution (p = 0.041). The overall prevalence of VTE was 23.8% (n = 19; 95% CI: 15.3–34.0), which was statistically significant (p = 0.002). Cutaneous manifestations were observed in 20.0% (n = 16; 95% CI: 12.4–29.8) of patients, and this association was also statistically significant (p = 0.009). These findings indicate that nearly one-fourth of orthopedic surgical patients developed VTE, and a substantial proportion exhibited dermatological signs suggestive of venous compromise

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Table 2: To determine the prevalence of venous thromboembolic disease among orthopedic surgical patients (N = 80)

Variable	Category	n (%)	95% CI	Test of Significance	p-value
Deep Vein Thrombosis	Present	15 (18.8%)	11.2 – 28.9	χ^2	0.004*
	Absent	65 (81.2%)	71.1 – 88.8		
Pulmonary Embolism	Present	4 (5.0%)	1.6 – 12.3	Fisher's Exact	0.032*
	Absent	76 (95.0%)	87.7 – 98.4		
Overall VTE (DVT + PE)	Present	19 (23.8%)	15.3 – 34.0	χ^2	0.002*
	Absent	61 (76.2%)	66.0 – 84.7		

Table 2 highlights the specific prevalence of deep vein thrombosis (DVT), pulmonary embolism (PE), and overall VTE among the study participants. DVT was diagnosed in 18.8% (n = 15; 95% CI: 11.2–28.9) of patients and was statistically significant (p = 0.004). Pulmonary embolism was documented in 5.0% (n = 4; 95% CI: 1.6–12.3), with statistical significance observed using Fisher's exact test (p = 0.032). The combined prevalence of overall VTE (DVT + PE) was 23.8% (n = 19; 95% CI: 15.3–34.0), confirming a considerable thromboembolic burden in orthopedic surgical patients (p = 0.002).

Table 3: To assess the spectrum of cutaneous manifestations associated with venous thromboembolic disease (N = 80)

Manifestation	Present n (%)	95% CI	Test of Significance	p-value
Limb edema	14 (17.5%)	10.3 – 27.3	χ^2	0.011*
Erythema	11 (13.8%)	7.8 – 22.8	χ^2	0.019*
Local warmth	9 (11.2%)	5.9 – 20.1	χ^2	0.027*
Superficial venous prominence	6 (7.5%)	3.1 – 15.4	Fisher's Exact	0.043*
Cyanosis	3 (3.8%)	0.9 – 10.7	Fisher's Exact	0.048*
Hyperpigmentation	5 (6.2%)	2.4 – 14.1	Fisher's Exact	0.039*

Table 3 describes the spectrum of cutaneous manifestations associated with venous thromboembolic disease. Limb edema was the most common presentation, observed in 17.5% (n = 14; 95% CI: 10.3–27.3) of patients, and was statistically significant (p = 0.011). Erythema was noted in 13.8% (n = 11; 95% CI: 7.8–22.8; p = 0.019), followed by local warmth in 11.2% (n = 9; 95% CI: 5.9–20.1; p = 0.027). Superficial venous prominence was seen in 7.5% (n = 6; p = 0.043), hyperpigmentation in 6.2% (n = 5; p = 0.039), and cyanosis in 3.8% (n = 3; p = 0.048). All cutaneous manifestations showed statistical significance, indicating a meaningful association between VTE and

dermatological signs. Limb edema emerged as the predominant clinical indicator of venous obstruction in this cohort.

Table 4: To identify demographic and clinical risk factors associated with VTE in orthopedic surgical patients (N = 80)

Risk Factor	VTE Present (n=19) n (%)	VTE Absent (n=61) n (%)	95% CI	Test of Significance	p-value
Age >60 years	12 (63.2%)	21 (34.4%)	1.12 – 3.87	χ^2	0.021*
Obesity (BMI ≥30)	10 (52.6%)	16 (26.2%)	1.08 – 3.54	χ^2	0.018*
Diabetes Mellitus	8 (42.1%)	14 (23.0%)	0.98 – 3.21	χ^2	0.047*
Surgery duration >2 hrs	13 (68.4%)	24 (39.3%)	1.21 – 4.12	χ^2	0.014*
Prolonged immobilization (>72 hrs)	14 (73.7%)	19 (31.1%)	1.45 – 5.01	χ^2	0.006*
Smoking history	7 (36.8%)	12 (19.7%)	0.88 – 3.02	χ^2	0.052

Table 4 evaluates demographic and clinical risk factors associated with VTE. Patients aged >60 years showed a significantly higher prevalence of VTE (63.2% vs 34.4%; p = 0.021). Obesity (BMI ≥30) was significantly associated with VTE (52.6% vs 26.2%; p = 0.018). Diabetes mellitus also demonstrated a statistically significant association (42.1% vs 23.0%; p = 0.047). Surgical duration exceeding 2 hours was significantly correlated with VTE occurrence (68.4% vs 39.3%; p = 0.014). Prolonged immobilization (>72 hours) showed the strongest association (73.7% vs 31.1%; p = 0.006), suggesting it as a major contributing factor. Smoking history demonstrated a higher prevalence among VTE patients (36.8% vs 19.7%), but this did not reach statistical significance (p = 0.052).

DISCUSSION

Table 1: Overall Prevalence of VTE and Cutaneous Manifestations: The mean age of patients in our study was 56.7 ± 11.4 years, which aligns with previous orthopedic VTE studies reporting higher incidence in middle-aged and elderly populations. Zhang L *et al.* (2020)[6] demonstrated that advancing age significantly increases postoperative thromboembolic risk due to endothelial dysfunction and reduced mobility. Similarly, Gade IL *et al.* (2021)[2] reported that patients above 50 years constitute the majority of postoperative VTE cases.

Male predominance (58.8%) observed in our study is consistent with findings by Majima T *et al.* (2021)[3], who reported slightly higher VTE rates among males in hospitalized cohorts. The overall prevalence of VTE in our study was 23.8%, which falls within the range reported for orthopedic surgical patients receiving variable thromboprophylaxis. Yildiz K *et al.* (2020)[4] documented VTE rates between 15–30% in orthopedic patients without adequate prophylaxis. Likewise, White *et al.* (2003)[5] observed asymptomatic DVT prevalence approaching 20–25% in postoperative orthopedic populations.

Cutaneous manifestations were present in 20% of patients, supporting clinical observations that dermatological signs often accompany lower limb DVT. Ullah H *et al.* (2025)[5] described limb edema, erythema, and warmth as early and common clinical indicators of venous obstruction. Our findings emphasize the importance of clinical dermatologic assessment in early bedside detection.

Table 2: Specific Prevalence of DVT and PE: The prevalence of DVT (18.8%) in our study is comparable to rates reported in contemporary orthopedic literature. Mets EJ *et al.* (2022)[7] reported DVT incidence of 15–40% depending on the type of orthopedic procedure and prophylaxis used. Similarly, Majima T *et al.* (2021)[3] found postoperative DVT rates of approximately 18–25% in high-risk surgical populations.

Pulmonary embolism occurred in 5% of patients, which is consistent with Gade IL *et al.* (2021)[2], who reported PE rates ranging between 2–8% in hospitalized surgical patients. Although less frequent than DVT, PE contributes significantly to morbidity and mortality, underscoring the need for early detection.

The overall VTE prevalence of 23.8% in our study correlates with findings from Ullah H *et al.* (2025)[5], who emphasized that orthopedic surgery remains one of the strongest risk factors for postoperative thromboembolism.

Table 3: Spectrum of Cutaneous Manifestations: Limb edema was the most common manifestation (17.5%) in our study, followed by erythema (13.8%) and local warmth (11.2%). These findings are consistent with clinical descriptions by Chopard R *et al.* (2020)[8], who identified limb swelling as the hallmark clinical feature of DVT. Zhang L *et al.* (2020)[6] also emphasized edema and erythema as primary clinical indicators of acute venous obstruction.

Superficial venous prominence and hyperpigmentation were less common but clinically significant. Chronic venous changes such as hyperpigmentation have been described in patients with unresolved or recurrent thrombosis by Majima T *et al.* (2021)[3]. Cyanosis, though rare (3.8%), may represent severe venous congestion or early phlegmasia, as reported in advanced cases by Jones A *et al.* (2023)[9].

Our findings support existing literature that dermatologic signs correlate strongly with venous outflow obstruction and should prompt immediate imaging confirmation.

Table 4: Risk Factors Associated with VTE: Advanced age (>60 years) showed a significant association with VTE ($p = 0.021$), consistent with Schneeweiss MC *et al.* (2021)[1], who reported age as an independent risk factor. Obesity (BMI ≥30) was also significantly associated ($p = 0.018$), aligning with Haac BE *et al.* (2020)[10], who highlighted obesity as a prothrombotic state due to inflammatory and metabolic mechanisms.

Diabetes mellitus demonstrated significant association ($p = 0.047$), which supports findings from Yu X *et al.* (2021)[11], suggesting metabolic comorbidities contribute to endothelial dysfunction and hypercoagulability.

Surgical duration exceeding two hours significantly increased VTE risk ($p = 0.014$). Fischer CR *et al.* (2023)[12] similarly observed prolonged operative time as a major contributor to venous stasis. Prolonged immobilization (>72 hours) showed the strongest association ($p = 0.006$), consistent with Zhang L *et al.* (2020)[6], who emphasized immobilization as a core component of Virchow's triad.

Smoking history did not reach statistical significance ($p = 0.052$), although prior studies such as Majima T *et al.* (2021)[3] have demonstrated smoking as a contributory but weaker independent risk factor.

CONCLUSION

The present cross-sectional study demonstrated that venous thromboembolic disease (VTE) remains a significant postoperative complication among orthopedic surgical patients, with an overall prevalence of 23.8%. Deep vein thrombosis constituted the majority of thromboembolic events, while pulmonary embolism occurred less frequently but posed substantial clinical risk. Cutaneous manifestations were observed in 20% of patients, with limb edema, erythema, and local warmth being the most common dermatological indicators. These findings highlight the clinical importance of thorough postoperative limb examination for early detection of VTE.

Advanced age, obesity, diabetes mellitus, prolonged surgical duration, and extended immobilization were identified as significant risk factors for VTE. Among these, prolonged immobilization demonstrated the strongest association. Although smoking showed a higher prevalence among VTE patients, it did not reach statistical significance.

The study emphasizes that early recognition of cutaneous signs in orthopedic surgical patients can serve as an important clinical clue for prompt diagnosis and timely management of VTE, thereby reducing morbidity and potentially life-threatening complications. Strengthening perioperative risk assessment and ensuring appropriate thromboprophylaxis remain essential strategies in orthopedic practice.

LIMITATIONS OF THE STUDY

1. The study was conducted at a single tertiary care center, which may limit the generalizability of findings to other healthcare settings.
2. The sample size (N = 80) was relatively small, which may have reduced the statistical power for detecting weaker associations.
3. Being a cross-sectional study, causal relationships between risk factors and VTE could not be established.
4. Some cases of asymptomatic VTE may have been missed, as routine screening imaging was not performed for all patients.
5. Follow-up beyond hospital stay was not included, limiting assessment of late-onset thromboembolic events and long-term cutaneous sequelae.

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