Original Article

Prevalence of Venous Thromboembolism in Patients with Acetabular or Hip Fractures and Their Association with Hemoglobin Concentration

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Abstract

Objectives: We aimed to determine the prevalence of venous thromboembolism (VTE) in patients with acetabular or hip fractures and the relationship between hemoglobin and VTE. **Methods:** The records of patients diagnosed with acetabular or hip fractures between 2009 and 2015 were reviewed. A 1:4 case–control study was conducted to determine the relationship between VTE and hemoglobin. In the "case" group, convenience sampling was used, including all the patients diagnosed with deep-vein thrombosis (DVT) or pulmonary embolism (PE). In the control group (n = 80), convenience sampling with age and gender matching was used. The prevalence of VTE was determined from the number of cases identified from 2009 to 2015 divided by the number of patients diagnosed with acetabular or hip fractures over the same period. **Results:** During the study period, 995 patients presented with acetabular or hip fractures. Four hundred and four patients had acetabular fractures, 20 (5%) of whom developed VTE, 11 (2.7%) were diagnosed with DVT alone, 7 (1.7%) with PE alone, and 2 (0.5%) with both DVT and PE. The prevalence of VTE following hip fracture was 3%, and the prevalence of DVT, PE, and both was 1.7%, 1%, and 0.5%, respectively. The mean hemoglobin concentration at admission was 11.7 ± 2.5 g/dl in patients with VTE and 12.3 ± 2.3 g/dl in controls (P = 0.45). **Conclusion:** The prevalence of VTE in patients with acetabular fracture was 5% and 3% with hip fracture. The present study showed no association between hemoglobin concentration at admission and VTE.

Keywords: Acetabular fractures, deep-vein thrombosis, hemoglobin levels, hip fractures, pulmonary embolism

Introduction

Deep-vein thrombosis (DVT) is a serious medical condition, characterized by clot formation in the deep venous system, especially in the lower limb.[1] Such a clot can completely or partially restrict the venous circulation, causing pain, swelling, skin changes, and local skin warming. In addition, the clot may fragment, and portions could travel through the circulation to the lung, causing a pulmonary embolism (PE).[2] DVT and its complication, PE, are collectively termed venous thromboembolism (VTE). Surgical patients are at a higher risk of VTE, particularly following orthopedic surgery.[3]

Hip and knee procedures are associated with higher risks of VTE than other orthopedic procedures, and they are the most common cause of hospital-acquired DVT. The prevalence of hospital-acquired DVT is 10%–40% in surgical and medical patients in Saudi Arabia,[4] but this increases to 40%–60% after a major orthopedic procedure, such as total knee or hip replacement.[5] In contrast, the prevalence is much lower following other joint procedures; as following foot procedures, it can be as low as 0.2%.[6]

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A retrospective study of patients with hip fractures in Peterborough District Hospital, UK, conducted between 1989 and 2007 showed that of 5300 patients admitted with a hip fracture, 117 suffered VTE complications (2.2%, 95% confidence interval: 1.8–2.6). Of these, 79 (1.5%) were diagnosed with DVT and 38 (0.7%) with PE.[7]

There is also evidence that low hemoglobin concentration may play a role in the development of VTE.[8,9] A case–control study has been conducted in Dokuz Eylül University Hospital in which 201 cases of VTE were compared with 201 controls showed that the hemoglobin concentration was lower among the cases.[8]

Thus, patient, hospital, and procedure-specific factors affect the development of VTE in surgical patients. VTE may be a particular problem in patients with acetabular or hip fractures. However, its prevalence has been determined in only a few studies to date. Therefore, the aim of the present study was to determine the prevalence of DVT and PE in patients with acetabular or hip fractures and the relationship between hemoglobin concentration at admission and the prevalence of VTE.

Materials and Methods

Study design and patient sampling

A 1:4 case–control study was conducted in the Level 1 trauma center at King Abdulaziz Medical City, Riyadh, Saudi Arabia. All the records of patients diagnosed with acetabular, neck of femur, or intertrochanteric fractures between January 2009 and December 2015 were reviewed. The sample obtained was divided into two groups: a "case" group comprising patients that had experienced symptomatic DVT, PE, or both, and a control group comprising those that had not. The prevalence of PE and DVT was determined using the number of cases diagnosed during the study period.

In the case group, convenience sampling of all the patients diagnosed with DVT and/or PE was performed, and in the control group, convenience sampling with age- and gender-matching was performed. The Information Management and Medical Record Center in King Abdulaziz Medical City provided an electronic list of names of the patients diagnosed with acetabular, neck of femur, or intertrochanteric fractures. PE was diagnosed by radiologists using computed tomography (CT) angiography and DVT by Doppler ultrasound. Acetabular fractures were diagnosed using CT, whereas neck of femur and intertrochanteric fractures were diagnosed using plain radiography.

Data collection

Date of birth, gender, fracture type and subtype, and laboratory test results at admission (hemoglobin concentration and platelet count) were recorded, along with the date of admission, date of procedure, and date of diagnosis with DVT and/or PE.

Data analysis

The data were analyzed using the Statistical Package for the Social Sciences program version 20 (IBM, Inc, Armonk, NY, USA). Categorical data are presented as frequencies and percentages, whereas numerical data are presented as mean ± standard deviation. The relationship between hemoglobin concentration at submission and the prevalence of VTE was determined using the Chi-square test. $P < 0.05$ was considered to represent statistical significance.

Results

The patient characteristics are presented in Table 1. Between 2009 and 2015, a total of 995 patients presented to our institution with acetabular, neck of femur, or intertrochanteric fractures. The mean (range) age of the patients was 54 (14–102) years, and 68% were men. There were 404 patients with acetabular fractures, 20 (5%) of whom developed VTE. Eleven patients (2.7%) were diagnosed with DVT alone, 7 (1.7%) with PE, and 2 (0.5%) with both. There were 304 patients with femoral neck fractures, 9 (3%) of whom developed VTE. Four (1.3%) patients were diagnosed with DVT alone, 4 (1.3%) with PE alone, and one (0.3%) with both. There were 287 patients with intertrochanteric fractures, of whom 10 patients (3%) developed VTE. Six (2%) patients were diagnosed with DVT alone, 2 (0.7%) patients with PE alone, and two patients with both (0.7%). Regarding all patients diagnosed with DVT of our study ($N = 26$), 22 patients (85%) had DVT proximal to popliteal vein and four (15%) at popliteal or distal.

A comparison of the mean of patients' hemoglobin concentrations at admission [Table 2] revealed that they were similar in the case and control groups (11.8 and 12.4 g/dl, respectively; $P = 0.45$).

Table 1: Patient characteristics

	All patients (%)	Deep-vein thrombosis (%)	Pulmonary embolism (%)	Both (%)
Number of patients	995	-	-	-
Mean age (years)	54±23			
Men	679 (68)			
Women	316 (31)			
Acetabular fracture	404	11 (2.7)	7 (1.7)	2 (0.5)
Neck fracture	304	4 (1.3)	4 (1.3)	1 (0.3)
Intertrochanteric fracture	287	6 (2)	2 (0.7)	2 (0.7)

Table 2: Associations between hemoglobin at admission and venous thromboembolism

	Control group (without VTE)	Case group (with VTE)	*P**
Number of patients	150	39	
Age (years)	52.3±24.8	57.5±21.2	0.191
Mean hemoglobin concentration (g/dl)	12.3±2.3	11.7±2.5	0.45

**T*-test. VTE: Venous thromboembolism

Discussion

This study was designed to determine the prevalence of VTE in patients with acetabular or hip fractures in Saudi Arabia and to determine the relationship between hemoglobin concentration at admission and the development of VTE. DVT and PE are critical complications encountered in trauma patients with hip or acetabular fractures.[10,11]

In the present study, 20 (5%) of 404 acetabular fracture patients were diagnosed with VTE, and 19 (3%) of patients with hip fractures were diagnosed with VTE. Other previous studies have generated similar rates to our current study with regard to the prevalence of VTE in hip fractures, but the prevalence of VTE in patients with an acetabular fracture is lower in our study than previously reported.[7,12-14] In the Peterborough study, 2.2% of patients suffered VTE,[7] whereas a cohort study conducted in French public and private hospitals showed a 1.34% prevalence of VTE in hip fracture patients,[12] and a prospective study of 152 Korean geriatric patients with hip fractures showed the prevalence of DVT to be 2.6%.[13]

In New York, a study of 659 orthopedic patients undergoing spiral CT of the chest, pelvis, or lower extremities revealed that the overall prevalence of VTE was 27.8% (193/695). Of these 193 scans, 155 (22.3%) were positive for PE alone, 24 (3.5%) for PE and DVT, and 14 (2.0%) for DVT alone.[15]

A retrospective study of 46 Japanese patients with pelvic and acetabular fractures showed that of 13 patients with acetabular fracture, five were diagnosed with DVT (38.5%), and three with PE (23.1%).[14] Furthermore, a 2-year prospective study conducted in a Level 1 trauma center in India that enrolled 56 patients with pelvic/acetabular injury recorded 16 cases of radiologically proven VTE (28.6%).[16]

There is controversy in the literature regarding the relationship between hemoglobin concentration and VTE. Although the exact pathophysiology remains unclear, it has been demonstrated that a reduction in blood viscosity or a low hemoglobin concentration is associated with impairment in the antithrombotic mechanism.[9] Other mechanisms assumed that hemoglobin and adenosine diphosphate released from hemolyzed erythrocytes may enhance thrombosis by promoting the platelet activation and aggregation.[17-18] Furthermore, a case–control study showed that blood hemoglobin was significantly lower in patients with PE than in controls.[8] However, a prospective study of 5300 hip fractures found that patients with high hemoglobin concentrations were at higher risk of developing symptomatic VTE ($P = 0.01$).[7] The present study has shown no association between hemoglobin at admission and VTE, which is consistent with the results of a retrospective case–control study of 1294 PE patients at an academic medical center, which found no relationship between hemoglobin and PE or the time to development of VTE.[19]

The findings of this study have to be seen in the light of some limitations. The files of the patients diagnosed with VTE have been reached retrospectively. We only included symptomatic patients with positive imaging findings of VTE, as our practice is in line with the guidelines of the American Academy of Orthopedic Surgeons and American College of Clinical Pharmacy of not obtaining routine imaging on asymptomatic individuals. The role of chemoprophylaxis or mechanical prophylaxis had not been investigated in this study, as the data collected did not show patients were or were not on any anticoagulant.

Conclusion

The prevalence of VTE in patients with acetabular fractures was 5%, that of DVT alone was 2.7%, that of PE alone was 1.7%, and that of both was 0.5%. The prevalence of VTE in patients with hip fractures was 3%, and those of DVT alone, PE alone, and both were 1.7%, 1%, and 0.5%, respectively. In addition, the study has shown no association between hemoglobin concentration at admission and the prevalence of VTE.

Ethical consideration

This study was approved by King Abdullah International Medical Research Center, Riyadh, Saudi Arabia.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Authors' contribution

SHA conceived the idea, designed the study, conducted the research, wrote the manuscript, collected and organized the data. AMA and AMK collected and organized, analyzed and interpreted the data. ZSA wrote the initial draft and collected the data. WSA help in editing the manuscript. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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