

## Chapter 2

# Incidence of Venous Thromboembolism in Orthopedic Surgery

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**Abstract** Venous thromboembolic disease in hospitalized patients results in substantial mortality, morbidity, and healthcare resource use. While the true incidence of venous thromboembolism (VTE) is difficult to determine, autopsy studies have shown that 5–10 % of hospital deaths are attributable to pulmonary embolism. Major orthopedic surgery is associated with a very high risk of VTE: without thromboprophylaxis objectively confirmed deep-vein thrombosis may occur in up to 60 % of patients within 2 weeks after lower extremity orthopedic surgery. Between 10 and 30 % of symptomatic VTE events present as proximal deep-vein thrombosis, with the potential to lead to post-thrombotic syndrome or pulmonary embolism. As both symptomatic and subclinical thromboembolism are common in patients undergoing major orthopedic surgery, risk assessment and, where appropriate, thromboprophylaxis should be considered.

**Keywords** Deep-vein thrombosis • Incidence • Orthopedic surgery • Pulmonary embolism • Venous thromboembolism

## Introduction

Venous thromboembolic disease in hospitalized patients is an important healthcare concern, resulting in significant mortality, morbidity, and healthcare resource expenditure. Over 40 years ago, Kakkar et al. [1, 2] determined the frequency of venous

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thrombosis in general surgical patients using  $I^{125}$  labeled fibrinogen leg scanning and were thus able to describe the natural history of postoperative deep-vein thrombosis (DVT). Better understanding of the natural history and the course of venous thromboembolism (VTE) and its associated risk factors has led to strategies for identifying individuals at risk of VTE in the perioperative period, together with methods of quantifying that risk, and approaches for the prevention of thrombotic episodes.

While many patients with a thrombosis remain asymptomatic and the thrombi resolve without causing complications, some patients will develop symptomatic DVT or pulmonary embolism, whereas others will suffer a fatal pulmonary embolism as the first manifestation of their thrombosis [3]. Approximately eight in ten patients who develop pulmonary emboli will have no evidence of peripheral venous thrombosis before presenting with pulmonary embolism [4].

The long-term sequelae of VTE also present a considerable healthcare concern and include post-thrombotic syndrome – a chronic, potentially disabling condition – recurrent VTE, and chronic pulmonary hypertension [5–9].

The aim of this chapter is to present and discuss the frequency of VTE events among patients undergoing orthopedic surgery.

## Determining the Incidence of Venous Thromboembolism

The true incidence of VTE and its associated morbidity and mortality is difficult to determine. Often, VTE is clinically silent, signs and symptoms are non-specific, and screening tests are not always sufficiently sensitive to detect disease in asymptomatic patients. The reported rates of VTE show considerable variation for a variety of reasons, some examples of which are given in Table 2.1.

Autopsy studies, which are increasingly infrequent nowadays, have shown that between 5 and 10 % of hospital deaths are attributable to pulmonary embolism [16–19]. Pulmonary embolism is therefore widely reported to be the most common cause of preventable death in patients hospitalized for surgical procedures [20].

**Table 2.1** Potential reasons for variation in reported rates of VTE [10–15]

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Distribution of risk factors (e.g., age, lifestyle factors)
Geographic differences (e.g., age, general health and nutritional state, socio-economic status, genetic, or environmental factors)
Variations in patient management or surgical technique (e.g., duration of surgery, length of hospitalization, period of immobilization, type of prosthesis, unilateral vs. bilateral)
Fluctuations over time (e.g., variations in surgical technique, use of prophylaxis)
Methods of diagnosis (e.g., $I^{125}$ -fibrinogen uptake test, venography)
Type of anesthesia used (e.g., regional, general)
Use and type of thromboprophylaxis (e.g., mechanical, pharmacological)
Duration of follow-up/timing of diagnostic end point
Study type (e.g., autopsy, clinical trial, observational study)
Representativeness of the population
Statistical reasons (e.g., small study sizes, leading to wide confidence intervals)

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Recent data on the frequency of VTE in surgical patients in the absence of prophylaxis are rare because few contemporary studies include untreated control groups.

## **Orthopedic Surgery and Thrombosis**

Major orthopedic surgery, which includes total hip replacement (THR), total knee replacement (TKR), and hip fracture surgery, is associated with a very high risk of postoperative VTE [21]. The level of VTE risk associated with surgery depends upon a combination of patient-specific predisposing factors and factors associated with the surgical procedure itself [22–24] (see Chap. 4). In terms of Virchow's triad of contributing factors for thrombus formation, the risk of postoperative VTE relates to perioperative immobilization, activated coagulation, and transient depression of fibrinolysis.

Without thromboprophylaxis, the rates of objectively confirmed DVT occurring within 7–14 days after lower extremity orthopedic surgery are around 40–60 % [21, 22]. Most of these thrombi resolve spontaneously, but a small percentage (1–14 %) will progress to symptomatic VTE [12, 25–34], often presenting after the patient has been discharged from the hospital [35–37].

Between 10 and 30 % of symptomatic VTE events present as proximal DVT [22]. This is a clinically more important manifestation than distal DVT because it is more frequently associated with post-thrombotic syndrome and has greater potential to embolize and cause pulmonary embolism [21, 38–40].

### ***Total Knee Replacement***

Without thromboprophylaxis, the reported risk of venographically documented DVT in patients undergoing TKR ranges from 41 to 85 % [22]. The rate of proximal DVT, as a thrombus extension from the calf veins to the popliteal or femoral veins, varies from 5 to 22 % [22].

Limited data are available on the incidence of pulmonary embolism after TKR in patients not given thromboprophylaxis. In two studies in which the objective end point included the diagnosis of pulmonary embolism on a perfusion lung scan, 22 % of 186 patients and 33 % of 12 patients showed symptoms of pulmonary embolism [15, 41]. The rates of symptomatic pulmonary embolism following TKR without prophylaxis are much lower, ranging from 1 to 2 %, and that of fatal pulmonary embolism is <1 % [11, 42].

### ***Total Hip Replacement***

THR is a common procedure, which is being performed with increasing frequency in elderly patients [43]. In the absence of thromboprophylaxis, the risk of venographically

documented DVT in patients undergoing THR ranges from 42 to 57 % and from 2 to 5 % for symptomatic events [22, 39, 44, 45]. While these rates are lower than those reported for TKR, perhaps due to the use of a tourniquet during knee replacement surgery [46], the risk of the more clinically important proximal DVT is higher, at 18–36 % [22, 39, 44, 45, 47–54]. The rate of symptomatic VTE in untreated patients is 2–5 % and that of fatal pulmonary embolism is 0.33 % [21].

The risk of VTE extends beyond the period of hospitalization, as shown in a study of 179 patients undergoing THR who were without venogram-proven DVT at hospital discharge [37]. In this study, 20 % of the patients given placebo developed venographic evidence of DVT compared with 7.1 % of patients randomized to enoxaparin prophylaxis [37]. VTE is also reported to be the most frequent cause for hospital readmission following THR surgery [55].

## ***Hip Fracture Surgery***

Patients undergoing hip fracture surgery are at very high risk of VTE. Thrombotic disease is a common cause of mortality and morbidity in this population. Among these patients, 46–60 % have venographic evidence of DVT, with 23–30 % of cases involving the proximal veins [22]. Even with the benefit of prophylaxis, symptomatic, objectively confirmed VTE has been reported to occur within 3 months of surgery in 1.3–8.2 % of this population [21, 56]. In a retrospective study of 470 patients treated for hip fractures who were not given thromboprophylaxis, the overall mortality rate within 1 month of the fracture was 18.5 % [57]; 19.5 % of these patients were found on autopsy to have died from pulmonary embolism.

## **Conclusion**

Both symptomatic and subclinical thromboembolism are common in patients undergoing major orthopedic surgery. In view of the unpredictable nature of their complication, risk assessment and – where appropriate – thromboprophylaxis should be considered.

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