



The Role of Deep Venous Thrombosis Prophylaxis After Anterior Cruciate Ligament Reconstruction

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Anterior cruciate ligament (ACL) reconstruction is one of the most commonly performed orthopaedic procedures. Venous thromboembolism is a rare, but potentially serious complication of ACL reconstructions and having a thorough understanding of the potential risk factors could help to minimize the incidence of postoperative deep vein thrombosis or pulmonary embolism. We review some of the literature on the risk factors, diagnosis and treatment of deep vein thrombosis or pulmonary embolism. Although current data does not support the routine use of thromboprophylaxis in all patients undergoing ACL reconstruction, it is important for the clinician to be aware that some consideration should be given for initiating pharmacological prophylaxis in some patients who may be at increased risk for thromboembolic disease.

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Introduction

Venous thromboembolism (VTE) is an infrequent, but potentially fatal complication of orthopaedic surgery.¹ This disease process consists of 2 entities: deep venous thrombosis (DVT) and the more life-threatening manifestation, pulmonary embolism (PE). Anterior cruciate ligament (ACL) reconstruction is one of the most common orthopaedic procedures, with over 100,000 cases performed each year in the United States alone.² Postoperative VTE is an uncommon, but potentially devastating complication of this operation. The associated morbidity and mortality can be significant. As such, a thorough understanding of the incidence, risk factors and potential methods for prevention is critical to optimizing the safety of our surgical patients.

Incidence

The reported incidence of VTE following arthroscopic procedures of the knee ranges from 0.03%-41.2%.³⁻⁷ This variability arises from inclusion of mixed patient cohorts (routine arthroscopy combined with arthroscopically assisted ACL reconstruction) and from differences in postoperative surveillance with some studies utilizing routine DVT screening on all patients and others reporting screening in symptomatic patients only. In a retrospective review of over 400,000 arthroscopic knee procedures, a symptomatic PE occurred within 90 days of surgery in 0.028% of patients, including one death (rate 0.0002%).⁶ In the 117 patients with a postoperative PE, an ACL reconstruction was performed in 15%. In another retrospective review of 20,770 arthroscopic knee procedures, a symptomatic DVT and PE developed in 0.25% and 0.17% of patients, respectively.⁸

Increased rates of postoperative VTE have been reported by several prospective studies, which utilize routine postoperative screening with ultrasound or venography. In a cohort of 537 patients undergoing ACL reconstruction, posterior cruciate ligament (PCL) reconstruction or combined ACL and PCL reconstruction, routine postoperative venography identified a

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DVT in 14.5% of patient; however, clinical signs and symptoms of DVT were evident in only 3.7% of patients.⁹ Strujik-Mulder et al,¹⁰ prospectively evaluated 100 patients with compression ultrasonography following ACL reconstruction. Routine screening identified a proximal DVT in 9% of patients, in whom, less than half (4%) were symptomatic.¹⁰ One patient developed a non-fatal PE during the 8-week follow-up period.¹⁰ In a systematic review assessing the rate of DVT and PE following ACL reconstruction in patients who did not receive postprocedural anticoagulation, the overall DVT rate was noted to 8.4%, and the rate of symptomatic PE in was found to be 0.2%.² Of those patients found to have a DVT, only 27% were symptomatic.

Risk Factors

Multiple factors have been identified to affect the risk of VTE following orthopaedic surgery. Recognition of these factors allows for improved understanding of a given patient's overall DVT or PE risk and provides guidance for potential risk factor modification.

Age

Increased patient age is one of the most consistently reported risk factors for VTE following ACL reconstructions.^{5,6,8-11} The impact of age appears to be dose dependent with risk progressively increasing with increasing age.^{6,12} An increase in the rate of DVT or PE has been shown to occur as early as 30-35 years of age.^{5,9,11} For patients over the age of 40, the risk of a PE has been reported to be increased more than 6 fold.⁶

Inherent Hypercoagulability

Inherited abnormalities in clotting function can predispose patients to postoperative VTE. Protein C and Protein S deficiency are two of the most common inherited clotting disorders, occurring in approximately 1 of every 500 people. Deficiency of either anticoagulant increases the affected individual's risk of developing a DVT or PE by up to 11-fold.^{1,13} All surgical patients should be questioned about a personal or family history thromboembolic events. A significant history may signal an inherited disorder and warrants further testing and/or referral to a hematologist. In those patients with a confirmed diagnosis of hypercoagulability, measures such as perioperative chemoprophylaxis should be taken to minimize the risk of postoperative thromboembolic complications.

Gender

The impact of gender on the risk of postoperative VTE remains unclear. Although some studies identify female gender as an independent risk factor, others report no difference in DVT/PE rates among genders.^{5,6,9,14} In a study of over 400,000 mixed knee arthroscopy procedures, female gender was associated with a 1.5-fold increase risk of PE.⁶ Notably, the use of oral contraceptives among female patients, a well-known risk factor for thromboembolism, was not reported in this cohort.

Malignancy

Underlying malignancy has been shown to increase an individual's propensity toward VTE. The risk of PE following arthroscopic knee surgery has been reported to be 3 times as high in patients with a history of cancer.⁶ The prothrombotic milieu generated by a cancerous state is implicated in the increased propensity to abnormal clotting.

Oral Contraceptive Use

The use of oral contraceptive is also associated with an increased risk of VTE.^{1,8,13} Maletis et al⁸ reported a postoperative incidence of symptomatic VTE in 0.63% of females taking oral contraceptives, compared with 0.30% in those females not taking medication. In this study, female gender was not an independent risk factor for postoperative DVT or PE.⁸ The increase risk associated with oral contraceptive use is further heightened in women with an underlying inherited hypercoagulability syndrome.¹³ Janssen and Sala,¹ reported a case of fatal PE following ACL reconstruction in an 18-year-old female patients. In this patient, oral contraceptive use combined with an underlying inherited hypercoagulability syndrome was implicated as the primary cause.¹

Tourniquet Time

A lower extremity tourniquet is frequently utilized during knee arthroscopy and ACL reconstruction. Tourniquet use has been associated with an increased rate of postoperative DVT or PE.^{15,16} The endothelial injury generated by surgery, combined with the stasis created with a tourniquet is believed to promote intravascular clot formation. In a meta-analysis of randomized controlled trials comparing the rate of VTE following total knee arthroplasty, Yi et al¹⁵ reported a higher rate of postoperative DVT (relative risk = 2.63) when a tourniquet was utilized compared to when it was not. The length of use appears to affect of impact of tourniquet use on DVT/PE risk. Multiple studies demonstrate increased rates of VTE when tourniquet times exceed 90 minutes.^{6,16,17}

Surgical Complexity

Increased operative time and surgical complexity have been reported as a risk factors for postoperative VTE.^{6,16,18} These 2 factors are likely linked, with greater surgical complexity requiring greater time to complete. Compared to arthroscopic knee procedures performed in <30 minutes, those requiring <90 minutes have been associated with a 3-fold increase rate of PE.⁶ Compared to isolated ACL reconstruction, both Sun et al⁹ and Dong et al,¹⁶ reported an increased rate of postoperative DVT following multiligamentous knee reconstruction, with a particular increase in DVT with procedures involving reconstruction of the PCL.

Diagnosis

The diagnosis of DVT or PE can prove difficult. The classic physical examination signs of increased pain, swelling, warmth

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