Incidence and Risk Factor Analysis of Symptomatic Venous Thromboembolism After Knee Arthroscopy

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Purpose: To (1) determine the incidence of symptomatic venous thromboembolic events (VTEs) after knee arthroscopy and arthroscopy-assisted procedures at a single institution and (2) determine associated risk factors for VTEs in these patients. **Methods:** The records of patients who underwent knee arthroscopy at a single institution between 1988 and 2008 were reviewed. Chemoprophylaxis was not routinely used. Confirmed VTEs occurring within 4 weeks after the index arthroscopy procedure were included. A 2:1 matched control group was generated to include patients in whom knee arthroscopy was performed by the same surgeon either on the same day or immediately before each case resulting in a VTE. Preoperative and perioperative data were collected with respect to demographic data, medical history, medications, and surgical and anesthesia data. Univariate and multivariate analyses were performed. **Results:** During the study period, 12,595 patients underwent knee arthroscopy. Among these patients, 43 cases of VTEs (35 deep venous thromboses [DVTs], 5 pulmonary embolisms [PEs], and 3 DVTs that progressed to PEs) occurred, resulting in an incidence of 0.30% (95% confidence interval [CI], 0.22% to 0.41%) for DVT, 0.06% (95% CI, 0.03% to 0.12%) for PE, and 0.34% (95% CI, 0.25% to 0.46%) for VTEs overall. Factors associated with an elevated risk of symptomatic postoperative VTEs included a history of malignancy ($P = .01$; odds ratio [OR], 6.3), a history of VTEs ($P = .02$; OR, 5.2), or the presence of more than 2 classic risk factors for VTEs ($P = .01$; OR, 13.6). **Conclusions:** In this study, symptomatic VTEs were rare and occurred infrequently, with an incidence of 0.34% (95% CI, 0.25% to 0.46%), after knee arthroscopy and arthroscopy-assisted cases in the absence of routine chemoprophylaxis. Patients with a history of VTEs, a history of malignancy, or 2 or more classic risk factors are at increased risk of VTEs after knee arthroscopy, and chemoprophylaxis should be considered in these select patients. **Level of Evidence:** Level III, case-control study.

Orthopaedic surgery in general carries a risk of venous thromboembolic events (VTEs), including the occurrence of either a deep venous thrombosis (DVT), a pulmonary embolism (PE), or a DVT progressing to a PE. Knee arthroscopy is the most common orthopaedic operation in the world, with over 3 million cases performed annually.[1] However, despite knee arthroscopy's high frequency, data on the associated risk of VTEs are limited. Currently, the reported incidence of VTEs without thromboprophylaxis after knee arthroscopy ranges from 0.6% to 18%, depending on the diagnostic method used.[2-6] Most published studies have included relatively small numbers of patients and provided few risk factors for these events,[7-9] making it difficult to create definitive guidelines for thromboprophylaxis in knee arthroscopy patients. Nonetheless, there are classic risk factors for the development of VTEs described in the literature.[7]

We designed a case-control analysis to evaluate potential risk factors associated with these events, thus helping guide future stratification of thromboprophylaxis for higher-risk patients. The purposes of this study were to (1) determine the incidence of symptomatic VTEs and (2) determine potential risk factors for VTEs after knee arthroscopy. We hypothesized that the incidence of VTEs would be low in patients undergoing arthroscopic knee surgery and that there would be potential risk factors that could be used to predict the development of VTEs.

Methods

Patients were retrospectively identified from a comprehensive surgical database at our institution

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Table 1. Incidence Rates for VTEs by Arthroscopic Procedure

	ICD-9 Code	Institutional Modifier	Procedures, n (%)	VTE Rate	95% CI
Lateral meniscectomy or repair	80.60	Arthroscopic lateral	2,155 (15.9)	0.0056	0.32-0.97
Medial meniscectomy or repair	80.60	Arthroscopic medial	4,933 (36.5)	0.0055	0.38-0.80
Chondroplasty	81.47	Arthroscopic joint repair	1,549 (11.5)	0.0084	0.49-1.43
Synovectomy	80.76	Arthroscopic	601 (4.5)	0.0050	0.17-1.56
Loose body and plica removal	80.26	Loose body diagnosis	1,113 (8.2)	0.0063	0.31-1.29
	80.86	Plica syndrome diagnosis			
Ligament reconstruction or repair	81.42-81.47	Arthroscopic	3,167 (23.4)	0.0016	0.07-0.37
Total			13,518 (100.0)		

NOTE. More than 1 procedure occurred in many of the arthroscopy cases (13,518 procedures in 12,595 arthroscopy cases). Institutional modifiers were used to identify select cases.

CI, confidence interval; ICD-9, *International Classification of Diseases, Ninth Revision*; VTE, venous thromboembolic event.

based on *International Classification of Diseases, Ninth Revision*[10] procedural codes for various arthroscopic procedures of the knee performed between March 23, 1988, and July 17, 2008 (Table 1), and institutional review board approval was obtained. Beginning in 2009, the prophylaxis protocol significantly changed, with the adoption of more rigorous guidelines for high-risk patients. When the *International Classification of Diseases, Ninth Revision* code was ambiguous, specific modifiers from our institutional coding system were used to select the procedure of choice (Table 1). These patients were cross-referenced with institutional diagnosis codes for DVT or PE and were included or excluded based on the timing of this presentation as related to the knee arthroscopy procedure. Patients were also excluded from the study if they were younger than 18 years at the time of surgery or had undergone surgery in the 3 months before knee arthroscopy. Review of the comprehensive surgical database at our institution identified 12,595 knee arthroscopy cases in 10,661 adult patients between March 23, 1988, and July 17, 2008. Procedures performed during arthroscopy in the included patients are outlined in Table 1. The rationale for including knee arthroscopy and arthroscopy-assisted procedures such as anterior cruciate ligament (ACL) reconstruction is that the reported rates of VTEs in ACL reconstruction versus simple knee arthroscopy are not significantly different, with the notable exception of the report of Sun et al.[11] in 2014. In addition, our postoperative protocols for knee arthroscopy and ACL reconstruction were similar, with range of motion and immediate weight bearing as tolerated.

All clinically symptomatic and imaging-confirmed cases of VTEs that occurred within 4 weeks of patients undergoing knee arthroscopy were considered adverse events and included in the study.[7,12-15] All VTEs were confirmed by positive Duplex ultrasonography, conventional venography ventilation/perfusion lung scan (V/Q scan), or computed tomography scan of the chest with intravenous contrast, as was indicated in each case. Indications for obtaining lower extremity imaging included calf pain or swelling on the operative side. Indications for chest imaging included shortness of breath or pleuritic chest pain. These VTEs were organized according to type (whether presenting as a DVT, a PE, or a DVT that progressed to a PE), as well as the specific vein thrombosed in the case of DVT.

A case-control methodology was selected to identify potential risk factors for VTEs because the outcome of a VTE after arthroscopy occurs infrequently. Therefore a 2:1 matched control group was generated using a computerized algorithm matching exactly for surgeon and surgical date either on the same day or immediately preceding each case in which a VTE occurred.[16] In this manner, data for each patient found to have a VTE were compared against data for another patient undergoing knee arthroscopy by the same surgeon in a narrow time frame. A thromboembolic event may encourage the surgeon to adopt a more aggressive prophylaxis regimen, creating a potential bias. Although considered, age and gender were not included in the matching process. Matching on these parameters would prevent their use in the risk factor analysis, which was an objective of the study. Procedures resulting in VTEs during the time frame for inclusion were performed by a total of 13 individual surgeons at our institution. No surgeon routinely used chemoprophylaxis for any knee arthroscopy procedures. However, patients with a history of DVT or PE were treated with chemoprophylaxis, either restarting chronic anticoagulation after surgery or being treated with low-molecular-weight heparin (LMWH) or warfarin for 4 to 6 weeks.

Data were collected to include classic risk factors as defined by Delis et al.[7]: age older than 65 years, obesity with a body mass index (BMI) over 30 kg/m^2, smoking, oral contraception or hormone replacement therapy, chronic venous insufficiency, and previous DVT. One additional variable was generated to analyze the presence of multiple risk factors in a single patient. This variable described the presence of at least 2 classic risk factors for VTEs, which have previously been defined by Delis et al. We also collected variables that are