Incidence of Symptomatic Thromboembolic Disease After Patellofemoral Arthroplasty

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Abstract

Venous thromboembolic (VTE) disease is a risk after patellofemoral arthroplasty (PFA) despite its less invasive nature and faster recovery. To our knowledge, this is the first study to address the incidence of VTE disease after PFA. One hundred forty-nine consecutive primary or revision PFA procedures were followed for the primary endpoint of symptomatic VTE/pulmonary embolus within 6 weeks after surgery. VTE prophylaxis type, American Society of Anesthesiologists (ASA) class, VTE risk factors, and complications were noted. The mean age of the patient population was 48 years. Eighty-three percent of patients received aspirin and calf pumps; 17% received warfarin. The average operative time was 76 minutes overall and 66 minutes for isolated PFA. One patient with an undisclosed family history of VTE, who was managed with aspirin and calf pumps, developed multiple small pulmonary emboli. No other VTE complications occurred. Symptomatic VTE incidence was 0.76%. Patients without significant risk of thrombosis undergoing PFA may be effectively managed with an aspirin-based protocol.

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Advances in surgical technique, patient selection, and prosthetic design for patellofemoral arthroplasty (PFA) have generated interest in this procedure as a viable alternative to total knee arthroplasty (TKA) for patients with isolated patellofemoral degenerative disease.[1,2] PFA preserves the structural integrity and kinematics of the joint by maintaining the areas of normal articular cartilage, menisci, and ligaments.[1,3] If tibiofemoral disease develops, PFA can be revised to TKA through the same incision with good results.[4] While the tissue preserving nature of PFA has had little morbidity, venous thromboembolic (VTE) disease remains a poorly studied risk after PFA.

VTE disease, specifically deep vein thrombosis (DVT) and pulmonary embolism (PE), is a concern after any lower extremity arthroplasty.[5] Researchers have demonstrated that 90% of symptomatic PE originates from lower extremity DVT, and more than 95% of PEs after total joint surgery occur within 6 weeks.[6-9] Whether or not prophylaxis is used, the incidence of fatal PE after TKA is approximately 0.1%.[10-14] Thus, chemical and mechanical prophylaxis is often used after knee arthroplasty to prevent VTE complications.

The benefits of chemical prophylaxis, however, must be carefully weighed against the risks of bleeding and wound drainage complications.[15,16] Typically, the method and duration of thromboembolism prophylaxis selected for PFA is similar to standard protocols for TKA.[2] Aspirin has been shown to be effective for the prevention of symptomatic and fatal PE after TKA with fewer bleeding events compared to other anticoagulants.[13] Furthermore, Lombardi and colleagues[5] showed that aspirin-based therapy, as a part of a risk-stratified protocol, is highly effective for VTE prophylaxis after minimally invasive unicompartmental knee arthroplasty. To our knowledge, no studies have specifically evaluated the incidence of symptomatic VTE disease and its prevention in patients undergoing PFA.

The purpose of this study was to report the incidence of symptomatic DVT and PE in a group of patients undergoing primary or revision PFA. We also sought to catalog any complications, and identify any particular risk factors associated with VTE in the setting of PFA.

Materials and Methods

We included 131 consecutive patients (149 knees) undergoing primary or revision PFA by the senior author (JHL) between November 1997 and December 2009. Six patients had follow-up care with their referring physician, as they lived out of state or in other countries. No postoperative complications, including VTE complications, were reported to us regarding these patients by time of analysis, and these patients were included in the aggregate analysis.

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Patient records were reviewed for the primary endpoint of VTE symptoms within the first 6 weeks after surgery, and data were collected on method of thromboembolic prophylaxis used and risk factors for thromboembolic events, including history of prior VTE event, family history of coagulopathy or VTE event, genetic propensity, use of oral contraceptives, or cancer history. Patient demographics were recording, as well as American Society of Anesthesiologists (ASA) class, and implant type. Charlson Comorbidity Index was also calculated, as higher scores on this index have previously been associated with increased risk of VTE.[17,18]

Each patient was evaluated preoperatively for VTE risk, in consultation with medical, cardiology, or hematology associates. Patients without significant risk factors for thromboembolism received 325 mg of enteric coated aspirin for 6 weeks following surgery. Patients considered at high risk for thromboembolism (ie, personal history of VTE, known coagulopathy or history of cancer), with pre-existing use of warfarin, aspirin sensitivity, nonsteroidal anti-inflammatory drugs (NSAID) intolerance, or contraindication factors, received warfarin for a minimum of 6 weeks. Patients on warfarin were dosed to achieve an international rationalized ratio (INR) between 1.8 and 2.5. All patients received bilateral intermittent pneumatic compression pumps while in the hospital postoperatively. Patients undergoing revision procedures were not considered at higher risk for VTE unless they met other high-risk criteria (ie, medical comorbidities and high risk status as described above). Therefore, this subset of patients was not managed more aggressively with chemoprophylaxis, compared with patients undergoing primary procedures.

All patients began continuous passive range of motion postoperatively and physical therapy with full weight-bearing and range of motion exercises were initiated by the afternoon of surgery. Rapid discharge from the hospital (postoperative day 1) and outpatient physical therapy were encouraged. All patients received perioperative antibiotics.

Descriptive statistics for demographic data, along with student t-tests and chi-squared analysis for comparisons amongst VTE prophylactic management groups, were performed using SPSS version 15.0 (SPSS Inc., Chicago, Illinois). Institutional Review Board approval was obtained.

Results

The mean patient age at surgery was 48.8 years (range, 28.8-80.7; standard deviation [SD], 11.3) and mean Body Mass Index (BMI) was 28.3 (range, 18.9-41.0; SD, 5.1). Thirty-six percent of PFA surgeries were performed in patients with a BMI greater than 30. Sixty-five percent of the patients were women (n = 82), and 96.2 % (n = 100) of patients were Caucasian. The mean operative time was 66 minutes for isolated and unilateral PFA (range, 33-76; SD, 18.3). Eighty-four percent of patients received physical therapy on the day of surgery. During the study period, including all of the bilateral and unilateral cases, contralateral TKAs, patellofemoral and bicompartmental knee arthroplasties, 72% were discharged by postoperative day 3 and 97.6% were discharged by day 4. Subsequently, since January 2009, with improved pain management and rapid recovery protocols, 92% of patients with isolated PFA were discharged from the hospital on day 1, with an average length of stay of 1.2 days. The majority of patients received epidural or spinal anesthesia (88.9%), 8.7% had general anesthesia, and the remaining patients had regional or a combination of anesthesia types. Ninety-two percent of patients were ASA class of I (normal, healthy patients) or II (mild systemic disease).

There were no significant differences in demographics between the patients receiving aspirin and those receiving warfarin (Table I). Aspirin-based prophylaxis with pneumonic calf pumps was used in the treatment of 109 patients (83.3%). Warfarin-based prophylaxis was used in 16.7% of patients. Aspirin prophylaxis was used in 80.8% of patients undergoing isolated PFA and 92.6% of patients undergoing bicompartmental surgery. The overall number of patients demonstrating 2 or more VTE risk factors was 7.9%. Four percent of patients receiving aspirin had 2 or more hypercoagulation risk factors, while 28.6% of patients receiving warfarin had 2 or more risk factors. Eighty-four percent of obese patients (BMI>30) were managed with an aspirin-based protocol. The majority of patients (82.5%) had a Charlson Comorbidity Index of 0, while 8.7% had an age-adjusted Charlson Comorbidity Index score of 1, and an additional 8.8% had an age-adjusted Charlson Comorbidity Index of 2 or greater. Data on other risk factors for VTE are presented in Table II.

Eighteen patients in our sample underwent bilateral PFA procedures. The mean age and BMI at the time of surgery were 55.8 years (range, 36.5-80.7; SD: 11.9) and 26.9 (range, 20.33-34.4; SD, 4.4), respectively. Half of these patients were women and 94.4% received physical therapy on the first postoperative day. Fifteen of these patients (83.3%) received aspirin for DVT prophylaxis. None of the eighteen patients had 2 or more VTE risk factors.

Fifty percent of PFA procedures performed were on the right knee. Simultaneous PFA and unicompartmental arthroplasty was performed in 27 knees (18.8%) and concurrent osteochondral autograft transplantation was performed in 7 knees (4.9%). Contralateral TKA was performed on the same day in 3 patients (2.1%). Sixty-seven percent of knees underwent prior surgery, with 16.0% of knees having undergone 1 or more prior distal realignment procedures.

Our sample also included 7 revision PFAs. The primary PFA procedures for 5 of these patients were performed by the senior author (JHL). The other 2 patients presented for revision surgery after primary PFA was done at another institution. Four of the 5 patients were women, and 4 were Caucasian. Three of the revisions were right knees, and one of these revision surgeries was a bicompartmen-

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Table I. Demographics, Operative Details for Patients on Aspirin Versus Warfarin

	Aspirin (n = 109)	Warfarin (n = 22)	*P* Values
Age (mean, years)	49.0	48.0	.717
BMI (mean, kg/m^2)	28.4	27.8	.654
Tourniquet time[a] (mean, min)	77.6	73.4	.523
Women	64.7%	66.7%	>.99
Caucasian	96.6%	93.8%	.493
Right knee surgery	43.8%	42.9%	>.99
Bicompartmental surgery	23.8%	9.5%	.242
Prior knee surgery	66.7%	80.9%	.301
Epidural anesthesia use	85.7%	89.5%	.703
ASA class <III	89.5%	80.9%	.276
Out of bed, postoperative day 1	86.7%	71.4%	.102
Discharged home	80.9%	76.2%	.565

[a]Tourniquet time, including bicompartmental knee arthroplasty

tal procedure. The mean time from primary PFA to revision surgery was 25.6 months (range, 7.2-70.9; SD, 26.0).

One of the revision PFA patients, with an undisclosed family history of VTE, developed dyspnea and pleuritic chest pain on postoperative day 5. Her deep VTE prophylaxis included aspirin and calf pumps postoperatively. Contrast-enhanced computed tomography of the chest demonstrated multiple small pulmonary emboli. She was managed successfully with an intravenous heparin bridge, followed by low molecular weight heparin, and 6 months of warfarin. She was subsequently diagnosed with a hereditary coagulopathy.

In the entire sample of 124 primary PFA procedures and 7 revision PFAs, no other symptomatic VTE complications occurred. Overall, 4 lower extremity ultrasounds were performed for calf pain and swelling to rule out DVT in the 6 week follow-up period. No evidence of DVT was seen on this imaging. One ultrasound revealed a popliteal fossa cyst in a patient taking aspirin. This patient was switched to warfarin and suffered no other complications. One ultrasound confirmed a hemarthrosis and accumulation of blood in the calf of an obese patient who was taking warfarin. This patient was switched to aspirin therapy, and his symptoms resolved after knee aspiration. Additionally, 21 knees experienced mild hematomas; 19 of these patients were aspirated in the clinic at time of follow-up with resolution of swelling. One major hematoma requiring an incision and drainage occurred in a patient taking aspirin. Three wound complications were noted, one of which required wound revision surgery. No knees had infections, and there were no patient deaths within the 6-week follow-up period after surgery.

The average total length of follow-up for patients in our sample was 24.8 months (range, 6 weeks to 8.4 years; SD, 26.7 months). Analysis of longer-term PFA outcomes revealed that 5 knees required arthroscopic surgery after PFA, and 8 knees required eventual revision to a TKA. The mean range of motion at the latest follow-up clinic visit was 132° of flexion (range, 90-165°; SD, 12.4), with 92.8% of knees having greater than 120° of flexion.

Discussion

Lower extremity arthroplasty has shown to be an independent risk factor for DVT and PE.[19-22] These risks have decreased over time due to a variety of factors, including earlier mobilization after surgery, more efficient and less traumatic surgery, compression devices, advancements in multimodal pain management, use of regional anesthesia, and use of chemical prophylaxis for VTE disease.[21] However, the use of chemoprophylaxis with agents that impact the clotting cascade are complicated by the risk of bleeding events, including blood loss, transfusion, transfusion-related transmission of disease, wound-healing problems, hematoma, wound drainage, and infection.[23] The purpose of this study was to characterize the incidence of VTE disease in patients undergoing primary or

Table II. VTE Risk Factors in Each Prophylaxis Management Groups

	Aspirin (n = 109)	Warfarin (n = 22)	Total (n = 131)
Current smoker	16.2%	19.0%	16.7%
Genetic predisposition	0%	0%	0%
Cancer history	1.9%	4.8%	2.4%
Oral contraceptives	3.8%	9.5%	4.8%
Family history of VTE	7.6%	23.8%	10.3%
Congestive heart failure	1.0%	0%	0.8%
Varicosities	4.8%	14.3%	6.3%
Prior DVT/PE	1.0%	14.3%	3.2%
Diabetes	1.0%	4.8%	1.6%
Age-adjusted CCI≥2	5.8%	23.9%	8.8%
≥2 VTE risk factors	3.8%	28.6%	7.9%

Abbreviations: CCI, Charlson Comorbidity Index; DVT, deep venous thrombosis; PE, pulmonary embolus.

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revision PFA using a conservative, risk-stratified approach to postoperative anticoagulation.

All patients undergoing primary or revision PFA received intermittent pneumatic compression devices. Oral aspirin was used in the management of the majority of cases and was typically administered for 6 weeks following surgery. Patients with procoagulative risk factors (ie, history of VTE, known coagulopathy, or history of cancer) or those with aspirin intolerance, contraindication to NSAID use, or preexisting use of warfarin were identified preoperatively and managed with warfarin for 6 weeks. The method of prophylactic management changed for 3 patients: one from warfarin to aspirin due to a bleeding complication, one from aspirin to warfarin for intolerance, and one from aspirin to intravenous heparin followed by 6 months of warfarin following pulmonary emboli. The incidence of symptomatic VTE disease and PE following PFA in this cohort was 0.76%.

Limitations of this study include its retrospective design and relatively small cohort. We reviewed data from charts completed over a 10-year period, thus, some practice changes have occurred that may have modified outcomes in ways that cannot be systematically documented in this study. Previous analyses of sample size have estimated that a prospective study comparing low molecular weight heparin to aspirin would require approximately 1500 patients per group to show equivalence, non-inferiority or superiority of one method over the other because of the low DVT rates in the low molecular weight group.[23] Clinically relevant VTE is rare, thus a prospective study would be difficult to accomplish.[13] In addition, this study addressed the clinical presentation and incidence of DVT and PE, it did not use routine ultrasound surveillance for DVT or routine ventilation perfusion scans or spiral CT scans for PE identification.

Previous studies of thromboembolic events after TKA have reported incidences of symptomatic DVT at 0.4% to 0.88%.[12,14,18,24] Rates of non-fatal PE are reported at 0.25% to 1.0%, and 0% to 0.2% for fatal PE following total joint arthroplasty with a variety of anticoagulants.[10-14, 18, 24-27] Few studies have investigated the incidence of thromboembolic events following partial knee arthroplasty. Lombardi and colleagues[5] reported no cases of VTE disease in a series of 432 knees undergoing unicompartmental knee arthroplasty.

Obesity and advancing age have been associated with an increased risk of DVT after lower extremity arthroplasty.[21] Thirty-six percent of our patients were obese, and 84.4% of these patients were managed with aspirin-based prophylaxis. All 3 wound complications (ie, hematoma requiring surgical evacuation, and symptomatic calf swelling from bleeding) occurred in obese patients. Only one of the patients in our sample was over the age of 75 at the time of surgery; he underwent bilateral PFA and did not experience VTE complications. The only clinically apparent VTE event in our series occurred in a patient who was subsequently diagnosed with a hereditary coagulopathy.

The rate of major bleeding events following chemoprophylaxis other than aspirin has been reported to be between 0.9% and 6%.[13,23,28-32] Major bleeding events in this study included a hematoma requiring evacuation, a wound complication requiring wound revision surgery, and a knee hematoma that tracked into the calf. Using our criteria, the overall incidence of major bleeding events in this study was 2.4% (1.9% of patients on aspirin vs 4.8% of patients on warfarin). This study demonstrates that an aspirin-based protocol may be effective in patients with standard risk for thrombosis undergoing PFA. Patients with hereditary coagulopathy, history of VTE, or cancer should likely be placed on an alternative anticoagulation protocol.

Authors' Disclosure Statement

Dr. Lonner wishes to report that he is Consultant for Zimmer, Blue Belt Technologies, CD Diagnostics; receives royalties from Zimmer, Blue Belt Technologies; and is Shareholder of Mako Surgical, Blue Belt Technologies, CD Diagnostics. Ms. Levack and Dr. Kamath report no actual or potential conflict of interest in relation to this article.

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