

Thromboembolism Following Shoulder Arthroscopy

A Retrospective Review

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Background: Thromboembolism following shoulder arthroscopy is considered an uncommon complication, with fewer than 50 cases reported in the literature. Arthroscopy of the shoulder is one of the most commonly performed orthopaedic procedures, with low associated risks.

Purpose: To identify potential risk factors for the development of venous thromboembolism (VTE) following shoulder arthroscopy and to determine the overall incidence of this complication.

Study Design: Case-control study; Level of evidence, 3.

Methods: A retrospective case-control review was performed of patients who developed symptomatic deep venous thrombosis (DVT) or pulmonary embolism (PE) following shoulder arthroscopy. Multiple surgeons from across North America were queried. For every case of DVT or PE identified, 2 control cases of shoulder arthroscopy were analyzed. The incidence of DVT/PE following shoulder arthroscopy was determined. A univariate analysis and a multivariate logistic regression model were conducted to identify any potential risk factors for the development of VTE following shoulder arthroscopy.

Results: A total of 17 surgeons participated in this study and had performed a total of 15,033 cases of shoulder arthroscopy from September 2002 through August 2011. Eleven of the 17 participating surgeons had had a patient with a VTE complication during this time frame. The incidence of VTE in the 15,033 cases was 0.15%; 22 patients of the 15,033 patients had a DVT (n = 15) and/or PE (n = 8). Forty-four control cases were also analyzed. Univariate and multivariate analyses were performed. No significant risk factors were identified other than patient positioning. All cases and controls were positioned in the beach-chair position for surgery.

Conclusion: The results of this study show that although rare, VTE occurs following shoulder arthroscopy at a rate of 0.15%. The variables analyzed in the cases of VTE compared with the control cases did not show any significant risk factors. All cases were positioned in the beach-chair position. Further analysis of future cases is warranted.

Keywords: shoulder arthroscopy; deep venous thrombosis; pulmonary embolism; venous thromboembolism; postoperative complication; rotator cuff; beach-chair position

Shoulder arthroscopy is one of the most commonly performed surgeries in orthopaedics and is generally

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considered a low-risk surgery.^{9,16,17,21} The literature on venous thromboembolism (VTE) following shoulder arthroscopy is sparse, with fewer than 50 cases reported in the literature.^{2-6,8,11-15,18-20} Guidelines exist for thromboprophylaxis in major orthopaedic surgeries such as total hip arthroplasty, total knee arthroplasty, and hip fracture surgery. However, there are no clear guidelines for upper extremity surgery in the United States or Canada.¹⁰ There is some evidence that the rate of VTE following shoulder arthroplasty may be comparable to arthroplasty of the hip and knee.²² Although the incidence of VTE following shoulder arthroscopy is low,⁷ it is still present and poses a serious potential risk, especially when no clear guidelines for thromboprophylaxis exist.

TABLE 1
Collected Variables^a

Patient characteristics	Age, sex, body mass index
Surgical characteristics	Procedure type, positioning, operative side, total anesthesia time, total surgical time, systolic blood pressure range, diastolic blood pressure range, use of a block, use of a pump, pump pressure
VTE prevention modalities	Ted hose, sequential compression device, postoperative anticoagulation (aspirin, lovenox, or warfarin)
Patient risk factors	Smoking history, VTE history (individual and family history), hypercoagulability disorder, anemia/blood disorder, heart disease, diabetes mellitus, lung disease, kidney disease, liver disease, cancer history

^aVTE, venous thromboembolism.

The purpose of the present study was to identify potential risk factors for the development of VTE following shoulder arthroscopy and to determine the overall incidence of this complication.

MATERIALS AND METHODS

Data Acquisition and Patient Selection

This study received institutional review board approval and was compliant with the Health Insurance Portability and Accountability Act (HIPAA). Members of the Association of Clinical Elbow and Shoulder Surgeons (ACCESS) group were surveyed regarding symptomatic upper/lower extremity deep venous thrombosis (DVT) or pulmonary embolism (PE) cases following shoulder arthroscopy in their practices. Participating members used personal retrospective recall and performed a review of surgical logs to identify cases of symptomatic DVT or PE following shoulder arthroscopy from the start of each member's practice to August 2011. Only cases of shoulder arthroscopy were included. Open procedures and arthroplasties were excluded.

Detailed information on each case of VTE was obtained, including patient demographics, intraoperative details, any VTE prophylactic measures utilized during or after surgery, and an extensive list of comorbidities and patient risk factors (Table 1). All patient information was deidentified. Two additional shoulder arthroscopy patients who did not have a VTE complication were identified for each symptomatic VTE case to serve as controls. Each control patient had undergone shoulder arthroscopy performed by the same surgeon within 1 week of a case of VTE. Similar detailed patient, operative, and risk factor data were collected on patients in the control group.

To analyze the rate of VTE after shoulder arthroscopy, the total number of shoulder arthroscopies performed by each participating surgeon was calculated from the start of each individual's practice to August 2011. If any of the participating surgeons did not have a case of VTE, they were still included in the study and their case numbers were used in the denominator for calculation of the incidence. All patient information analyzed in this study was completely deidentified to comply with HIPAA standards.

Statistical Analysis and Identification of Risk Factors

Data were separated into 2 groups for simplification when calculating descriptive characteristics. These 2 groups were

the VTE group and the control group. A univariate analysis was conducted to identify unadjusted differences between cases and controls for each variable, with use of a Wilcoxon 2-sample test for continuous variables and a chi-square test for categorical variables. Significance in this analysis was set at $P < .05$. Second, a multivariate logistic regression analysis was conducted to compare selected operative characteristics and comorbidities. Five variables were selected to undergo the multivariate analysis. These variables were sequential compression device use, postoperative anticoagulation use, smoking history, age, and total surgical time. Significance in this model was also set at $P < .05$.

RESULTS

Seventeen ACCESS surgeons participated in this study. A total of 15,033 shoulder arthroscopies were performed by the participating surgeons, from a reported date as early as September 2002 to August 2011. From this group of surgeons, 11 had at least 1 case of VTE. Six surgeons had not had a case of VTE. A total of 22 patient cases of VTE were identified. Of the 15,033 cases, the incidence of VTE was 0.15%.

There were 8 cases of PE and 15 cases of DVT. Only 1 case of PE had a documented DVT from the lower extremity; however, only 3 of these cases had ultrasound workup after the PE was diagnosed. Eight of the 15 (53.3%) DVT cases were located in the upper extremity compared with 7 of the 15 (46.7%) in the lower extremity. All of these were treated with enoxaparin or warfarin. One of the patients in the VTE group had a known hypercoagulable state, and 1 was on birth control at the time of surgery. There were no deaths.

Case and control group information was compared. As shown in Table 2, the average age was 57.0 years (range, 19-81 years) in the VTE group and 54.1 years (range, 19-74 years) in the control group. The average body mass index (BMI) in the VTE group was 30.5 kg/m² compared with 29.7 kg/m² in the control group. Eighteen of 22 (81.8%) patients were males in the VTE group, compared with 32 of 44 (72.7%) patients in the control group. All VTE cases and controls were performed in the beach-chair position. There were no cases of symptomatic VTE performed in the lateral position in our cohort. Twenty of 22 (90.1%) VTE cases had an interscalene block, compared with 42 of 44 (95.5%) in the control group. Sixteen of 22 (72.7%) cases with VTE had at least a rotator cuff repair performed during the operation, while 33 of 44 (75.0%) controls also

TABLE 2
Comparative Analysis of Variables Between Groups^a

Variable	VTE Group (n = 22)	Control Group (n = 44)
Age, y, average (range)	57.0 (19-81)	54.1 (19-74)
BMI, kg/m ² , average	30.5	29.7
Sex, male, n (%)	18 (81.8)	32 (72.7)
Positioning, n	22 beach chair	44 beach chair
Regional anesthesia, n (%)	20 (90.1)	42 (95.5)
Rotator cuff repair, n (%)	16 (72.7)	33 (75.0)
Anesthesia time, min, average	120.5	121.9
Operative time, min, average	80.2	79.7
Use of a pump, n (%)	17 (77.3)	34 (77.3)
Compression stocking use, n (%)	8 (36.4)	16 (36.4)
Sequential compression device use, n (%)	13 (59.1)	28 (63.6)
Thromboprophylaxis use, n (%)	10 (45.5)	18 (40.9)
Smoking history, n (%)	3 (13.6)	5 (11.4)
Known hypercoagulability, n (%)	1 (0.45)	0 (0.0)

^aBMI, body mass index; VTE, venous thromboembolism.

underwent at least a rotator cuff repair. The average anesthesia time for the VTE group and control group was 120.5 and 121.9 minutes, respectively. The average operative time was 80.2 minutes for the VTE group and 79.7 minutes for the control group. Seventeen of 22 VTE cases (77.3%) used a pump for joint distention, which was the same percentage for the control group (34/44; 77.3%). Eight of 22 (36.4%) VTE cases used compression stockings intraoperatively, equaling the rate in the control group (16/44; 36.4%). Thirteen of 22 (59.1%) VTE cases used sequential compression devices compared with 28 of 44 (63.6%) in the control group. Ten of 22 (45.5%) VTE cases used postoperative thromboprophylaxis compared with 18 of 44 (40.9%) in the control group. As seen in Table 1, multiple comorbidities were assessed. For simplification, only smoking history and known thrombophilia are listed in Table 2. Only 3 of 22 VTE cases were smokers compared with 5 of 44 in the control group. Only 1 patient had a known thrombotic disorder, and this patient was in the VTE group.

The univariate analysis did not reveal any variables as significantly increasing the risk of VTE. This included the list of comorbidities as seen in Table 1. There was a slight trend toward age and failure to use sequential compression device with increased risk for developing VTE, but it did not reach significance. Five variables were selected by the authors for the subsequent multivariate analysis, which included: sequential compression device use, postoperative anticoagulation use, smoking history, age, and total surgical time. As seen in Table 3, these variables did not show a significant risk of VTE development following shoulder arthroscopy.

DISCUSSION

It is well known that thromboembolic phenomena are more prevalent in certain patient groups undergoing orthopaedic

TABLE 3
Multivariate Results

Variable	P Value
Sequential compression device	.43
Postoperative anticoagulation use	.63
Smoking history	.92
Age	.26
Surgical time	.74

surgery, namely those undergoing hip and knee arthroplasty as well as those undergoing hip fracture surgery. Guidelines exist for these types of operations to help prevent potentially devastating thromboembolic complications. There is a paucity of literature regarding thromboembolic complications following shoulder arthroscopy, and there are no clear guidelines to help physicians protect their patients from thromboembolic events.

Burkhart⁴ was the first to describe VTE after shoulder arthroscopy in 1990 in a patient with a known risk factor. Several others have suggested that risk factors such as cancer history, thrombophilia, smoking history, longer operative time, and lateral positioning as variables that may increase the risk of developing a VTE following shoulder arthroscopy.^{2,4,11,18} In this study, we were hoping to identify risk factors for developing a VTE by creating a case-control analysis by assessing multiple perioperative variables between 2 groups. This type of analysis has not been published up to this point for shoulder arthroscopy. From our data, we were also able to calculate the incidence of VTE following shoulder arthroscopy. Prior to this study, only 49 cases of VTE following shoulder arthroscopy had been reported. This study increases that number to 71 cases reported in total. Table 4 shows a list of all cases reported and further subdivides the VTE into type and location.

The causes of DVT following shoulder arthroscopy have not been determined. Data on several variables were collected to search for risk factors that may lead to VTE. Having a control group allowed us to compare data between 2 groups through a logistic regression model. This study did not reveal any variables as potential risk factors for the development of VTE. Interestingly, all cases submitted were performed in the beach-chair position. We did not have a comparative group with surgeries performed in the lateral position. Although previous studies suggest that the lateral position may increase the risk of DVT, it is also plausible to consider the beach-chair position as putting one at risk for a lower extremity DVT. With the legs dependent and partially flexed, this may increase venous stasis, predisposing one to a DVT, especially during long cases. To prevent this potential risk, one could consider intraoperative compression stockings and foot/calf pumps. This study does not necessarily recommend this action, given the rate of VTE was 0.15% overall.

In addition to looking at risk factors, the incidence of VTE was calculated at 0.15%, which is consistent with the study by Martin et al.¹⁶ Upper extremity DVT is rare in comparison with lower extremity DVT. Previous studies have shown that only 4% of all cases of DVT involve the

TABLE 4
Reported VTE in Literature Following Shoulder Arthroscopy

	VTE	DVT Total	Upper Extremity DVT	Lower Extremity DVT	PE
Brislin et al ³	1	1	1	—	—
Burkhart ⁴	1	1	1	—	—
Bongiovanni et al ²	3	3	2	1	—
Cortes et al ⁵	1	—	—	—	1
Creighton and Cole ⁶	1	1	1	—	1
Garofalo et al ⁸	2	2	2	—	1
Hariri et al ¹¹	1	1	1	—	1
Hoxie et al ¹²	3	1	—	1	3
Jameson et al ¹³	7	3	—	—	5
Kim et al ¹⁴	1	1	1	—	1
Kuremsky et al ¹⁵	6	5	3	2	4
Martin et al ¹⁶	14	8	—	—	6
Polzhofer et al ¹⁸	1	1	1	—	1
Randelli et al ¹⁹	6	5	—	—	1
Starch et al ²⁰	1	1	1	—	1
Schick et al (current study)	22	15	8	7	8
Total	71	49	22	11	34

^aDVT, deep venous thrombosis; PE, pulmonary embolism; VTE, venous thromboembolism.

upper extremities.^{1,5} However, the PE rate with upper extremity DVT is high, with reported rates of up to 36%.⁵ After a thorough literature review of all reported cases of VTE following shoulder arthroscopy, there was more reported upper extremity DVT than in the lower extremity. This challenges previous data.

This study has limitations that merit discussion. First, this is a retrospective study with the limitations inherent to such a design. Many of the symptomatic VTE cases were identified by surgeon recall. It is possible that the number of VTE cases is higher than what we report if we did not capture all VTE cases or if the VTE cases did not report back to their surgeon for treatment of the VTE complication. All cases and controls, remarkably, in this analysis were done in the beach-chair position. Several surgeons participating in this study perform some of their shoulder arthroscopies, usually shoulder instability cases, in the lateral decubitus position. We do not have data on how many of the 15,033 cases were done in the beach-chair position versus in the lateral decubitus position. The absence of cases performed in the lateral position limits the generalizability of our data.

CONCLUSION

Twenty-two cases of symptomatic VTE were identified amid 15,033 shoulder arthroscopy cases, for a risk of 0.15%. All cases were performed in the beach-chair position. No patient, operative, or risk factor variables were found to be predictive of symptomatic VTE following shoulder arthroscopy.

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