Pulmonary Embolism After Shoulder Arthroscopy

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abstract

Deep venous thrombosis and pulmonary embolism events are common complications following lower-extremity orthopedic surgery. Conversely, deep venous thrombosis and pulmonary embolism events are rare following upper-extremity surgery, specifically shoulder arthroscopy. The purpose of this article is to emphasize the necessity of performing a thorough preoperative workup to uncover possible risk factors for deep venous thrombosis/pulmonary embolism despite the rare occurrence of developing a pulmonary embolism following shoulder arthroscopy.

This article describes 3 patients who developed a nonfatal pulmonary embolism following elective shoulder arthroscopy. All 3 surgeries were performed with the patient in the lateral decubitus position. No complications were noted intraoperatively. Symptoms appeared at postoperative days 14, 29, and 2, respectively. One patient demonstrated no risk factors for developing a pulmonary embolism, whereas the other 2 exhibited risk factors for deep venous thrombosis and pulmonary embolism.

Pulmonary embolism is a rare but serious complication following shoulder arthroscopy. Shoulder surgeons should be aware of the presenting signs and symptoms. Mechanical or chemical prophylaxis should be administered for patients with identified coagulopathic risk factors. Although it is rare for patients to develop a pulmonary embolism following upper-extremity shoulder arthroscopy, orthopedic surgeons must be aware of the possibility that a pulmonary embolism can occur after elective, uncomplicated shoulder arthroscopy. Surgeons should consider prophylactic measures for patients with identified coagulopathy disorders.

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Venous thromboembolic events, including deep venous thrombosis (DVT) and pulmonary embolism (PE), are common complications following lower-extremity orthopedic surgery. In contrast, DVT and PE are infrequent complications following upper-extremity surgery. Willis et al\(^1\) reported that the risk of PE in the shoulder arthroplasty literature ranges from 0.2% to 2%, with a mortality rate of 1%. More specifically, DVT and PE are “rare in shoulder arthroscopy.”\(^2\)

This article describes a series of 3 patients in which a PE occurred following shoulder arthroscopy. Although developing a PE following shoulder arthroscopy is rare, being more thorough in a patient’s preoperative workup to uncover possible risk factors for DVT and PE is necessary. In addition, a greater emphasis on preoperative planning for patients with known risk factors may further limit the occurrence of DVT and PE.

**CASE REPORTS**

**Patient 1**

A 26-year-old right-hand-dominant man presented with an 8-year history of intermittent right shoulder pain. The patient described a traumatic event while working with a nail gun in which his shoulder was placed into a position of forced external rotation. The patient had undergone 2 previous arthroscopies of the right shoulder with capsular thermal shrinkage 6 years previously and an open capsular shift 1 year previously. No postoperative complications occurred with either surgery, but the patient had not experienced pain relief. His surgical history also included a knee arthroscopy at age 15 years, without postoperative complications. The patient had a body mass index (BMI) of 34.7 kg/m\(^2\). He initially reported no family history of hematologic clotting or bleeding abnormalities.

Three months after initial presentation, he underwent an arthroscopic debridement and revision labral repair while in the lateral decubitus position under general anesthesia with an interscalene block. Operative time was 60 minutes, and no complications occurred intraoperatively. He was progressing well 10 days postoperatively. On postoperative day 14, the patient reported acute-onset severe chest pain and mild shortness of breath. He presented to the emergency department, and a chest computed tomography scan confirmed a right segmental PE. He was admitted to the hospital and began taking low-molecular-weight heparin and warfarin, with an expected treatment duration of 6 months. Duplex ultrasounds of his upper and lower extremities were negative for DVT.

On further questioning, he noted a family history of his mother, maternal aunt, and maternal grandmother having a history of DVT. The patient and his family subsequently underwent a genetic and familial workup for coagulopathy. The patient and his family were positive for a prothrombin gene mutation. Factor V Leiden, lupus anticoagulant, homocysteine level, and cardio-lipin levels were normal. The patient completed the 6-month warfarin treatment with no other complications. Proteins C and S were normal after the 6-month warfarin treatment was complete.

**Patient 2**

A 45-year-old right-hand-dominant woman presented with a 10-month history of increasing right shoulder pain after playing significant amount of volleyball. Her medical history was significant only for an anxiety disorder. No family history of clotting disorders was identified. Examination suggested biceps and rotator cuff tendinitis, and her BMI was 24.5 kg/m\(^2\). She underwent an 8-week course of physical therapy but made no significant improvements. Further treatments, including nonsteroidal anti-inflammatory drugs and injections, did not significantly alleviate pain. Magnetic resonance imaging revealed a partial-thickness rotator cuff tear and a questionable superior labrum anteroposterior lesion.

Right shoulder arthroscopic subacromial decompression, possible rotator cuff repair, and biceps tenotomy were planned. Surgery was performed with the patient in the lateral decubitus position while under general anesthesia and an interscalene block. Sequential compression devices were placed on her lower extremities for DVT prophylaxis. Intraoperatively, a near full-thickness rotator cuff tear was identified. She underwent a biceps tenotomy, rotator cuff repair, and subacromial decompression. The procedure was uncomplicated, and operative time was 65 minutes. Her initial postoperative course was routine.

On postoperative day 29, she presented to her physical therapist with significant palpitations, anxiety, and right-sided scapular pain. The physical therapist noted that she became dizzy, and as a result, she was taken to the hospital. A chest computed tomography scan revealed a right-sided lower lobe PE. Ultrasounds of both upper and lower extremities were negative. She was prescribed enoxaparin and warfarin for a total of 6 months. A full hematological workup revealed no coagulopathies or abnormalities increasing her risk of DVT or PE. No family history was identified, and no ultimate cause was obtained. She subsequently fully recovered from the rotator cuff repair and returned to all activities of daily living.

**Patient 3**

A 59-year-old left-hand-dominant man with a history of 2 PEs presented with a 1.5-year history of right shoulder pain. The authors obtained a magnetic resonance image taken 1.5 years previously that showed a high-grade, partial-thickness tear of the supraspinatus tendon. He had undergone a course of physical therapy 1 year previously but continued to have worsening pain. At initial presentation, he had significant pain and weakness with rotator cuff testing and a BMI of 35.1 kg/m\(^2\). He wanted to pursue surgical options. He was taking chronic warfarin therapy due to a known coagulopathy. His hematologist recommended stopping the warfarin 4 days preoperatively and taking enoxaparin 40 mg twice daily.
Surgery was performed with the patient in the lateral decubitus position with sequential compression devices placed on both lower extremities for DVT prophylaxis intraoperatively. General anesthesia without interscalene block was used. He underwent a right shoulder arthroscopic rotator cuff repair, biceps tenodesis, and subacromial decompression. Operative time was 78 minutes. The patient tolerated the procedure well and was discharged to start enoxaparin that evening.

On postoperative day 2, the patient reported significant left-sided chest pain and presented to the emergency department. A chest computed tomography scan revealed a left-sided PE, and he was admitted for observation. He began taking warfarin again and treatment doses of enoxaparin (1 mg/kg twice daily) until his international normalized ratio/prothrombin time levels stabilized. He was discharged on postoperative day 4 and began physical therapy at the routine time 7 to 10 days postoperatively. His postoperative course was otherwise unremarkable, and he obtained full strength and function by 6 months. It was noted postoperatively that the patient had not taken his enoxaparin preoperatively after he stopped taking warfarin. Ultrasounds of both lower extremities were negative. No hematological workup was performed because he had a known history of thrombophilia, which was identified as being caused by a single G-20210-A mutation in the factor II gene.

**DISCUSSION**

Little literature exists concerning PE following shoulder arthroscopy because symptomatic PE after upper-extremity surgery is rare. Burkhart was the first to report a case of thromboembolism, which developed in a 32-year-old man following shoulder arthroscopy in 1990. Arcand et al reported a similar case in which a 32-year-old man underwent elective shoulder arthroplasty; however, this patient developed a PE shortly postoperatively. Furthermore, Polhofer et al reported a patient with diabetes mellitus and obesity as risk factors who developed PE after an arthroscopic acromioplasty procedure.

Randelli et al reported the incidence of DVT in shoulder arthroscopy in surgeries occurring between 2005 and 2006 from 59 orthopedic surgeons. They reported 6 patients who developed DVT from a total of 9385 surgeries. One of 6 patients developed a PE. Four of the patients were treated for rotator cuff lesions, 1 was treated for glenohumeral instability, and 1 only underwent an acromioplasty. None of these patients sustained a fatal PE.

Kim et al, the first to report a case in which a patient sustained a fatal PE, reported the case of a 45-year-old woman who developed contralateral axillary vein thrombosis after elective arthroscopic right rotator cuff repair. In the following days, the patient developed a fatal PE.

As the aforementioned case reports illustrate, the frequency of shoulder arthroscopy complicated by PE is rare. Nonetheless, the current authors experienced 3 PEs following elective shoulder arthroscopy. The senior authors (S.N., R.H.) have performed more than 2000 shoulder arthroscopies in the lateral position in 7 years and have noted only these 3 thromboembolic complications. From their experience, the incidence is rare.

The general risk factors for DVT for upper and lower extremities are similar and include history of venous thromboembolism, increasing age, varicosities, obesity, diabetes mellitus, and venous stasis. Trauma and other inheritable disorders have also been implicated in the development of DVT. Specific risk factors of developing DVT in the upper limbs are the presence of a central venous catheter and operating in the lateral decubitus position with the affected limb in traction. The frequency of DVT and PE depends on the interaction of numerous risk factors, not solely on 1 specific factor.

Hariri et al reported an isolated case of PE following shoulder arthroscopy. A 25-year-old patient developed thrombophlebitis of the brachial vein complicated by PE postoperatively. The patient exhibited risk factors that indicated thrombosis, including operating in the lateral decubitus position, prolonged surgery, neoplasm, and antithrombotic factor deficiency. Although the patient presented some risk factors that indicated thrombosis, the incidence of developing thrombosis from shoulder arthroscopy are so low that preventative treatment was not administered preoperatively.

Bongiovanni reported 3 patients who developed DVT after shoulder arthroscopy but were not further complicated by PE. All 3 patients tested positive for heritable thrombophilia. Bongiovanni reported that unrecognized coagulation disorders might have a serious influence on minimally invasive surgery with regard to the development of DVT. Further research on the role coagulation disorders play in the development of DVT and PE is needed to address this issue. Currently, no international guidelines exist for the prevention of thromboembolism after shoulder arthroscopy.

In the current series, 1 patient demonstrated no risk factors for developing a PE, whereas the other 2 patients exhibited risk factors that increased the risk of a DVT and PE. Patient 1 initially reported no family history of DVT. However, additional questioning postoperatively revealed one. Moreover, the patient and his family tested positive for a prothrombin gene mutation, but Factor V Leiden levels were normal. Westrich et al reported that inherited hypercoagulable conditions, such as mutations of the genes that encode antithrombin, protein C, protein S, and Factor V Leiden increase the risk of developing DVT and PE. Patient 3 also tested positive for thrombophilia, which was identified as being caused by a single G-20210-A mutation in the factor II gene. His BMI was also more than 30 kg/m², and his risk was further increased due to his obesity. Given the patient’s BMI, it is possible that enoxaparin 40 mg twice daily was not an adequate enough dose to prevent DVT.
This patient also increased his risk of DVT and PE by not following instructions to take enoxaparin preoperatively. All 3 patients were operated on while in the lateral decubitus position, and no complications occurred intraoperatively. Surgical time was not excessive. All 3 patients received mechanical prophylaxis intraoperatively in the form of sequential compression devices. This measure is routinely used by the senior authors.

In the current series, 2 patients presented acutely with classic symptoms of chest pain and shortness of breath. The other patient had a medical history significant only for anxiety disorder. Her initial symptoms of palpitations and a restless feeling mimicked her prior panic attacks. Also, her right scapular pain might easily have been attributed to the shoulder that had recently been operated on or her sling use. The time from surgery to presentation with the embolus varied from days 2 to 29. This is unusual considering the minimal convalescence associated with upper-extremity surgery. The patient who developed an embolus postoperative day 29 was fully functional except for the use of the sling. Surgeons should be aware of the possibility of this as a late complication.

The lateral decubitus position is commonly used for shoulder arthroscopy. All 3 patients were operated on in this position. Kuremsky et al19 reported that operating on patients who are in this position can lead to upper-extremity thrombosis. However, thrombosis has also been reported in patients who have been operated on while in the beach-chair position.20,21 Additional research focusing on the effects of patient positioning on complications following shoulder arthroscopy is needed.

Obesity is also a risk factor of DVT and PE. Two of the current patients were obese. However, no available data establishes the relative increase in risk for DVT and PE in the setting of upper-extremity surgery. Also, when evaluating the large number of patients undergoing shoulder arthroscopy who are obese, any relative increase in risk is likely to be low. As a result, a recommendation regarding the use of DVT prophylaxis in patients undergoing shoulder arthroscopy who are obese cannot be made until further research is performed.

**CONCLUSION**

Although developing a PE following upper-extremity shoulder arthroscopy is rare, orthopedic surgeons must be aware that a PE can occur after elective, uncomplicated shoulder arthroscopy. Surgeons should consider prophylactic measures for patients with identified coagulopathy disorders. A hematological consult should be obtained so that proper preoperative planning to prevent DVT and PE can be completed. Further recommendations for prophylaxis in the general population or in patients with other risk factors cannot be made and should be at the surgeon’s discretion.

**REFERENCES**


