# Fatal pulmonary embolism after arthroscopic rotator cuff repair: a case series

**Thomas J.S. Durant**
**Mark P. Cote**
**Robert A. Arciero**
**Augustus D. Mazzocca**

The UCONN Health Center, New England Musculoskeletal Institute and Augustus D. Mazzocca receive research support from Arthrex Inc. Naples, FL

**Corresponding author:**
Thomas J.S. Durant
University of Connecticut
Department of Orthopaedic Surgery
Farmington, CT 06034
Tel: 860-679-6709
Fax: 860-679-6649
E-mail: sakrisondurant@uchc.edu

**Summary**

***Background:*** **pulmonary embolism (PE) is a rare and serious complication of arthroscopic orthopaedic surgery. Currently there is great paucity in the literature regarding PE events following arthroscopic rotator cuff (ARCR) surgery. The purpose of this case series was to (1) report our known incidence rate of symptomatic PE following ARCR for a single surgeon and (2) describe five cases of pulmonary embolism following ARCR, detailing patient medical history and potential perioperative risk factors.**
***Methods:*** **the number of PE events were queried retrospectively from the institutional database with the ICD-9 code 415.1 within a 10 year time frame (2003-2013). Cases of PE identified by ICD-9 query were reviewed for type of procedure, postoperative day of event, and surgeon. Only patients with a confirmed diagnosis by computed tomography (CT) scan or post-mortem exam, were included in this study. Patient medical records belonging to affected patients were ordered and reviewed by a single investigator. Pre, intra, and postoperative information was obtained and summarized.**
***Results:*** **5 cases of PE were identified, two of which were fatal. All events occurred in the perioperative period following ARCR. The 10 year incidence rate for PE following ARCR was 0.89%. Medical record review revealed significant risk factors for these patients when compared to current VTE prophylactic guidelines.**
***Conclusions:*** **our ten year incidence rate of PE following arthroscopic shoulder surgery and ARCR was 0.25 and 0.89% respectively. These rates were found to be considerably higher than reported rates of PE in the general population and following arthroscopic shoulder surgery. In addition, our methods failed to detect subclinical PE events, resulting in the likelihood of this value to be an underestimate of the true incidence. Medical record review revealed risk factors which would qualify patients for chemoprophylaxis under certain guidelines, however, the validity of available risk stratification methods continue to be a topic of debate.**
**Level of Evidence: Level IV; case series.**

*KEY WORDS: pulmonary embolism, arthroscopy, shoulder, rotator cuff repair.*

## Introduction

Pulmonary embolism (PE) is a rare and serious sequela of arthroscopic rotator cuff repair (ARCR)[1,2]. Current literature concerning PE events following ARCR is limited to case reports and expert reviews of the literature[3-7]. At the present time, there is no prospective data describing the prevalence, or risk factors associated with the development of PE following arthroscopic shoulder surgery.
While reported events of pulmonary embolism following ARCR are infrequent, fatal PE events following ARCR are particularly rare, and are limited to a single case report in the literature. Kim et al.[8] described a case in which a patient sustained a fatal PE following ARCR. To our knowledge, there are no other reports of fatal PE following arthroscopic shoulder surgery.
The purpose of this case series was to (1) report our known incidence rate of symptomatic PE following arthroscopic RCR for a single surgeon and (2) describe five cases of pulmonary embolism following arthroscopic RCR, detailing patient medical history and potential perioperative risk factors.

## Methods

The methods described in this paper were considered best practice in regards to commonly considered

standards for research protocols. Best efforts were made to make the following justifiable and appropriate for the procurement of the conclusions stated, and the results from which they were drawn[9].

A retrospective review of the entire practice of a single, fellowship trained orthopaedic surgeon was performed. This was performed for two reasons: (1) to ensure that all known PE cases were captured and (2) to determine the total number of patients who underwent an arthroscopic procedure during the study period. IRB approval was obtained prior to the start of the study.

Patients with a postoperative presentation of PE event confirmed by computed tomography (CT) scan were considered eligible for this study. This included patients who were diagnosed and treated offsite, as this complication requires emergent care due to its acute onset. In an effort to ensure all known PE events were identified, a search of the institution's database of hospital records was conducted using the ICD-9 code 415.1 for PE and infarction. The medical records of patients identified by this search as having a PE event were screened to determine eligibility using the following criteria:

Inclusion Criteria: all patients who had undergone an arthroscopic shoulder procedure by the primary surgeon between 2003 and 2013 who carried a clinical diagnosis of PE and infarction (415.1) confirmed by computed tomography (CT) scan or post mortem exam.

Exclusion Criteria: patients with events greater than 4 weeks following arthroscopic surgery or patients who had procedures that were not performed arthroscopically were excluded.

A second query of the institution's database of hospital records was performed within the same time frame (2003-2013) using all CPT codes related to arthroscopic shoulder surgery (Appendix 1) in order to determine the total number of patients that underwent arthroscopic shoulder surgery during the study period. These figures were used to calculate 10-year incidence rate of known PE events following arthroscopic shoulder surgery in a single surgeons practice.

To address the second purpose of this study, evaluation of potential risk factors and etiology, a retrospective chart review was conducted. The medical records of all patients with known PE events were obtained and reviewed by a single investigator. Information regarding past medical and family history, patient comorbidities, intra-operative data, postoperative course, and socio-demographic information was extracted using a formal data collection sheet. This data was then summarized and compared to currently utilized guidelines for prevention of thromboembolic events.

## Results

### Incidence of PE events following arthroscopic shoulder surgery

During the 10-year period from 11/1/2003 and 11/1/2013, the ICD-9 search returned 5 PE events all of which occurred in a cluster of a 2-year period (2010-2012). These PE events were all found to have occurred following ARCR. Of these 5 events, three were diagnosed with confirmatory CT angiography, and two were diagnosed on post-mortem exam.

During the 10-year period examined in this study, CPT code search indicated the primary surgeon performed 2,003 arthroscopic shoulder surgeries for an incidence rate of 0.25% of known PE following arthroscopic shoulder surgery. Of these 2,003 arthroscopic procedures, 565 were rotator cuff repairs for an incidence rate of 0.89% for known PE following arthroscopic rotator repair.

### Retrospective analysis for etiology and risk factors

Of the 5 patients diagnosed with PE following ARCR, the mean age was 61.4 (range; 54 - 67 yrs). Of these patients, there were 3 females and 2 males. The average time to diagnosis of a PE event following surgery was 6.8 days post-operatively (range; 3 - 18 days). Data regarding past medical history, family medical history, and pertinent information regarding thromboembolic risk factors for each patient are displayed in Table 1. None of the patients had documented hypercoagulable states or history of thromboembolic events. None of these patients were smokers. Two of the five patients reported a family history of blood clots; however there was no documentation to indicate whether this history was related to first-degree relatives.

Intraoperative information was obtained and summarized. All 5 documented cases, described below, were operated on in the modified upright sitting (beach chair) position under general anesthesia with laryngeal mask airway (LMA) support. Prior to induction of anesthesia, bilateral lower extremity compression sleeves were applied for DVT prophylaxis. Warm blankets were applied to control body temperature, and active temperature control was achieved with forced air warming therapy to the lower body. An arthroscopic approach was performed via standard posterior portals in order to visualize intra-articular pathology visualized. Following the diagnosis of structural pathology, the appropriate procedures were subsequently performed. Materials used for RCR included 5.5 mm anchors to secure the rotator cuff tendons in all five cases. On completion of each procedure, anesthesia was successfully reversed in all cases and the patients were placed in an external rotation brace and sent to the PACU.

Diagnosis of PE for these patients was made by CT studies and post-mortem exams. Two events of PE were fatal, with diagnosis of PE made on post-mortem examination. The remaining three events in this cohort experienced PE events which were diagnosed in the emergency department (ED), via spiral CT studies. Treatment for these 3 patients involved a 6 month course of Warfarin after a low-molecular weight heparin (LMWH) bridge to a therapeutic INR range of 2.0 - 3.0. Hypercoaguability testing was undocumented in these three patients. All patients who underwent treat-

**Appendix 1.**

| CPT Code | Procedure description |
|---|---|
| 29805 | Arthroscopy, shoulder, diagnostic, with or without synovial biopsy |
| +2479 | + arthroscopic reduction and internal fixation of glenoid fracture |
| +1984 | + arthroscopic RCR acute |
| +1876 | + arthroscopic RCR |
| +1913 | + arthroscopic removal of hardware |
| +1891 | + arthroscopic tenodesis of long tendon biceps |
| 29806 | Arthroscopy, shoulder, surgical; capsulorrhaph |
| 29807 | Arthroscopy, shoulder, surgical; repair of SLAP lesion |
| 29819 | Arthroscopy, shoulder, surgical; with removal of loose body or foreign body |
| +1988 | + arthroscopic resection or transplant of long tendon of biceps |
| 29820 | Arthroscopy, shoulder, surgical; synovectomy, partial |
| 29821 | Arthroscopy, shoulder, surgical; synovectomy, complete |
| 29822 | Arthroscopy, shoulder, surgical; debridement, limited |
| 29824 | Arthroscopy, shoulder, surgical; distal claviculectomy including distal articular surface (Mumford procedure) |
| 29825 | Arthroscopy, shoulder, surgical; with lysis and resection of adhesions |
| +1928 | + arthroscopic biceps tenotomy |
| 29826 | Arthroscopy; decompression of subacromial space with partial acromioplasty |
| 29827 | Arthroscopy, shoulder, surgical; with rotator cuff repair |
| 29826-51 | 51 modifier if – arthroscopic RCR WITH arthroscopic subacromial decompression with or without acromioplasty and/or coraco-acromial ligament release |
| 29828 | Arthroscopy, shoulder, surgical; biceps tenodesis |

**Table 1. PE events identified via retrospective review, during the perioperative period of arthroscopic RCR.**

| Event | Gender | Age | Operative Diagnosis | Operative Procedure | Position operated in | Post-operative day of PE event | NICE Risk Factors (1 or more risk factor = prophylaxis) |
|---|---|---|---|---|---|---|---|
| 1 | Female | 54 | RCT (supra-infra) complex with glenoid retraction Type II acromion | RCR Biceps tenotomy SAD | | 6 | > 60 y.o. Anesthesia time = 121 minutes One or more significant comorbidity (PAD, HTN, DM2) |
| 2 | Female | 60 | RCT Supraspinatus | RCR SAD Bursectomy | | 18 | > 60 y.o. Anesthesia time= 107 minutes |
| 3 | Male | 67 | RCT Supra-Infra complex Bicep tendonosis Subcutaneous Lipoma | RCR Bicep tenotomy SAD | Modified upright sitting (barber chair) position | 4 | > 60 y.o. Anesthesia time = 200 minutes One or more significant comorbidity (HTN) |
| 4 | Female | 62 | RCT (supra-infra) Type II Acromion | RCR SAD Bursectomy | | 3 (fatal event) | > 60 y.o. Anesthesia time = 134 minutes |
| 5 | Male | 63 | RCT (three tendon) Type II acromion | RCR Biceps tenotomy SAD | | 3 (fatal event) | > 60 y.o. Anesthesia time = 190 minutes One or more significant comorbidity (HTN, DM2, hx of esophageal cancer in remission) |

PAD = Peripheral Arterial Disease; MI = Myocardial Infarction; DM2 = Diabetes Mellitus type 2; HTN = Hypertension; SAD = Subacromial decompression; RCR = Rotator Cuff Repair; RCT = Rotator Cuff Tear; h/o = history of

ment for PE had an uncomplicated recovery without persistent comorbidities related to the PE.
The 5th PE event identified was the last event that occurred within our 10-year time frame. Prior to this PE event, the protocol for VTE prophylaxis was modified to include chemoprophylaxis for VTE in the form of Aspirin 325 mg p.o. twice daily for four weeks. This was the only patient who received anticoagulant prophylaxis during the perioperative and postoperative period.

## Discussion

Pulmonary embolism is a well-known complication of many different surgical procedures. However, PE following shoulder arthroscopy is a rare complication, with a reported incidence rate of 0.01 - 0.06%[1,10,11]. This rate is slightly lower than, but closely approximates the incidence of PE in the general population without surgery is reported to be 0.062-0.112%[12]. Given the apparent rarity of this complication following arthroscopic RCR, we performed a retrospective review of a single surgeon's practice to determine our own incidence of symptomatic PE. Further, we reviewed the medical records of these patients to provide information regarding risk factors for thrombolytic events following arthroscopic surgery.
To our knowledge, there is only one report in the literature which describes an incidence rate of PE following rotator cuff repair. Hoxie et al.[13] performed a retrospective case study of 1176 patients who underwent surgery for rotator cuff repair in a 5-year period. The reported incidence rate in this population was 0.26% (3 PE events). This rate is comparable to our 10-year incidence of 0.25%. Of these 1,176 patients, 309 (26%) of these patients were repaired arthroscopically. In this subgroup, 2 patients developed a PE, yielding an incidence rate of 0.64%. Our ten year incidence rate of PE following arthroscopic RCR is 0.89%, with 5 events occurring in 565 patients who underwent arthroscopic RCR. It's important to note that these figures refer to symptomatic PEs. The true incidence of PE would require radiographic screening for VTE to ensure detection of subclinical events.[1]
Prophylaxis for VTE events following outpatient arthroscopic shoulder surgery remains a topic of debate. The National Institute of Clinical Excellence (NICE) does not recommend routine prophylaxis for upper limb day procedures, risk stratification for inpatient surgical procedures may help guide a clinician when considering indications for chemoprophylaxis against VTE (Tab. 2)[14,15]. For the inpatient surgical population, one or more risk factor for venous VTE suggests the need for chemoprophylaxis. NICE guidelines recommend low molecular weight heparin (LMWH) started within 6 - 12 hours after surgery and mechanical VTE prophylaxis during and after surgery, with both continued until patient mobility is restored[14]. Jameson et al.[2] did not observe a difference in the incidence of PE following shoulder arthroscopy, following the implementation of the NICE prophylactic guidelines. Additionally, under NICE guidelines, 42% (27,427 patients) of the arthroscopy population in this study were stratified into the high risk category, raising concern regarding over qualification of patients as appropriate for VTE prophylaxis[2].
The American College of Chest Physicians (ACCP)[16], and SFAR/ANAES (Société française d'anesthésie et de réanimation/Agence nationale d'accréditation et d'évaluation ensanté)[17] also offer guidelines for the prevention of thromboembolic events (Tab. 3). Similar to NICE, these guidelines do not recommend routine prophylaxis for ambulatory orthopaedic surgery[2,16,17].
The occurrence of PE events observed in the present study led to the modification of our clinic's chemoprophylactic protocol during the perioperative period for arthroscopic shoulder surgery. LMWH was not considered a routine option for our practice due to the lack of strong evidence supporting the NICE guidelines, concerns over the complications of LMWH, and our clinic being an outpatient facility. We do not administer subcutaneous injections of unfractionated heparin (UFH) or LMWH unless there is a personal history of VTE. In these cases, LMWH is administered as per NICE guidelines[2]. In a prospective randomized control trial, known as the PE Prevention (PEP) trial, Aspirin was shown to significantly reduce the incidence of both PE and fatal PE following hip fracture orthopaedic surgery[18,19]. Meta-analysis has also shown Aspirin to reduce the risk of PE following major orthopaedic surgeries when compared with LMWH and UFH[18,19]. Accordingly, our practice now uses 325 mg po bid for 4 weeks for all patients following surgery requiring general anesthesia[20,21].
Comorbidities which may have placed this cohort of patients at higher risk for thromboembolic events were screened for prior to surgery and confirmed retrospec-

**Table 2. NICE risk factors qualifying patients for VTE prophylactic treatment.**

| | NICE High Risk Factors for VTE[1] |
|---|---|
| VTE prophylaxis if 1 or more risk factor present | · Active cancer treatment<br>· Age over 60 years old<br>· Critical care admission<br>· Dehydration<br>· Known thrombophilia<br>· BMI > 30 kg/m$^2$<br>· One or more significant medical comorbidity<br>· Personal history or 1st degree relative with history of VTE<br>· Use of hormone replacement therapy<br>· Varicose veins with phlebitis<br>· Women who are pregnant or have given birth in previous 6 weeks<br>· Surgical time > 90 minutes |

[1]. Venous Thromboembolis: reducing the risk of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to the hospital.http://www.nice.org.uk/nicemedia/live/12695/47920/47920.pdf.

**Table 3. Published guidelines regarding prophylactic treatment for venous thromboembolic events following ambulatory or upper extremity orthopaedic surgery.**

| | NICE* | ACCP** | SFAR/ANAES*** |
|---|---|---|---|
| Routine VTE Prophylactic guidelines | No routine prophylaxis required for UE procedures | No prophylaxis required for routine procedures (does not mention ambulatory ortho procedures – except knee arthroscopy) | No prophylaxis routinely required for ambulatory orthopaedic procedures |
| In the presence of risk factors | Patients with increased risk VTE<br>· LMWH 6 – 12 hours s/p surgery until mobility is restored<br>· Pneumatic compression sleeves thigh or knee high<br>· Foot impulse devices<br>· Anti-embolic stockings | Patients with preexisting VTE risk factors (knee arthroscopy)<br>· LMWH for unspecified duration | Patients with increased risk of VTE<br>· LMWH for no more than 7 days |

*National Institute of Clinical Excellence
**American College of Chest Physicians
***Société française d'anesthésie et de réanimation/Agence nationale d'accréditation et d'évaluation ensanté

tively through review of medical records. Risk factors for VTE were evaluated for in the five patients in this cohort based on known risk factors established by current guidelines (Tab. 2)[14,16,17]. Pertinent findings in this patient series included age over 60-years, possibility of occult cancer, obese (> 30 BMI), one or more significant medical comorbidity, first degree relative with history of VTE, and surgical anesthesia time greater than 90 minutes (Tab. 1)[14]. In addition, one of the fatal patients was found to have esophageal cancer in remission, and two of the five patients reported a family history of blood clots. However, it is unknown whether or not this history was with first degree relatives, which is a known risk factor[14,22].

The cases of fatal PE demonstrate the magnitude of this potential complication following arthroscopic shoulder surgery. Fatal PE events following arthroscopic RCR is an extremely rare occurrence with only one case report in the literature. Kim et al.[8] reported a fatal pulmonary embolism following arthroscopic RCR which embolized from the contralateral upper extremity. To our knowledge there are no other reports of fatal PE following arthroscopic RCR. On review of medical records and surgical records of our cohort, there were no factors associated with a disproportionate increase in risk for any of the 5 patients who developed a PE.

Various aspects associated with surgical procedures may play a role in the development of PE. Literature regarding the technical procedures of arthroscopic shoulder surgery and their potential relationship to thrombolytic events is fairly limited[3-5,23,24]. In the present study, the beach chair position was utilized in all 5 patients. This position has been suggested as a potential cause of a PE and a DVT in two case reports[25,26]. This implication is based upon the upright positioning of the patient which may lead to pooling of blood in the lower extremities[26]. The lateral decubitus is another common position used in arthroscopic shoulder surgery. This position has been utilized in reported cases of PE following shoulder arthroscopy, however this data is also observational[2-4,24]. Further studies are needed to elucidate the role of operative techniques and positions in the development of PE.

### Limitations

There are several limitations of this study. The lack of a screening protocol prohibited the detection subclinical PE events and as such the incidence reported in this study likely does not reflect the true incidence of PE in our practice. The small study group (n=5) limits our capability to draw valid conclusions regarding risk factors. Additionally, the information regarding risk factors was obtained retrospectively. Pertinent information obtained may have been left out of the medical record. For example, BMI, which is a potential risk factor, was not routinely recorded. Additionally, risk factors were determined solely on the current perception of what is most prominent in literature concerning VTE risk stratification[2,27]. As our understanding of PE events continues to develop, previously unrecognized risk factors may be identified. Lastly, we did not perform an analysis to explore the role of various patient characteristics and technical aspects of the operative procedure. Such an analysis would require a larger sample of patients with a PE and was felt to be beyond the scope of this study.

## Conclusion

Our 10-year incidence of PE was 0.25% following arthroscopic shoulder surgery and 0.89% following arthroscopic rotator cuff repair. These rates were found to be considerably higher than reported rates of PE for both the general population and for those who

underwent arthroscopic shoulder surgery. Medical record review revealed risk factors that would qualify patients who are appropriate for chemoprophylaxis under current guidelines. While prevention continues to be studied, current guidelines are general, stratifying a large percentage of the population into high risk. As a result, chemoprophylaxis may be indicated for too many patients[2]. This case series demonstrates that PE events do occur following ARCR and have the potential to be fatal. Further studies are warranted to thoroughly elucidate risk factors, improve the accuracy of incidence rates, and generate prophylactic guidelines to identify patients at risk for PE or VTE events following arthroscopic shoulder surgery.

## References


1. Dattani R, Smith CD, Patel VR. The venous thromboembolic complications of shoulder and elbow surgery: a systematic review. Bone Joint J. 2013;95-B(1):70-74.
2. Jameson SS, James P, Howcroft DW, et al. Venous thromboembolic events are rare after shoulder surgery: Analysis of a national database. J Shoulder Elbow Surg. 2011.
3. Garofalo R, Notarnicola A, Moretti L, Moretti B, Marini S, Castagna A. Deep vein thromboembolism after arthroscopy of the shoulder: two case reports and a review of the literature. BMC Musculoskelet Disord. 2010;11:65.
4. Cortes ZE, Hammerman SM, Gartsman GM. Pulmonary embolism after shoulder arthroscopy: could patient positioning and traction make a difference? J Shoulder Elbow Surg. 2007;16(2):e16-17.
5. Hariri A, Nourissat G, Dumontier C, Doursounian L. Pulmonary embolism following thrombosis of the brachial vein after shoulder arthroscopy. A case report. Orthop Traumatol Surg Res. 2009;95(5):377-379.
6. Kuremsky MA, Cain EL, Jr., Fleischli JE. Thromboembolic phenomena after arthroscopic shoulder surgery. Arthroscopy. 2011;27(12):1614-1619.
7. Edgar R, Nagda S, Huffman R, Namdari S. Pulmonary embolism after shoulder arthroscopy. Orthopedics. 2012;35(11): e1673-1676.
8. Kim SJ, Yoo KY, Lee HG, Kim WM, Jeong CW, Lee HJ. Fatal pulmonary embolism caused by thrombosis of contralateral axillary vein after arthroscopic right rotator cuff repair -A case report. Korean J Anesthesiol. 2010;59 Suppl:S172-175.
9. Padulo J, Oliva F, Frizziero A, Maffulli N. Muscles, Ligaments and Tendons Journal. Basic principles and recommendations in clinical and field science research. MLTJ. 2013;4:250-252.
10. Yamamoto T, Tamai K, Akutsu M, Tomizawa K, Sukegawa T, Nohara Y. Pulmonary embolism after arthroscopic rotator cuff repair: a case report. Case Rep Orthop. 2013;2013:801752.
11. Martin CT, Gao Y, Pugely AJ, Wolf BR. 30-day morbidity and mortality after elective shoulder arthroscopy: a review of 9410 cases. J Shoulder Elbow Surg. 2013;22(12):1667-1675 e1661.
12. Wiener RS, Schwartz LM, Woloshin S. Time trends in pulmonary embolism in the United States: evidence of overdiagnosis. Arch Intern Med. 2011;171(9):831-837.
13. Hoxie SC, Sperling JW, Cofield RH. Pulmonary embolism following rotator cuff repair. Int J Shoulder Surg. 2008;2(3): 49-51.
14. Venous Thromboembolis: reducing the risk of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to the hospital.http://www.nice.org.uk/nicemedia/live/12695/47920/47920.pdf.
15. Jameson SS, James P, Howcroft DW, et al. Venous thromboembolic events are rare after shoulder surgery: analysis of a national database. J Shoulder Elbow Surg. 2011;20(5):764-770.
16. Geerts WH, Pineo GF, Heit JA, et al. Prevention of venous thromboembolism: the Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy Chest. 2004;126 (3 Suppl):338S-400S.
17. Mismetti ea. Prévention de la maladie thromboembolique en orthopédie et traumatologie. Ann Fr Anesth Reanim. 2005;24: 871-889.
18. Eikelboom JW, Karthikeyan G, Fagel N, Hirsh J. American Association of Orthopedic Surgeons and American College of Chest Physicians guidelines for venous thromboembolism prevention in hip and knee arthroplasty differ: what are the implications for clinicians and patients? Chest. 2009;135(2):513-520.
19. Prevention of pulmonary embolism and deep vein thrombosis with low dose aspirin: Pulmonary Embolism Prevention (PEP) trial. Lancet. 2000;355(9212):1295-1302.
20. He J, Whelton PK, Vu B, Klag MJ. Aspirin and risk of hemorrhagic stroke: a meta-analysis of randomized controlled trials. Jama. 1998;280(22):1930-1935.
21. Gorelick PB, Weisman SM. Risk of hemorrhagic stroke with aspirin use: an update. Stroke. 2005;36(8):1801-1807.
22. Pedersen AB, Sorensen HT, Mehnert F, Overgaard S, Johnsen SP. Risk factors for venous thromboembolism in patients undergoing total hip replacement and receiving routine thromboprophylaxis. J Bone Joint Surg Am. 2010;92(12):2156-2164.
23. Polzhofer GK, Petersen W, Hassenpflug J. Thromboembolic complication after arthroscopic shoulder surgery. Arthroscopy. 2003;19(9):E129-132.
24. Starch DW, Clevenger CE, Slauterbeck JR. Thrombosis of the brachial vein and pulmonary embolism after subacromial decompression of the shoulder. Orthopedics. 2001;24(1):63-65.
25. Cortes ZE, Hammerman SM, Gartsman GM. Pulmonary embolism after shoulder arthroscopy: could patient positioning and traction make a difference? J Shoulder Elbow Surg. 2007; 16(2):e16-17.
26. Willis AA, Warren RF, Craig EV, et al. Deep vein thrombosis after reconstructive shoulder arthroplasty: a prospective observational study. J Shoulder Elbow Surg. 2009;18(1):100-106.
27. Goldhaber SZ, Bounameaux H. Pulmonary embolism and deep vein thrombosis. Lancet. 2012;379(9828):1835-1846.