

Pulmonary Embolism after Screw Fixation for a Greater Tubercle Fracture of Humerus

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Pulmonary embolism is a serious complication, which is well known in patients undergoing total hip or total knee arthroplasty or lower extremity fracture surgery. But, there are few literatures concerning pulmonary embolism after upper extremity surgery. Pulmonary embolism after minor upper extremity fracture surgery is extremely rare. We report a case of 66-year-old female patient that developed pulmonary embolism after percutaneous cannulated screw fixation for a greater tubercle fracture of the proximal humerus with literature review.

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Key Words: Pulmonary embolism; Fracture fixation; Shoulder fractures

Deep vein thrombosis (DVT) and pulmonary embolism is a commonly recognized complication after lower extremity arthroplasty. It is rare after upper extremity surgery. The majority of reported cases of pulmonary embolism after upper extremity surgery have occurred in patients after shoulder arthroplasty,¹⁻⁴⁾ shoulder arthroscopic surgery,^{2,5-7)} but their incidence rates are very low. Rarely, single cases of pulmonary embolism after open glenohumeral joint debridement, subacromial decompression of the shoulder, and surgical treatment of ulnar pseudoarthrosis have been reported. Pulmonary embolism after surgery for a proximal humerus fracture has been also reported, but these procedures involved hemiarthroplasty or open reduction-internal fixation.^{1,2)} Pulmonary embolism after minor upper extremity fracture surgery is extremely rare. We experienced a case of a 66-year-old female patient that developed pulmonary embolism after percutaneous cannulated screw fixation for a greater tubercle fracture of the right proximal humerus. However, little information is available in the literature concerning pulmonary embolism after upper extremity surgery.^{2,4,8)} Here, we report a case of pulmonary embolism after percutaneous cannulated screw fixation for a greater tubercle fracture of the proximal humerus with literature review.

Case Report

A case of 66-year-old female without any explicit risk factor presented at our out-patient department after slip down during which her right shoulder struck the ground complaining of pain in right shoulder joint. She did not have any history of medical disease or a family history of DVT or pulmonary embolism. Her surgical history included kyphoplasty for an osteoporotic compression fracture of the T12 spine with an uneventful outcome 3 years previously. Physical examination showed no external wound but severe tenderness over the greater tubercle of right proximal humerus. She was unable to elevate the right arm actively to an overhead position, but motor, sensory and vascular examinations of upper extremity were normal. Right shoulder radiographs revealed no definite fracture line but coronal magnetic resonance imaging revealed a diffuse high signal change in the greater tubercle of the right proximal humerus on T2W image and a lower signal change on T1W image, suggesting non-displaced fracture of the greater tubercle of the proximal humerus. The arm was protected with c-type sling.

One week later, the right shoulder pain had not resolved and a follow-up plain radiograph showed a slightly displaced fracture

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of the greater tubercle of the right proximal humerus. She was scheduled for fracture fixation. Her body mass index at the preoperative anesthetic evaluation was 30 kg/m². Blood test results, including complete blood cell count, electrolytes, liver function tests, and coagulation screening were normal, and electrocardiography (EKG) and chest X-ray results were unremarkable. Under general anesthesia, the patient was placed on radiolucent operative table. The fracture was fixed percutaneously with three 4.0 mm diameter cannulated screws and washers (Synthes, West Chester, PA, USA) under c-arm guidance (Fig. 1). During the procedure, no active bleeding was noticed and vital signs were stable, transfusion was not needed. The procedure lasted 20 minutes. Postoperatively a sugar-tong splint was applied and prophylactic anticoagulation regiment was not considered, because it is not the routine practice in our clinic following upper extremity surgery. The patient had an uneventful day of surgery,



Fig. 1. Postoperative radiograph showing a well reduced fracture of the greater tubercle of proximal humerus, which was fixed with cannulated screws and washers.

and on the first postoperative day, she was out of bed performing walking exercises.

However, on the third postoperative day, she complained of sudden onset chest pain and shortness of breath. Her blood pressure, pulse rate, respiration rate was 110/80 mmHg, 108 beats/min, 28 breaths/min each, and her body temperature was 36.5°C. The surgical wound in the right shoulder was clean but subcutaneous ecchymosis was detected at the lateral aspect of the upper arm. The right upper extremity was not swollen, and there were no palpable venous thromboses in the arm or supra-scapular area. Her leg veins were normal on examination, and Homan's sign was negative. A chest film was taken but returned negative results. Her EKG showed sinus tachycardia and nonspecific T wave abnormality, and her arterial blood gas analysis on room air yielded the following levels: pH=7.466, PaO₂=57.9 mmHg, PCO₂=25.9 mmHg, and O₂ saturation=85.1%. Pulmonary computed tomographic angiography revealed that right hilar, upper central, interlobar and lower pulmonary, and left upper and lower pulmonary arteries were filled with emboli (Fig. 2). Color Doppler of both lower and upper extremities did not reveal any DVT.

The patient was transferred to the coronary intensive care unit, and anticoagulant therapy was instituted by a cardiovascular specialist; 70 mg of enoxaparin was injected subcutaneously twice daily for 3 days and 5 mg of oral warfarin was prescribed daily until her international normalized ratio/prothrombin time levels stabilized. Oxygen was administered via a nasal cannula to maintain an oxygen saturation of more than 90%. Three days after the embolic event, she has experienced no further symptoms of chest pain. Follow-up computed tomography at two weeks after embolic event revealed reduced pulmonary thrombosis. Her postoperative course was otherwise unremarkable. The patient was discharged on postoperative day 21, and she completed 6 months of warfarin treatment with no further complication. The fracture united, and shoulder was functioning normally again. The patient provided informed consent for the

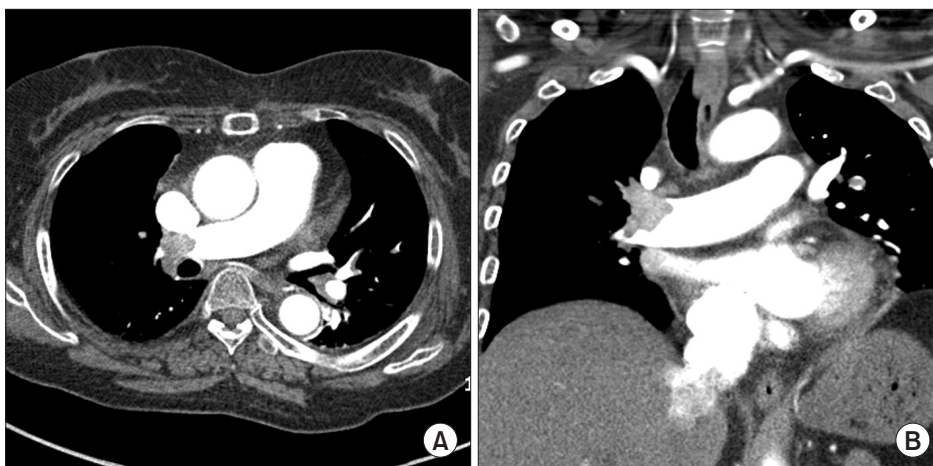


Fig. 2. Axial (A) and Coronal (B) pulmonary computed tomography showing large embolus obstructing the right hilar pulmonary artery.

publication of this case report.

Discussion

The incidence of pulmonary embolism after upper extremity surgery has not been well documented. Ojike et al.,⁸⁾ in a systemic review, reported an incidence of DVT after shoulder surgery of 0.24%, pulmonary embolism of 0.11%, and an overall incidence of venous thromboembolism (VTE) after shoulder surgery of 0.35%. However, recent studies^{2,4)} have indicated although the absolute rates of thromboembolic complications are lower for shoulder arthroplasty than for lower limb procedures, that pulmonary embolism accounted for a larger percentage of these complications after shoulder arthroplasty. Literature values for the risk of pulmonary embolism after shoulder arthroplasty range from 0.173% to 3%, whereas the mortality rate is around 1%.^{2,4)} Pulmonary embolism after shoulder arthroscopy is rarer than after arthroplasty.^{2,7)} Jameson et al.²⁾ reported DVT and pulmonary embolism rates were both less than 0.01% for shoulder arthroscopic procedures. Randelli et al.⁷⁾ described 6 cases of DVT that developed after 9,385 shoulder arthroscopy surgeries; one of the 6 developed a pulmonary embolism. The reported risk of pulmonary embolism after a proximal humeral fracture ranges from 0.40% to 5.1%.^{1,2)} Jameson et al.²⁾ reported overall DVT and pulmonary embolism rates after proximal humeral fracture surgery of 0.19% and 0.40%, respectively, and the rate of pulmonary embolism after hemiarthroplasty for a proximal humeral fracture was higher than after open reduction-internal fixation (0.52% vs. 0.31%, respectively). Hoxie et al.¹⁾ reported an overall incidence of pulmonary embolism among those treated for an isolated proximal fracture of 5.1%, that is, 4 of 37 (10.8%) after humeral head replacement arthroplasty, and 3 of 102 (2.94%) after open reduction-internal fixation. Accordingly, it seems that the arthroplasty for a proximal humeral fracture has higher risk of pulmonary embolism than open reduction-internal fixation. But there has been no published case report of pulmonary embolism after percutaneous cannulated screw fixation for a greater tubercle fracture of the proximal humerus as in our case.

It is uncertain that veins which are located in the upper and lower extremities are involved in pulmonary embolism from thrombosis after upper extremity surgery. In most cases, it might be expected that thrombi originate from the upper extremity rather than the lower extremity.^{6,8)} Brachial vein thrombosis with pulmonary embolism has been commonly reported.⁶⁾ Hariri et al.⁶⁾ reported a case of pulmonary embolism following thrombosis of the brachial vein after shoulder arthroscopy. However, some authors have reported that the deep vein thrombus originated in the lower extremity.³⁾ Willis et al.⁴⁾ reported that the prevalence of DVT after reconstructive shoulder arthroplasty was 13.0% in 100 consecutive patients. These included

6 ipsilateral and no contralateral upper extremity DVTs and 5 ipsilateral and 2 contralateral lower extremity DVTs. Pulmonary embolism occurred in 3 of the 6, 1 from posterior tibial DVT, one from subclavian vein thrombosis, one from an unknown origin. They postulated that a significant pooling of blood in the lower extremities because of lack of muscular pumping due to an upright, near seated position for an extended period of time, might contribute to the higher prevalence of DVT after shoulder arthroplasty. Rockwood et al.³⁾ reported two cases of pulmonary embolism after elective shoulder arthroplasty. In one case, autopsy revealed a large clot in the femoral vein, but in the other, no evidence of DVT was found in upper or lower extremities. Edgar et al.⁵⁾ described three patients who developed a nonfatal pulmonary embolism following elective shoulder arthroscopy with negative ultrasounds in both upper and lower extremities. In our case, we also failed to find evidence of thrombosis in upper extremity and lower extremities by color Doppler study.

The risk factors of pulmonary embolism are prior DVT, a history of pulmonary embolism, coagulation problems, chronic smoking, hypertension, diabetes, mobility limitation, obesity, venous stasis, phlebitis, a history of malignancy, and any other condition requiring prolonged bed rest.^{3,5)} Specific risk factors of shoulder arthroscopic surgery are operating in the lateral decubitus position with the affected limb in traction and a prolonged operative time.⁵⁾ Jameson et al.²⁾ reported higher VTE rates for traumatic arthroplasty than for elective arthroplasty, but without major clinical significance (all lower than 1%). Navarro et al.⁹⁾ found no significant associations between procedure type (total shoulder arthroplasty, reverse total shoulder arthroplasty, or hemiarthroplasty) or surgery indication (traumatic or elective) and the risks of pulmonary embolism, DVT, VTE, or 90-day mortality. In our case, the patient did not have any risk factor, and we could not find any DVT.

The exact cause of pulmonary embolism remains unknown. We surmise that the pulmonary embolism was possibly caused by direct injury to veins around the surgical neck of humerus during the insertion of the guide pin or screws, or by mechanical irritation of a vein by a screw after fixation, because postoperative radiography showed the screw used for fixation was little long, and that its tip penetrated too far from the medial cortex of surgical neck of humerus (Fig. 1).

Although many guidelines have been issued regarding pharmacologic prophylaxis before hip and knee surgery, there is no universally accepted prophylactic treatment for upper extremity surgery. Randelli et al.⁷⁾ did not advise the administration of VTE prophylaxis for shoulder arthroscopy, because of its minimal tissue invasiveness. However, mostly reported cases of pulmonary embolism after upper extremity surgery were not given prophylactic medication to prevent thromboembolism, some authors agree that prophylactic measures be considered for patients with identifiable risk factors.^{5,8)} Willis et al.⁴⁾ reported a 13% of preva-

lence of DVT and 3 cases of pulmonary embolism after shoulder arthroplasty despite postoperative DVT prophylaxis, consisting of enteric coated aspirin, pneumatic compression foot pumps, and early ambulation. They now use perioperative compression stockings and intraoperative pneumatic compression boots, as well as postoperative aspirin, as prophylaxis against VTE in all shoulder arthroplasty cases, and routinely perform screening postoperatively for DVT using Doppler ultrasound. Many agents have been used to DVT and pulmonary embolism, such as, aspirin, warfarin, low-molecular-weight dextran, heparin, or simply postoperative thigh-high intermittent pneumatic compressive devices.^{3,4,8)} The National Institute for Health and Clinical Excellence (NICE) in England recommended that high-risk patients undergoing upper limb surgery should be offered low-molecular weight heparin prophylaxis.¹⁰⁾ High-risk patients were defined as those aged over 60, those with significant comorbidities, those undergoing surgery with a combined anesthetic and surgical time of greater than 90 minutes, and obese patients.¹⁰⁾ However, Jameson et al.²⁾ reported very low VTE events and mortality rates after shoulder arthroscopy or proximal humeral fracture surgery, and pointed out that no significant difference in VTE event or mortality rates occurred after the introduction of the 2007 NICE guideline.¹⁰⁾ They concluded VTE disease is not a significant problem after shoulder surgery, and that thromboprophylaxis may not be required, even in high-risk patients.

This case report alerts all surgeons that pulmonary embolism can indeed occur after minimally invasive upper extremity procedures of the shoulder. Since pulmonary embolism is a rare event after minor upper extremity fracture surgery, medical prevention cannot be offered to these patients, however, orthopaedic surgeons must be aware of the possibility that pulmonary embolism can occur after minor upper extremity procedures, should be aware of risk factors, should carefully review patient history and physical examination results to determine whether a patient is in a high, moderate, or low risk category for pulmonary embolism. In addition, surgeons should maintain a high level of suspicion when symptoms are identified after the operative treatment of proximal humeral fractures, even after minor surgery.

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