Subcutaneous Emphysema, Pneumomediastinum, and Potentially Life-Threatening Tension Pneumothorax*

Pulmonary Complications from Arthroscopic Shoulder Decompression

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Subcutaneous emphysema, pneumomediastinum, and tension pneumothorax are previously unreported complications of shoulder arthroscopy with subacromial decompression. Three patients developed extensive subcutaneous emphysema, pneumomediastinum, and bilateral tension pneumothorax during or immediately after shoulder arthroscopy with subacromial decompression. The procedure was terminated and appropriate treatment was given. All three patients recovered completely with no residual damage. The complications are thought to be associated with the extravasation of air that may be drawn in from the lateral portal when the arthroscopic infusion pump and power shaver with suction are turned on. Early diagnosis, followed by immediate termination of the infusion pump and suction shaver along with appropriate treatment can be life-saving.

(A Chest 1992; 101:1265-67)

Arthroscopy has become a major diagnostic tool and treatment option for several shoulder conditions.1,2 Shoulder arthroscopy with subacromial decompression has been successfully performed for patients with impingement syndrome.3 The procedure involves the use of a pressure-monitored infusion pump with saline solution to keep the subacromial space inflated followed by resection of the coracoacromial ligament, subacromial bursae, and anterior-inferior acromion with a power shaver.3 The recognized complications of shoulder arthroscopy with subacromial decompression are intra-articular bleeding,3 fluid extravasation,4 nerve palsy, infection,5 articular cartilage damage,6,7 development of a synovial cyst,8 and rotator cuff tear.9 The absorbed water may also cause hemolysis and postoperative pain. To our knowledge, however, subcutaneous emphysema, pneumomediastinum, or pneumothorax has not been described previously. We report three patients who developed extensive subcutaneous emphysema, pneumomediastinum, and tension pneumothorax during or immediately after shoulder arthroscopy with subacromial decompression. The technique, length of surgery, and amount of fluid used for inflating the subacromial space during the three procedures were not different from our other cases.

Case Reports

Case 1

A 45-year-old housekeeping aide, with long-standing history of right shoulder pain, had extensive physical therapy and numerous steroid injections into the subacromial space and acromioclavicular joint without improvement. An arthrogram revealed normal rotator cuff. Impingement syndrome was diagnosed and the patient was admitted to the hospital for shoulder arthroscopy with subacromial decompression. Surgery was performed with the patient in the sitting position, under general anesthesia with endotracheal intubation and positive pressure ventilation. The arthroscope was placed through the posterolateral portal in the subacromial space and the inflow was placed in the posterior portal with the shaver being placed in the lateral portal (Fig 1). The subacromial space was then inflated by pressure pump infusion with normal saline solution and the area was debrided by a power shaver with suction. After all instruments were removed from the shoulder area, a large amount of subcutaneous air was noted. The portals were closed with 4-0 polypropylene (Prolene) and sterile dressings were applied. The extravasation of air extended into the neck, down into both arms and hands. A chest roentgenogram revealed extensive subcutaneous emphysema, pneumomediastinum, and bilateral pneumothorax. Computed tomographic (CT) scan of the chest (Fig 2) revealed 20 percent right-sided pneumothorax with complete collapse of the

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Figure 1. Portals for shoulder arthroscopy with subacromial decompression. A, power shaver with suction through lateral portal; B, arthroscope through posterolateral portal; and C, inflow cannula with a pressure-monitored infusion pump for fluid insufflation through posterior portal.
CASE 2

A 43-year-old woman, with a long-standing history of right shoulder pain, had failed to respond to conservative treatment. Impingement syndrome was suspected and she was admitted to the hospital for shoulder arthroscopy with possible subacromial decompression. She was intubated under general anesthesia and placed in the sitting position to facilitate access and viewing of the shoulder joint and subacromial space. Using a posterolateral entry portal, the scope was inserted into the shoulder joint and the inflow was placed posterior. After a normal arthroscopic evaluation was noted for the shoulder, the subacromial space was inflated by pressure pump and a decompression was carried out. The wounds were sutured with 4-0 polypropylene (Prolene) and a sterile dressing was applied. Immediately after the surgery, she was noted to have marked swelling in her face, neck, and chest. She complained of tightness in the chest and a chest roentgenogram revealed extensive subcutaneous emphysema and pneumomediastinum, but no evidence of pneumothorax. Her condition improved by the next day and the subcutaneous emphysema gradually resolved over the next 72 h.

CASE 3

A 40-year-old man sustained left shoulder injury about three years earlier while lifting weights. He had been treated with physical therapy, nonsteroidal anti-inflammatory medications, and numerous local steroid injections with no relief. An arthrogram demonstrated an intact rotator cuff. Impingement syndrome was diagnosed and he was admitted to the hospital for shoulder arthroscopy with subacromial decompression. Arthroscopy was performed with the patient in the sitting position, under general anesthesia with endotracheal intubation and positive pressure ventilation. After normal gleno-humeral arthroscopy was noted, the scope was then placed above the rotator cuff along with the inflow for pressure-monitored infusion. The power shaver with suction was placed in the lateral portal. The subacromial bursa was debrided with anterior inferior acromioplasty and division of the coracoacromial ligament. Before the procedure could be completed, extensive swelling was noted in the region of the neck. The procedure was terminated and the portals were closed with 4-0 polypropylene (Prolene). Chest roentgenogram (Fig 3) indicated a tension pneumothorax on the left side with extensive subcutaneous emphysema and pneumomediastinum. A 28-French thoracostomy chest tube was placed immediately. The pneumothorax was relieved and the chest tube was pulled out two days later. Subcutaneous emphysema and pneumomediastinum gradually subsided and subsequent recovery was uneventful.

DISCUSSION

All three patients had shoulder arthroscopy followed by subacromial decompression for impingement syndrome that had not responded to conservative treatment. The clinical hallmark of impingement syndrome is a painful arc of motion of the shoulder joint, especially with motion greater than 90° abduction and/or flexion. Shoulder arthroscopy with subacromial decompression is indicated in patients with advanced disease that has failed to respond to conservative treatment for six months to one year.3

Arthroscopic treatment of impingement syndrome requires placement of the arthroscope in the subacromial space that lies under the deltoïd muscle and acromial arch and is not a contained space. To obtain good visualization, all patients were placed in the upright position and the subacromial space was distended by fluid connected to an arthroscopy infusion pump through the posterior portal and drained intermittently through the power shaver with suction in the lateral port (Fig 1). The pump infusion runs intermittently to maintain a relatively constant pressure of 50 mm Hg. However, when the power shaver is turned on with high intermittent suction, the pump infusion may run continuously to keep up with the suction. The pressure in the subacromial space may drop transiently and become negative relative to the atmospheric pressure.

Although the exact mechanism of the entry of air is not known, we speculate that due to transient changes
of pressure in the subacromial space relative to atmospheric pressure, air may be drawn in through the lateral portal. When the power shaver with suction is turned off, the positive pressure from the pump infusion may push air into the surrounding tissue causing extensive subcutaneous emphysema. The air may then penetrate into the axillary sheath with further extension through the prevertebral space of the neck surrounding the trachea and esophagus, to result in pneumomediastinum. Further rise in the mediastinal pressure, during expiration or positive pressure ventilation, may cause the mediastinal parietal pleura to rupture, leading to pneumothorax.\textsuperscript{11,12} Therefore, patients may have subcutaneous emphysema and pneumomediastinum only or present with more serious complications of unilateral or bilateral pneumothorax and tension pneumothorax. Fortunately, both our patients with bilateral pneumothorax (case 1) and tension pneumothorax (case 3) did well after prompt recognition and appropriate treatment with chest tubes. Extensive subcutaneous emphysema, pneumomediastinum, and pneumothorax have been reported with endotracheal intubation.\textsuperscript{13,14} This complication has been attributed to hypopharyngeal perforation, cervical esophageal injury, tracheal tear, or an increased intra-alveolar pressure during intubation.\textsuperscript{15,16} All of our three patients had endotracheal intubation and were receiving positive pressure ventilation during arthroscopy. However, our patients did not have underlying lung disease and there was no evidence of hypopharyngeal, cervical esophageal, or tracheal injury during the endotracheal intubation. Positive pressure ventilation under general anesthesia over a short period of time is associated with very low incidence of such complications.\textsuperscript{17,18} Therefore, it is very unlikely that positive pressure ventilation alone could have caused the extensive subcutaneous emphysema, pneumomediastinum, and tension pneumothorax in our patients. Although all our patients were placed in the upright position during surgery, to the best of our knowledge, upright position is not associated with increased risk of pneumothorax. We believe that the use of the arthroscopic pressure infusion pump combined with power-run shaving devices are the factors causing these complications. However, it cannot be completely excluded that positive pressure ventilation may not have contributed further to the development of tension pneumothorax.

Early recognition, immediate termination of the pump infusion and the power shaver suction, along with appropriate treatment may be life-saving. Because of the life-threatening nature of the complications, we suggest reappraisal of the safety of shoulder arthroscopy with subacromial decompression.

REFERENCES