Case Report

Subcutaneous emphysema after shoulder arthroscopy. A case report and review of the literature

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ABSTRACT

Introduction: Subcutaneous emphysema (SE) and pneumomediastinum are rare complications after shoulder arthroscopy.

Case report: A case is presented in which SE was seen after arthroscopic cuff repair.

Discussion: A review of current literature shows that SE after shoulder arthroscopy can be due to locoregional anaesthesiology, endotracheal intubation, gas-forming infection, postoperative mobilisation or the arthroscopic procedure itself. During the procedure air can be sucked into the subacromial space due to suction and subsequently transferred into subcutaneous tissue by the positive pressure of the infusion pump.

When the condition is recognised early and addressed properly spontaneous resolving is possible with good clinical outcome.

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1. Introduction

Subcutaneous emphysema (SE) is a condition in which air infiltrates in the subcutaneous tissues. Most of the time, it occurs in the soft tissues of the thoracic wall and the neck, but it can also occur in other place. Possible causes are blunt or penetrating trauma, pneumothorax barotrauma, infection, malignancy or surgical procedure. It can occur spontaneously as well.¹ After a pneumothorax, air can move from the interpleural space to the soft tissues of the chest wall and to de mediastinum causing a pneumomediastinum (PM). In patients with pre-existing lung diseases with bullae formation, the bullae can rupture after overdistension causing a pneumothorax and SE and PM.^{2,3} Both conditions are rare complications after shoulder arthroscopy however. In the literature, only a few cases are described. The purpose of this article is to show a case in which the condition was seen after straightforward shoulder arthroscopy and review recent literature concerning the condition. Determine the possible causes of SE and pneumomediastinum after such surgical procedure.

2. Case report

A 74-year old patient consulted the orthopaedic surgeon because of pain and loss of power in the right shoulder. Clinical examination showed a passive full range of motion, painful impingement tests and indeed a loss of abduction force. Radiographs and ultrasound of the shoulder showed a type II acromion, calcifications in the supraspinatus tendon, fluid exacerbation in the bursa and a full thickness rupture of the supraspinatus tendon. In his medical history, only cardiac pathology was kept. The patient never smoked nor was not known with pulmonary diseases.

A shoulder arthroscopy with supraspinatus tendon repair was performed under interscalene block and general anaesthesia by an experienced shoulder surgeon. The interscalene block with 20 ml Naropin 0.75% was performed in plain, short axis under ultrasound guidance to prevent a pneumothorax due to this block. Nerve stimulation with 0.3 mA was used for early detection of intra-neural injection. General anaesthesia was induced with Sufenta 5 µg, Propofol 2 mg/kg and Rocuronium 25 mg. An endotracheal tube size 8.5 was used for intubation. A PSV-VG system was used for ventilation with PEEP at 5 mmHg. A classic three-port arthroscopy of the right shoulder confirmed the diagnosis of a rotator cuff rupture. No trocar were used and the shoulder was flushed with physiological water at a pressure of 50 mmHg. Reattachment of the tendon was performed arthroscopically.

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During the procedure no problems were observed, immediately postoperative, the patient noticed a swollen face, throat and swollen feet. His voice sounded distorted. Subcutaneous thoracic crepitations were observed and a radiograph of the chest was performed. This showed SE on the right hemithorax and some SE on the left side. Extensive SE but no signs of a pneumothorax were noticed (Fig. 1). A CT scan was performed for further evaluation and also showed SE as well as inclusions of air in the mediastinum but no pneumothorax (Fig. 2). The patient was treated conservatively with bed rest, pain control and observation. The problem resolved progressively spontaneously and the patient left the hospital in good condition.

3. Discussion

SE is a condition where air gets into the soft tissues under the skin. During shoulder arthroscopy, SE can occur due to the anaesthesiological procedures or it may be induced by the arthroscopic procedure itself.⁴ Also a postoperative infection with gas-forming bacteria may cause SE.⁵

Air in subcutaneous tissues has been described after endotracheal intubation (EI).^{6–8} In these cases SE is due to hypopharyngeal perforation, cervical oesophageal injury, tracheal tear or an increased intra-alveolar pressure during intubation and associated with a pneumothorax.^{6–8} Major mechanical factors which can lead to such trauma are over inflation of the cuff, sudden movement of the tube, vigorous coughing or Valsalva during extubation^{4,8,9} and repeated attempts during difficult intubation.^{10,11} These factors may cause a tear in the tracheal mucosa.¹⁰ Once a tear is formed, easily and rapidly extension of this tear by inflation of an endotracheal cuff against the torn mucosa can occur.⁸ The ideal pressure of the endotracheal tube cuff lies between 15 and 22 mmHg,⁹ which is equivalent to an injection of a volume of two to four millilitres in the cuff independent of the tube size.¹⁰ Overinflation can cause tracheal wall ischaemia, stenosis and tracheo-oesophageal fistulae. Underinflation is also to avoid because this can cause leakage and aspiration. Women are more vulnerable to tracheal tears than men. This is probably due to anatomical factors such as a weaker pars membranosa tracheae and a smaller diameter of the trachea which

Fig. 1. RX thorax. Subcutaneous emphysema on the right side of the thorax extending to the neck. Limited subcutaneous emphysema on the left thoracic side.

Fig. 2. CT thorax. Subcutaneous emphysema localised on both right and left thoracic side as well as anterior of the right shoulder. Mediastinal emphysema.

makes females more vulnerable to cuff overinflation.⁹ A short stature could be a predisposing factor for tracheal rupture too.⁹ Iatrogenic tracheobronchial tears typically are longitudinal lacerations of the posterior tracheal wall, either centrally or laterally located, with an additional avulsion of the membranous wall from its cartilaginous insertion.¹⁰ Increased intra-alveolar pressure can lead to rupture of subpleural blebs or cysts in patient with pre-existing lung diseases.^{4,7} In our case, the anaesthesiologist did not experience any problem during the intubation, the pressures of positive pressure ventilation were correct and there were no signs of a pneumothorax. However, since the presence of air in the mediastinum, it may be possible that air entered the mediastinum after a small tracheal tear, followed by entering of air in the subcutaneous tissues.

Risk factors for SE or a pneumothorax after locoregional anaesthesia are threefold. First is operator dependency and associated, second is a technical problem of the ultrasound device with loss of a good visualisation and finally patient related factors such as long disease, smoking, emphysema and obesity. In patients with a history of smoking, a high pleural dome can be present which increases the risk of puncture of the pleura.³ In our patient, the locoregional anaesthesiology was performed under ultrasound and the tip of the needle was visible constantly in correct positions. The possibility that the SE was due to the loco-regional anaesthesiology is thus low but not completely eliminated. The fact that there were no signs of a pneumothorax makes us suspect that it is not induced by locoregional anaesthesiology.

SE due to the arthroscopy itself may be explained by transient changes of the pressure in the subacromial (SA) space relative to the atmospheric pressure during the procedure. When the SA pressure is lower than the atmospheric pressure due to suction performed to eliminate debris, air may enter in the SA space. The positive pressure from the infusion pump may push this air subsequently into the subcutaneous tissues after turning of the suction and thus cause SE.^{4,12} The air may penetrate into the axillary sheath and extend through the prevertebral space of the neck surrounding the trachea and oesophagus, which can result in a pneumomediastinum. Increasing pressure in the mediastinum by positive pressure ventilation or during expiration may cause a rupture in the mediastinal parietal pleura and eventually cause a pneumothorax,⁶ which was not present in our case. Complementary, the surgeon who performed this arthroscopy, does not use suction but instead let the water flow out the shoulder as the result of the high flushing pressure. In that way, it seems unlikely that an amount of air as seen in this case, can be sucked in the SA space.

Another entrance for air into the subacromial space is by a loose junction between the solution bag and the valve of the inflow tube.^{4,5} It is important to detect this immediately and purge out the air. Operation room personnel should alert the surgeon when the connection valve is detached for replacement of the fluid bag.^{4,12} Technical damage like a fissure in a part of the connection pipe between the fluid bag and the irrigation system can produce SE identically.¹³ Because nobody thought of this as a cause of SE immediately postoperative, the tubes and connections were not controlled.

A third way in which arthroscopy may cause SE, is by inflow of air through the portals. This risk can be minimised by using cannulae equipped with a sealing dam.⁴ In our case, this was not used but the pressure of 50 mmHg of the irrigation fluid prevents the shift of air from the environment to the subacromial space. If, despite this, air still comes into the subacromial space, the air bubbles would immediately limit the view so the arthroscopy cannot be continued.

A last cause of arthroscopy-induced SE is early mobilisation. When the wound is not yet healed, the soft tissues around this wound may function as a one-way flap valve. Air can be sucked in the soft tissues with movement of the shoulder and will be trapped when the arm is moved back to the original position.⁵

Peri- or postoperative infection with gas-forming bacteria may also cause SE. The time between the surgery and the onset of the SE can be indicative for the origin of the gas. Gas-forming bacteria need around 18 h to produce a clinically detectable amount of gas. Signs of infection like erythema, fever, increased leukocytosis and/or CRP suggest rather an infectious cause.⁵ In our case this was not present.

4. Conclusion

After shoulder arthroscopy under interscalene block and general anaesthesia, subcutaneous emphysema can occur due to the procedure itself, the endotracheal intubation or the locoregional anaesthesia. In our case, it was not possible to determine the exact cause. However, it is important to keep in mind that

subcutaneous emphysema can occur after arthroscopic shoulder surgery and to recognise this in time so an adequate therapy can be established if needed.

Conflicts of interest

The authors have none to declare.

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