

Massive Subcutaneous Emphysema with Bilateral Pneumothorax and Pneumoscrotum Following Clavicle Fracture without Rib Fracture: A Rare Case Report

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Learning Point of the Article:

Even isolated clavicle fractures can rarely cause occult life-threatening thoracic air leaks, requiring a high clinical suspicion, timely intervention, and cautious intercostal drain removal.

Abstract

Introduction: Clavicle fractures are common injuries encountered in orthopedic practice, but the combination of bilateral pneumothorax, extensive subcutaneous emphysema, and pneumoscrotum without rib fractures is rare and potentially fatal. These complications are usually accompanied by pneumomediastinum and air leak in cases of blunt chest trauma.

Case Report: A 74-year-old male fell and sustained a fracture of the right clavicle and scapula. While in hospital, he presented with respiratory symptoms and widespread chest wall, neck, back, and scrotal subcutaneous emphysema. Thoracic computed tomography revealed bilateral pneumothorax, extensive subcutaneous emphysema, and no rib fractures. He was intubated, and a drain was placed in an intercostal space. The fractured clavicle was treated with open reduction and internal fixation with a plate and screws. After the removal of the intercostal drain (ICD), the patient had recurrent subcutaneous emphysema with respiratory distress that required re-intubation and re-insertion of the ICD. The patient recovered with further conservative management and was discharged well.

Conclusion: Pneumoscrotum with extensive subcutaneous emphysema after clavicle fracture without rib fracture is rare. Potential air leak and pneumomediastinum should be thought of, and close monitoring with late removal of the ICD is required to avoid recurrence.

Keywords: Bilateral pneumothorax, clavicle fracture, intercostal drainage, Macklin effect, pneumomediastinum, pneumoscrotum, subcutaneous emphysema.

Introduction

Clavicular fractures are relatively common and are often treated conservatively or with surgery, depending on the fracture characteristics and patient demographics. These fractures are commonly accompanied by chest trauma, but pneumothorax is a rare complication and tends to be more common in patients with rib fractures or high-energy trauma [1,2].

Subcutaneous emphysema is defined as the presence of air

pockets in the subcutaneous tissue planes, and is commonly associated with pneumothorax, pneumomediastinum, or tracheobronchial injury. Occasionally, the air may dissect extensively along fascial planes to involve the neck, chest wall, back and even the scrotum, leading to extensive surgical emphysema and pneumoscrotum. This air tracking can result in respiratory distress and death due to compromise of the airway and chest wall mobility [3,4,5].

Author's Photo Gallery



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Pneumoscrotum can be defined as the presence of air inside the scrotal sac. It is often caused by air migration from the chest or abdomen through the fascial planes and inguinal canal to the scrotum, and is usually associated with pneumomediastinum and widespread subcutaneous emphysema [3,5].

We present a rare case of clavicle fracture associated with bilateral pneumothorax, extensive subcutaneous emphysema, and pneumoscrotum in the absence of rib fractures, with recurrence due to persistent air leak requiring repeated intercostal drainage and ventilatory support.

Case Report

A 74-year-old male presented with a history of blunt injury to the chest and right shoulder. On initial assessment, radiological evaluation revealed a fracture of the middle third of the right clavicle along with a fracture involving the body and spine of the scapula (Fig. 1). No rib fractures were identified on initial imaging (Fig. 2).

During the hospital stay, the patient developed progressive swelling over the neck and chest wall accompanied by respiratory distress and oxygen desaturation, for which he was intubated, and ventilatory support was initiated. A high-resolution computed tomography (CT) scan of the thorax was performed, which revealed bilateral pneumothorax, more on the right side, along with extensive subcutaneous emphysema involving the superficial and deep tissue planes of the chest wall, neck, bilateral shoulder region, and upper back. No rib fractures were seen. The image findings were consistent with bilateral pneumothorax and massive surgical emphysema (Fig. 2, 3, 4, 5, 6).

A right intercostal drain (ICD) was placed and monitored with serial chest radiograph imaging and drain output. Progressively, the patient exhibited clinical improvement, and the

subcutaneous emphysema reduced.

Under general anesthesia, the patient underwent open reduction and internal fixation of the right clavicle with plate and screws. The intraoperative period was uneventful, and the patient was monitored in the intensive care unit postoperatively. After clinical and radiological improvement, the ICD was removed. However, on the following day, the patient developed recurrent swelling over the neck and chest wall associated with respiratory distress and desaturation, and he was intubated again. A repeat CT scan of the thorax showed persistent extensive subcutaneous emphysema with a reduction in the size of the pneumothorax compared to the previous scan. In view of recurrent symptoms, a right-sided ICD was reinserted (Fig. 3 and 4).

During this period, the patient also developed significant scrotal swelling, which was diagnosed as pneumoscrotum secondary to extensive subcutaneous emphysema. The swelling gradually subsided following intercostal drainage and supportive management (Fig. 5).

Management was undertaken through coordinated multidisciplinary care involving the pulmonology, cardiothoracic surgery, anesthesia, and intensive care teams. Their recommendations guided respiratory stabilization, ICD management, perioperative care, and subsequent treatment following recurrence. Bronchoscopy was considered by the pulmonology team only in the event of further clinical



Figure 1: Pre-operative radiograph of right clavicle at presentation.

FINDINGS:

LUNGS:

Right moderate; left minimal pneumothorax
Bilateral minimal pleural effusion noted
Few paraseptal emphysematous changes noted in the bilateral upper lobe
Few centrilobular emphysematous changes noted in bilateral lung fields predominantly in the bilateral lower lobes
Patchy area of fibrosis noted in the anterior segment of right upper lobe and lingular segment.
Mild subpleural fibrosis noted in the anterior segment of right upper lobe
Normal aeration of all the bronchovascular segments of both the lungs seen with normal bronchovascular markings.
No evidence of interstitial lung disease is seen.

PLEURA, CHEST WALL, MEDIASTINUM:

Moderate pneumomediastinum noted
Diffuse extensive emphysematous changes noted in the superficial, deep subcutaneous, intermuscular plane in the chest wall, neck, bilateral shoulder regions, upper back and costochondral junction of bilateral 1st rib and right 2nd ribs.
Endotracheal tube and nasogastric tube noted
The aorta and pulmonary arteries are normal.
No mediastinal lymphadenopathy seen.
The trachea, carina and the major bronchi show no pathology.
The dorsal spine and ribs appear normal.

Fracture as follows:

- Linear displaced fracture seen in mid segment of right clavicle.
- Linear undisplaced fracture noted in the body and spinous process of right scapula.
- Linear displaced fracture with sclerosed ends seen in spinous process of C6 vertebra - old fracture.

Figure 2: Initial high-resolution computed tomography of the thorax showing diffuse, extensive subcutaneous emphysema, moderate pneumomediastinum and pneumothorax without evidence of rib fractures.

CT THORAX (PLAIN)**CLINICAL HISTORY:** Follow up scan of RTA

The topogram shows normal configuration of the heart and lungs.

TECHNIQUE: Serial axial sections of the thorax there are studied from the apices to the domes of the diaphragm without the administration of intravenous contrast.

FINDINGS:**LUNGS:**

Right mild to moderate pneumothorax (Mild interval decrease)

Right mild pleural effusion noted (Mild interval increase - in setting of trauma likely represents hemothorax)

Complete interval resolution of left minimal pneumothorax and effusion

Paraseptal emphysematous changes noted in the left upper lobe

Few centrilobular emphysematous changes noted in bilateral lung fields predominantly in the bilateral lower lobes

Patchy area of fibrosis noted in the anterior segment of right upper lobe and lingular segment.

Mild subpleural fibrosis noted in the anterior segment of right upper lobe

Normal aeration of all the bronchovascular segments of both the lungs seen with normal bronchovascular markings.

No evidence of interstitial lung disease is seen.

PLEURA, CHEST WALL, MEDIASTINUM:

Moderate pneumomediastinum noted (Mild interval decrease)

Diffuse extensive emphysematous changes noted in the superficial, deep subcutaneous, intermuscular plane in the chest wall, neck, bilateral shoulder regions, upper back and costochondral junction of bilateral 1st rib and right 2nd ribs (No significant interval change).

Endotracheal tube and nasogastric tube noted

The aorta and pulmonary arteries are normal.

No mediastinal lymphadenopathy seen.

The trachea, carina and the major bronchi show no pathology.

The dorsal spine and ribs appear normal.

Fractures as described previously

Figure 3: Follow-up CT thorax showing interval changes compared to the first CT thorax.

deterioration to evaluate for a possible occult tracheobronchial injury. As the patient's respiratory status improved with intercostal drainage and supportive treatment, bronchoscopic evaluation was not required.

The patient was subsequently monitored with serial chest radiographs and ICD output. The ICD was removed after confirming adequate lung expansion and clinical improvement.

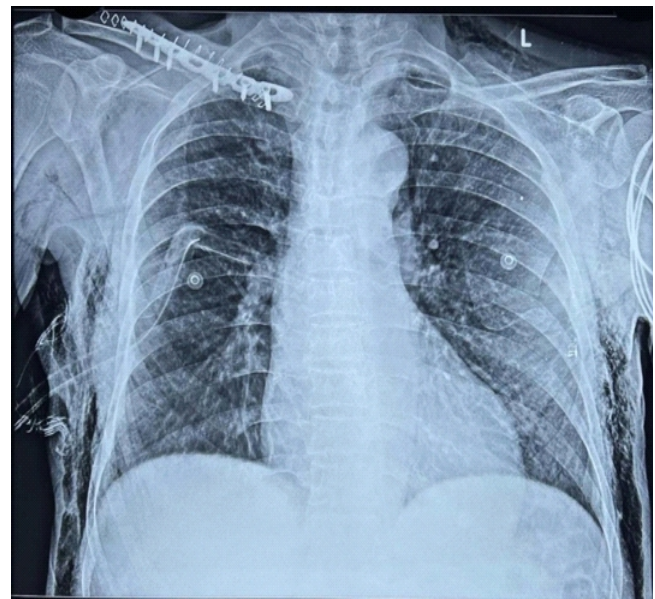


Figure 4: Post-operative chest radiograph following clavicle fixation with intercostal drainage (ICD) tube in situ.

The patient improved symptomatically, was shifted to the ward, and sutures were removed on post-operative day 15. The patient was discharged in stable condition and was followed for 1 year and showed no complications.

Discussion

Although clavicle fractures are common, the occurrence of bilateral pneumothorax and extensive subcutaneous emphysema without associated rib fractures is rare. Pneumothorax in clavicle fractures may occur due to injury to

the lung apex by a displaced fracture fragment or due to underlying lung parenchymal injury following blunt trauma [2].

The likely mechanism in this case is explained by the Macklin effect, in which blunt chest trauma leads to alveolar rupture, allowing air to track along the bronchovascular sheaths into the mediastinum, resulting in pneumomediastinum. From the mediastinum, air can dissect into the subcutaneous tissues of the neck, chest wall, and abdominal wall, leading to extensive subcutaneous emphysema. The air may further extend through the inguinal canal into the scrotum, resulting in pneumoscrotum [1,6,7,8,9,10].

Subcutaneous emphysema may be associated with respiratory distress, secondary to airway compression and chest wall rigidity. Life-

Time from injury	Clinical event
Day 0	Blunt chest trauma resulting in right midshaft clavicle fracture and scapular fracture; admitted to hospital.
Day 1	Developed progressive neck and chest wall swelling with respiratory distress and oxygen desaturation, requiring endotracheal intubation and mechanical ventilation.
Day 1	HRCT thorax revealed bilateral pneumothorax with extensive subcutaneous emphysema without rib fractures.
Day 1	Right-sided intercostal drain (ICD) inserted.
Days 2-4	Gradual clinical improvement with reduction in subcutaneous emphysema.
Day 5	Open reduction and internal fixation of the right clavicle using plate and screws.
Day 9	ICD removed following clinical and radiological improvement.
Day 10	Recurrent subcutaneous emphysema with respiratory distress and oxygen desaturation, requiring re-intubation.
Day 10	Repeat CT thorax demonstrated persistent extensive subcutaneous emphysema with a reduced pneumothorax compared with the initial scan.
Day 10	Right-sided ICD reinserted for suspected persistent air leak.
Subsequent days	Pneumoscrotum developed and resolved with continued intercostal drainage and supportive management.
Before discharge	Clinical and radiological recovery achieved; ICD removed after confirmation of lung expansion.
1-year follow-up	Patient remained asymptomatic with no recurrence or complications.
HRCT: High-resolution computed tomography	



Figure 5: Clinical image showing pneumoscrotum as a complication.

threatening subcutaneous emphysema may warrant airway support and intercostal drainage, even with minimal pneumothorax [7,8].

Return of the subcutaneous emphysema after ICD removal suggests an air leak, which could be from lung parenchymal damage or apical pleural trauma caused by the clavicle fracture. In these cases, prolonged intercostal drainage and close monitoring are required before the drain can be removed [2,8].

Pneumoscrotum is a rare complication and is usually seen in association with pneumomediastinum and subcutaneous emphysema. This condition should be recognized as it is usually treated conservatively by addressing the underlying cause, and surgery is rarely needed [3,4,5].

A definite causal link between the clavicle fracture and bilateral pneumothorax could not be established. However, the temporal sequence of events, absence of associated rib fractures, and radiological findings suggested a trauma-related thoracic air leak as the most plausible explanation. The patient was managed with serial cardiothoracic surgical assessments, repeat chest imaging, and continuous ICD monitoring to evaluate and treat the suspected persistent air leak. Other potential causes of extensive subcutaneous emphysema and pneumoscrotum, such as tracheobronchial, esophageal, or intra-abdominal injuries, were considered but were considered unlikely based on the clinical course and imaging findings.

This case highlights the need to promptly recognize subcutaneous emphysema and pneumomediastinum in patients with clavicle fractures presenting with respiratory symptoms, even when rib fractures are not present. Although



Figure 6: Clinical image showing increased swelling over the right side of the chest compared to the left.

this presentation is exceptionally rare, the management described should not be considered universally applicable. Instead, this case highlights the importance of individualized management based on the patient's clinical status, imaging findings, and multidisciplinary assessment.

Limitations

The exact source of the air leak could not be definitively identified; therefore, the proposed mechanism (alveolar rupture, pleural injury, or lung parenchymal tear with Macklin effect) remains speculative. The contribution of perioperative factors, including general anesthesia, positive-pressure ventilation, and surgical intervention, to the recurrence of subcutaneous emphysema could not be definitively established. Although relevant literature was reviewed, comparison with a larger number of similar published cases may have further strengthened the discussion. The extent of pneumothorax, subcutaneous emphysema, and pneumoscrotum was assessed qualitatively based on clinical and radiological findings, without standardized quantitative measurements.

Conclusion

Bilateral pneumothorax, pneumomediastinum, massive subcutaneous emphysema, and pneumoscrotum in the absence of rib fractures are rare but severe complications of clavicle fractures. If subcutaneous emphysema keeps recurring after removal of the ICD, it indicates an air leak and needs extended drainage and monitoring. Prompt diagnosis and treatment are necessary to avoid respiratory complications and ensure a good outcome.

Clinical Message

Severe thoracic complications, including bilateral pneumothorax and massive subcutaneous emphysema, can rarely be encountered in patients with clavicular fractures even without rib fractures. Recurrence of emphysema on removal of the intercostal drain suggests ongoing air leak. Observation and timing of drain removal are crucial for avoiding recurrence and complications.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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