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Case Report

Recurrent Benign Subcutaneous Emphysema: A Clinical Masquerader of Gas Gangrene – A Case Report

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Abstract

Background: Benign subcutaneous emphysema (BSCE) is a rare, non-infectious condition characterized by the presence of air within subcutaneous and intermuscular planes. It can closely mimic life-threatening necrotizing soft tissue infections (NSTIs) such as gas gangrene, posing a diagnostic challenge and risking overtreatment if misdiagnosed.

Case Report: We present the case of a 15-year-old girl who developed spontaneous, diffuse swelling of the left upper limb and anterior chest wall, associated with crepitus but no systemic signs of infection. A small lesion resembling an insect bite was noted on the dorsum of her hand. Imaging revealed extensive subcutaneous emphysema without deeper tissue involvement. Laboratory parameters including the laboratory risk indicator for necrotizing fasciitis score were reassuring. The patient was managed conservatively with intravenous antibiotics, limb elevation, and close monitoring, with complete resolution of symptoms within 2 weeks. She had a recurrence 2 months later with similar signs and symptoms and was admitted and was conservatively managed. She had her 3rd recurrence subsequently after 2 months and was admitted with similar signs and symptoms and was planned for excision biopsy of the forearm point scab as assumed this was the cause for one-way valve hypothesis. After one year follow up period patient doesn't have a recurrence. Thus proving arrector pili one way valve mechanism.

Discussion: This case emphasizes the importance of differentiating BSCE from NSTIs. Clinical stability, low inflammatory markers, sterile cultures, and characteristic imaging findings are a key to diagnosis. Inappropriate surgical intervention can be avoided by maintaining a high index of suspicion and correlating clinical, laboratory, and radiological data.

Conclusion: BSCE should be considered in the differential diagnosis of spontaneous limb swelling with crepitus, particularly in the absence of systemic toxicity. Early recognition can facilitate conservative management and prevent unnecessary surgical procedures.

Key words: Benign subcutaneous emphysema, Conservative management, Crepitus, Gas gangrene, Necrotizing fasciitis, Spontaneous limb swelling

INTRODUCTION

Subcutaneous emphysema (SE) refers to the presence of air within the subcutaneous tissues and can arise from various etiologies, including trauma, infections, or surgical procedures. While SE often signals serious underlying conditions such as gas gangrene or necrotizing fasciitis, there exists a benign variant – benign subcutaneous emphysema (BSCE) – which is non-infectious and typically self-limiting. Differentiating BSCE from its life-threatening counterparts is crucial to avoid unnecessary surgical interventions.

BSCE has been documented following minor traumas, insect bites, or iatrogenic causes like punch biopsies. For instance, Yadav *et al.* reported a case of BSCE following

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a punch skin biopsy, emphasizing its self-resolving nature without the need for aggressive treatment.[1] Similarly, Das *et al.* described an instance of iatrogenic BSCE of the upper limb resulting from pressurized air injection, which was managed conservatively.[2]

The clinical presentation of BSCE can mimic more severe conditions, presenting with rapid swelling and crepitus. However, the absence of systemic signs such as fever, tachycardia, or hypotension, along with stable laboratory parameters, can aid in distinguishing BSC from infections requiring surgical management. Imaging studies, including radiographs and computed tomography (CT) scans, can further assist in confirming the diagnosis by revealing air confined to subcutaneous planes without deeper tissue involvement.[3]

In this report, we present a rare case of BSCE, highlighting the importance of accurate diagnosis to prevent unnecessary surgical procedures and to ensure appropriate patient management.

CASE REPORT

A 15-year-old female student was referred to our tertiary care center with a history of spontaneous onset swelling of the left upper limb, noticed since the early morning hours. The swelling was gradually progressive and associated with dull aching pain and a characteristic crackling sensation on palpation. There was no history of trauma, fever, or any precipitating event. She denied any similar episodes in the past.

On presentation 12 h after symptom onset, the patient was afebrile and hemodynamically stable. Clinical examination revealed diffuse swelling of the entire left upper limb extending up to the anterior chest wall and axilla [Figure 1a and b]. A small (2 × 2 mm), non-tender black lesion – resembling an insect bite – was noted on the dorsum of the left hand [Figure 2]. There was no local warmth, erythema, or significant tenderness. Peripheral pulses were symmetrical bilaterally, and the range of motion in the limb was preserved. No systemic signs of infection were observed.

Initial laboratory tests showed a hemoglobin level of 12.3 g/dL, total leukocyte count of 11,500 cells/mm^3, and elevated creatine kinase (CK) at 46 mg/L. Urine myoglobin test was negative. Repeat blood investigations after 4 days revealed improvement with normalization of leukocyte count (6,200 cells/mm^3) and CK reduction to 26 mg/L. The laboratory risk indicator for necrotizing fasciitis (LRINEC) score was 1, indicating low risk [Table 1].

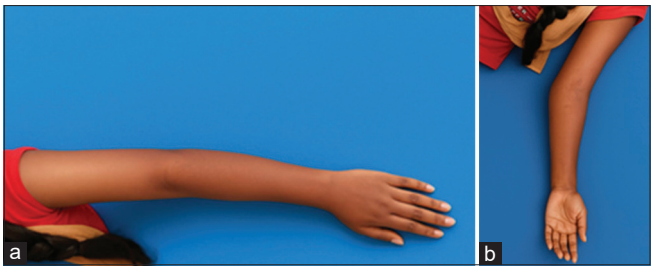

Figure 1: (a and b) Clinical photograph showing diffuse swelling of the left upper limb at presentation

Figure 2: Close-up view of the dorsum of the left hand revealing left hand with a scab suspicious of insect bite, which may have served as the portal of air entry

Table 1: LRINEC score calculation for case report

Variable	Patient value	Score assigned	Scoring criteria
C-reactive protein (mg/L)	24	0	0 if <150; 4 if ≥150
Total leukocyte count (×10^3/mm^3)	11.5	0	0 if <15; 1 if 15–25; 2 if >25
Hemoglobin (g/dL)	12.3	1	0 if >13.5; 1 if 11–13.5; 2 if <11
Serum sodium (mmol/L)	137	0	0 if ≥135; 2 if <135
Serum creatinine (μmol/L)	53.04	0	0 if ≤141; 2 if >141
Glucose (mmol/L)	4.33	0	1 if ≤10; 1 if >10
Total LRINEC score: 1			

LRINEC: Laboratory risk indicator for necrotizing fasciitis. Interpretation: 0–5: Low risk, 6–7: Intermediate risk, ≥8: High risk

Imaging studies including an X-ray of the chest and upper limb demonstrated extensive SE involving the left anterior chest wall and circumferentially around

the left upper limb [Figure 3a and b]. Plain CT chest further revealed intermuscular and SE involving the suprascapular region, anterior and lateral chest wall, and axilla [Figure 4a and b]. No lung pathology, pneumothorax, or bullae were noted. Doppler ultrasonography showed normal vascular flow.

The patient was managed conservatively with intravenous antibiotics (meropenem and clindamycin), limb elevation, analgesics, and close monitoring of limb girth. No surgical intervention was required. Blood cultures were sterile, and the clinical course remained uneventful. The emphysema gradually resolved over the next 2 weeks without recurrence on follow-up [Figure 5a and b]. Interestingly, the previously inconspicuous 2 × 2 mm black lesion over the dorsum of the left hand had become more prominent and well-demarcated, resembling an old insect bite or puncture mark. There were no signs of infection, discharge, or recurrence of swelling [Figure 6].

Repeat X-ray and clinical picture revealed complete resolution of emphysema [Figures 7 and 8].

2 months later, she had a recurrence with similar signs and symptoms and was managed conservatively. Further, after 2 months, the patient had a similar recurrence with minimal signs and symptoms and was admitted and an evaluation was done. Planning was done for excision biopsy of the scab over the dorsum of hand, assuming the reason one-way valve hypothesis. Histopathology revealed skin with

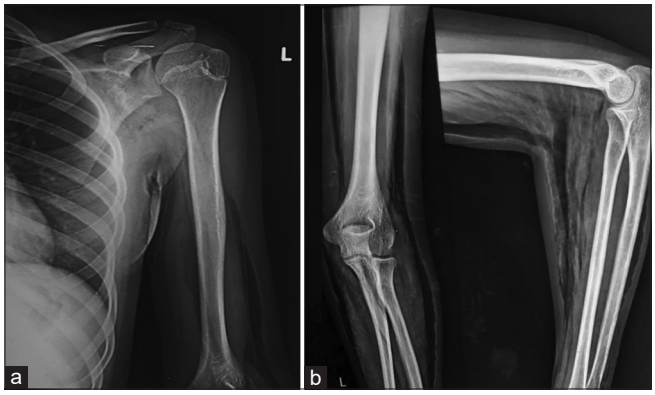

Figure 3: (a and b) Plain radiographs of the left upper limb and chest demonstrating extensive subcutaneous emphysema extending circumferentially along the limb and into the anterior chest wall

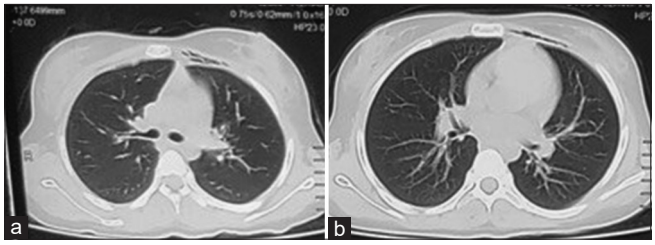

Figure 4: (a and b) Axial computed tomography chest images showing intermuscular and subcutaneous emphysema involving the suprascapular region, anterior and lateral chest wall, and axilla, without evidence of pneumothorax or lung pathology

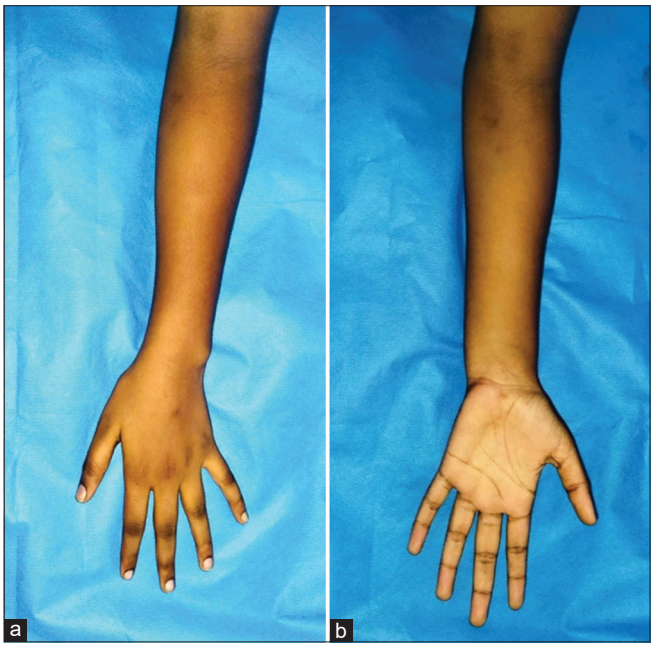

Figure 5: (a and b) Clinical images at 2-week follow-up showing complete resolution of swelling and subcutaneous emphysema

Figure 6: The previously inconspicuous lesion over the dorsum of the left hand appearing more prominent and well-demarcated at follow-up, resembling an old insect bite

adnexal structures with lymphocytic infiltrates [Figure 9]. We followed up with the patient for a year and there are no signs of recurrence. Thus, proving the one-way valve mechanism of the wound could be the cause for recurrence and reassuring evolutionary significance.

Figure 7: Follow-up radiograph showing complete resolution of subcutaneous emphysema in the left upper limb and chest wall

Figure 8: Follow-up clinical picture showing complete resolution of subcutaneous emphysema in the left upper limb and chest wall

DISCUSSION

Benign subcutaneous emphysema (BSCE) is a rare condition, particularly in pediatric or adolescent patients, and is characterized by the presence of air within the subcutaneous and intermuscular planes without an underlying infection or traumatic etiology. In our case, a 15-year-old girl presented with an acute onset of painless swelling and crepitus involving the left upper limb and chest wall. The absence of systemic toxicity, normal vital signs, and a low LRINEC score were pivotal in ruling out life-threatening causes such as necrotizing soft tissue infections (NSTIs).

Only a few case reports have documented non-infectious SE arising after minor skin injuries or without any identifiable external insult.[4-6] In contrast, NSTIs – caused by organisms such as *Clostridium perfringens*, group A *Streptococcus*, or anaerobic spore-forming bacteria – tend to have a more aggressive clinical course, often involving rapid tissue destruction, severe pain, and systemic deterioration.[7,8]

Clostridial gas gangrene typically develops 12–18 h post-injury and is characterized by a fulminant progression with muscle necrosis, bullae, and sepsis. Non-clostridial gas gangrene progresses more insidiously and often occurs in immunocompromised individuals or those with chronic conditions such as diabetes or malignancy.[8] Monomicrobial necrotizing fasciitis due to group A *Streptococcus* begins with erythema, mild tenderness, and minimal skin changes but rapidly progresses to skin necrosis, bullae, and systemic signs like hypotension and multiorgan failure. Significant crepitus, when present, develops after a longer latency period compared to BSCE.[9]

In contrast, BSCE typically has a rapid onset – within minutes to a few hours – and may follow trivial trauma or even be idiopathic. In our case, the patient had no obvious injury, though a small lesion resembling an insect bite on the dorsum of the hand might have served as a portal for air entry. The pathophysiology of BSCE is mechanical:

Figure 9: Intraoperative picture showing excision of the lesion in dorsum of the left hand

a one-way valve effect may allow air to enter through a superficial skin defect and spread along subcutaneous and intermuscular planes of low resistance, especially around neurovascular bundles.[10,11] Movement of the limb further promotes the dissemination of trapped air.

Imaging plays a vital role in differentiating benign from infectious SE. In our patient, CT revealed extensive air tracking along soft tissue planes without any evidence of pulmonary pathology, pneumothorax, or fluid collection. This ruled out both deep soft-tissue infection and thoracic sources. The absence of leukocytosis and the declining C-reactive protein levels during the course of hospitalization supported a non-infectious etiology. Blood cultures remained sterile, and the patient responded well to conservative treatment, including intravenous antibiotics, limb elevation, and observation.

Excision biopsy was planned in view of recurrence and the patient had no recurrence after the procedure proving one-way valve mechanism.

Differential diagnoses of non-infectious SE include air injection injuries, post-operative changes, or factitious causes.[12] In severe cases, particularly with high-pressure air injection injuries, compartment syndrome can occur and may necessitate surgical decompression.[13]

This case underscores the importance of distinguishing BSCE from more severe infectious causes. Misdiagnosis may lead to unnecessary surgical intervention or overtreatment. Conversely, under-recognition of NSTIs may delay life-saving care. Therefore, a careful synthesis of clinical, laboratory, and radiologic findings is essential for accurate diagnosis and management.

CONCLUSION

In the early stages, differentiating between infectious SE and benign SE can be challenging. Therefore, we recommend hospital admission for patients presenting with features suggestive of BSCE to allow for close observation and ongoing reassessment.

This case highlights the importance of recognizing benign SE as a differential diagnosis for spontaneous limb swelling with crepitus. A high index of suspicion, combined with clinical stability and appropriate imaging, can help avoid unnecessary surgical interventions and promote effective conservative management.

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