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CASE REPORT

To perform or not to perform fasciotomy? A rare case report

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ABSTRACT

Subcutaneous emphysema, caused by the presence of air or gas in subcutaneous tissues, can be infectious or noninfectious. A thorough clinical evaluation, including both physical examination and radiological imaging, is required to distinguish benign subcutaneous emphysema from necrotizing soft tissue infections. In this article, we report a 12-year-old female patient with benign subcutaneous emphysema of the upper extremity and highlight the importance of an accurate diagnosis to avoid unnecessary surgical intervention. The rarity of benign subcutaneous emphysema in non-traumatic and non-infectious cases underscores the need for clinicians to differentiate it from more severe conditions, such as life-threatening infections. Conservative treatment is typically sufficient for benign subcutaneous emphysema, with fasciotomies reserved for emergencies. Proper diagnosis and treatment are essential to avoid unnecessary surgical procedures.

Keywords: Communicable diseases, emerging, fasciotomy, subcutaneous emphysema.

Subcutaneous emphysema refers to the presence of air or gas in the subcutaneous tissues, just beneath the skin. It can be caused by both infectious and non-infectious factors. Infectious subcutaneous emphysema, such as necrotizing soft tissue infection, is rare but has a high incidence of morbidity and mortality, with a reported incidence of four to 15.5 cases per 100,000 population.[1,2] Conversely, non-infectious causes, such as air extending into the arm and hand or trauma to the thorax, can lead to benign subcutaneous emphysema.[3]

Symptoms of subcutaneous emphysema include swelling, crepitus, and the presence of gas under the skin, which may appear as a "bubble-like" formation. However, subcutaneous emphysema does not always indicate a serious infection, such as necrotizing fasciitis. For accurate diagnosis, clinicians must be familiar with the differences between benign subcutaneous emphysema and necrotizing soft tissue infection.

Differentiating between the two conditions requires a thorough clinical evaluation, including a physical examination for signs of infection, such as swelling, erythema, and disproportionate pain. Imaging studies, including radiographs or computed tomography (CT) scans, can help visualize the subcutaneous gas.[4,5] By being aware of the characteristics and diagnostic approaches for benign subcutaneous emphysema, healthcare professionals can effectively manage and differentiate this condition from more severe infections, thereby guiding appropriate treatment strategies.

In this article, we report a case of benign subcutaneous emphysema of the upper extremity caused by non-traumatic pulmonary emphysema. The case presents clinical and therapeutic data on an exceptional phenomenon, aiming to avoid unnecessary surgical and medical interventions such as fasciotomies and/or antibiotic therapies.

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CASE REPORT

A 12-year-old female patient presented with a rash on her left forearm and was referred to the Pediatrics Emergency Department of Kayseri City Training and Research Hospital from an external facility with a diagnosis of cellulitis. The external facility initially diagnosed gas gangrene. Blood tests from the previous center showed slightly elevated antistreptolysin O (1,459 IU\mL), with no other significant findings. According to the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score (Table I), the risk of necrotizing fasciitis was low. The patient was diagnosed with compartment syndrome despite the absence of growth in the blood culture. Brucella agglutination tests were negative. A detailed medical history revealed no history of trauma, and no scars were observed on the patient's upper extremity.

Ultrasonography of the upper extremity showed widespread echogenic foci in the posterior part of the left forearm, and similar foci were noted in the subcutaneous fat tissue of the upper arm, suggestive of air values. There were no signs of lymphedema or abscess indicative of necrotizing soft tissue pathology. Urine cultures were negative. One day after an orthopedic consultation, gas gangrene was diagnosed based on widespread gas shadows and crepitus observed on the X-ray (Figure 1). The patient underwent surgical debridement and forearm fasciotomies. No pus or suspicious fluid collections were detected during surgery, and the surrounding soft tissue at the fasciotomy sites appeared vital and well-perfused. Tissue samples were obtained for bacteriologic analysis. Postoperative recovery was uneventful, and the emphysema spontaneously resolved shortly after surgery. The patient was discharged three days after admission. Bacterial cultures of intraoperative samples showed no growth.

At the follow-up examination five days after discharge, the patient reported relief, with reduced crepitus and decreased gaseous areas observed on X-ray (Figure 1 and Video 1). A pulmonary CT scan

TABLE I
Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score of the patient

	LRINEC score		
Variable (units)	Score of LRINEC	Patient value	Patient score
C-reactive protein (mg/L)			
<150	0	5.9	0
≥150	4		
Total leucocyte count (×1000/mm^3)			
<15	0	5.53	0
15-25	1		
>25	2		
Hemoglobin (gr/dL)			
>13.5	0	13.2	1
11-13.5	1		
<11	2		
Serum creatinine (mg/dL)			
≤1.6	0	0.56	0
>1.6	2		
Glukoz (mg/dL)			
<180	0	76	0
>180	1		
Sodyum (mmol/L)			
≥135	0	141	0
<135	2		
Total score			1

LRINEC: Laboratory risk indicator for necrotizing fasciitis.

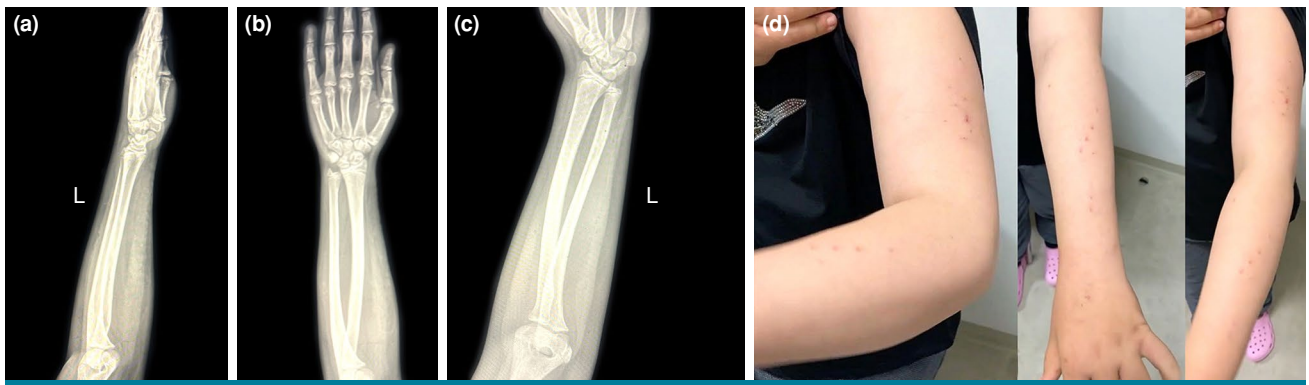


FIGURE 1. Forearm X-ray and clinical view of the case. **(a)** Lateral view. **(b)** Anteroposterior view. **(c)** Oblique view. **(d)** Clinical images of patient's forearm; post-treatment.

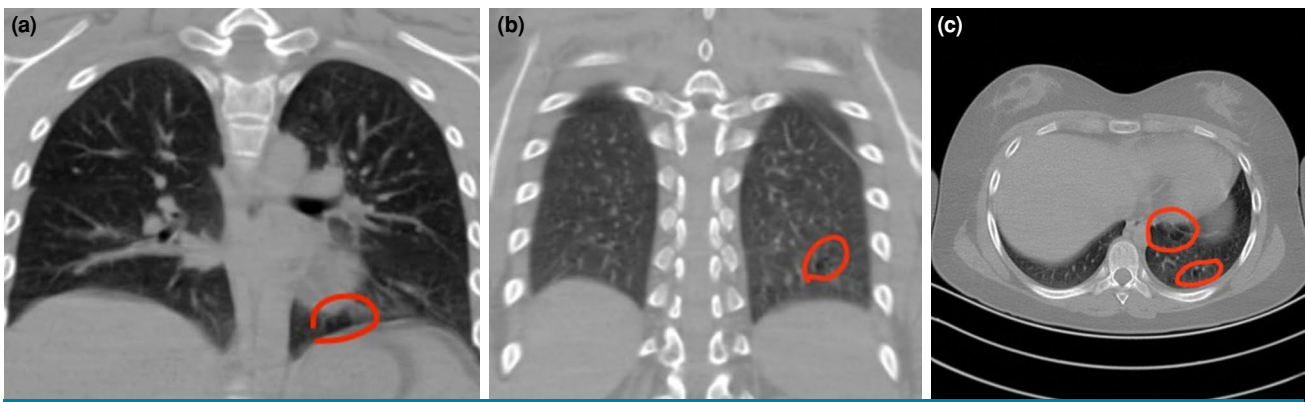


FIGURE 2. Pulmonary computed tomography views, emphysematous areas highlighted in red circles. **(a, b)** Coronal view of the thorax. **(c)** Axial view of the thorax.

showed emphysematous areas in the medial basal and anterior-medial basal segments of the left lower lobe (Figure 2). The family history revealed that the patient's mother was diagnosed with systemic lupus erythematosus. Rheumatological tests performed on the patient and the final out-patient clinic examination of the patient were normal (Video 1). A written informed consent was obtained from the parent of the patient.

DISCUSSION

In such cases, the presence of air or gas in the subcutaneous tissues does not indicate a serious infection or necrotizing fasciitis, but rather a benign condition that typically resolves with conservative management, provided compartment syndrome has not developed.

Benign subcutaneous emphysema of the upper limb is often associated with traumatic injury or infection.[6,7] However, in our patient, who developed subcutaneous emphysema without any trauma, the condition was likely benign and unrelated to a serious infection. Clinical evaluation, supported by routine blood tests, can assist in ruling out necrotizing soft tissue infections. The LRINEC score, developed in 2004, is a valuable tool for assessing risk in such cases.[8] A score of >8 points strongly indicates necrotizing soft tissue infection, with a positive predictive value of 93.4%.[9] However, a low LRINEC score does not entirely exclude the possibility of necrotizing fasciitis; therefore, the criteria for surgical investigation should be low in unstable patients.

Treatment for necrotizing soft tissue includes aggressive wound debridement, high-dose antibiotics (with a toxin suppressor), and hyperbaric oxygen therapy.[10,11] Hu et al.[12] proposed a novel approach involving vacuum therapy with continuous



VIDEO 1. Clinal view of the patient at final out-patient clinics follow-up.

irrigation using potassium permanganate. Despite advancements in critical care and heightened awareness, mortality rates for necrotizing soft tissue infections remain significant even with appropriate therapy. The time between initial trauma and the onset of swelling and crepitus is much shorter in benign subcutaneous emphysema than in necrotizing soft tissue infections.[13] Unlike infectious emphysema, benign subcutaneous emphysema develops rapidly, within minutes to hours, without interruption. Mild redness and tenderness may be present in the affected area.

The etiology of benign subcutaneous emphysema is mechanical, often caused by a unidirectional valve mechanism,[14] where air enters through a small skin wound and spreads through the subcutaneous layers along paths of least resistance, such as neurovascular bundles. Certain anatomical locations, such as the first interdigital space, may be more susceptible to benign subcutaneous emphysema formation.[15]

Conservative management is usually sufficient for benign subcutaneous emphysema. Treatment may include immobilization or splinting of the affected limb, pain management, and monitoring for signs of infection. If the condition worsens or fails to improve, surgical intervention such as fasciotomy may be necessary, as seen in this case. Prompt diagnosis of benign subcutaneous emphysema is essential to distinguish it from potentially life-threatening conditions such as necrotizing soft tissue infections. Imaging modalities such as ultrasonography or CT scans can aid in confirming the diagnosis.[16]

Once benign subcutaneous emphysema is confirmed, conservative management, including observation and pain management, is typically sufficient; unnecessary surgical and medical interventions must be avoided.[17]

In severe cases, low suction thoracotomy may help to alleviate subcutaneous emphysema.[18-20]

In conclusion, this case report highlights the rarity of benign subcutaneous emphysema of the forearm in a child and underscores the importance of accurate diagnosis and differential diagnosis to ensure appropriate management and avoid unnecessary surgical and medical interventions. While the presence of crepitus and subcutaneous gas on radiographs raises concern for necrotizing fasciitis, benign conditions should also be considered in the absence of trauma or infection. This case demonstrates that benign subcutaneous emphysema can occur under non-infectious and/or non-traumatic circumstances and should be included in the differential diagnosis of acute subcutaneous emphysema.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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