



CASE REPORT

# Subcutaneous emphysema of the upper extremity following penetrating blackthorn injury to the wrist

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## KEYWORDS

Subcutaneous emphysema;  
Blackthorn;  
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Hand infection

**Summary** Noninfective subcutaneous emphysema of the upper extremity, albeit rare, has to be borne in mind when treating patients with subcutaneous emphysema. The misdiagnosis of this condition as its serious infective counterpart often leads to unnecessary aggressive treatment. Noninfective subcutaneous emphysema often accompanies a patient who has no systemic symptoms of illness. Unfortunately, the distinction is not always easy especially when history of injury suggests involvement of an infective or reactive element. Penetrating blackthorn injury is common, especially in rural communities, and often occurs from farming or gardening activities. Blackthorn penetration can cause numerous tissue reactions once embedded under the skin and they are often contaminated with soil. Here we present, for the first time, a case where penetrating blackthorn injury to the wrist resulted in noninfective subcutaneous emphysema involving the whole upper limb and neck, and its subsequent management.

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The presence of gas in the soft tissues after trauma is usually associated with serious gas-forming infection either by *Clostridia* or by a variety of aerobic and anaerobic bacteria.<sup>1,2</sup> Albeit rare, subcutaneous emphysema of the hand and upper extremity of noninfectious origin has been documented.<sup>3–7</sup> It was described in the literature as early as 1964 by Brummelkamp.<sup>6</sup> Its occurrence needs to be clearly differentiated from its infective cases to avoid overtreatment.<sup>3,5</sup>

Blackthorn (*Prunus spinosus*), a member of the Rosacea family, is well known for causing infections and acute to chronic tissue reactions.<sup>8–10</sup> Their occurrence is common in rural areas and often involves farming or gardening activities.<sup>8–10</sup> Once penetrated into the skin, they are difficult to extract completely as the tip is easily broken into fragments.<sup>9,10</sup> They are also known to migrate in the coronal, sagittal, and deeper tissue planes once embedded.<sup>8</sup>

Here we present for the first time, a case where penetrating blackthorn injury to the wrist resulted in noninfective subcutaneous emphysema of the hand which subsequently propagated to involve the whole upper limb and neck.

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## Case report

An 18-year-old man with a history of a dirty gardening injury from blackthorn penetration on the ulnar side of his right wrist, presented to emergency department (ED) 2 days after the injury with pain and mild crepitus on the surrounding skin. The patient had only partial success in removing the blackthorn himself. In the ED, the wound was washed and explored under local anaesthesia with no evidence of retaining blackthorn. The patient was discharged with oral flucloxacillin.

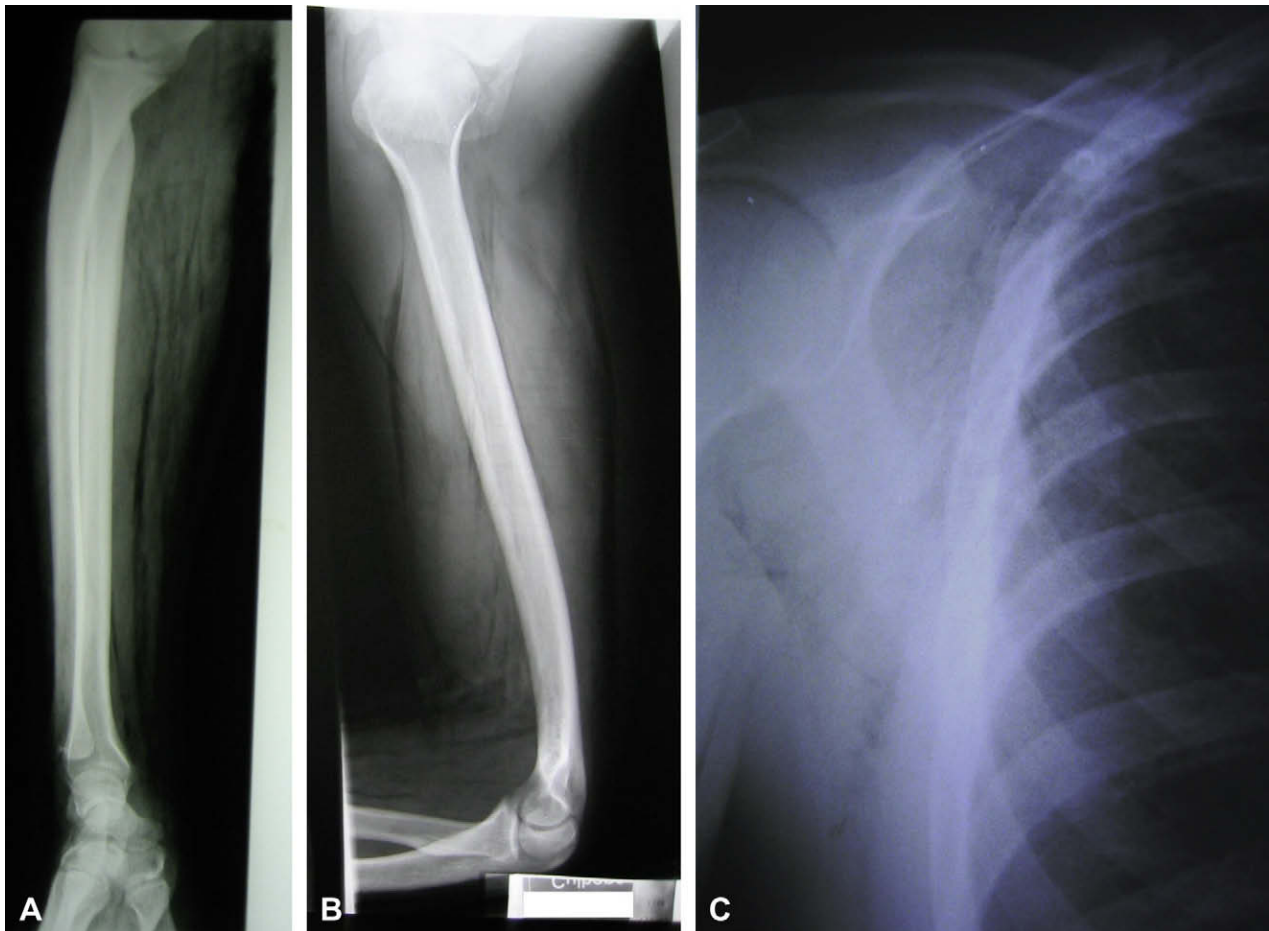
Three days later, he re-presented to the hospital with worsening of the crepitus spreading up to his elbow. He also complained of tightness and pain going up his forearm and elbow. Radiographs revealed subcutaneous emphysema in the tissue planes. A chest radiograph was taken to rule out the pneumothorax as a cause. He was admitted to the hospital and his wound was explored under general anaesthesia and the blackthorn removed. The wound was closed directly. The next morning, the crepitus had extended up to the patient's shoulder. Further radiography had confirmed subcutaneous and interfascial emphysema extending to the whole upper limb (Figure 1). At this stage, his pain had worsened with exacerbation on passive stretching of fingers.

He was immediately referred to our unit, 6 days after the initial incident. On arrival, he complained of pain,

stiffness and tightness to his whole upper limb. The limb was swollen with loss of skin creases and tender to touch. His pain was worst on passive stretching of his fingers. Crepitus consistent with subcutaneous emphysema was easily palpable up to the right mastoid region. His wound on the right wrist appeared clean with only mild localised swelling, erythema and induration due to a reaction from the embedded blackthorn (Figure 2). There was no sign of lymphadenopathy or systemic illness. He was afebrile and his wound culture had been negative. Empirical treatment with intravenous piperacillin, gentamicin and metronidazole was commenced following the advice of an infectious disease Specialty in view of the potential infection with gas-forming bacteria.

Considering the history of dirty penetrating blackthorn injury and clinical symptoms and signs of compartmental syndrome, the decision was taken to explore the wound and a fasciotomy was performed on the same day.

In theatre, the original wound was fully excised with a clear margin of healthy skin. On fasciotomy, gas bubbles were seen in all forearm compartments within the areolar tissue planes. There were no signs of inflammation, infection or tissue reactions from the blackthorn. There was also no sign of any embedded blackthorn. The muscles appeared healthy and no gas bubbles were seen in the muscles. The wound was left open and a second look



**Figure 1** Extensive noninfective subcutaneous and interfascial emphysema in the tissue planes involving the whole right upper extremity extending up to the neck. (A) Hand and forearm; (B) arm; (C) shoulder.



**Figure 2** Only mild localised swelling, erythema and induration noted on the wound from an embedded blackthorn at the wrist.

operation was scheduled for 48 h later. On second operation, the crepitus continued to be extensive. Vacuum-assisted closure (VAC) therapy was employed to facilitate resolution of the emphysema at a continuous pressure of 75 mmHg.

A repeat radiograph on day 3 after VAC treatment revealed complete clearance of subcutaneous and interfacial emphysema (Figure 3). The wound was then closed uneventfully. The patient was commenced on hand

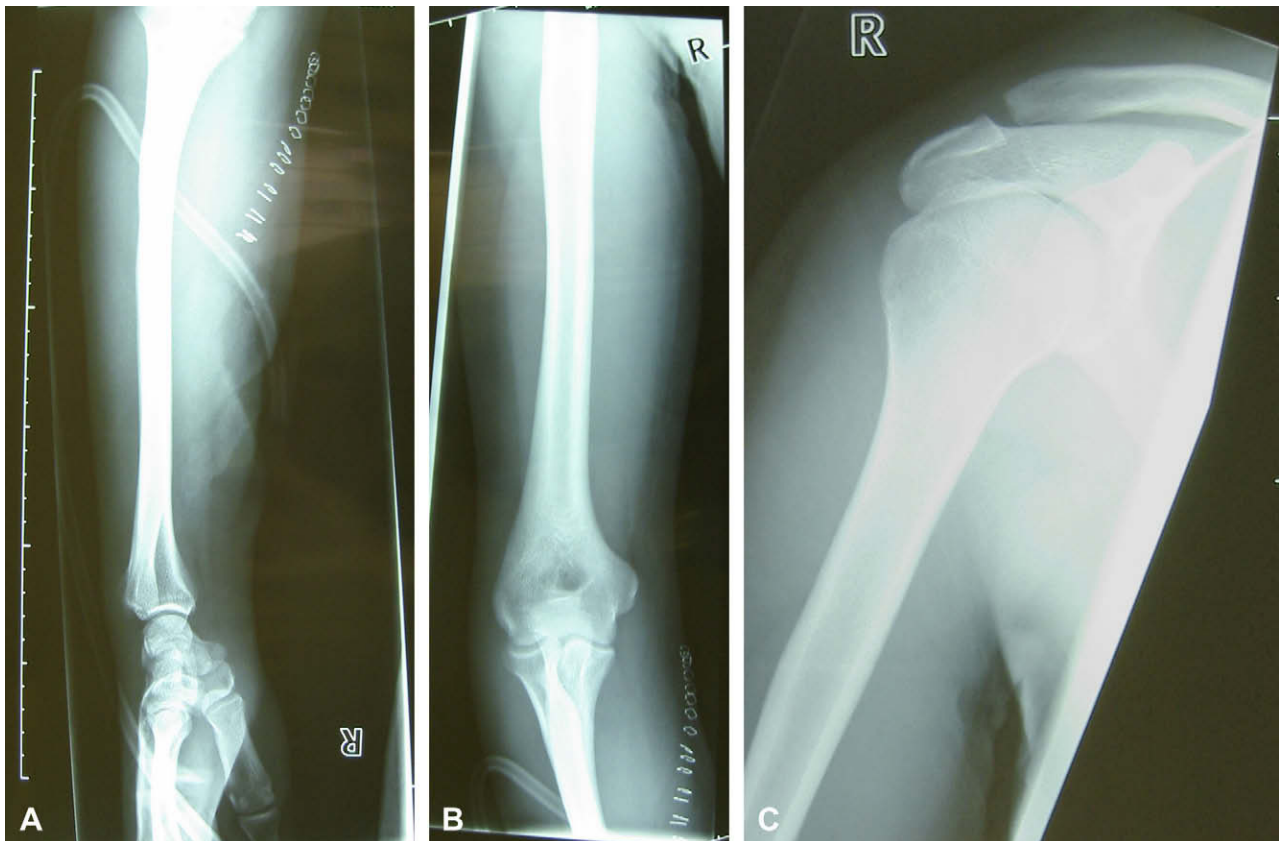
physiotherapy immediately. He was discharged 2 days later after completion of the full course of intravenous antibiotics. At 3 months follow up, he had achieved a full recovery.

## Discussion

Subcutaneous emphysema in the hand is commonly associated with clostridial infection, as gas gangrene.<sup>11</sup> The appearance of extensive soft tissue gas in relation to a wound is often interpreted as a sign of severe infection with a gas-forming organism. This is particularly true when the mechanism of injury is traumatic and involving contamination of a wound with blackthorn and soil.<sup>2,12</sup>

It is imperative that noninfective subcutaneous emphysema be differentiated from gas gangrene (clostridial myonecrosis) or crepitant infection caused by other gas-producing bacteria, such as anaerobic *Streptococcus* and some coliform bacteria, to prevent an overly aggressive treatment.<sup>3,11</sup> Noninfective causes tend to settle quickly with minimal intervention whereas gas gangrene requires aggressive wound debridement or amputation, high dose of antibiotics and hyperbaric oxygen therapy.<sup>5</sup>

A noninfective cause of subcutaneous emphysema affecting an isolated limb is rare.<sup>4,5,11</sup> We are careful not to synonym the term 'noninfective' with 'benign' as noninfective causes of subcutaneous emphysema do not always run a benign course. Among the noninfective causes reported in



**Figure 3** Resolution of noninfective subcutaneous emphysema 3 days after commencing VAC therapy. (A) Hand and forearm; (B) arm; (C) shoulder.

the literatures are subcutaneous emphysema due to pneumomediastinum, wound irrigation with hydrogen peroxide, generation of gas following wound contamination with chemicals, accidental or deliberate injection of air directly into the tissues and usage of a high-vibration tool with no apparent breach of the skin.<sup>3,5,7,13-17</sup>

Patients with noninfective subcutaneous emphysema do not have systemic upset, and the wound often appears clean. Gas gangrene, on the other hand, is characterised by marked systemic toxæmia, fever, extensive inflammation and crepitus, due to gas production within the soft tissues. Noninfective subcutaneous emphysema has gas distributed in the tissue planes.<sup>3,5,11</sup> The radiographic appearance of gas gangrene shows gas within the muscle bellies rather than confined to tissue planes alone.<sup>5</sup> Also, a literature review has revealed most noninfective subcutaneous emphysema to have only a short delay (as short as 6 hours) between the injury and the development of palpable crepitus, whereas any infection by gas-forming bacteria usually takes at least 12 to 18 hours to generate enough gas to be clinically detectable.<sup>3-5,11</sup>

It has been postulated that in noninfective subcutaneous emphysema, sometimes the wound can act as a ball valve mechanism where movement and continued use of the limb leads to air being sucked into the wound with wide dispersal throughout the interfascial planes.<sup>1,3-5,11</sup> This type of wound has been described in penetrating wounds involving the webspace of hand, elbow, knee, and foot where the underlying areolar tissues tend to be lax and undergo continual compression and stretching.<sup>1,3-5</sup> To the best of our knowledge, this is the first case to document a ball valve wound effect occurring on the wrist. We do not feel that the extensive interstitial gas in the tissue planes in our patient was due to a reaction from the blackthorn itself as there was no sign of inflammation noted in the soft tissues during fasciotomy. The presence of the blackthorn acted like a splint to keep the wound opened and trapped the air which was subsequently forced into the subcutaneous tissue like a pump. Interestingly, our patient also developed some compartmental symptoms following his extensive gas collection in his right upper limb. Unfortunately, there was no measurement taken of the compartment pressure before surgery to confirm this finding.

Although it is known to be essential to differentiate noninfective from infective causes of subcutaneous emphysema, it is not always easy in clinical practice. Our case was overshadowed by the history of penetrating blackthorn injury and soil contamination which led us to pursue aggressive management.

A brief literature review of blackthorn injury revealed the myriad potential presentation of blackthorn injury ranging from mechanical dermatitis, cellulitis, abscess, foreign body granuloma, peritendinitis, tendonitis, pericapsulitis, synovitis to acute septic arthritis.<sup>8-10</sup> Because of its potentially complicated course, Sharma et al. had recommended immediate and thorough exploration of the blackthorn wound under general anaesthesia if there is a clear history to suggest blackthorn injury.<sup>9</sup>

In conclusion, noninfective subcutaneous emphysema should be borne in mind whenever encountering gas in soft tissues, especially if there is no sign of infection or the wound is located over an area of continual compression and stretching such as the wrist. Even with the history of exposure to an infective or reactive agent, it is wise to adopt a watch-and-wait policy for 24–48 hours while commencing the patient on empirical intravenous antibiotic treatment and limb elevation. Aggressive surgical intervention is only warranted if the extremity deteriorates or the patient becomes haemodynamically unstable. However, if there is any doubt in the diagnosis, surgery should be advised. In surgery, we recommend the original wound to be fully excised with a healthy tissue margin to disrupt the dynamics of the ball valve mechanism. Postoperatively, physiotherapy should be commenced immediately.

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