Noninfectious Subcutaneous Emphysema in the Lower Extremity: A Case Report

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Background

Benign noninfectious subcutaneous emphysema in the lower extremity is a rare phenomenon. Noninfectious emphysema has been rarely reported in the upper extremities, and even more so in the lower extremity, secondary to traumatic injuries. (1,2) The mechanism of entry is that of a one-way valve creating a vacuum of air within the subcutaneous tissue. (3) The soft tissue and skin act as a flap creating a one-way valve and with repeated movement; air is suctioned or vacuumed into the limb and dispersed throughout the fascial layers. This causes extensive distribution of the air in the limb appearing similar to major infectious emphysema. To the best of the author's knowledge, there have been no reports of this phenomenon in the lower extremity.

Methods

A 63 year old diabetic male with peripheral neuropathy and Charcot neuroarthropathy with a chronic nonhealing plantar ulceration. There was no erythema, crepitus, drainage noted on physical exam. The wound did not probe to bone. Plain radiographs and computed tomography (CT) exam revealed extensive emphysema within the subcutaneous tissue extending from the wound to the proximal leg (Figures 1-9). The patient has a recent history of bilateral hip replacements, therefore was considered high risk clinically and exploratory surgical evaluation was attempted. In most instances with infectious emphysema, multiple irrigation and debridement's or fasciotomies are required. This patient was taken to the operating room for wound debridement to explore, and also to prevent potential seeding into the implants, however due to the lack of clinical infectious intraoperative signs the decision was made to not perform a radical fasciotomy and debridement. Table 1 is the criteria for benign subcutaneous emphysema that was proposed to evaluate if urgent fasciotomy is indicated in the presence of emphysema (3,4). According to the algorithm, the fasciotomy was not indicated for our patient.

Table 1

Criteria to distinguish between necrotizing fasciitis and benign subcutaneous emphysema	
WBC	8.96
Serum sodium	135
BUN	19
XR	No ST gas
CT	Subcutaneous gas dorsal to soft tissue along forefoot, hindfoot and distal lower leg, not intramuscular.
Clinical signs	T: 98.2 ° F, RR: 16, BP: 114/65, P: 97
Gram stain	CNS, Strep viridans
Timing	Ulcer > 3 months

Results

An Incision and debridement was performed under general anesthesia. Patient was discharged with PO Bactrim and Keflex for 14 days and local wound care. He was admitted 4 months post op due to generalized weakness was found to be bacteremic with an intramuscular abscess on left iliopsoas muscle. He was also found to have left lower lung pneumonia. Due to the long standing ulceration that probed to bone with potential for recurrent infections, patient elected to undergo a below knee amputation. At 12 month follow up patient has been successfully ambulating in a prosthetic.

Clinical and radiographic Images


Fig 1


Fig 2


Fig 3


Fig 4


Fig 5

Fig 6

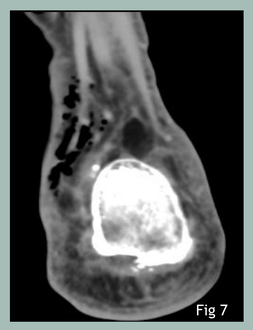
Fig 7

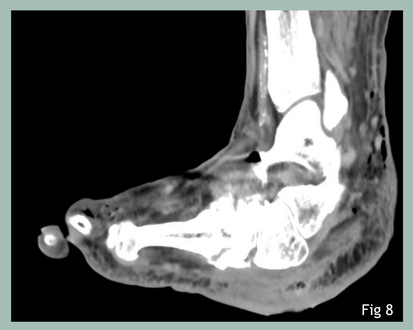
Fig 8

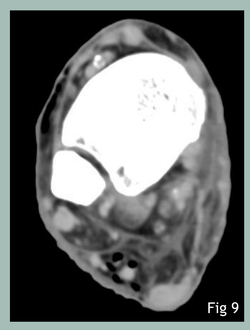
Fig 9

Fig 1-3: plantar lateral midfoot ulcer, probed to bone. No purulence, minimal erythema extending to the medal arch. No fluctuance or crepitation.

Fig 4-6: AP, lateral and tib-fib films. No erosive periarticular or subcortical changes noted to indicate osteomyelitis.

Fig 7-9: large amount of subcutaneous gas is identified throughout forefoot along the dorsal soft tissues extending into the 1st through 4th digits along the dorsal aspects. Multiple locules of subcutaneous gas are also seen within the medial and plantar soft tissues of the foot. Gas is also is seen extending along the dorsal lateral aspect of the foot into the lower leg

Radiographic findings: infectious gas forming bacteria infiltrate the intramuscular structures whereas noninfectious gas tends to remain mainly in the superficial subcutaneous structures. This is easier to discern on XR or CT rather than relying on physical exam as it can be hard to ascertain the location of the crepitus. In our patient, the emphysema was noted in the dorsal forefoot extending proximally through the hindfoot and infiltrated the lower 50% of the lower leg. The emphysema is superficial and could be found within the muscle of through the fascial planes.

Discussion

There is literature explaining the myriad etiologies and mechanisms of noninfectious gas. The mechanisms include high pressure water injuries, arthroscopy, chemical reactions, or from medical conditions such as pneumomediastinum. We hypothesize that in our case, the most likely explanation is a one way valve mechanism where the open wound on the plantar surface of the foot had soft tissue that acted as a one-way ball valve created air to be trapped within the soft tissue from repetitive movement and the continued motion of the leg caused the trapped air to be suctioned from negative pressure into multiple tissue planes. (3)

We must be vigilant in assessing the patient with noninfectious gas as it is possible for the patient to develop possible compartment syndrome or become septic in a matter of hours. We advise to monitor the patient closely, to check vitals every hour if they are in-patient, start aggressive broad-spectrum IV antibiotics, assess tetanus status and give tetanus shot or IG if indicated.(1-4)

Conclusion

Subcutaneous emphysema is a radiographic finding that typically warrants emergent incision and debridement. However, in the presence of a benign clinical exam with normal inflammatory markers, nonsurgical or minimally invasive surgical treatment may be warranted. We present a case study which highlights this principle in which a lower extremity wound was found to have extensive non-infectious subcutaneous emphysema extending to mid tibia and fibula where non-aggressive surgical treatment is indicated.

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