CASE REPORT

Case report: role of bedside ultrasonography in early diagnosis of myonecrosis rapidly developed in deep soft tissue infections

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Abstract

Background Myonecrosis can rapidly develop in soft tissue necrotizing infections, often with initial sparing of the skin. Despite the improvements in management of necrotizing soft tissue infections, mortality remains high, according to the location, microbial agents and comorbidities, ranging between 17 and 46 %. A prompt diagnosis represents the greatest challenge for the emergency physician.

Case report We describe the case of a patient with a history of hypertension and arrhythmia who developed nonclostridial necrotizing fasciitis with extensive myonecrosis, after articular infiltration procedure. A bedside focused ultrasonography (US) revealed disappearance of the regular fibrillar architecture of the long head of biceps muscle, with diffuse abnormal hyperechogenicity assembled in a “clod pattern”. Computed tomography (CT) of the right arm did not depict muscle involvement, but showed a small gas collection around the shoulder, spreading to the subclavian region behind the major pectoral muscle. Necrotizing fasciitis with wide myonecrosis was confirmed by surgical debridement. Microbiological results showed a *Staphylococcus aureus* infection,

managed by a selected antibiotic therapy. The patient was discharged after a small period of mechanical ventilation.

Conclusion This is the first report of a previously healthy patient developing a nonclostridial necrotizing fasciitis with extensive myonecrosis attributable to infiltrative procedure and detected early by bedside US in emergency department. The role of bedside US in the emergency setting may save time for the prompt management of life-threatening necrotizing infections.

Keywords Bedside ultrasonography · Emergency ultrasound · Necrotizing fasciitis · Myonecrosis · Soft tissue infections

Riassunto

Introduzione La mionecrosi può rapidamente svilupparsi come conseguenza di un’infezione necrotizzante dei tessuti molli superficiali. Nonostante i miglioramenti nelle cure delle infezioni necrotizzanti dei tessuti molli, la mortalità resta alta (tra il 17% ed il 46%), dipendendo da localizzazione dell’infezione, agenti responsabili e comorbidità. Una diagnosi precoce è il punto chiave e rappresenta una grande sfida per il medico d’urgenza.

Descrizione del caso Descriviamo il caso di un paziente presentatosi in Pronto Soccorso per febbre e dolore al braccio dx, trattato in precedenza senza beneficio con antiinfiammatori ed infiltrazioni locali, e successivamente con antibiotici. In presenza di segni di infezione dei tessuti molli superficiali, veniva eseguita dal medico d’urgenza un’ecografia clinica (“bedside”), che documentava la scomparsa della regolare architettura fibrillare del muscolo bicipite del braccio destro, con una iperecogenicità anomala e diffusa disomogeneità della ecostruttura, che appariva assemblata a zolle; coesisteva una minima raccolta fluida lungo il piano fasciale distalmente. La TC del

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braccio destro non mostrava il coinvolgimento muscolare, ma evidenziava una piccola quota di gas intorno alla spalla. Una fascite necrotizzante con estesa mionecrosi veniva confermata dall'intervento chirurgico. L'esame microbiologico documentava infezione da *Staphylococcus aureus*, per cui si impostava terapia antibiotica mirata. Il paziente veniva dimesso dopo breve ciclo di ventilazione meccanica assistita e ricovero in rianimazione.

Conclusioni E' il primo caso descritto di un paziente con fascite necrotizzante con mionecrosi non da clostridio, successiva a infiltrazione locale, diagnosticata precocemente tramite un'ecografia "bedside" in Pronto Soccorso. L'ecografia "bedside" si conferma presidio accurato e tempestivo nella gestione di condizioni potenzialmente fatali come le infezioni necrotizzanti dei tessuti molli.

Background

Soft tissue infections have a wide range of presentations, including common simple forms and severe life-threatening ones. Hence, according to the depth of soft tissue involvement, these infections imply superficial uncomplicated infections (impetigo, erysipelas and cellulitis) and necrotizing infections (fasciitis and myonecrosis), with or without gas production [1]. Tissue necrosis is a common feature in necrotizing infections, with wide spectrum of systemic symptoms. Moreover, the clinical findings of each soft tissue infections could evolve and overlap in the same patient [2].

Despite the improvements in management of necrotizing soft tissue infections, mortality remains high, according to the location, microbial agents and comorbidities, ranging between 17 and 46 % [3, 4]. Crucial in the management of these infections is a prompt diagnosis, sustained by a strong suspect based on disproportionate pain, swelling and discoloration of the skin, and systemic symptoms [5]. However, necrotizing infections commonly do not display specific symptoms, also because "the deeper soft tissue infection is the more normal the skin surface appears" [2].

Case report

We present the case of a 72-year-old man, complaining of right shoulder pain for over 2 weeks, for which he endured multiple medical examinations in the emergency department (ED), always being discharged after diagnosis of an impingement syndrome and receiving nonsteroidal anti-inflammatory drugs. After poor results with pharmacological therapy, he further received methylprednisolone and lidocaine local injection for 4 days without benefit. A

day later, empirical antibiotic therapy (amoxicillin plus clavulanic acid and teicoplanin) was started for signs of superficial infections and orthopedic surgery was recommended. Nevertheless, worse pain and fever rapidly developed and he returned to the ED. He had a history of hypertension and arrhythmias, and was being treated with captopril, hydrochlorothiazide, propafenone, and omeprazole as medications.

On admission evaluation, the patient was tachycardiac, hemodynamically stable, febrile and tachypneic, without confusion. Physical examination revealed swelling, erythema, hardness, and severe pain in the lateral side of his right arm, and he was unable to move it. ECG documented a sinus tachycardia. Because of the clinical probability of pulmonary embolism based on common clinical decision rules (Wells and revised Geneva scores), arterial blood gas analysis was performed, which revealed a moderate hypossiemic-hypocapnic state. Routine laboratory test showed alteration in muscle enzymes and inflammation signs (Table 1).

A bedside chest US examination was performed by the emergency physician, according to previous report of integrated ultrasonographic approach in a peri-arrest setting [6]. A negative chest US picture ("dry lung") was found, excluding interstitial syndrome as well as peripheral lung consolidations, pneumothorax, and pleural effusion. Cardiac US, performed using subcostal view, revealed normal global cardiac systolic function without pericardial effusion or right or left ventricular enlargement. A collapsed inferior caval vein was detected according to the reduced volume status. The compression US of the lower limbs excluded deep vein thrombosis. Finally, a focused US of the patient's right arm, corresponding to the region of the maximum pain produced by pressure of the probe, revealed disappearance of the regular fibrillar architecture of the long head of the biceps muscle, with diffuse abnormal hyperechogenicity assembled in a "clod pattern", extending to the overlying subcutaneous tissue and producing marked edge shadowing (Fig. 1). A small dependent fluid collection along the fascia plane was depicted in a more distal site (Fig. 2 and Clips 1 and 2). No typical comet tail artifacts ("gas sign") were detected.

Computed tomography (CT) of the right arm did not depict muscle involvement, but showed a small gas collection around the shoulder, spreading to the subclavian region behind the major pectoral muscle (Fig. 3). Moreover, chest CT scan excluded pulmonary embolism and detected a postero-basal paramediastinal lung consolidation.

A widespread antibiotic therapy (piperacillin plus tazobactam and metronidazole) was promptly started, and a surgical debridement was performed. The soft tissue necrosis and muscle ischemia were confirmed, and pus

Table 1 Clinical data, routine laboratory tests, and blood gas analysis of patient with extensive myonecrosis in necrotizing fasciitis on admission to ED

Clinical data		
Heart rate		120 beats/min
Blood pressure		105 –80 mmHg
Respiratory rate		30 breaths/min
Body temperature		38.2 °C
Mental status (GCS)		15
Oxygen saturation		90 %
Laboratory tests		
Parameter	Normal values	Serum levels
Serum creatinine	0.70–1.20 mg/dl	1.30
Sodium	136–145 mmol/l	128
Potassium	3.4–4.5 mmol/l	3.7
LDH	248–480 IU/l	499
CK	38–174 IU/l	183
ALT	<41 IU/l	79
AST	<38 IU/l	123
C-reactive protein	<5 mg/l	504.3
Myoglobin	28–72 ng/ml	312
Troponin T HS	<0.014 ng/ml	<0.010
Hemoglobin	13.1–16.1 g/dl	13.2
Platelets	140–450 × 10 ⁹ /l	214 × 10 ⁹ /l
Leucocytes	4.2–12.4 × 10 ⁹ /l	4.7 × 10 ⁹ /l
Neutrophils	1.9–8.2 × 10 ⁹ /l	4.2 × 10 ⁹ /l
Arterial blood gas analysis		
pH	7.38–7.42	7.46
pCO ₂	38–42 mmHg	32.4
Bicarbonates	24–26 mmol/l	20.6
pO ₂	85–98 mmHg	62.1
Lactates	0.5–1.6 mmol/l	2.2

Abnormal values are marked in bold type

GCS Glasgow Coma Scale, LDH lactate dehydrogenase, CK creatine kinase, ALT alanine aminotransferase, AST aspartate aminotransferase, HS high sensitivity

collection in the articular space was drained, whose cultures yielded *Staphylococcus aureus*. The patient was admitted to ICU for mechanical assisted ventilation and discharged after complete recovery.

Discussion

Necrotizing fasciitis usually affects the lower and upper limbs, perineum, and abdomen in decreased order of incidence and is often due to a mix of aerobic and anaerobic

Fig. 1 Bedside goal-directed ultrasonography performed by “small parts” probe on longitudinal scanning of affected right arm is shown. Myonecrosis of right long biceps muscle is revealed by the disappearance of the regular arrangement of muscular architecture, which is diffusely substituted by a hyperechoic “clod US pattern” (asterisk), due to disruption of myocytes and inflammatory infiltrate, exceeding the fascial plane (full arrow). No intramuscular necrotic fluid collection is present. Deep hyperechoic humeral surface is marked by the broken arrow

Fig. 2 Abnormal diffuse thickening of long biceps fascia is evident (full arrow), with small fluid collection spreading along the fascial plane (asterisk). Overlying soft tissue and underlying muscle layers are hyperechoic and overthrown in their regular architecture due to inflammatory infiltration and necrosis involvement. Deep hyperechoic humeral surface is marked by the broken arrow

germs (type 1). The shoulder localization of necrotizing fasciitis is very rare and has poor diagnosis because of its potential to spread to the chest wall [7]. The most frequent agents involved are Gram-positive group A Streptococci and *S. aureus*, with the incubation period ranging from 1 to 4 days and the onset of the disease being estimated in 6–24 h [2–5]. Many patients have underlying causes of immunocompromise such as diabetes, advanced age,

Fig. 3 Reconstructed chest CT scan shows gas bubbles in soft tissue (arrow), medially to the right shoulder, in the subclavian region below the pectoral major muscle. This minimal deep gas collection was not revealed on physical examination, standard Rx, or bedside ultrasonography

cancer, chronic renal disease, and congestive heart failure [4]. Cases of necrotizing fasciitis caused by *Staphylococcus* infection after acupuncture have been described in high-risk patients [8], and myonecrosis has been reported as an uncommon complication of diabetes mellitus [9]. This is the first report of a previously healthy patient developing a nonclostridial necrotizing fasciitis with extensive myonecrosis, attributable to infiltrative procedure and detected early by bedside US in ED.

Myonecrosis can rapidly develop in necrotizing fasciitis, often with initial sparing of the skin, so its early recognition is difficult prior to extensive tissue destruction and systemic evolution. Sometimes, differentiation from a less dangerous infection is not easy, based only on the physical examination. That is why bedside-focused US is useful to exclude alternative etiologies [10] and confirm the occurrence of necrotizing infection depicting diffuse thickening of fascia and abnormal fluid collection [11], so combining a cost-effective advantage with a bedside real-time focused assessment. An irregularly shaped, poorly shaped hypoanechoic area exhibiting posterior acoustic shadowing, due to focal fat necrosis and inflammatory changes, may be the only finding detected in early phase by focused real-time US examination [12]. US appearance of calcific myonecrosis has been also recently described [13]. Moreover, gas production may be recognized by comet tail artifacts (“gas sign”) [7]. In traumatic injury, bedside US can also distinguish a gas-producing bacterial infection by air contamination of a penetrating wound in soft tissue, which displays typical distribution and movement like those of “sparkling-wine microbubbles” [14]. Currently, MR is considered the gold standard imaging technique, for its

great soft tissue contrast. CT scan is less precise than RM in muscle study but RM is too expensive and often unavailable in ED. CT scan remains the main imaging modality to detect even small fluid and/or air collections in ED, although it is not efficient in assessing muscle involvement [15].

Conclusion

The role of US in the emergency setting for early diagnosis of necrotizing fasciitis has been previously reported in literature and its accuracy estimated as 92 % by Yen et al. [16] also before or without gas production. Its utilization should be stressed to save time for the prompt management of life-threatening necrotizing infections.

Conflict of interest The authors, Americo Testa, Rosangela Giannuzzi, and Valeria De Blasio, declare no competing interest.

Informed consent Patient informed consent was received according to ethical standards, and he was assured that all pictures would be anonymized.

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