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Necrotizing fasciitis following an arthroscopic shoulder surgery: a case report and literature review

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Necrotizing fasciitis is a rare but severe and rapidly progressing infection characterized by necrosis and destruction of muscles, fascia, and surrounding tissues with associated systemic toxicity and a high mortality rate.[14] It is more common in the lower limbs followed by perineum but also occurs in the upper extremity with or without an open injury or wound. It usually results from polymicrobial infection, with a predominance of group-A streptococcal bacteria or *Staphylococcus aureus*, either alone or in synergy with streptococci.[6] Commonly affecting patients in an immunocompromised state, an early diagnosis and treatment are crucial for patients' survival.[12]

We report an unusual case of necrotizing fasciitis after arthroscopic shoulder surgery. We present the clinical and management details of this case as well as a literature review of necrotizing fasciitis following arthroscopic surgery of the upper limb.

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Case presentation

A previously healthy 51-year-old male presented at our outpatient clinic with right shoulder pain that persisted for six months despite physical therapy and two corticosteroid injections.

Physical examination showed decreased active and passive range of motion of the shoulder. The patient had negative Jobe and belly-press tests. The speed test was positive. Magnetic resonance imaging (MRI) showed a bursal surface rotator cuff tear and a fluid signal in the long head of the tendon sheath.

The patient was scheduled for an arthroscopic shoulder arthrolysis. A posterior, anterior capsule, and rotator interval release was performed. Subacromial bursectomy and acromioplasty were also performed, and the bursal rotator cuff tear was débrided. The patient received antibiotic prophylaxis with cefazolin; thromboprophylaxis with low-molecular-weight heparin was also administered.

On the third postoperative day, the patient developed fever (38.1°), malaise, and pain on his shoulder (Fig. 1). Over the following 48 hours (4th and 5th postoperative day), the patient remained afebrile but developed erythema, tenderness, and edema at the anterior and posterior shoulder. Neurological and vascular examinations of the limb were normal. Initial blood test revealed leukocytosis (17,570 white blood cells/mm^3) with neutrophilia (81.7% polymorphonuclear cells), elevated C-reactive protein (14.5 mg/dL), and erythrocyte sedimentation rate (27 mm/h). A chest radiograph was normal. Blood cultures were obtained, and empirical broad-spectrum intravenous antibiotic therapy (linezolid plus ceftriaxone) was initiated.

Over the ensuing hours, repeated hourly examinations of the shoulder showed persistent tenderness, progression of the

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	3d PO day	4th-5th PO day	6th PO day	7th PO day
General status	Fever (38.1º) Malaise	Afebrile	Afebrile	Signs systemic toxicity
Shoulder	Normal appearance	Erythema, tenderness, edema	Progression erythema, induration	
Tests		Blood tests: leukocytosis, elevated PCR and ESR		x-ray, US, MRI, blood tests suggestive of NF
Treatment	Observation	Empirical antibiotic therapy: Linezolid + Ceftriaxone	Antimicrobial regimen changed: piperaciclin/tazobactm + Clindamycin	Surgery débridement

Figure 1 Flowchart showing clinical evolution, tests, and treatments of the patient before undergoing débridement surgery. *PO*, postoperative; *PCR*, c reactive protein; *ESR*, erytrocyt sedimentation rate; *US*, ultrasound; *MRI*, magnetic resonance imaging; *NF*, necrotizing fasciitis.

erythema, development of "wooden-hard" induration of the subcutaneous tissues of all anterior, lateral, and posterior shoulder regions including supraspinatus and infraspinatus fossae, but with no evidence of blistering or skin eruption. The antimicrobial regimen was changed on the 6th postoperative day to intravenous piperacillin/tazobactam plus clindamycin. On the 7th postoperative day, the patient was asked for an x-ray, ultrasound, MRI, and new laboratory tests. The radiograph of the shoulder showed air bubbles in the subacromial space and intermuscular deltoid (Fig. 2 *A* and *B*). An ultrasound study showed edema and gas within the subacromial space and deltoid, with no evidence of fluid collections. An MRI of the shoulder confirmed the presence of gas within the intramuscular fat, the subacromial space, and the subacromial and subdeltoid bursas, associated with extensive edema involving the subcutaneous cellular tissue, the intramuscular fat of the periarticular and subacromial regions, and the deltoid muscle (Fig. 3 *A* and *B* and Fig. 4). There was no evidence of a fluid collection. The patient remained afebrile but developed clinical signs of systemic toxicity, including tachycardia, hypotension, and lethargy. Results of repeated laboratory studies were consistent with sepsis and early-stage multisystem organ failure. A decision was made to perform urgent surgery.

In the operating room, a chocolate-colored purulent exudate spontaneously drained from the anterior and posterior arthroscopic portals (Fig. 5). A deltopectoral approach with wound débridement was performed, revealing infection and necrosis that involved the superficial tissues, fascia, and deltoid musculature, with extension to the glenohumeral joint. A Judet approach to the scapula was also performed. The deltoid and trapezius muscle were dissected and retracted to reveal the underlying infraspinatus and teres minor muscles. Necrosis and infection were observed all along the fascia and muscles. Wide excision and débridement of infected tissue and lavage with 12 liters of saline solution were performed. Tissue biopsies and wound cultures were obtained.

Postoperatively, wide spectrum antibiotic coverage with linezolid, piperacillin/tazobactam plus clindamycin was continued. All wound and deep soft tissue cultures were positive for *Streptococcus anginosus*. Antibiotic therapy was adjusted to the microorganism isolated and the susceptibility results. Histological analysis of the tissue obtained showed necrosis affecting muscles, fat, and fascia with associated hemorrhage and edema.

Two additional surgical débridements were performed, 48 and 72 hours after the first débridement, until no signs of necrosis or infection were observed (Fig. 6). Between the first and second débridements, the surgical wound was closed over a drain; between the second and third débridements, the wound was left open and packed with sterile gauze.

The patient improved clinically, and laboratory parameters slowly normalized. He received a total of 12 days of intravenous antimicrobials followed by oral antibiotics (levofloxacin 500 mg)

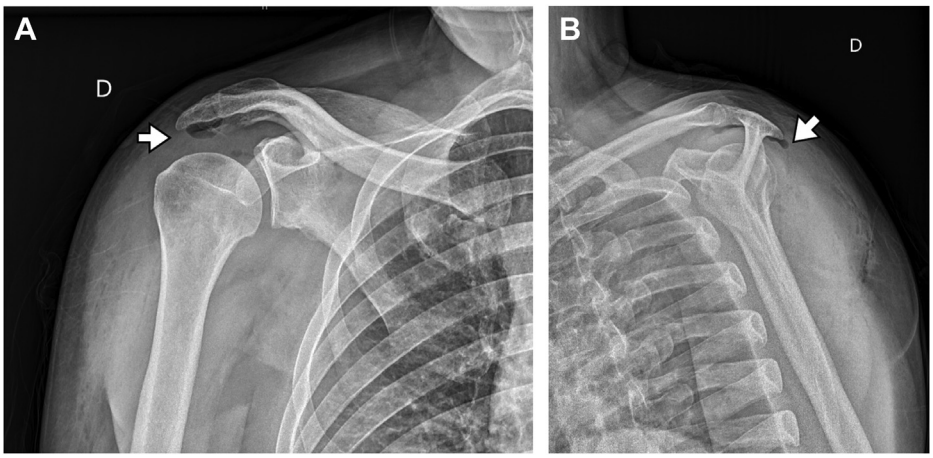

Figure 2 (**A** and **B**) Radiographs show air lucencies bubbles on subacromial space and within the soft tissues.

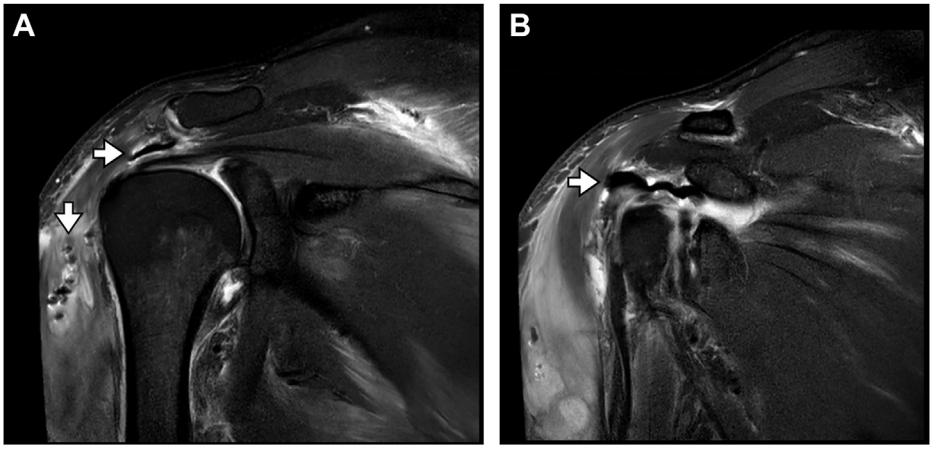

Figure 3 (**A** and **B**) Coronal oblique fat-suppressed MRI right shoulder. Gas within soft tissue and extensive edema of the subcutaneous and intramuscular fat is observed.

for an additional 14 days. The patient was discharged twenty-five days after the initial arthroscopic procedure.

At the last follow-up after 9 months, there was no evidence of recurrence of the infection. Active shoulder abduction and flexion were possible to 30°; the passive range of motion of the shoulder was also significantly reduced.

Discussion

This case is of particular importance because, to our knowledge, there are no previous reports of necrotizing fasciitis following an arthroscopic shoulder surgery, a very common procedure with a low infection rate.[2] Published literature indicates that the incidence of deep soft tissue infections after arthroscopic shoulder surgery ranges between 0.18% and 0.27%.[16] Pauzenberg et al[8] in 2017 analyzed the incidence of infection following an arthroscopic rotator cuff repair. After evaluating 3294 procedures, they found an infection rate of 0.09. Of note, only local signs of infection were present in 68% of patients. The incidence of spontaneous or post-surgical necrotizing fasciitis in the shoulder is even lower, with few reports available in the literature,[11,18] and nothing has been published yet regarding the development of necrotizing fasciitis after a shoulder arthroscopic procedure.

Necrotizing fasciitis is a rapidly spreading and life-threating soft tissue infection with a mortality rate that exceeds 70%.[13] Most patients have a pre-existing immunosuppressing condition such as diabetes, the chronic use of corticosteroids, or renal failure. Survival significantly improves with an early, aggressive surgical treatment. However, the rarity of the disease, its nonspecific clinical presentation, and the absence of a diagnostic test may delay its diagnosis.[14]

Early diagnosis of necrotizing fasciitis can be challenging because the initial presentation is often nonspecific. Recently, Stevens et al[13] performed a review on this topic. The authors described as the most common symptom pain, followed by skin changes such as erythema, edema, hard “wooden” changes of the subcutaneous tissue, crepitus, or bullae. Fever could be absent. When a severe pain disproportionate to the degree of erythema or swelling is present, necrotizing fasciitis should be included in the differential diagnosis. If the infection progresses, systemic signs such as tachycardia, hypotension, altered mental status, and shock or organ dysfunction would develop.[13] Failure to respond to initial antibiotic therapy is also commonly associated to this entity.[12] Our patient was febrile only one day, and skin bullae were not seen. The most remarkable symptom in our case was the severe pain associated with skin changes, especially the hard induration and erythema of the soft tissues of the posterior and anterior shoulder regions, and the development of systemic toxicity within 72 hours of presentation. This case shows that a close follow-up with repeated clinical examinations and blood tests is mandatory when suspecting

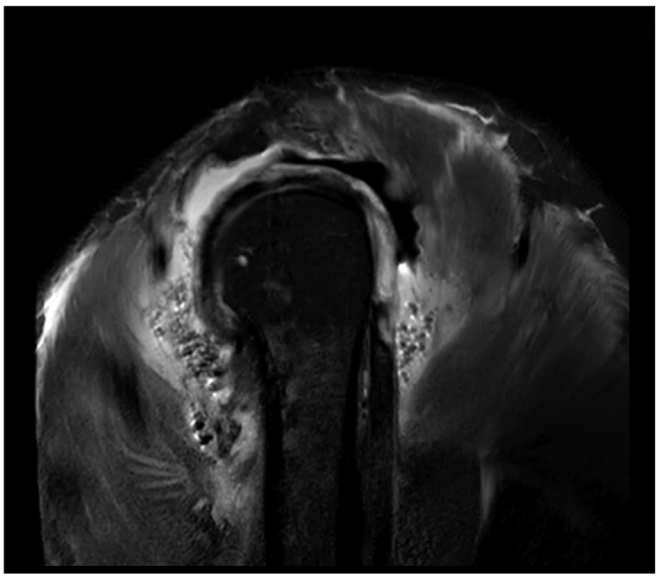

Figure 4 Sagittal oblique fat-suppressed MRI right shoulder. There is extensive subcutaneous edema and gas within the soft tissue, consistent with right shoulder fasciitis.

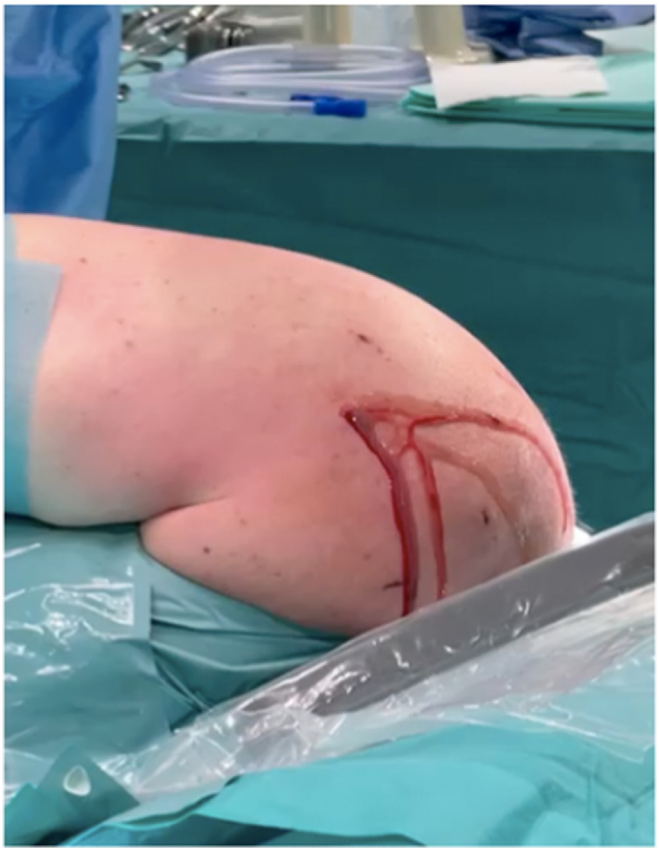

Figure 5 Drainage from the anterior infected arthroscopy portal immediately before the open débridement and lavage.

necrotizing fasciitis in order to establish a prompt diagnosis and institute early and aggressive treatment.

There are no specific diagnostic tests for necrotizing fasciitis. In 2004, Wong et al[15] described the Laboratory Risk Indicator for

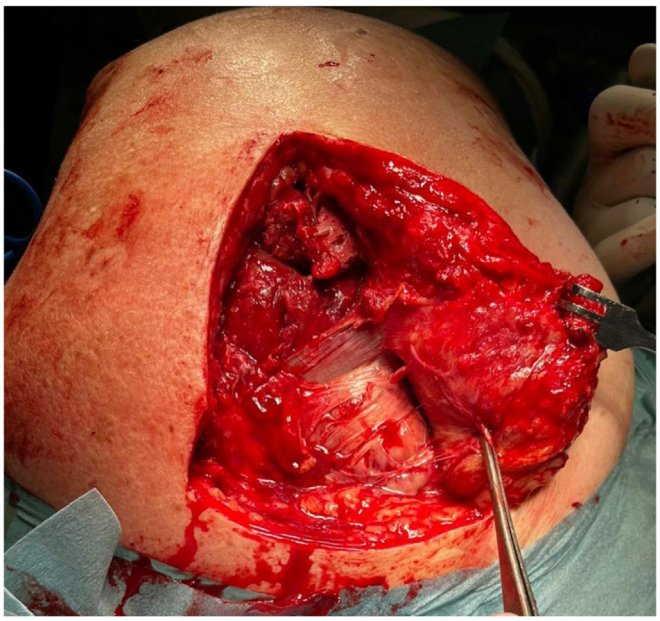

Figure 6 Intraoperative findings of the posterior shoulder area during the second lavage.

Necrotizing fasciitis (LRINEC) score to distinguish among necrotizing fasciitis and other soft tissue infections. Parameters considered in the LRINEC score include total white cell count, C-reactive protein, hemoglobin, serum, sodium, creatinine, and glucose. A score of $\geq$6 indicates a high risk for necrotizing fasciitis.[15] In a recent systematic review, the LRINEC score has shown to be useful in the clinical diagnosis of necrotizing fasciitis.[4] X-ray and ultrasound studies may reveal gas, inflammatory signs, or collections in the soft tissue, but the sensitivity and specificity of these techniques for the diagnosis of necrotizing fasciitis are low. MRI may be a useful imaging study in the diagnosis of necrotizing fasciitis.[1,17] Gas in the fascia is one of the most specific signs of necrotizing fasciitis.[9] Thickening of the deep fascia and multi-compartmental involvement are other parameters used for the differentiation of necrotizing fasciitis from cellulitis.[17] Our patient had a LRINEC score of 9 that suggested the diagnosis of necrotizing fasciitis. In addition, gas in deep tissues was observed in ultrasound, x-ray, and MRI studies (Figs. 2-4), supporting the diagnosis. However, the definitive diagnosis of necrotizing fasciitis requires histological confirmation in samples of affected tissues.[7]

Based on the clinical presentation (skin changes, systemic signs), the results of blood tests (evolving renal and hepatic failure consistent with sepsis) and the findings in imaging studies (gas within the soft tissue), the diagnosis of necrotizing fasciitis was established, and an urgent surgical débridement was performed. Treatment of necrotizing fasciitis involves prompt, extensive surgical débridement, and long-term intravenous antibiotics directed against the pathogen identified.[5] According to the literature, multiple débridements and lavage may be required for the complete eradication of a deep shoulder infection. Athwal et al[3] did an average of 3.5 open débridements until the infection was eradicated in a series including 39 patients diagnosed of deep shoulder infections. Similarly, Settecerri et al[10] in a 16 patient's series with deep infection following a rotator cuff repair, needed a mean of 3.5 débridements for eradication of the infection. These data are in line with those for the patient analyzed in our study, in which three débridements were necessary. Between surgeries, the wound should be left open and packed with sterile gauze.[3,10,12] A single débridement may not be sufficient to resolve the infection; it is

advisable that the patient returns to the operating room 24-36 hours after the first débridement, and every 24-48 hours thereafter until there are no further signs of necrosis or infection.

This case highlights that necrotizing cellulitis, although rare and even less frequent in the shoulder, may occur after arthroscopic shoulder surgery, and it should be suspected when severe pain with minimal skin changes is present. A close follow-up together with repeated clinical and laboratory evaluations is essential for an early diagnosis of this severe entity.

Conclusion

Necrotizing fasciitis is a rare but devastating infection. Severe pain out of proportion to the clinical findings suggests the diagnosis. Although the LRINEC score and MRI findings may be helpful, a high index of suspicion is key for an early diagnosis of this entity. Urgent and aggressive surgical débridement, together with intravenous antibiotics, are essential for a good outcome. A multidisciplinary approach and multiple débridements may be necessary to achieve full eradication of necrosis and infection.

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Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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