Musculoskeletal Infections: What Emergency Radiologists Need to Know.

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Authors: M. Leyva Vásquez-Caicedo, D. Pereira Barreiro, L. Gutierrez Rodríguez, R. V. Verdini Montemuiño, G. Romero, A. Orihuela; Pontevedra/ES
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Learning objectives

Review the spectrum of musculoskeletal infections, recognize and describe the imaging findings of the main infectious entities of the musculoskeletal system at the emergency department.

To know the diagnostic characteristics of musculoskeletal infections and perform an adequate differential diagnosis, given the importance of imaging techniques in early diagnosis and timely treatment.
Background

Musculoskeletal infections are common diseases at the emergency department, depending on the type of infection and the affected tissue causes a different clinical presentation. The importance of early detection is crucial in reducing morbidity and mortality caused by these entities.

The imaging techniques play a crucial role to clarify the diagnosis and early treatment.

Classification of different types of infections depending on the tissue affected:

- Cellulitis.
- Necrotizing fasciitis.
- Infectious myositis.
- Soft tissue abscess.
- Osteomyelitis.
- Septic arthritis.

In this educational exhibit we discuss and illustrate the spectrum of musculoskeletal infections that may be encountered and specific imaging features that help distinguish among these disorders.
Imaging findings OR Procedure details

**Cellulitis:** (Fig. 1)

Infection of the dermis and subcutaneous tissue due to a disruption in the skin with subsequent colonization by microorganisms (S.aureus, S. pyogenes).

Cellulitis appears as a swollen, red area of skin that feels hot and tender, and it may spread rapidly.

Risk factors:
Trauma, peripheral vascular disease, diabetes, foreign body, etc.

Ultrasound show diffuse thickening and increased echogenicity of the skin and subcutaneous tissues. A cobblestone appearance may be seen with anechoic strands randomly traversing the subcutaneous tissues (Fig. 2).

CT demonstrates skin thickening, septation of the subcutaneous fat, and thickening of the underlying superficial fascia.

**Necrotizing fasciitis:**

Rapidly progressive infection of the deep fascia with secondary necrosis of the subcutaneous tissues.

It can occur after trauma or around foreign bodies in surgical wounds, although it can also be idiopathic, as in scrotal or penile necrotizing fasciitis (Fournier gangrene).

It is a life-threatening emergency, taking as a predictor of the same a delay in diagnosis.

The imaging findings in necrotizing fasciitis are similar to those in cellulitis but are more severe and show involvement of deeper structures. This lesion may appear with the presence of gas in the subcutaneous tissue caused by anaerobic bacteria, also may find a layer of anechoic fluid measuring >4mm, adjacent to the deep fascia (Fig. 3-4).

**Abscess:**

An abscess is an enclosed collection of liquefied tissue, known as pus, somewhere in the body, in most cases, causes swelling and inflammation around it.

US appearance is quite variable, ranges from anechoic to irregularly hyperechoic, internal echoes; may find hyperechoic sediment, septae, or even gas, posterior acoustic enhancement may be your only sonographic finding, ranges from round and generally well-defined to irregular, lobulated. (Fig. 5). At CT, a well-demarcated fluid collection with
a peripheral pseudo-capsule showing rim enhancement is characteristic of an abscess and helps differentiate an abscess from simple cellulitis or fasciitis.

**Infectious myositis:**

Skeletal muscle infection may be acute, subacute or chronic.

Is prevalent in tropical countries, in immunocompromised patients, and in intravenous drug abusers who traumatically contaminate their muscles with foreign material. The causative agent is S. aureus in over 80% of cases.

There are two stages of the disease. The first stage consists of a phlegmon, which is characterized by localized muscle edema and appears as a nonspecific, hypoechoic, ill-defined area within one or more muscles. (Fig. 6). Later in the course of the disease, an intramuscular fluid collection corresponding to a formed abscess, also can be appreciated enlargement and decreased attenuation of the affected muscle due to edema with effacement of adjacent fat planes. The muscular involvement is disproportionate to the involvement of the subcutaneous tissue. Intramuscular fluid collections can be observed.

**Osteomyelitis:**

Osteomyelitis is an acute or chronic inflammatory process of the bone and its structures secondary to infection with pyogenic organisms.

In young adults, it is most commonly associated with an open fracture or direct trauma, whereas in elderly and pediatric patients, the cause of osteomyelitis is typically bacteremia. Disease states known to predispose patients to osteomyelitis include diabetes mellitus, sickle cell disease, acquired immune deficiency syndrome (AIDS), intravenous (IV) drug abuse, alcoholism, chronic steroid use, immunosuppression, and chronic joint disease.

Conventional radiography is not sensitive in the detection of early osteomyelitis because bone changes are generally not evident until 14-21 days after the onset of infection (Fig. 7).

The earliest sign of osteomyelitis at US is nonspecific soft-tissue swelling adjacent to the affected bone. In the appropriate clinical settings, demonstration of a fluid collection immediately adjacent to the involved bone is highly suggestive of osteomyelitis.

At CT we can appreciate effacement of fat planes, soft-tissue swelling, medullary low-attenuation areas or trabecular coarsening, focal cortical erosions, subperiosteal abscess and periosteal reaction (Fig. 8).

**Septic Arthritis:**
May represent a direct invasion of joint space by various microorganisms, most commonly caused by a variety of bacteria. However, viruses, mycobacteria, and fungi have been implicated.

US is very sensitive in detection of a joint effusion and may be particularly helpful in the hip, wrist, or shoulder, where physical examination is less reliable and radiographs are often noncontributory in the acute setting. CT features of septic arthritis include a joint effusion and bone erosions around the joint. A fat-fluid level can be a specific sign in the absence of trauma.

CT findings are otherwise similar to those on plain radiographs and include joint effusion, joint-space narrowing, bone and cartilage erosions, gas within the joint, and soft tissue swelling (Fig. 9-11).
Fig. 1: A 68 year old patient with increased volume in the right arm: Important subcutaneous tissue thickening regarding cellulitis.

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Fig. 2: A 68 year old patient with increased volume in the right arm: Important subcutaneous tissue thickening regarding cellulitis.

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Fig. 3: A 76 year old patient was admitted with pain and swelling in his right hip associated with malaise: It evidences diffusely distributed gas in soft tissue adjacent to the right femur, right iliac bone and extending to the right iliac muscle. The study demonstrated no contrast enhancement by the thickened fascia.

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Fig. 4: A 76 year old patient was admitted with pain and swelling in his right hip associated with malaise: It evidences diffusely distributed gas in soft tissue adjacent to the right femur, right iliac bone and extending to the right iliac muscle. The study demonstrated no contrast enhancement by the thickened fascia.

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**Fig. 5:** A 75 year old patient with pain and redness in his right shoulder. There is a hypoechoic collection with small specks of gas inside of 4 x 3 x 1.2 cm in right supraclavicular space. Sonographic findings compatible with abscess.

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Fig. 6: A 64 years old patient who presented an area of erythema, induration and painful in anterior left arm. Is evidenced an area of 10 x 3 cm, ill-defined borders with heterogeneous hypoechoic echotexture and small birefringent images suggestive of myositis.

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Fig. 7: Plain X-ray that shows osteomyelitis in 1st finger of right foot and right wrist.

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Fig. 8: A 45 year old patient with a history of pain and swelling in ankle. CT shows a small foci of intraosseous air, areas of erosion, cortical destruction and soft tissue edema.

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Fig. 9: A 80 year old patient with a history of right hip surgery goes to emergency room with fever and malaise. CT shows significant deformity, sclerosis, periarticular bone resorption and gas in the medullary cavity. The findings described suggest the diagnosis of septic arthritis and osteomyelitis.

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Fig. 10: A 80 year old patient with a history of right hip surgery goes to emergency room with fever and malaise. CT shows significant deformity, sclerosis, periarticular bone resorption and gas in the medullary cavity. The findings described suggest the diagnosis of septic arthritis and osteomyelitis.

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**Fig. 11:** A 80 year old patient with a history of right hip surgery goes to emergency room with fever and malaise. CT shows significant deformity, sclerosis, periarticular bone resorption and gas in the medullary cavity. The findings described suggest the diagnosis of septic arthritis and osteomyelitis.

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Conclusion

- In addition to the clinical characteristics, imaging evaluation is necessary to determine the presence, location, extent, monitoring and response to treatment of musculoskeletal infections.

- Ultrasound is a rapid, nonionizing, portable, sensitive imaging technique for confirming the presence of soft-tissue fluid collections and joint effusions and useful as a guide to aspirated and drainage procedures.

- CT can give better anatomic delineation of the extent of infection. It has an important role as a guide for diagnostic and therapeutic procedures.
References


