Necrotizing fasciitis: a condition not to be taken lightly.

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Learning objectives

- To emphasize the importance of a prompt diagnosis and the value of radiologic procedures involved.

- To identify most common CT signs in early stages.

- To discern between NF and other soft-tissue infections.
Background

Necrotizing fasciitis (NF) is a rare, life-threatening and rapidly progressive infection of the deep fascia, deep to the skin but without muscle involvement.

The disease is more frequent in men and in immunocompromised patients. The most common risk factors are alcohol or drug abuse, poor nutrition, diabetes mellitus, neoplasms or corticoids therapy. Other risk factors are underlying infections secondary to wounds, surgery or even insect bites.

The etiology can vary, with two main types known: the most common is a polymicrobial infection caused by aerobic and anaerobic microorganisms (Clostridium Perfringens, Bacteroides Fragilis, Escherichia Coli, etc) and the second form is caused by Streptococcus A (“flesh-eating bacteria”).

The mortality rate is as high as 30 - 70% in some studies. It is related to the weakening immune situation, in some cases because of previous patient immune condition and, in others, secondary to the infection process in itself. Another factor that leads to increased morbidity is the indolent nature of NF and its non-specific clinical manifestations, which can considerably delay the diagnosis and, in consequence, its surgical treatment.

Clinically, the patient may present fever, local pain, inflammation and edema and it is classically described a "wooden skin" aspect with mottled, purple patches. Crepitus is rarely palpable. Extreme pain followed by anaesthesia may suggest the diagnosis. If the treatment is delayed, sepsis and even death may appear.

There is a subtype of NF, that affects perineal, perianal and genital area which is known as "Fournier gangrene".

This potentially lethal condition requires a rapid diagnosis, which may be facilitated by radiological procedures.

NF is a surgical emergency that requires extense débridement, therefore, in a clear clinical setting, imaging studies should not delay surgery.
Findings and procedure details

We reviewed several cases of NF from our Hospital between years 2000-2013 and present its radiological findings in plain radiography and CT, as well as some examples of its specific perineal subtype (Fournier’s gangrene).

To illustrate the differential diagnosis, we bring typical cases of other soft-tissue infections, such as myositis and cellulitis.

RADIOLOGICAL FINDINGS IN NECROTIZING FASCIITIS.-

- PLAIN RADIOGRAPHY:

It is usually normal until late phases.

The characteristic finding is gas in deep soft tissues.

- CT:

The CT hallmark of NF is soft-tissue gas dissecting along fascial planes although it is not always present.

Other findings are: collections in deep fascia, thickening and absence of demonstrable enhancement of fascial layers, fat stranding, abscesses and reactive lymphadenopathy.

In addition, CT can reveal the source of infection and/or another pathologic findings not related to NF, and it provides anatomical information that may be needed by the surgeon.

SUBTYPE OF NECROTIZING FASCIITIS: FOURNIER'S GANGRENE.-

It is a subtype of NF that involves perineal, perianal or genital areas. It was the first NF reported, and it was described in 1883 by Fournier as an "idiopathic gangrene of the scrotum" in healthy young men. It is also a surgical emergency. The diagnosis is often made clinically, but radiological procedures may be needed in those patients without a typical presentation or when the extension of the disease is difficult to discern.

CT plays an important role in diagnosis and post-treatment follow up of Fournier's gangrene. Its CT findings are similar to those described in NF in others parts of the body: gas, asymmetric fascial thickening, fluid collection, abscess and fat stranding. The subcutaneous emphysema dissects fascial planes, with possible extension to scrotum, perineum, inguinal regions, thighs, abdominal wall and retroperitoneum.
DIFFERENTIAL DIAGNOSIS WITH OTHER SOFT TISSUES INFECTIONS.

CELLULITIS.

It is an infection of dermis and subcutaneous tissues but without involvement of epidermis. Making a differential diagnosis between NF and cellulitis is important: NF is a surgical emergency whereas cellulitis has a medical management. Clinically they can be very difficult to distinguish in some cases. Radiological findings in cellulitis are thickening and/or fluid collections of subcutaneous tissues, but it does not affect deepest structures. In these cases we may consider others entities as necrotizing fasciitis or myositis.

MYOSITIS.

It is defined as an inflammation of skeletal muscles. There is a wide range of myositis, which can be divided in infective and non-infective (autoimmune, farmacological, genetical, etc).

Infectious myositis may be secondary to bacteria, virus, fungi or parasites.

Its presentation may vary, and includes local muscle abscesses, diffuse infectious myositis, generalized myalgias and even rhabdomyolysis.

Radiologically, we must consider differential diagnosis between NF and some bacterial myositis (GAS, clostridium, polymicrobial…) that produces gas and muscle necrosis without fascial involvement. In some cases, fasciitis and myositis may be present at the same time. The management in these cases are similar to NF, with surgical debridement and intravenous antibiotherapy.
Fig. 5: Case 1.a) AP left lower limb radiograph obtained in a 79-year-old man with a history of polymyositis in childhood and previous surgery in left femur, who presented with 1-week fever. The image shows gas in deep soft tissues.

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Fig. 6: Case 1. b) Axial CT scan shows gas in fascial planes and edema in muscles of posterior compartment of the thigh, findings that suggest necrotizing fasciitis.

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Fig. 7: Case 1. c and d) c)(Left image) Coronal CT scan shows typical finding of gas dissecting along fascial planes, as well as subcutaneous fat stranding. d)(Right image) Sagittal CT scan shows ectopic gas dissecting fascial planes from gluteal region that extends to posterior compartment of the thigh.

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**Fig. 8:** Case 2. a) Lateral right lower limb radiograph in a 91-year-old woman with a long term evolution degenerative neurologic disease, who presented with erythema and perimeter growth in right lower limb. The image shows important amount of gas in soft tissues dissecting fascial planes, a finding that suggests necrotizing fasciitis.

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Fig. 9: Case 2. b and c) Axial and sagittal CT images show large amounts of gas in fascial planes that suggest the diagnosis of NF, with gas and edema in subcutaneous layer.

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Fig. 10: Case 2. b and c) Axial and sagittal CT images show large amounts of gas in fascial planes that suggest the diagnosis of NF, with gas and edema in subcutaneous layer.

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Fig. 11: Case 2. d) Axial CT scan at a pelvic level shows extension of gas to right gluteal area and lateral abdominal wall, to both inguinal regions and pelvis (cranially, the gas extended to retroperitoneum - not shown). Subsequently, the patient died.

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Fig. 12: Case 3. a and b) a) (Left image) Coronal CT scan obtained in a 47-year-old woman with a history of alcohol abuse and chronic alcoholic liver hepatitis, who presented with pain in right lower limb, abdominal pain and fever. The image shows inflammatory mass in right iliac fossa (red arrow) and gas in fascial planes of right thigh (blue arrows). These findings are confirmed by surgery and anatomopathological findings, which reported a perforated acute appendicitis with retroperitoneal abscess that progress towards right lower extremity causing necrotizing fasciitis. b) (Right image) Sagittal CT image demonstrates continuity of gas from right iliac fossa to right thigh (blue arrows) and the abdominal inflammatory mass described previously (red arrow).

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Fig. 13: Case 3. c) Axial CT image shows heterogeneity in muscle density of the thigh (red arrow) with fluid collection and gas in intermuscular planes (white arrow), findings that suggest simultaneous myositis and necrotizing fasciitis.

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Fig. 14: Case 4. a) Axial CT image in a 65-year-old man with history of alcohol abuse and diabetes, who presented with scrotal pain. The image shows ectopic gas and fat stranding in perineum, scrotum and penis, typical findings of Fournier’s gangrene.

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Fig. 15: Case 4. b) Axial CT image at a caudal level, illustrates gas in both scrotal regions.

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**Fig. 16:** Case 5. a and b) a) (Left image) Axial CT scan in a 45-year-old man with history of alcohol abuse, who presented with septic shock and important right scrotal swelling. The image demonstrates inflammatory changes and gas pockets in perineum extending to the right hemiscrotum (white arrows), anal triangle (blue arrow) and right gluteal region (red arrow), findings that suggest Fournier’s gangrene. b) (Right image) Sagittal CT scan shows ectopic air dissecting Dartos fascia with affection of perineum and right hemiscrotum. The patient underwent surgical debridement and intravenous antibiotic therapy.

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**Fig. 17:** Case 5.c) A control CT scan made a few days later shows radiological improvement of perineal and genital affection, but with several incidental findings in context of complications of Fournier’s gangrene, not previously present. The postoperative axial CT scan at a perineal level shows a fluid collection in right gluteus maximus as a complication of Fournier’s gangrene.

Fig. 18: Case 5. d) A control CT scan made a few days later shows radiological improvement of perineal and genital affection, but with several incidental findings in context of complications of Fournier's gangrene, not previously present. The postoperative coronal CT scan at a pelvic level demonstrates hypodense intraluminal content that suggests septic embolisms in right common iliac vein (red arrow) and right internal iliac vein (not shown).

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**Fig. 19:** Case 5. e) A control CT scan made a few days later shows radiological improvement of perineal and genital affection, but with several incidental findings in context of complications of Fournier's gangrene, not previously present. The postoperative CT scan (comparative mediastinal and lung window) demonstrates multiple bilateral cavitated pulmonary nodules that suggest septic pulmonary embolisms (blue arrows), and bilateral pleural effusion (red arrows).

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**Fig. 20:** Case 6. a and b) a)(left image) Axial CT scan in a 70-year-old man, who presented with perianal pain. The image demonstrates ectopic air and fat stranding surrounding elevator muscle of anus, with inferior extension to perineum (not shown), findings that suggest Fournier's gangrene. b) (Right image) Sagittal CT scan shows gas and inflammatory changes in perianal region, with extension into pelvis and posterior to pubic symphysis.
**Fig. 23:** Case 6. c and d) One month later axial and sagittal CT scan shows a large multiloculated fluid collection, located posterior to pubis symphysis, with anterior extension to abdominal wall, which spreads posteriorly to both internal obturator muscles, as a complication of Fournier's gangrene.

**Fig. 21:** Case 7. Axial and coronal CT scan in a 46-year-old man, who presented with fever and myalgias, show enlarged volume and heterogeneous density of internal
compartment muscles of the thigh, without intra or intermuscular gas bubbles, findings 
that suggest myositis.

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**Fig. 22:** Case 8. a) Axial CT scan in a 74-year-old man, with relapse of epidermoid 
carcinoma of larynx, who presented with swelling and pain in right axillary region. The 
image shows edema in subcutaneous layer but without presence of gas or fascial 
involvement. These findings suggest cellulitis. The origin of the process was the 
superinfection of a swollen axillary lymphadenopathy with secondary abscess formation.

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Conclusion

Necrotizing fasciitis is a life-threatening infection that affects deep fascial planes.

When the perineal area is affected, it is necessary to remind a subtype of NF called "Fournier’s gangrene".

Early diagnosis and surgical debridement improves prognosis.

CT is the "gold-standard" radiological procedure when NF is suspected, and some characteristic findings are gas in fascial planes, assymetric fascial thickening and/or collection in deep fascia.

It is necessary to make differential diagnosis with other soft-tissue infections, specially cellulitis and myositis.
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