A case study is presented to demonstrate the importance of clinical reasoning and its relevance to excellent patient care using an analysis of the clinical case of a young adult male who presented with fever and painful scrotal swelling. A focused health history and relevant physical findings are described. Four differential diagnoses are generated, defended, and ranked from most probable to least probable. Using the conclusions of the differential diagnosis analysis, diagnostic tests that further validate the diagnosis are discussed. Probabilistic, prognostic, and pragmatic approaches are described and enlisted in the development of the diagnosis.

Overview of Case Presentation

Mr. N.P., a 21-year-old man, presented to the emergency department (ED) of a large urban tertiary care hospital. He came to the ED complaining of a “red and painful lump” in his groin and said he was “really not feeling well.” A detailed health history revealed no significant or relevant co-morbid medical problems. He was in his usual state of health when he reported noticing a small red, hardened area on his right scrotum three days earlier. He initially disregarded it as “an ingrown hair from shaving.” However, the area of redness and induration spread to his entire right scrotal sac and to the medial aspect of his inner thigh. By the time he presented to the ED, the area was hot and painful, and he had been experiencing chills and feeling acutely ill for the past six hours. His social history revealed that he was a full-time university student, worked as a bartender, usually had 8 to 12 alcoholic drinks nightly when working, and was a sexually active homosexual.

Examination Findings

The physical examination revealed several significant findings. Mr. N.P. had a fever of 101.8 degrees Fahrenheit. Inspection revealed a large (approximately 20 cm) area of erythema, extending from the right scrotum to the inner aspect of his right thigh. Palpation of the area revealed erythematous skin that was indurated, hot, and exquisitely tender to touch. At the superior aspect of his right scrotum, there was an area of increased fluctuance, indicative of a fluid collection deep in the soft tissues. Inguinal nodes were palpable on the right side only.

The Process of Diagnosis

The process of diagnosis is complex and requires both logic and pattern recognition (Sox, Blatt, Higgins, & Marton, 1998). The first step is to generate diagnostic possibilities (Barondess & Carpenter, 1994). The experienced diagnostician often summarizes the presenting problem from which a spectrum of diagnoses is possible. Increased local temperature, erythema, pain, and edema are the cardinal signs of infection and should prompt the
clinician to suspect a skin infection (Chandrasoma & Taylor, 2005). A summary of the presenting problem for this case could be “infection of scrotal skin.” Utilizing clinical knowledge of pathophysiology, four potential differential diagnoses for scrotal skin infection are proposed: 1) Fournier’s gangrene, 2) abscess, 3) cellulitis, and 4) syphilis.

The next phase is analysis of the clinical findings, which rules out some of the relative possibilities, and ultimately, points to the most responsible diagnosis (Ba-rondess & Carpenter, 1994). The clinical findings may either increase or decrease the likelihood of each diagnosis. Table 1 summarizes epidemiologic information for each diagnosis, Mr. N.P.’s pertinent history, and clinical signs that increase or decrease the likelihood of a potential diagnosis.

**Table 1.**

<table>
<thead>
<tr>
<th>Possible Diagnosis</th>
<th>Epidemiologic Information</th>
<th>Rule-In</th>
<th>Rule-Out</th>
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<tbody>
<tr>
<td><strong>Fournier’s Gangrene:</strong> Necrotizing fasciitis usually of the male perineum, which often involves the scrotum.</td>
<td>Overall incidence was 1.6/100,000 males (Sørensen et al., 2009).</td>
<td>Occurs most frequently in men (Sørensen et al., 2009).</td>
<td>Average age of patient is 50 years old (Morua, Lopez, Garcia, Montelongo, &amp; Guerra, 2007).</td>
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<td></td>
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<td>Chronic ethanol abuse (Yanar et al., 2006).</td>
<td>85% had diabetes mellitus as a predisposing factor (Simsek Celik et al., 2011).</td>
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<td></td>
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<td>Local trauma (Unalp et al., 2008).</td>
<td>Steroid use.</td>
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<td>Malignancies, liver and kidney diseases (Corcoran, Smaldone, Gibbons, Walsh, &amp; Davies, 2008).</td>
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<td></td>
<td></td>
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<td>Obesity (Sørensen et al., 2009).</td>
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<td>Crepitant skin (Unalp et al., 2008).</td>
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</table>

**Abscess:** Collections of pus within the dermis and deeper skin tissues.

<table>
<thead>
<tr>
<th>Epidemiologic Information</th>
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<th>Rule-Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common but precise epidemiologic information not available for the general population.</td>
<td>Can develop after trauma related to shaving (Stevens et al., 2005).</td>
<td>Diabetes mellitus and immunologic abnormalities (Kars, van Dijk, &amp; Salmines, 2005).</td>
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<td></td>
<td>Develops over several days with an area of fluctuance that is indicative of a collection of pus (Gordon &amp; Lowry, 2005).</td>
<td>IV drug user; other injections (Gordon &amp; Lowry, 2005).</td>
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</table>

**Cellulitis:** Non-necrotizing inflammation of the skin and subcutaneous tissues.

<table>
<thead>
<tr>
<th>Epidemiologic Information</th>
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<tbody>
<tr>
<td>200 cases per 100,000 patient-years (Ellis Simonsen, van Orman, &amp; Hatch, 2006).</td>
<td>Peau d’orange appearance can be noted (Ellis Simonsen et al., 2006).</td>
<td>Observed most frequently among middle-aged and elderly (Ellis Simonsen et al., 2006).</td>
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<td></td>
<td>Can result from trauma (McNamara et al., 2007).</td>
<td>Most common in the lower limb (Ellis Simonsen et al., 2006).</td>
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<td>Pre-existing skin infection (Ellis Simonsen et al., 2006).</td>
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<tr>
<td></td>
<td></td>
<td>Morbid obesity (Ellis Simonsen, 2006).</td>
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<td></td>
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<td>Edema from co-morbid conditions (McNamara et al., 2007).</td>
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</table>

**Early Primary Syphilis:** A chronic infection caused by the bacterium *Treponema pallidum*

<table>
<thead>
<tr>
<th>Epidemiologic Information</th>
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<th>Rule-Out</th>
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<tbody>
<tr>
<td>2.1 to 3.7 cases per 100,000 population, 64% of reported cases were in men who have sex with men (Centers for Disease Control and Prevention [CDC], 2007).</td>
<td>Papule tends to progress to a painless 1 to 2 cm non-exudative ulcer quite rapidly with bilateral lymphadenopathy (CDC, 2007).</td>
<td>Initial presentation is a papule, usually occurring on the genitalia 10 to 90 days (average 3 weeks) after sexual contact with an infected person (CDC, 2007).</td>
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**Fournier’s Gangrene**

*Fournier’s gangrene* is an aggressive infection that usually begins abruptly with severe pain that is out of proportion with skin findings. The infection and pain can spread rapidly to other tissues. It is often characterized by crepitus skin with necrosis, but its early presentation is an erythematous and edematous patch of skin. It is usually caused by the penetration of the gastrointestinal mucosa.
or urethral mucosa by enteric organisms. It is a rare disorder, which is most common in middle-aged men who may be diabetic or otherwise immune-compromised (Morua, Lopez, Garcia, Montelongo, & Guerra, 2007).

Skin Abscess

A skin abscess is a collection of purulent exudate in the dermis and deeper skin tissues. Skin abscesses usually present as painful, tender, fluctuant, and erythematosus lesions or nodules, frequently accompanied by a pustule and an extending area of cellulitis. Regional adenopathy may be observed. Systemic symptoms include fever, chills, and general malaise. Abscesses frequently occur in areas of previous trauma and are found more commonly in intravenous drug users than in the general population (Gordon & Lowry, 2005).

Cellulitis

Cellulitis is an infection confined to the dermis and subcutaneous fat that develops as a result of bacteria entering through breaches in the skin barrier, such as fissures. It presents as a localized area of erythema and edema that is warm to touch and often on the lower limb. The skin may also appear to have a peau d’orange texture. Cellulitis tends to have an indolent course with progressive development of symptoms over several days. Obesity is a common risk factor for cellulitis (Stevens et al., 2005).

Syphilis

Syphilis is a sexually transmitted infection that usually presents with a single erythematosus painless nodule at the area of transmission, often the genitals. In 2006, 64% of syphilis cases were diagnosed in men who have sex with men (Centers for Disease Control and Prevention [CDC], 2007). The primary lesion usually appears after a two- to three-week incubation period. This nodule tends to ulcerate quickly after presentation and tends to be non-exudative (CDC, 2007).

Diagnostic Approaches

Once a list of possible diagnoses is formulated, the differential diagnoses are ranked using one of the following four approaches: the possibilistic approach, the probabilistic approach, the prognostic approach, or the pragmatic approach. Many clinicians intuitively consider more than one approach when developing a leading hypothesis (Schmidt, Norman, & Boshuizen, 1990).

In a possibilistic approach, all diagnoses are possible and should be considered. In this approach, the differential diagnosis list would be extensively longer for Mr. N.P. and would include unlikely cancers, tropical diseases, and skin infections that are not usually found on the genitalia. The possibilistic approach may be particularly helpful for teaching health care professionals or in the event of treatment failure. An initial possibilistic approach to diagnosis might lead to unnecessary diagnostic tests, possibly at the expense of patient well-being and health care funding (Richardson & Wilson, 2008).

An approach often considered in developing a leading hypothesis is the prognostic approach or the thought that a condition will result in poor patient outcomes if left undiagnosed and untreated. For Mr. N.P., this approach illustrates the importance of considering Fournier’s gangrene as a possible diagnosis. Fournier’s gangrene is an aggressive and life-threatening infection that requires emergent surgery to debride infected tissues before the infection overwhelms the patient systemicly. The other three differential diagnoses may also be serious, but they are not often life-threatening.

A more selective approach to developing a leading hypothesis is the probabilistic approach. In this approach, the disorders that are most likely are considered. For Mr. N.P., cellulitis would be the likely disorder because it is so common, followed closely by abscess. After evaluation of the clinical picture, abscess becomes the leading hypothesis because it includes an area of fluctuance, which correlates with the physical examination. Fluctuance is not commonly found in cellulitis. Fournier’s gangrene would not be considered in this approach because it is rare, especially considering Mr. N.P.’s young age, lack of immune-compromise, and lifestyle.

A more selective approach is the pragmatic approach – the disorders most responsive to treatment are considered. In Mr. N.P.’s case, cellulitis and syphilis have good treatment response to antibiotics, and abscess has a good response to incision and drainage followed by antibiotics. Fournier’s gangrene often has a poor treatment response, with reported mortality rates as high as 40% to 78% (Yanar et al., 2006). A more recent population-based study on Fournier’s gangrene reported a mortality rate of 7.5% (Sørensen et al., 2009). The probabilistic, prognostic, and pragmatic approaches all pointed to scrotal abscess as the leading hypothesis for Mr. N.P.’s “infection of the scrotal skin,” followed by cellulitis, and then more distantly, syphilis and Fournier’s gangrene.

To review, at this point in the diagnostic process for Mr. N.P.’s case, one potential diagnosis is a medical emergency because it is imminently life-threatening (Fournier’s gangrene), and two other soft tissue infections, although potentially life-threatening if left untreated over time, are typically very treatable. Syphilis has already been ruled out. It is critical to rule out the aggressive and life-threatening diagnosis quickly. Fortunately, the test for Fournier’s gangrene has few risks to the patient, is cost-effective, and is relatively helpful in confirming the diagnosis.

Laboratory Testing

At this stage of clinical reasoning, it is important to judiciously use tests to arrive at a working diagnosis. Although laboratory findings are generally
non-specific, blood test results for a patient with any necrotizing fasciitis (such as Fournier’s gangrene) typically demonstrate leukocytosis with a marked left shift, coagulopathy, and elevations in the serum lactate, creatinine kinase, and creatinine concentration (Simonart et al., 2001). It is noteworthy that blood cultures are only positive in approximately 60% of patients with Group A Streptococcal (GAS) necrotizing fasciitis (Wong, Chang, Pasupathy, Khin, & Low, 2003) and are not very useful in diagnosing Fournier’s gangrene.

Other diagnostic examination possibilities for Mr. N.P. include computed tomography (CT) scan and magnetic resonance imaging (MRI). They are most helpful to visualize gas in the tissue; however, gas is highly specific but not very sensitive (Anaya & Dellinger, 2007). An emergent non-contrast CT examination to assess for the presence of air along the fascial planes may be the most practical imaging study (Zacharias et al., 2010).

Mr. N.P.’s laboratory results correlated negatively with the risk calculator (see Table 2) for necrotizing fasciitis, so Fournier’s gangrene was ruled out as the leading hypothesis, leaving abscess and cellulitis as the two remaining possibilities. Because there was an area of fluctuance on the skin without an obvious collection of fluid near the skin, an ultrasound was done to confirm a collection of fluid in the deeper tissues that needed incision and drainage. Squire, Fox, and Anderson (2005) found that bedside ultrasound was superior to clinical examination in identifying abscess. The bedside ultrasound revealed a collection of fluid, confirming the diagnosis of abscess.

### Table 2.
**Laboratory Risk Indicator for Necrotizing Fasciitis**

<table>
<thead>
<tr>
<th>Test Day</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>White blood cell count 15,000 to 25,000/microL</td>
<td>1 point</td>
</tr>
<tr>
<td>Hemoglobin 11.0 to 13.5 g/dL</td>
<td>1 point</td>
</tr>
<tr>
<td>Serum sodium less than 135 meq/L</td>
<td>2 points</td>
</tr>
<tr>
<td>Serum creatinine greater than 1.6 mg/dL (141 micromol/L)</td>
<td>2 points</td>
</tr>
<tr>
<td>Serum glucose greater than 180 mg/dL (10 mmol/L)</td>
<td>1 point</td>
</tr>
</tbody>
</table>

A total score greater than or equal to 6 should raise the suspicion for necrotizing fasciitis, while a score greater than or equal to 8 was highly predictive (greater than 75%). Among patients with necrotizing fasciitis, 75% to 80% had a score greater than or equal to 8, while only 7% to 10% had a score less than 6. Thus, the score is only useful when severe soft tissue infection is strongly suspected.


Patient-centered care was the primary focus throughout Mr. N.P.’s initial and subsequent visits. Specific attention was given to respecting the patient’s values and preferences, coordinating and integrating his care, communicating effectively with and educating the patient, providing physical comfort, offering emotional support, involving family and friends, and providing continuity of care (Sidani, 2008). During his ED visit, the patient was informed that he probably had an abscess and that laboratory tests and imaging examinations were being completed to assess for other less likely differential diagnoses. The team expressed empathy that this was an upsetting experience. Emotional support was offered, and the patient was reassured that he was coping well. Patient education was provided to give Mr. N.P. and his partner a better understanding of the diagnosis, the procedure, and post-procedure.
care, and anticipated follow up. He was provided with a private room where he and his partner could rest and talk comfortably while waiting for test results, diagnosis, and treatment. The patient and his partner were offered many opportunities to ask questions. All questions were answered with sensitivity and in lay terminology. The partner was reassured that this was not a contagious infection.

Conclusion

In conclusion, Mr. N.P.’s presentation of scrotal infection was clinically analyzed, and a range of differential diagnoses was proposed, including abscess, cellulitis, Fournier’s gangrene, and syphilis. Review of epidemiologic data, the clinical presentation, and patient’s history excluded the diagnosis of syphilis. Laboratory results excluded Fournier’s gangrene. Ultrasound confirmed an abscess, which was treated appropriately with incision/drainage and intravenous antibiotics. Mr. N.P. received patient- and family-centered care and made a full recovery. The case exemplifies how clinical reasoning, using evidence-based practice, provides effective outcomes while avoiding unnecessary and costly testing.

References


Epidemiology and Infection, 134, 293-299.


Additional Readings
