CLINICAL CASE OF THE MONTH

Group G Streptococcal Bacteremia Secondary to a Burn Wound Infection

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CASE PRESENTATION

A 61-year-old man presented to the emergency department with second degree burns along his right arm and hand. He reported that his knees suddenly gave out while holding a soup result(0,10),(997,993) in the scalding liquid spilling over his arm. His medical history is significant for alcohol abuse, chronic obstructive pulmonary disease, atrial fibrillation, congestive heart failure with preserved ejection fraction, chronic knee instability, and degenerative joint disease of the spine.

Vital signs revealed a temperature of 101.5°F, pulse 110/minute, blood pressure 123/83 mmHg, respiratory rate of 21/minute and oxygen saturation of 99% on ambient air. On exam, he was tremulous and had difficulty walking. His right upper extremity had patchy areas of burns, with the largest lesion measuring 12 x 5 cm (Image 1 and 2). There were ruptured blisters along his thumb and forearm and a non-ruptured blister on his index finger. The wound bed appeared pale pink, and the surrounding skin appeared intact with no signs of acute infection. He also had a small abrasion on the right side of his scalp. His complete blood count revealed a white blood cell count of 11.4 (4-10 x 10^9/L). His renal function, electrolytes, and liver enzymes were within normal range. He was noted to be intoxicated with alcohol and he had an elevated blood alcohol level of 41 mg/dl (<15 mg/dl). A non-contrast computed tomography (CT) of the head revealed diffuse cerebral and cerebellar atrophy. He was admitted for management of alcohol withdrawal and wound care.

On day three of admission, he appeared acutely ill and a temperature of 101.2°F was recorded. Blood cultures were drawn and empiric antibiotic therapy was initiated with vancomycin and piperacillin-tazobactam. Blood cultures revealed the growth of beta-hemolytic Group G Streptococcus (Image 3). Antibiotics were narrowed to intravenous penicillin G and he was discharged home to complete a two week course of antibiotics.
DISCUSSION

Introduction

Each year in the United States, an estimated 486,000 people sustain burns which require medical attention. With the loss of a natural barrier to the environment the underlying dermis and soft tissues are exposed to microbial colonization. The most common organisms associated with noscomial burn wound infections are Gram-positive organisms including *Staphylococcus aureus* (23%), *Enterococcus species* (11%), and coagulase-negative staphylococci (4.3%). Potential Gram-negative pathogens include *Pseudomonas aeruginosa* (19.3%), *Escherichia coli* (7.2%), *Serratia marcescens* (3.5%), and *Klebsiella pneumonia* (2.6%).

Isolation of fungal pathogens, most often *Candida albicans* (3.5%), is less common. Streptococcal species-associated sepsis in burn patients have been reported in the literature, but are usually due to Group A β-hemolytic *Streptococcus*. Group G streptococcus is part of normal human commensal flora of the skin, upper airway, gastrointestinal tract, and genitourinary system. It most closely resembles Group A streptococcus in genetic sequencing and also shares many of the same virulence factors resulting in similar clinical manifestations.

MICROBIOLOGY

Taxonomy

Group G β-hemolytic streptococci were first identified by Lancefield and Hare in 1935 and were not considered to be pathogenic organisms. Today several species of streptococci carry the Lancefield G carbohydrate antigen on their cell wall, and are categorized as a Group G Streptococcus. These species include *Streptococcus dysgalactiae*, *Streptococcus canis*, and the *Streptococcus anginosus* group which includes *S. anginosus*, *S. constellatus*, and *S. intermedius*. Isolates found in humans were initially categorized as *Streptococcus dysgalactiae* subspecies which expressed either C or G antigens.

Sixty years later, Vandamme et al. further divided Streptococcus dysgalactiae into two separate subspecies based on chemical properties and appearance. Group G streptococcus generally form large (>0.5mm) pearl gray colonies on sheep blood agar.

In 1999, Vieira et al classified all β-hemolytic, large-colony forming Group G streptococci found in human infections as *Streptococcus dysgalactiae* subspecies equisimilis (SDSE) and *Streptococcus dysgalactiae* subspecies dysgalactiae (SDSD) for animal isolates of Group C. The two subspecies are clustered together on phylogenetic trees because they share some genes but they do not have any identical alleles. Zoonotic infections with SDSD infection have been reported as case reports in the the literature but are uncommon.

In our patient’s case, the streptococcal isolate was identified as beta-hemolytic based on the clear zones of total hemolysis and demonstration of large colony types greater than 0.5 mm with no odor. The isolate then underwent latex agglutination testing which determined the Lancefield group as G. No further taxonomic classification was performed to subspeciate the isolate in our lab and is not usually performed in standard clinical laboratories.

Virulence Factors and Pathogenic Mechanisms

The majority of virulence factors found in Group G streptococci are also found in Group A streptococci (i.e., *Streptococcus pyogenes*), including adhesions, the M protein, Streptolysin O and Streptolysin S, C5a peptidase, streptokinase, and various superantigens. These factors are shared via horizontal gene transfer from *S. pyogenes* to SDSE via streptococcal phages. Accordingly, these genetic similarities result in Group A streptococcus and Group G streptococcus sharing similar clinical manifestations, including skin and soft tissue infections, pharyngitis, bacteremia, and toxic shock-like syndrome.

The clinical features of Group G streptococcal infections can be attributed to its virulence factors which include adhesins, toxins, and proteases. Adhesions facilitate invasion of bacteria through damaged epithelial and mucosal surfaces. The M protein virulence factor encoded by the emm gene facilitates the characteristic spreading of SDSE infections by resisting phagocytosis, inhibiting the complement cascade and disrupting the coagulation system. This is further exacerbated by streptokinase, which converts plasminogen to plasmin and thereby prevents clot formation and facilitating spread of the organism. Toxins of note in SDSE include Streptolysin O and Streptolysin S. These toxins are involved in necrotizing soft tissue infection and also are responsible for the phenotypic β-hemolysis seen on blood agar plates. Superantigens also play a significant role in more severe streptococcal infections such as streptococcal toxic shock-like syndrome.

EPIDEMIOLOGY

Group G streptococci inhabit human epithelial and mucosal surfaces. From these sites, the organism can invade into deeper structures or into normally sterile sites, such as the blood stream, to produce disease. Group G streptococcal infections are more common in men than women and increase in incidence with age. The organism can be transmitted from person to person. The median reported age at presentation of patients with GGS bacteremia varies in the literature, but generally falls between ages 55-67. A distinctive feature of Group G streptococcal infection is its association with underlying chronic illness. Of patients with SDSE infection, some of the common coexisting comorbidities include cardiovascular disease, diabetes mellitus, malignancy, and alcohol abuse. Multiple sources have reported an increase in the frequency of reports of Group G streptococcal infections. The explanation for this increase remains unclear; Rantala et al. hypothesized that the aging population and increased survival of adults with chronic disease could be a factor. Watsky et al suggests that although virulence factors contribute to an organism’s pathogenicity it is disruption of mucosal barriers which plays the major role in overcoming host defense.
CLINICAL PRESENTATION

Group A streptococci and Group G streptococci can cause similar types of infections. Like Group A streptococci, Group G streptococci can cause skin and soft tissue infections, such as wound infections, erysipelas, cellulitis,19 bacteraemia, endocarditis,25 acute rheumatic fever, acute glomerulonephritis, and toxic shock-like syndrome22 associated with necrotizing fasciitis.10 The most common portal of entry in patients with GGS bacteremia is the skin.16,19,26,27,28 This further highlights the importance of dermatologic disease in the elderly populations as a predisposing factor to infection. This includes lower leg cellulitis and decubitis ulcers,22 and skin malignancies including squamous cell cancer and mycosis fungoides.26 In patients with Group G Streptococcal bacteremia, the mortality rate varies between 2-18 percent.19

TREATMENT

Group G streptococcal bacteremia are susceptible responsive to β-lactam antibiotic therapy. Improvement in clinical course can be seen within 24-48 hours of antibiotic therapy initiation.27 The drug of choice for GGS bacteremia is intravenous penicillin G.19,26,28,30,31 Other effective treatment options include second and third generation cephalosporins, vancomycin, and fluoroquinolones.26,32 The resistance to macrolide antibiotics, like erythromycin, varies; with some regions such as North American reporting macrolide resistance as high as 19%.12 Thus, these antibiotics may not serve as reliable empiric treatment options. In cases of toxic shock-like syndrome with necrotizing fasciitis, clindamycin is often added to β-lactam antibiotic therapy for toxin inhibition by facilitating phagocytosis of streptococci by inhibiting M protein and suppressing both penicillin binding proteins needed for cell wall synthesis and tumor necrosis factor production.23

CONCLUSION

Group G streptococcus is a pathogen which should be considered in the setting of burn wound infections. Infections with this organism are typically seen in patients with chronic underlying illness such as alcohol abuse, cardiovascular disease, diabetes mellitus, and malignancy.

REFERENCES


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