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MAJOR ARTICLE

Clinical Characteristics and Outcome of *Staphylococcus aureus* Prostate Abscess From Ten Years of Experience at a Tertiary Care Center

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Objective. Prostatic abscess (PA) is an uncommon infection that is generally secondary to *Escherichia coli* and other members of the *Enterobacteriaceae* family. In recent years, although rare, more reports of *Staphylococcus aureus* (*S. aureus*) PA have been reported, especially with increasing reports of bacteremia associated with injection drug use (IDU).

Method. This was a retrospective review of adult patients admitted to a tertiary care hospital between 2008 and 2018 and who had a diagnosis of *S. aureus* PA.

Results. Twenty-one patients were included. The average age was 46 years. Fourteen (67%) patients presented with genitourinary concerns. Main risk factors included concurrent skin or soft tissue infections (52%), history of genitourinary disease or instrumentation (48%), IDU (38%), and diabetes mellitus (38%). Methicillin-resistant *Staphylococcus aureus* (MRSA) was identified in 57% and concomitant bacteremia in 81% of patients. Surgical or a radiologically guided drainage was performed in 81% of patients. Antibiotic treatment duration ranged from 3 to 8 weeks. Six patients were lost to follow-up. Clinical resolution was observed in the remaining 15 (81%) patients who had follow-up.

Conclusions. *S. aureus* PA continues to be a rare complication of *S.aureus* infections. In most published reports, MRSA is the culprit. In high risk patients with persistent bacteremia, physicians need to consider the prostate as a site of infection.

Key words: injection drug use; prostate abscess; *Staphylococcus aureus*.

INTRODUCTION

Prostatic abscess (PA) is an uncommon infection that is generally secondary to *Escherichia coli* and other members of the *Enterobacteriaceae* family. In recent years, although rare, more reports of *S. aureus* PA have been reported [1]. Only 40 cases of *staphylococcal* PA were reported in the literature through January 2017, of which 26 cases were reported with methicillin-resistant *Staphylococcus aureus* (MRSA) [2]. Clinical presentation of PA is variable; commonly patients present with fever, chills, dysuria, urinary frequency, and perineal or low back pain [3]. Reported common risk factors of MRSA PA include recent instrumentation, diabetes mellitus, immunosuppression, hepatitis C infection, and intravenous drug use (IDU) [2, 3]. Historically, PA carried a high mortality rate, but that decreased with improving diagnostics and appropriate antibiotics [4]. In view of increasing reports of *S. aureus*, especially MRSA PA cases, physicians need to consider the prostate as the site of primary or persistent infection in cases of bacteremia in high-risk patients [5].

In our study, we are reviewing all cases of *S. aureus* PA admitted to our tertiary center over a 10-year span. To our knowledge, this is the largest reported cohort of patients from a single center.

METHODS

This study is a retrospective review of adult patients admitted to a tertiary care hospital in eastern Tennessee between 2008 and 2018 and who had a diagnosis of *S. aureus* prostatic abscess. The search term "prostate abscess" was used on the discharge diagnoses to narrow down the search results; only patients who had *S. aureus* as the culprit organism were included. Clinical, radiographic, and bacteriological data were analyzed. Data were gathered through retrospective chart review of the electronic medical record. The University of Tennessee institution review board approved the study.

RESULTS

Twenty-one patients met the inclusion criteria. Demographic and clinical data were listed in Tables 1 and 2. The average age

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Table 1. Demographic and Clinical Data of Patients With *Staphylococcus aureus* Prostate Abscess

Age (Years)	Clinical Presentation	Risk Factors	IDU	Susceptibility (Source)	Bacteremia	Abscess Size (cm)	Method of Source Control	Antibiotic Regimen	Duration of Therapy	Outcome
55	Fevers, back pain, incontinence	BPH	No	MRSA (PA)	Yes	5.0 × 4.8	Percutaneous drainage	Daptomycin	6 weeks	Resolved
55	Altered mental status, respiratory failure, lower back pain	DM with DKA septic arthritis of lumbar spine, BPH, history of recurrent UTIs	No	MSSA (PA)	Yes	4.0 × 2.6 × 2.7	Percutaneous drainage	Cefazolin	8 weeks	Resolved
63	Lower abdominal pain, dyspnea, urinary retention with perineal pain, and constipation	BPH, Type 2 DM, balanoposthitis Foley catheter placement three weeks prior for chronic urinary retention	No	MRSA (PA)	Yes	3.8 × 3.0	Percutaneous drainage, followed by transurethral unroofing of prostate abscess	Vancomycin and bactrim, then vancomycin, and ceftaroline with rifampin followed by daptomycin	6 weeks	Resolved after relapse
27	Pelvic pain with urinary retention, nausea, vomiting	Hepatitis C	Yes	MSSA (PA)	No	3.9 × 3.6	Conservative management followed by percutaneous drainage	Bactrim and doxycycline, nafcillin and cefazolin, followed by clindamycin	4 weeks	Resolved after relapse
53	Urinary retention, lower extremity weakness, and lower back pain	Concomitant low-grade urothelial carcinoma epidural abscess	Yes, TTE negative for endocarditis	MRSA (blood, epidural abscess)	Yes (MRSA)	2.0 × 3.0	Transurethral resection of PA	Vancomycin, then dalbavancin followed by vancomycin	8 weeks	Resolved
46	Right-sided chest pain, productive cough, fevers, and chills	Hepatitis C, history of MRSA bacteremia, concomitant MRSA chest wall abscess secondary to recent trauma	Yes, TTE negative for endocarditis	MRSA (blood, abscess of head, lower respiratory sputum, chest wound)	Yes (MRSA)	Multiple small	Conservative management	Cefepime, vancomycin, cefazolin, followed by linezolid	4 weeks	Unknown, lost to follow-up
35	Back pain, right-sided chest pain, fevers, and chills	Hepatitis C concomitant T8 osteomyelitis	Yes, TTE negative for endocarditis	MRSA (PA)	Yes (MRSA)	Multiple	Percutaneous drainage	Vancomycin	Unknown	Unknown, left against medical advice
42	Shortness of breath, hypoxic respiratory failure	DM	No	MSSA (PA)	Yes (MSSA)	1.6 × 1.0	Percutaneous drainage	Vancomycin, followed by oxacillin	6 weeks	Resolved
50	Right flank and lower abdominal pain	Type 2 DM, cirrhosis secondary to sarcoidosis, bilateral ureteral stent placement with subsequent removal, BPH	No	MSSA (PA)	Yes (MSSA)	2.2	Percutaneous drainage	Cefazolin	4 weeks	Resolved
54	Generalized myalgias and weakness	Concomitant polyarticular septic arthritis, psoas abscess, gluteal abscesses, vertebral epidural abscess, discitis of lumbar spine, history of steroid use for chronic back pain	No	MRSA (prostate)	Yes (MRSA)	3.7 × 2.4 × 2.8	Percutaneous drainage	Daptomycin and ceftaroline, then daptomycin	8 weeks	Resolved

Table 1. Continued

Age (Years)	Clinical Presentation	Risk Factors	IDU	Susceptibility (Source)	Bacteremia	Abscess Size (cm)	Method of Source Control	Antibiotic Regimen	Duration of Therapy	Outcome
39	Dysuria, recent UTI	Poorly healing burn wound to right upper extremity, Type 2 DM, concomitant septic pulmonary emboli, iliopsoas abscess	No	MRSA (iliopsoas wound culture)	No growth	Multiple small	Conservative treatment	Daptomycin	6 weeks	Unknown, lost to follow-up
52	Knee pain, weight loss, night sweats	Concomitant septic arthritis of knee, vertebral osteomyelitis with epidural abscess, multiple abscesses of right and left iliopsoas and left quadratus lumborum, multiple septic pulmonary emboli	No	MRSA (left and right iliopsoas abscesses, left knee synovial fluid, and urine)	Yes (MRSA)	2.4	Conservative treatment	Vancomycin	6 weeks	Resolved
62	Fevers, chills, sweats, nocturia, urinary frequency	Concomitant osteomyelitis of right second toe, history of urethral stricture and nephrolithiasis, Type 2 DM	No	MSSA (urine)	Yes (MSSA and Group B Streptococcus)	4.0 × 3.1 × 2.8	Transurethral Uunroofing of prostate with abscess drainage	Ceftriaxone followed by daptomycin	6 weeks	Resolved
81	Right-sided chest pain with dyspnea, suprapubic pain	Recent UTI with prostatitis, recent MRSA bacteremia, BPH, rheumatoid arthritis	No	MRSA (blood)	MRSA	2.4 × 1.4 and 2.4 × 1.1	Percutaneous drainage	Vancomycin	6 weeks	Resolved
28	Weakness, fatigue, weight loss, right flank pain	None	Yes, TTE negative for endocarditis	MRSA (PA and perinephric abscess)	Yes (MRSA)	3.5 × 2.3	Percutaneous drainage	Vancomycin, followed by bactrim	Unknown	Unknown, lost to follow-up
33	Chest pain, myalgia, arthralgia, shortness of breath, confusion, and night sweats	Concomitant MRSA bacteremia with septic pulmonary emboli, Hepatitis C, history of necrotizing fasciitis	Yes, TTE negative for endocarditis	MRSA (blood and urine)	Yes (MRSA)	1.6	Percutaneous drainage	Vancomycin, then daptomycin	6 weeks	Resolved
40	Fevers, right flank and groin pain with right lower extremity weakness	DM, history of MSSA cellulitis, chronic tinea pedis, and onychomycosis concomitant right abductor muscle abscess	No, TTE negative	MSSA (PA)	Yes (MSSA)	1 × 1.5	Transrectal needle aspiration	Cefazolin	3 weeks	Resolved
33	Urinary retention, purulent discharge	IDU, tobacco, multiple Foley catheter placements	Yes, no TTE performed	MSSA (PA)	No	Multiple	Percutaneous drainage	Ciprofloxacin	Unknown	Resolved
42	Dysuria, fevers, chills, left eye pain	DM	No, TEE negative	MSSA (blood)	Yes (MSSA)	Not listed	Percutaneous drainage (placed at outside hospital)	Nafcillin	Unknown	Unknown

Table 1. Continued

Age (Years)	Clinical Presentation	Risk Factors	IDU	Susceptibility (Source)	Bacteremia	Abscess Size (cm)	Method of Source Control	Antibiotic Regimen	Duration of Therapy	Outcome
32	Fevers, chills, right flank pain, fatigue	Recent tattoo, tobacco concomitant perinephric abscess	No, TTE negative	MRSA (urine)	No	1.7 cm	None	Vancomycin, followed by bactrim and ciprofloxacin	Unknown	Unknown
35	Groin pain, dysuria	DM, cocaine use	Yes, TTE negative for endocarditis	MSSA (PA)	Yes (MSSA)	2.8 × 2.5	Percutaneous drainage	Nafcillin	6 weeks	Resolved

Abbreviations: BPH, benign prostatic hypertrophy; DKA, diabetic ketoacidosis; DM, diabetes mellitus; IDU, intravenous drug use; MSSA, methicillin-susceptible *Staphylococcus aureus*; MRSA, methicillin-resistant *Staphylococcus aureus*; PA, prostatic abscess; TTE, transthoracic echocardiography.

was 46 years. Fourteen patients (67%) presented with genitourinary concerns. Risk factors included concurrent diagnosis of skin or soft tissue infection in 11 patients (52%). There was a history of genitourinary disease or instrumentation in 10 patients (48%). History of IDU was reported in 8 patients (38%). Eight patients (38%) had a diagnosis of diabetes mellitus. Four patients (19%) had a known diagnosis of hepatitis C infection. One patient had a diagnosis of cirrhosis secondary to sarcoidosis, 1 patient had a diagnosis of rheumatoid arthritis, and another patient had low-grade urogenital carcinoma. In addition, 1 patient had a history of chronic systemic glucocorticoid use, many patients had more than 1 risk factor and 1 patient had no identifiable risk factors. Twelve patients (57%) were identified as having PA secondary to community-associated MRSA. Seventeen patients (81%) had concomitant bacteremia. Treatment included antibiotics in every patient (100%), with either a surgical or a radiologically guided drainage of PA in 17 (81%) of patients. Duration of antimicrobial therapy ranged from 3 to 8 weeks. Six patients (29%) were lost to follow-up. After an initial relapse in 2 patients who did not receive adequate source control initially, clinical resolution was observed in the 15 (71%) patients who had follow-up.

DISCUSSION

S. *aureus* is an important human pathogen that causes a diverse spectrum of diseases ranging from minor skin infections to more serious and life-threatening infections, such as bacteremia, endocarditis, and sepsis. The emergence of MRSA, which is resistant to virtually most β-lactam antibiotics, has increased the impact of this pathogen. Methicillin-resistant *S. aureus* was originally considered a hospital-associated infection, but infection in previously healthy individuals in the community emerged in the 1990s and, so, it now is referred to as community-associated MRSA (CA-MRSA) [6]. The incidence of invasive *S. aureus* infection has increased in recent years, with similar frequently reported infections irrespective of the methicillin-resistant status (except for the association of methicillin-susceptible *S. aureus* (MSSA) with septic arthritis), although smaller studies have reported more pneumonia, bacteremia or sepsis, and endocarditis among MRSA patients [7, 8].

Developing deep-seated and occult abscesses has been described as a complication of *S. aureus* bacteremia in patients with predisposing risk factors, but PAs continue to be a rare entity with only a few published reports in the literature, mainly as CA-MRSA [2]. In the antibiotic era, the epidemiology of PA has changed from a disease usually affecting young sexually active men to affecting the immunocompromised and debilitated [4].

In this series, 21 patients with the diagnosis of *S. aureus* PA were included, the average age was 46 years, and 12 patients had CA-MRSA. Common risk factors included associated skin

Table 2. Descriptive Clinical Characteristics of patients with *Staphylococcus aureus* Prostate Abscess

Variable	Descriptive Statistic
Age (years)[a]	45.57 (13.55)
Duration of therapy (weeks)[a]	5.81 (1.47)
Days to bcteremia clearance[a]	5.41 (3.18)
Concomitant bacteremia[b]	
Yes	17 (81%)
No	4 (19%)
Staphylococcus aureus[b]	
Methicillin-resistant *Staphylococcus aureus*	12 (57%)
Methicillin-susceptible *Staphylococcus aureus*	9 (43%)
Diabetes mellitus[b]	
Yes	9 (43%)
No	12 (57%)
History of urogenital disease of urogenital instrumentation[b]	
Yes	8 (38%)
No	13 (62%)
Initial treatment response[b]	
Resolved	13 (62%)
Relapsed/resolved	2 (9%)
Unknown	6 (29%)
Method of treatment[b]	
Drainage + antibiotics	17 (81%)
Treatment with antibiotics only	4 (19%)
Concomitant focal sites of infection[b]	
Yes	11 (52%)
No	10 (48%)
History of concomitant skin or soft tissue infection[b]	
Yes	9 (43%)
No	12 (57%)
Antibiotics choice[b]	
Vancomycin	10 (48%)
Daptomycin	6 (29%)
Cefazolin	4 (19%)
Naficillin/oxacillin	4 (19%)
Bactrim	4 (19%)
Ceftaroline	2 (10%)
Ciprofloxacin	2 (10%)
Linezolid/clindamycin/rifampin/dalbavancin	1 (5%)

[a]Values are mean (standard deviation).

[b]Values are frequency (percentage).

and soft tissue infections, a history of genitourinary disease or instrumentation, diabetes mellitus, IDU, hepatitis C infection, and the presence of immunodeficiency state. This is similar to current published literature [2, 9–12]. One patient had no identifiable risk factors but had MRSA bacteremia, and it is likely that the PA developed from the hematogenous seeding of the prostate after diagnostic delay and inadequate initial antibiotic therapy [13].

The first published report of the association between IDU and *S. aureus* PA was by Baker et al in 2004; more reports were published since then especially in CA-MRSA [2, 14]. In our cohort, 38% of patients had history of IDU; this patient population is at higher risk of *S. aureus* bacteremia (SAB) and possible seeding of the prostate, likely due to increased prevalence of *S. aureus* colonization, more frequent skin and soft tissue infections, and the sharing of needles [15].

The most common presentation in our patient's cohort was with genitourinary concerns in 67%. Other complaints included fever, night sweats, altered mental status, weakness or fatigue, and musculoskeletal concerns. This is similar to current published case studies [2, 13].

Treatment of bacterial prostatitis can be challenging largely because most antibiotics have relatively poor penetration into infected prostate tissue and fluids. Available antibiotics to treat *S. aureus* PA depending on local drug-resistance patterns include vancomycin, daptomycin, cefazolin, trimethoprim-sulfamethoxazole, and fluoroquinolones [16]. All patients in our cohort received antibiotic therapy directed towards *S. aurues* most commonly with vancomycin; other antibiotics for cohort treatment included daptomycin, cefazolin, and naficillin. One patient who relapsed was treated with drainage and combination therapy, which led to resolution. Dalbavancin was used in 1 patient, and to our knowledge, there are no published reports on its use for this indication. Treatment duration was 6 weeks on average, ranging from 3 to 8 weeks, and the recommended duration of treatment varied depending on the severity of infection and presence of concomitant bacteremia ranging from 2–6 weeks [16].

There are no established treatment guidelines for PA, and, in most published reports, treatment involves using the appropriate antibiotic toward the most likely pathogen, with or without drainage of the abscess [4]. In Carrol et al, the researchers reviewed 40 cases of *S. aureus* PA, and 80% of the patients had abscess drainage. Factors affecting the drainage depended on patient's response to antibiotic therapy and the size and accessibility of the abscess [2]. In a single-center retrospective study, Elshal et al recommended a transrectal approach as the best drainage method for select PA cases [17]. This also was recommended by a previous small size study by Aravantinos et al [18]. However, Collad et al reported that transrectal drainage should precede transurethral drainage, due to the potential risk of sexual dysfunction or severe complications associated with transurethral procedures [19]. Furthermore, Vyas et al reported that transrectal drainage benefited patients with abscesses larger than 20 mm presenting with severe lower urinary tract symptoms, or leukocytosis, or both [20]. Kazuhiko et al also recommended transrectal drainage except in cases of multiple abscesses with a long axis exceeding 30 mm [21]. There is a need for a large-size randomized study of optimal selection of drainage methods.

Duration to SAB clearance was 5.8 days in our cohort, all patients received antibiotics immediately after admission, and work up, including image studies, was performed to rule out suppurative complications after blood cultures failed to clear by Day 3. When PA was diagnosed, source control was performed in 17 patients

around Day 4 of bacteremia; 2 of them had surgical drainage and the remaining 15 had percutaneous drainage through a transrectal route. Persistent SAB should alert the treating physician to the possibility of a suppurative complication, and physicians should consider obtaining appropriate imaging studies [22].

Six patients in our cohort were lost to follow-up, but of the remaining 15 who had clinical resolution, 2 patients with large PA of more than 38 mm had an initial relapse after being initially treated conservatively. Appropriate drainage then was performed with resolution. This is similar to the published literature, stressing the importance of prompt identification and management of *S. aureus* PA to decreasing mortality rate and improving outcomes [2, 13].

Due to the increasing number of IDU at our institution, a multidisciplinary task force was formed with representatives from infectious diseases, psychiatry, cardiac surgery, infection control, and hospital leaders. The task force's aim was to standardize diagnostic algorithms and treatment plans for these high risk patients in order to improve outcomes.

There are a number of limitations in our study. First, cases were identified from discharge summary diagnosis codes, so there is a possibility that some PA cases may not have been identified using this method. Second, although this is a rare diagnosis, it is difficult to draw firm conclusions regarding best treatment approaches due to the limited sample size. Further reporting and research on *S. aureus* PA cases with a standardized approach is needed to assist physicians in understanding pathogenesis and best treatment options.

Prostate abscess caused by *S. aureus* infections are a rare complication, and it is often cited as being secondary to MRSA in published literature. In lieu of a lack of published guidelines on appropriate management, the best approach is early diagnosis, drainage, and administration of appropriate antibiotics. In high risk patients with persistent bacteremia, physicians need to consider the prostate as a site of infection.

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