Prostate abscess (PA) is an uncommonly encountered clinical entity. The most commonly associated organisms have been *Staphylococcus aureus*, *Escherichia coli* and recently *Klebsiella pneumoniae*. *Pseudomonas aeruginosa* has rarely been associated with PA.

**Introduction:** Prostate abscess (PA) is an uncommonly encountered clinical entity. The disease occurs mainly in patients with diabetes mellitus, in those with a chronic indwelling urinary catheter, after instrumentation and rarely in immunosuppressed patients (Meares, 1986; Weinberger et al., 1988). The incidence of PA has been declining due to the advent of effective antimicrobial agents (Baker et al., 2004). The incidence of PA in patients hospitalized with prostatic disease has been low (Baker et al., 2004). The most commonly associated organisms have been *Staphylococcus aureus*, *Escherichia coli* and recently *Klebsiella pneumoniae* (Bae et al., 2003; Bastide et al., 2005; Liu et al., 2003). *Pseudomonas aeruginosa* has rarely been associated with PA.

**Case report:**
A 72-year-old white male with a past medical history of hypertension, hyperlipidaemia, congestive heart failure and coronary artery disease underwent orthotropic heart transplant (OHT) for decompensated heart failure. Two weeks post-OHT, while still hospitalized, he was found to be confused and hypotensive. The patient was maintained on tacrolimus 0.5 mg every 12 h, mycophenolate 2000 mg every 12 h, prednisone 15 mg every 12 h and valganciclovir 450 mg daily. The donor and recipient were cytomegalovirus negative. Physical examination revealed a temperature of 36.9 °C, blood pressure of 97/59 mmHg and a pulse of 87 beats min⁻¹. The physical examination was normal except for his neurological examination revealing the patient to be awake but disoriented to time, place and person, and unable to follow commands. Genitourinary examination revealed no indwelling Foley catheter with no costovertebral or scrotal tenderness and no urethral discharge. The laboratory data showed a white blood cell count of 27 × 10⁹ l⁻¹ with 95 % neutrophils and 1 % lymphocytes, haemoglobin of 88 gm l⁻¹, platelets of 141 000 mm⁻³, creatinine of 241.33 mmol l⁻¹, aspartate transaminase of 60 U l⁻¹, alanine transaminase of 78 U l⁻¹ and alkaline phosphatase of 100 U l⁻¹. Urinalysis showed a pH of 6.5, with trace proteins, a urine white blood cell count of 9 × 10⁶ l⁻¹ and red blood cell count of 206 × 10⁹ l⁻¹, and negative nitrite and leukocyte esterase. A Foley catheter was placed pre-operatively, and was removed 12 days later. Two sets of blood and urine cultures revealed Gram-negative rods after 24 h of incubation in a Bactec 9240 incubator (Becton Dickinson). The patient was started empirically on a broad-spectrum antibiotic, meropenem 500 mg every 12 h, to cover for a possible infection with a resistant Gram-negative organism. The blood and urine isolates were identified as *P. aeruginosa* by a MicroScan Walk-Away-96 Plus System (Siemens). The organism was susceptible to amikacin, aztreonam, cefepime, ciprofloxacin, levofloxacin, meropenem, piperacillin-tazobactam and tobramycin. Meropenem was switched to cepapin 2 g daily after identification of the organism and its sensitivity panel. The patient improved clinically with resolution of...
his confusion and normalization of his leukocytosis to \(4 \times 10^9 \text{l}^{-1}\). A repeat urine culture showed no growth, but repeat blood cultures again grew *P. aeruginosa* after 48 h with the same susceptibility pattern identified by the same identification system. The antibiotics were changed back to meropenem and intravenous levofloxacin in the belief that the repeated positive blood cultures reflected antibiotic failure. Ultrasound of the kidneys showed bilateral renal cysts measuring 2.8 \(\times\) 3.2 \(\times\) 2.7 cm without any evidence of hydronephrosis. The prostate-specific antigen (PSA) level was 18 ng ml\(^{-1}\) (normal level < 4 ng ml\(^{-1}\)). A transrectal ultrasound (TRUS) of the prostate showed a 3 cm complex fluid collection in the peripheral zone of the prostate gland on the left side, suspicious for an abscess (Fig. 1). As the patient was clinically improving, a surgical intervention for drainage was deferred. Another set of blood cultures was again positive for *P. aeruginosa* with the same susceptibility pattern. As microbiological clearance was not achieved on the above two antibiotics, intravenous amikacin at 15 mg kg\(^{-1}\) daily was added to the regimen in an attempt to enhance the antibiotic activity in a difficult-to-penetrate concealed anatomical site such as the prostate, and in order to suppress the likelihood of seeding other tissues in this vulnerable post-OHT patient. After 3 days on this triple regimen, the blood cultures became sterile. A repeat PSA test showed a reduction of the level to 9 ng ml\(^{-1}\). After 10 days of this triple regimen, the patient was discharged on oral levofloxacin 500 mg every 48 h for 2 months. A repeat TRUS of the prostate 2 months later showed resolution of the previously documented fluid collection (Fig. 2). Antibiotics were discontinued as the patient was asymptomatic and the PSA level had normalized to 1.80 ng ml\(^{-1}\). Two sets of blood cultures taken after completion of the antibiotic treatment at 2 months revealed no growth.

**Discussion**

PA is uncommonly seen in clinical practice. It is thought to be a sequela of untreated or inappropriately treated acute prostatitis (Bastide *et al.*, 2005). PA is diagnosed in 0.2 % of patients with urological symptoms and 0.5–2.5 % of patients with prostatic symptoms (Mariani *et al.*, 1983). The disease generally occurs in 50–60-year-old patients but has also been described in children and older patients (Park *et al.*, 2011; Weinberger *et al.*, 1988).

Up to 16 % of patients with PA have underlying diabetes mellitus as a risk factor (Weinberger *et al.*, 1988). Other risk factors include chronic indwelling catheters and instrumentation of the lower genitourinary tract after prostatectomy or prostate biopsy. Cases of PA have been described in chronic haemodialysis patients, AIDS patients and those on an immunosuppressive regimen (Meares, 1986; Weinberger *et al.*, 1988).

In the pre-antibiotic era, PA was associated with gonococcal urethritis in 75 % of cases and was thought to result from an ascending urethral infection (Meares, 1986) with a mortality rate between 30 and 60 % (Barozzi *et al.*, 1998). A retrograde flow of contaminated urine within the prostate during micturition is thought to be an important pathogenic mechanism for the development of PA, even in the antibiotic era (Weinberger *et al.*, 1988). Among Gram-positive organisms, *S. aureus* is the most common organism isolated in PA (Krishnamohan *et al.*, 2013). The postulated pathogenic mechanism for PA caused by *S. aureus* is thought to be metastatic infection from a distant focus of infection or secondary to urethral instrumentation (Weinberger *et al.*, 1988). Gram-negative bacilli are isolated in 60–80 % of cases of PA (Collado *et al.*, 1999; Lim *et al.*, 2000). The uropathogens *E. coli* and *K. pneumoniae* are the most commonly implicated (Bae *et al.*, 2003; Bastide *et al.*, 2005; Liu *et al.*, 2003).

Clinically, patients with PA may present with fever, abdominal pain, dysuria, frequency, perineal discomfort and even tenesmus (Collado *et al.*, 1999; Lim *et al.*, 2000). Digital rectal examination may reveal an enlarged
prostate with tenderness in 48–100 % of patients, and fluctuation and bogginess in 88 % of patients (Collado et al., 1999; Thornhill et al., 1987). The clinical presentation may be subtle (Bae et al., 2003) and clinically difficult. The diagnosis of PA requires a combination of history, rectal examination and imaging modalities such as computed tomography scans and TRUS (Bae et al., 2003; Dalton, 1989; Tai, 2007). Serum PSA level may be elevated in PA. In a study by Jang et al. (2012), patients with PA had an elevated PSA level with a mean (±SD) of 18.54 ± 13.2 (normal range 2.0–57.0 ng ml⁻¹) (Göğüş et al., 2004).

Treatment of PA includes the use of antibiotics and surgical drainage (Pier & Ramphal, 2010). Abscesses that are less than 1 cm in diameter can be treated with a combination of antimicrobial therapy and placement of a suprapubic catheter, whereas those that are more than 1 cm in diameter need surgical drainage combined with antibiotics (Ludwig et al., 1999). Surgical drainage can be done transrectally, transperineally or via a transurethral approach (Bae et al., 2003). The TRUS-guided PA drainage has a success rate of about 83.3 % (Collado et al., 1999). Transurethral resection of prostate is indicated if the patient cannot tolerate the procedure under general anaesthesia, but it may increase the risk of sepsis and bacteraemia (Bae et al., 2003).

Complications of PA include spontaneous rupture into the urethra, perineum, bladder or rectum, chronic prostatitis, infertility and sepsis secondary either to a late diagnosis or inadequate drainage of the abscess (Bae et al., 2003).

P. aeruginosa, a Gram-negative bacterium, known to cause bacteraemia, pneumonia, skin and soft-tissue infection and urinary tract infection, has only rarely been described as the cause of PA. In vitro, the organism produces greenish pigment and a characteristic ‘grape-like’ odour. The organism grows best aerobically but can be grown anaerobically in the presence of nitrate. P. aeruginosa does not ferment carbohydrates but produces acid from sugars such as glucose, fructose and xylose but not lactose or sucrose. It is strongly positive in an indophenol oxidase test and can grow at 42 °C (Grandos et al., 1992).

There have been four documented cases of P. aeruginosa-associated PA (Table 1). Of the four patients, only one patient was >60 years old. Of the other three, one had a history of Hodgkin’s lymphoma, one had underlying diabetes mellitus and the other patient had no underlying medical problems. Three of the four patients had either bacteraemia, urinary tract infection or a combination of both, and were treated with both antibiotic and surgical drainage. Only one patient received antibiotic therapy without surgical intervention.

To the best of our knowledge, our patient is only the second reported case of P. aeruginosa-associated PA in an OHT recipient. Meares (1986) described a patient with OHT diagnosed with PA due to P. aeruginosa; the patient had an unsuspected chronic bacterial prostatitis, which flared up immediately post-transplant, probably due to

<p>| Table 1. List of patients described in the literature with PA due to P. aeruginosa |</p>
<table>
<thead>
<tr>
<th>Reference</th>
<th>Age (years)</th>
<th>Co-morbidities</th>
<th>Urine/blood culture</th>
<th>Prostate culture</th>
<th>Antibiotic(s)</th>
<th>Surgical drainage</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meares (1986)</td>
<td>Middle aged</td>
<td>Heart transplant</td>
<td>P. aeruginosa + E. coli</td>
<td>P. aeruginosa + E. coli</td>
<td>Polymyxin</td>
<td>Transperineal</td>
<td>Survived</td>
</tr>
<tr>
<td>Becker &amp; Harim (1964)</td>
<td>55</td>
<td>Hodgkin’s lymphoma</td>
<td>P. aeruginosa</td>
<td>P. aeruginosa</td>
<td>Streptomycin/tetracycline followed by sulfonamide</td>
<td>Transvesical</td>
<td>Survived</td>
</tr>
<tr>
<td>Klotz (1959)</td>
<td>74</td>
<td>None</td>
<td>P. pyocyanea</td>
<td>P. pyocyanea</td>
<td>Streptomycin/tetracycline</td>
<td>Transurethral</td>
<td>Survived</td>
</tr>
<tr>
<td>Mariani et al. (1983)</td>
<td>56</td>
<td>Diabetes mellitus</td>
<td>P. aeruginosa</td>
<td>P. aeruginosa</td>
<td>Tobramycin</td>
<td>Transurethral</td>
<td>Survived</td>
</tr>
</tbody>
</table>

*+ indicates that antibiotics were given, but it is unknown which antibiotics were given.
the use of immunosuppressive therapy. The patient was bacteraemic and was treated with antibiotics, but no surgical drainage was performed and the patient died.

Our patient had a Foley catheter for 12 days post-OHT. The patient had no symptoms suggestive of urinary tract infection or prostatitis prior to surgery. It is possible that the Foley catheter played a role in the pathogenesis of our patient’s PA. Although the prostatic collection was not cultured, the fact that the patient had the same organism isolated from blood and urine and a TRUS showing a collection suggestive of an abscess with an elevated PSA are suggestive of PA. Moreover, the resolution of the prostatic collection on repeated TRUS and normalization of the PSA after antibiotic treatment further supports the diagnosis of PA due to \textit{P. aeruginosa}.

**Conclusion**

In summary, we have described a case of a PA caused by \textit{P. aeruginosa} in an OHT recipient. The patient had persistent bacteraemia with the same bacteria growing in the urine and was successfully treated with antibiotics without surgical drainage. Clinicians should include the diagnosis of PA in patients with persistent \textit{P. aeruginosa} bacteraemia after OHT.

**References**


