CASE REPORT

CONCOMITANT EMPHYSEMATOUS PROSTATIC AND PERIURETHRAL ABSCESSES DUE TO *KLEBSIELLA PNEUMONIAE*: A CASE REPORT AND REVIEW OF THE LITERATURE

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Abstract. Although gas-forming infections of the urinary tract account for a very small percentage of all urinary tract infections, they can lead to mortality if an early diagnosis is not made and aggressive management initiated. Emphysematous urinary tract infections occur mainly in patients with poorly controlled diabetes mellitus or an obstructed urinary tract. Here we present a case of concomitant emphysematous prostatic and periurethral abscesses caused by *Klebsiella pneumoniae* in a 70-year-old male with poorly controlled diabetes mellitus. Given the high prevalence of patients with diabetes mellitus and the high mortality rate associated with emphysematous prostatic abscesses, clinicians should be aware of this rare but potentially fatal condition.

Keywords: emphysematous prostatic abscess, emphysematous periurethral abscess, *Klebsiella pneumoniae*

INTRODUCTION

Gas-forming urinary tract infections (UTIs) were first described in 1898 (MacGallum and Kelly, 1898), and a number of such infections have since been reported in the medical literature. Although emphysematous infections account for a small proportion of all UTIs, they are potentially life-threatening and require early diaganosis and treatment. Reported emphysematous UTIs include pyelonephritis (Mokabberi and Ravakhah, 2007), pyelitis (Mokabberi and Ravakhah, 2007), cystitis (Thomas *et al*, 2007), and rarely infections of the prostate (Wen *et al*, 2012), periurethral tissues (Ranjan *et al*, 2013), and scrotum (Patel *et al*, 1992).

An emphysematous prostatic abscess (EPA) is characterized by gas in the tissues and abscess formation in the prostate, and was first reported in 1983 (Mariani *et al*, 1983). The most common predisposing factor for EPA is poorly controlled

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diabetes mellitus (Wen *et al*, 2012). Periurethral abscesses are classically considered to be complications of strictures or gonococcal urethritis (Walther *et al*, 1987; Campell, 1929). However, recent studies have reported predisposing factors for periurethral abscesses to include trauma, penile prostheses, cavernosography and intracorporeal papaverine injections (Sater and Vandendris, 1989; Niedrach *et al*, 1989). Ranjan *et al* (2013) reported the first case of an emphysematous periurethral abscess (EPUA) in a 48-year-old male with diabetes mellitus who was successfully managed endoscopically. The management of emphysematous prostatic and periurethral infections is not standardized due to the limited number of cases reported.

We report here a case with concomitant emphysematous prostatic and periurethral abscesses, and review the literature.

CASE REPORT

A 70-year-old man with poorly controlled diabetes mellitus for 10 years and spinal stenosis, had undergone decompressive laminectomy in 2006 and was bedridden with an inderelling Foley catheter for 7 years; he presented to our emergency department with a 1-day history of stupor and a 2-day history of purulent discharge from the urethra.

Physical examination revealed a blood pressure of 92/53 mmHg, a temperature of 37.9°C, a heart rate of 89 beats/minute, a respiratory rate of 20 breaths/minute, and a Glasgow Coma Scale score of E1V1M4. He had Kussmaul breathing, pale conjunctivae, and dry skin with reduced turgor. Urogenital examination revealed crepitus and induration of the left scrotum. Compression of the left scrotum resulted in discharge of foul-smelling pus with gas bubbles from the urethral orifice. Digital rectal examination (DRE) revealed an enlarged and tender prostate.

Laboratory testing showed a white cell count of 19.01×10^9/l with 84% granulocytes, 6% lymphocytes, 4% monocytes, and 6% band cells. The hemoglobin concentration was 10.7 g/dl, the mean corpuscular volume was 108.0 fl, and the platelet count was 222,000 /mm^3. The serum sodium level was 146 mmol/l (normal: 135-147 mmol/l) and potassium level was 5.1 mmol/l (normal: 3.4-4.7 mmol/l). Renal function tests showed a blood urea nitrogen level of 121 mg/dl (normal: 7-20 mg/dl) and a serum creatinine level of 3.32 mg/dl (normal: 0.7-1.5 mg/dl). Liver function tests were normal. Urine analysis showed a white blood cell count of >100 per high-power field, a red blood cell count of 25-50 per high-power field, and a specific gravity of 1.020 (normal: 1.005-1.030). The random blood glucose level was 1,417 mg/dl (normal: 65-200 mg/dl) and the lactate level was 2.48 mg/dl (normal: 0.7-2.1 mg/dl). Serum ketones were negative. An arterial blood gas on room air showed a pH of 7.295, a $PaCO_2$ of 34.7 mmHg, a PaO_2 of 74 mmHg, a $HCO3^-$ of 17.1 mmol/l, and an base excess of -7.9 mmol/l, revealing metabolic acidosis with incomplete compensation.

Because of the crepitus and induration of the left scrotum, an abdominal CT was performed to evaluate for suspected Fournier's gangrene, and unexpectedly showed emphysematous prostatic and periurethral abscesses (Fig 1A,1B).

He was diagnosed with emphysematous prostatic and periurethral abscesses complicated by sepsis and hyperosmolar non-ketotic syndrome; he was treated with rehydration, insulin infusion, and

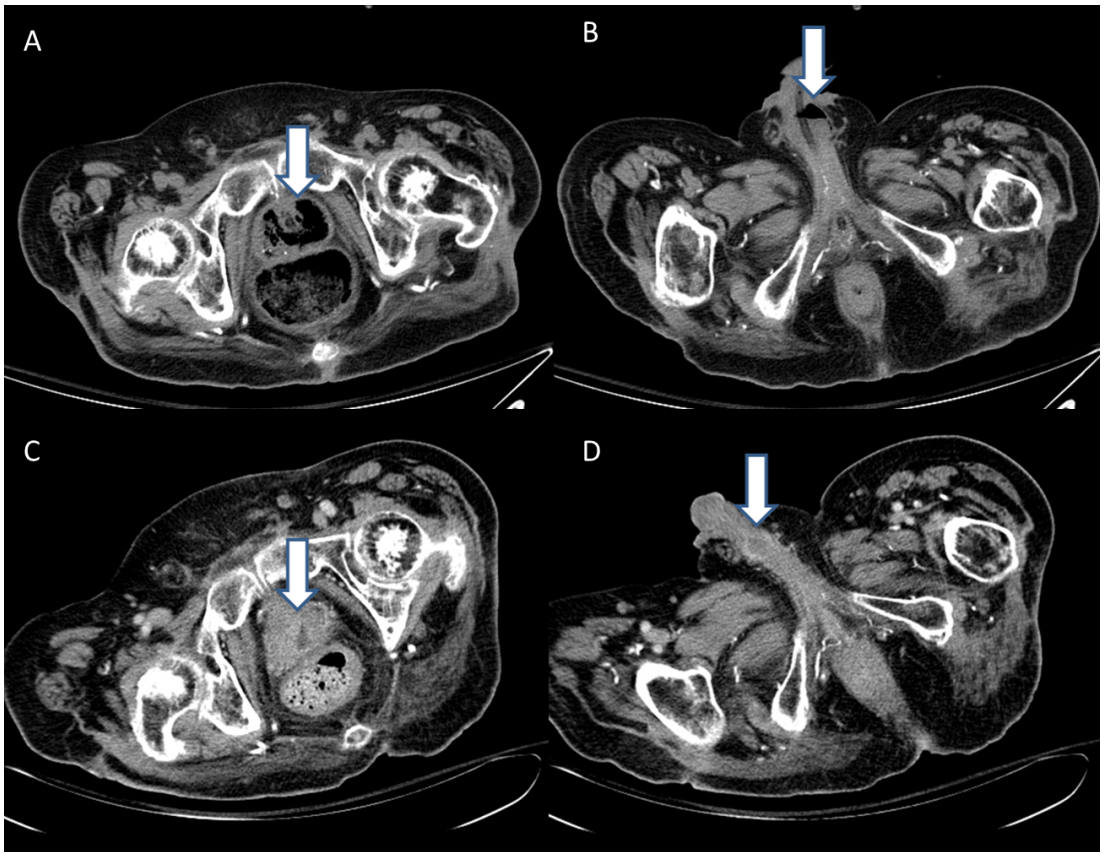

Fig 1–Computed tomography of the abdomen on Day 1 of hospitalization showing abscesses with gas in the prostate (A, arrow) and corpus spongiosum (B, arrow). Computed tomography of the abdomen on Day 24 of hospitalization, after transperineal drainage, suprapubic cystostomy and intravenous antimicrobial therapy showing resolution of the abscesses in the prostate (C, arrow) and corpus spongiosum (D, arrow).

an antimicrobial agent. A smear of the urethral discharge showed gram-negative bacilli and antimicrobial treatment was initiated with cefepime (2 g every 12 h). A consulting urologist recommended CT-guided transperineal drainage of the prostatic abscess, which was performed on Day 4 of hospitalization, and yielded 10 ml of reddish purulent fluid. A suprapubic cystostomy was performed on Day 7. The penis and left scrotum were massaged daily to facilitate drainage of the periurethral abscess via the urethra, and the urethral discharge resolved by Day 10. Cultures of the urethral discharge, prostatic abscess fluid, and blood all grew *Klebsiella pneumoniae*, and the antimicrobial agent was changed to ceftriaxone (2 g daily) on Day 7 based on sensitivity testing. The patient's fever and stupor resolved by Day 12. An abdominal CT scan on Day 17 showed small residual abscesses of the prostate and corpus spongiosum (Fig 1C, 1D). The patient was discharged on Day 24 on oral ciprofloxacin for 30 days. There was no relapse in infection 1 month after

Table 1
Demographic characteristics, initial diagnosis, diagnostic delay[a], and pathogens found in 15 reported patients with emphysematous prostatic abscesses.

Study	Case number	Age	Country	Underlying disease	Initial diagnosis	Diagnostic delay[a]	Imaging modality[e]	Pathogen
Mariani *et al*, 1983	1	56	USA	DM	UTI	N/A	IVP, gallium scan	*Pseudomonas aeruginosa*, *Bacteroides fragilis*
Bartkowski and Lanesky, 1988	2	60	USA	DM, recurrent pancreatitis	UTI	10 days	KUB/CT	*C. albicans*
Lu *et al*, 1998	3	45	Taiwan	DM, alcoholism	UTI	4 days	CT	*K. pneumoniae*
Lin *et al*, 2001	4	55	Taiwan	DM, LC, HCC	EPA	No delay	CT	*K. pneumoniae*
Bae *et al*, 2003	5	50	Korea	DM	EC	12 days	KUB/TRUS/CT	*K. pneumoniae*
Kuo *et al*, 2007	6	60	Taiwan	DM, alcoholic/ HCV hepatitis	EPA	No delay	KUB/TRUS/ CT	*K. pneumoniae*
Sampathkumar *et al*, 2007	7	57	India	ESRD with renal transplantation, DM, HTN	EPA, EP, EC	No delay	CT	*E. coli*
Tai, 2007	8	60	Taiwan	DM, alcoholic LC	EPA	No delay	KUB/TRUS/CT	*K. pneumoniae*
Thorner *et al*, 2010	9	64	USA	ESRD, DM	EPA	No delay	CT	*Citrobacter* species
Cheung and Tsang, 2011	10	68	Taiwan	DM, stroke	EPA, EC	No delay	KUB/CT	*E. coli*[b],
Wen *et al*, 2012	11	72	Taiwan	No DM, no alcoholism	Acute prostatitis	N/A	KUB/TRUS/CT	*E. coli*
	12	68	Taiwan	DM, LC	UTI	7 days	CT	*C. albicans*
	13	81	Taiwan	No DM	Left obstructive uropathy, EPA	No delay	KUB/CT	*E. coli* (ESBL+), *C. glabrata*
Hsu *et al*, 2013	14	54	Taiwan	DM, LC,HBV	N/A	N/A	KUB/TRUS/CT	*K. pneumoniae*
Present case	15	70	Taiwan	DM	EPA, EPUA	No delay	CT	*K. pneumoniae*

[a]Time from admission to correct diagnosis. [b]Pathogens isolated from urine. CT, computed tomography; DM, diabetes mellitus; EPA, emphysematous prostatic abscess; EP, emphysematous pyelitis; EC, emphysematous cystitis; EPUA, emphysematous periurethral abscess; ESRD, end-stage renal disease; HTN, hypertension; HCC, hepatocellular carcinoma; IVP, intravenous pyelography; KUB, plain film of the kidneys, ureter, and bladder; LC, liver cirrhosis; N/A, not available; TRUS, transrectal ultrasonography; UTI, urinary tract infection; ESBL, extended spectiam betalactamase.

Table 2
Management and outcomes of 15 reported patients with emphysematous prostatic abscesses.

Case number	Prostatic abscess drainage	Cystostomy	Antibiotics	Duration of antibiotics	Hospital stay	Other abscess or complication	Outcome
1	TUIP	Yes	Tobramycin	N/A	24 days	None	Survived
2	TUIP	Yes	Amphotericin B	7 weeks	29 days	EC	Survived
3	Sonography-guided transperineal needle aspiration	No	Flomoxef, gentamicin	9 days	9 days	EC	Died
4	Perineal incision and drainage	Yes	N/A	N/A	26 days	Abscess extending to periurethral and perineal areas	Died
5	Transperineal drainage	Yes	Pefloxacin, ceftriaxone, metronidazole, aztreonam, ciprofloxacin	11 weeks	11 weeks	EC, acute pyelonephritis	Survived
6	TUIP	No	Ciprofloxacin	6 weeks	N/A	None	Survived
7	Cystourethroscopic drainage	No	Imipenem/cilastatin	2 days	2 days	EP, EC	Died
8	TUIP	No	Ciprofloxacin, metronidazole	N/A	15 days	None	Survived
9	Transurethral drainage and unroofing	Yes	Unknown antibiotic agent	N/A	N/A	None	Survived
10	TUIP	No	N/A	N/A	N/A	Emphysematous scrotum	Survived
11	CT-guided transgluteal drainage	Yes	Levofloxacin	6 weeks	15 days	None	Survived
12	CT-guided transperineal drainage	No	Amoxicillin/clavulanate, levofloxacin, fluconazole	7 weeks	2 weeks	None	Survived
13	CT-guided drainage	No	Levofloxacin, meropenem, fluconazole	N/A	45 days	Prostatic fistula	Survived
14	Sonography-guided transperineal aspiration and TUIP	N/A	Ciprofloxacin	N/A	N/A	None	Survived
Present case 15	CT-guided transperineal drainage	Yes	Cefepime, ceftriaxone, ciprofloxacin	54 days	24 days	EPUA	Survived

CT, computed tomography; EP, emphysematous pyelitis; EC, emphysematous cystitis; EPUA, emphysematous periurethral abscess; N/A, not available; TUIP, trans-urethral incision of the prostate.

completion of the oral antibiotic.

DISCUSSION

This report describes an unusual case and its management of a gas-forming UTI caused by *K. pneumoniae* in a patient with poorly controlled diabetes mellitus and a long-term indwelling Foley catheter.

We searched PubMed for English language publications using the keywords "emphysematous prostatitis" or "emphysematous prostatic abscess" or "emphysematous periurethral abscess" for the period 1980 to 2013. Fourteen cases with EPA and one case with EPUA were described in 12 and 1 reports, respectively. We reviewed the demographic characteristics, initial diagnosis, diagnostic delay, management, and outcomes of the 14 patients with EPA (Tables 1 and 2). The median age of patients was 60 years (range, 45-81 years); 13 (86.7%) had diabetes mellitus. Interestingly, 6 patients (40%) had other concomitant gas-forming infections; emphysematous cystitis (*n*=3), cystitis and pyelitis (*n*=1), a periurethral abscess (*n*=1) and a scrotum infection (*n*=1). Seven of 14 patients (50%) underwent a suprapubic cystostomy. The median length of hospital stay was 15 days (range, 2-77 days); three patients (20%) died at a median of 9 days (range 2-26 days) hospital stay.

The diagnosis of an EPA is based mainly on the clinical history, a digital rectal examination, and imaging examination findings (Tai, 2007; Wen *et al*, 2012). Because of the non-specific symptoms and physical findings, patients are often initially treated for a simple UTI. Among the cases reviewed, an EPA was initially unrecognized in 6 of 14 patients (42.9%), with a median delay in a correct diagnosis of 8 days (*n*=4, range 4-12 days). These patients were initially misdiagnosed as having acute prostatitis (*n*=1), an uncomplicated UTI (*n*=4) or as having emphysematous cystitis (*n*=1).

Radiological examination is necessary to confirm an EPA. Plain films of the kidneys, ureter, and bladder (KUB) provide a conventional screening tool, but mottled gaseous shadows in the prostate may be difficult to differentiate from bowel gas or emphysematous cystitis (Bae *et al*, 2003). Abdominal CT is the imaging modality of choice since it can show swelling of the prostate, abscess fluid, gas and other concomitant gas-forming infections, which existed in 40% of the cases we reviewed. Transrectal ultrasonography can confirm fluid and gas collection in the prostate gland.

The most commonly reported microorganisms causing EPA were *K. pneumoniae* (*n*=7, 46.7%). Unlike other gas-forming UTIs, such as emphysematous pyelonephritis (EP) and emphysematous cystitis (EC), *K. pneumonia,* rather than *E. coli,* is the most common causative pathogen in cases of EPA (Thomas *et al*, 2007; Ubee *et al*, 2011). Six (85.7%) of the seven patients with EPA caused by *K. pneumoniae* in our literature review were from Taiwan. A distinct invasive syndrome caused by virulent strains of *K. pneumoniae* characterized by a hypermucoviscous phenotype associated with serotypes K1 and K2 and the regulator of mucoid phenotype A gene (rmpA) has been detected in Taiwan and many southeast Asian countries since the late 1980s (Siu *et al*, 2012). However, the *K. pneumoniae* isolated in the case described in our paper had a negative string test, meaning lack of hypermucoviscosity, and the antibiogram was not typical for a wild-type strain. Whether some virulent strain of *K. pneumoniae* or host factor resulted in the high rate of *K. pneumoniae* isolated in cases of EPA in Taiwan deserves further

investigation.

We reviewed the treatment of EPA reported in the literature. Patients were usually treated with a combination of abscess drainage and intravenous antimicrobial therapy. Transurethral incision and drainage of the prostate was performed in 8 (53.3%) of the 15 reported patients. This procedure can provide drainage but should be performed with caution during the active stage of infection to avoid introduction of pathogens into the circulation, which may result in septic shock. Transperineal drainage was the next most commonly performed procedure in our review (n=6, 40%). The route is safer, but a disadvantage is possible incomplete drainage. Our patient was successfully managed by CT-guided transperineal drainage combined with prolonged antimicrobial therapy.

Periurethral abscesses are rare but potentially life-threatening infections of the male urethra and periurethral areas. The management of periurethral abscesses includes surgical debridement through a transperineal or transurethral incision, urinary diversion, and antimicrobial therapy (Walther *et al*, 1987; Komolafe *et al*, 2002; Kraus *et al*, 2004). Ranjan *et al* (2013) reported the first case of EPUA involving both corporal bodies successfully treated by endoscopy, cystostomy and antimicrobial therapy. In our case, the EPUA improved greatly after conservative therapy with antimicrobial agents, cystostomy, and daily massage of the penis and scrotum to encourage drainage of purulent material from the urethra. Further studies are needed to evaluate the demographic characteristics and appropriate management of patients with EPUA.

In conclusion, EPA is a condition mainly seen in diabetic patients, which may progress rapidly and is potentially fatal. The diagnosis of EPA is often delayed because of the non-specific manifestations and rare occurrence. Abdominal CT and transrectal ultrasonography can assist with diagnosis and evaluate concomitant gas-forming UTI. The higher rate of *K. pneumoniae* isolated in cases of EPA in Taiwan needs further investigation. The higher prevalence among patients with diabetes mellitus and the high mortality rate associated with EPA should be known by clinicians who care for these patients.

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