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Prostatic abscess in southern Taiwan: another invasive infection caused predominantly by *Klebsiella pneumoniae*

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Prostatic abscess, though rarely encountered since the introduction of broad-spectrum antibiotics, can cause significant morbidity and mortality. We retrospectively reviewed 17 cases of prostatic abscess treated during an 11-year period at 2 medical centers in southern Taiwan. Most of these patients were elderly (mean age, 59 years) with diabetes mellitus (10 cases, 59%) or hepatic cirrhosis (5 cases, 29%). Fourteen (82%) of the 17 patients were febrile, with chills occurring in about a half of these. Of the symptoms and signs referable to the lower urinary tract, dysuria (71%) was the most common complaint. Pain was usually localized in the suprapubic (35%) or perineal (18%) area. The common findings of digital rectal examination were prostatic enlargement (77%) and fluctuation (23%). Prostatic abscess was impressed from the findings of hypoechoic area with thick walls on transrectal ultrasound or an enlarged gland with fluid-density collections on computed tomography. All causative pathogens were gram-negative bacilli, including *Klebsiella pneumoniae* (10 cases), *Escherichia coli* (2), and *Pseudomonas aeruginosa* (1). Various measures were undertaken to allow drainage, including transurethral incision or resection of the prostate, open perineal incision, laparotomy, and transrectal ultrasound- or computed tomography-guided needle aspiration. In conclusion, *K. pneumoniae* was the predominant pathogen of prostatic abscess, and was frequently identified as the causative pathogen in patients with diabetes mellitus. Diagnosis of prostatic abscess based merely on symptomatology is implausible, and image studies, such as transrectal ultrasound or computed tomography scan, are warranted. Optimal management includes adequate drainage of abscess and antimicrobial therapy.

Key words: Diabetes mellitus, *Klebsiella pneumoniae*, prostatic abscess

The incidence of prostatic abscesses (PA) has declined sharply with the widespread use of antibiotics and the decreasing incidence of urethral gonococcus infections. Although rare, PA can result in severe complications, including rupture to the periprostatic space, urethra, rectum, perivesical space, perineum, and even the peritoneum and bladder [1-6]. The pathologic spectrum of PA ranges from microabscesses, which resolve with antimicrobial treatment alone, to large multilocular abscesses requiring certain drainage measures [1]. Antemortem diagnosis of PA has historically been regarded as difficult, because of the lack of pathognomonic symptoms or specific clinical signs. The advents of transrectal ultrasound (TRUS), computed tomography (CT), and magnetic resonance imaging (MRI) have greatly facilitated the diagnostic process [7-19].

The dominant organisms in PA since 1945 have been *Escherichia coli*, other enteric gram-negative bacilli, and *Staphylococcus* species, alone or in combination [20]. Prostatic abscess often occurs in patients with diabetes mellitus, chronic renal failure, or prostatitis [20-22]. Recently, we encountered several cases of PA caused by *Klebsiella pneumoniae* in diabetic patients, suggesting the possibility of a shift in the causative agents and in the predisposed underlying disease factors associated with the disease.

This retrospective study investigated the clinical presentations, causative pathogens, underlying disease, diagnostic methods, clinical management, and outcome of PA at 2 medical centers in southern Taiwan.

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Materials and Methods

A database of clinical diagnoses of PA at 2 medical centers, National Cheng Kung University Hospital (NCKUH) and Chi-Mei Hospital (CMH), was searched for cases of PA diagnosed according to ICD-9 criteria (code 601.2). Medical records of the patients with a discharge diagnosis coded for PA were reviewed. Information on clinical manifestations, demographic data, underlying disease, causative pathogens, concurrent infections, laboratory findings, diagnostic methods, radiologic imaging, digital rectal examination, treatment course, and outcomes were collected.

The diagnosis of PA was based on CT, TRUS, or pathological findings. The identification of causative pathogens from drained or aspirated pus from PA, or concurrent urine and blood cultures, was based on colonial morphology and traditional biochemistry reactions in test tubes. Antimicrobial susceptibility tests were performed using the disc diffusion method in accordance with the National Committee for Clinical Standards [23]. Transrectal ultrasound was performed using a biplane liner and 7.5-MHz sector transducer. The prostate was examined in the transverse and longitudinal planes. Typical sonographic findings of PA were a particularly hypoechoic or anechoic area with thick walls or perifocal edema [11]. The CT finding suggestive of PA was an enlarged gland with fluid-density collections that was sometimes multiseptated or had an enhancing rim [8]. Those patients with interruption of follow-up in outpatient service were followed by telephone interview.

Results

During the 11-year study period, the diagnosis of PA was made in 17 men (10 from NCKUH, 7 from CMH), with a mean age of 59 years (range, 35-83 years). The most frequent underlying medical illness was diabetes mellitus (10 patients, 59%), followed by hepatic cirrhosis (5, 29%), alcoholism (4, 24%), and malignancy (3, 18%). Five (29%) patients had an indwelling urinary catheter at the time of PA diagnosis. Three (18%) had undergone invasive procedures that would be likely to predispose them to the development of PA, including hemorrhoidectomy (2 cases) and transurethral microwave thermotherapy (1 case). The latter case was previously reported in the urologic literature [24].

Fourteen (82%) patients were febrile, with about half of them experiencing chills. Constitutional manifestations indicating septicemia, such as hypotension, severe dyspnea, or respiratory distress, and altered consciousness, were found in 7 (41%) patients. Of the symptoms and signs referable to the lower urinary tract, dysuria was the most common complaint, noted in 12 (71%) patients. Other urinary symptoms and signs included frequency (59%), urine retention (59%), urgency (41%), nocturia (29%), and difficulty in urination (29%). Less common presentations were urinary incontinence, dribbling, and gross hematuria. Three (18%) patients had no complaints pertaining to urination.

Focal pain was usually localized in the suprapubic area (35%) or perineum (18%), and less frequently in the anus (12%), scrotum (12%), or flank (12%). Uncharacteristically, 2 (12%) patients presented with diffuse abdominal pain. At initial presentation, neither focal nor diffuse abdominal pain was noted in 4 (24%) patients. Table 1 shows the clinical characteristics of the 17 patients.

The most common findings of laboratory investigations were leukocytosis (82%) and pyuria (82%). Microscopic hematuria was found in 12 (71%) patients. Serum levels of prostate-specific antigen were determined in 11 patients and were elevated in 6 (55%) of these patients. Initial digital rectal examination was performed in 13 (76%) patients. The prominent finding was prostatic enlargement, noted in 77% of these patients. Fluctuation on palpitation, a more sensitive sign of PA than prostatic enlargement, was found in only 23% of the prostates initially examined, while prostatic tenderness and hard consistency were noted in 46% and 15%, respectively. Urosepsis without specific localization (6 patients, 35%) and benign prostate hypertrophy (4 patients, 24%) were common first impressions, but were the correct diagnosis in only 3 (18%) of these patients.

In the 12 patients who underwent CT scan, the characteristic findings in the prostate were single or multiple low-density lesions, gas-fluid collection, or enhanced multiseptated fluid-density (Fig. 1), and periprostatic area involvement. Among the 10 patients who underwent TRUS, a hypoechoic lesion with homogeneous fluid was found in 2 and inhomogeneous material in 7. The abscesses were located mainly in the peripheral zone of the prostate gland. Prostatic abscess involved the right, left, or both lobes of the prostate with equal frequency. The amount of pus evacuated ranged from 1 to 80 mL. Prostate enlargement was found only in one patient. Gallium-67 scan was done in 4 patients, but none had any positive uptake in the prostate.

Causative pathogens (Table 2) isolated from blood (10 patients), urine (10), or prostate aspiration (6) were *K. pneumoniae* in 10 patients, *E. coli* in 2, and *Pseudomonas aeruginosa* in 1. In 3 patients, cultures

Table 1. Clinical characteristics of 17 patients with prostatic abscess

No.	Age (yr)	Underlying disease	Symptom/sign	Lower urinary tract symptom	Localization of pain	Max. temp. (°C)	DRE finding of prostate
1	77	—	—	D, UR, F, U, N, DU	—	37	Enlargement
2	48	DM, LC, HCC	Fever, dyspnea	D	Abdominal	39.2	Enlargement
3	68	DM, LC	Fever, chills	D, U, DU	Suprapubic	40.5	Tenderness
4	65	SLE	Fever	D, UR, F	Suprapubic	38.8	Enlargement
5	41	DM, LC	Fever, chills, shock	D, UR, F, U, H, DB	Suprapubic	38.3	Fluctuation, tenderness
6	68	NPC	Fever	UR, F, U, N, DU	Suprapubic	38.8	Enlargement, tenderness
7	56	DM, LC	Fever, dyspnea	D, F, U	Perineal, flank	38.7	—
8	73	—	Fever, shock, dyspnea	—	—	40	Enlargement
9	59	DM	Fever	—	—	39	—
10	40	DM	Fever, dyspnea	D, UR, F	Perineal	39	Enlargement
11	53	DM	Fever, shock, dyspnea	—	Abdominal	39	—
12	54	DM	—	D, UR	Anal	37	Fluctuation, tenderness
13	66	—	—	D, UR, F, U	—	37.3	Enlargement
14	35	—	Fever	D, F	Suprapubic, scrotal	39.3	Enlargement
15	83	—	Fever	D, UR, F, U, C	—	39	Enlargement
16	55	DM, LC, HCC	Fever	UR, DU	Suprapubic, perineal, anal, scrotal	38	—
17	59	DM	Fever, chills, shock	D, UR, F, U, N	Flank	39.4	Fluctuation, tenderness

Abbreviations: DM = diabetes mellitus; LC = liver cirrhosis; HCC = hepatocellular carcinoma; SLE = systemic lupus erythemataus ; NPC = nasopharyngeal carcinoma; D = dysuria; UR = urine retention; F = frequency; U = urgency; N = nocturia; DU = difficulty in urination; H = hematuria; DB = dribbling; C = incontinence; DRE = digital rectal examination

of specimens were sterile. All *K. pneumoniae* isolates were resistant to ampicillin, but susceptible to all cephalosporins, fluoroquinolones, and aminoglycosides, which is the typical antibiogram of community-acquired *K. pneumoniae* strains in Taiwan.

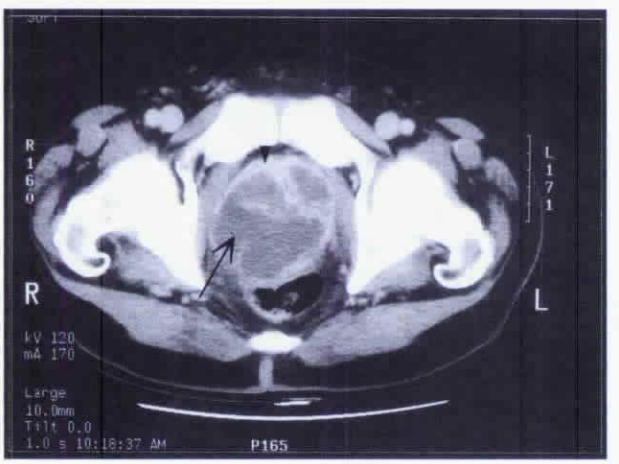

Fig. 1. Pelvic CT scan shows a large low-density lesion (arrow) and enhanced rim (arrowhead) within enlarged prostate gland, consistent with abscess formation.

The most common procedure used for PA drainage was transrectal aspiration under TRUS guidance, which was performed in 7 (41%) patients. One of these 7 patients required transurethral resection of the prostate (TURP) for residual abscess. Four of these patients recovered completely and the other 2 patients died of *K. pneumoniae* bacteremia. Two patients were cured by transurethral evacuation or incision drainage (unroofing). Two patients underwent TURP and one of them recovered completely. The other had epididymoorchitis with abscess formation 1 month after TURP, and *K. pneumoniae* was isolated from initial PA and subsequent scrotal abscess. Due to the initial presentation of acute abdomen, laparotomy was undertaken in 1 patient and spontaneous rupture of PA with peritonitis was found. Open incision and drainage of the perineum was performed in one patient, who died of *Acinetobacter baumannii* and vancomycin-resistant *Enterococcus* (VRE) bacteremia 1 month later. One patient received CT-guided perineal drainage and recovered completely. Three patents were cured with antimicrobial therapy alone.

The overall mortality rate was 18% (3 of 17 patients). *K. pneumoniae* bacteremia was the cause of

Table 2. Bacterial isolates, clinical management, and outcome of 17 patients with prostatic abscess

No.	Urine isolate	Blood isolate	Prostatic isolate	Diagnostic tool	Drainage procedure	Duration of antimicrobial therapy (days)	Clinical outcome (days)[a]
1	No growth	No growth	No growth	TRUS	TU-I	Pipemidic acid (38)	Cure
2	*K. pneumoniae*	*K. pneumoniae*	ND	CT+TRUS	—	Ofloxacin (55)	Cure
3	*K. pneumoniae*	*K. pneumoniae*	*K. pneumoniae*	CT+TRUS	TRNA	Cefotaxime (18)	Died (18)
4	No growth	*E. coli*	ND	CT	Laparotomy	Ciprofloxacin (17)	Cure
5	*K. pneumoniae*	*K. pneumoniae*	*K. pneumoniae*	CT+TRUS	TRNA	Ciprofloxacin (44)	Cure
6	No growth	*K. pneumoniae*	*K. pneumoniae*	TRUS	TRNA	Pefloxacin (20) Pipemidic acid (100)	Cure
7	No growth	*K. pneumoniae*	No growth	CT+TRUS	TRNA	Cefotaxime (28) Gentamicin (12)	Died (28)
8	*E. coli*	*E. coli*	No growth	CT	TRNA	Ciprofloxacin (99)	Cure
9	*P. aeruginosa*	No growth	ND	CT	—	Ciprofloxacin (20)	Cure
10	*K. pneumoniae*	*K. pneumoniae*	No growth	CT	TRNA	Ciprofloxacin (209)	Cure
11	*K. pneumoniae*	*K. pneumoniae*	*K. pneumoniae*	CT	—	Ciprofloxacin (41)	Cure
12	No growth	No growth	No growth	CT	CT-guided TPNA	Ciprofloxacin (19)	Cure
13	Not done	No growth	Not done	TRUS	TURP	Cefazolin (9)	Cure
14	No growth	No growth	No growth	TRUS	TU-I	Cefazolin (9)	Cure
15	*K. pneumoniae*	No growth	No growth	TRUS	TURP	Cefazolin (5)	Infectious complication
16	*K. pneumoniae*	*K. pneumoniae*	*K. pneumoniae*	CT	Open incision	Cefotaxime (26)	Died (26)
17	*K. pneumoniae*	No growth	*K. pneumoniae*	CT+TRUS	TRNA	Ciprofloxacin (62)	Cure

Abbreviations: ND = not done; TRUS = transrectal ultrasound; CT = computed tomography; TU-I = transurethral incision of the prostate; TRNA = transrectal needle aspiration; TPNA = transperineal needle aspiration; TURP = transurethral resection of the prostate
[a]Days from admission to death.

death in 2 of these 3 patients. The other patient died of *A. baumannii* and VRE bacteremia. Fourteen (82%) patients completely recovered from the disease. The mean hospital stay was about 20 days (range, 4-98 days) and the mean duration of follow-up among the survivors was 4.5 months (range, 2-8 months). The mean duration of antimicrobial therapy for PA was 49 days (range, 5-209 days). The most frequent prescription was ciprofloxacin, which was given in 9 (53%) patients.

Discussion

Prostatic abscess is an infrequent condition in the modern antibiotic era, with an incidence of 0.5% to 2.5% of all prostatic diseases [25,26]. However, PA remains a serious disease with an estimated mortality rate of 3% to 30% [27]. Prostatic abscess can occur in patients of any age but is mainly found in men in their 5th and 6th decade of life [21].

Prostatic abscess is generally thought to develop secondarily to reflux of infected urine into the prostate [28-30] or hematogenous dissemination [12]. The former is the most common pathologic mechanism of this disease and stasis of urine may play an important role in providing the source of infection [12,28-30]. Abscesses are usually located in the periphery of the gland because the ducts draining this area are longer and more curvilinear and their layout contributes to reflux [12,28,29]. Other possible routes of infection include ascending urethral infection and invasion by rectal bacteria via direct extension or lymphogenous spread. The former may be an important route of infection in gonococcal PA and prostatitis [2,3,30], and the later is related to preceding hemorrhoidectomy, as in 2 cases of this series.

Predisposing factors for PA include diabetes mellitus, urethral instrumentation, prostatitis, indwelling urinary catheter, chronic renal failure, and prostatic cancer [20-22]. Not surprisingly, diabetes mellitus played a predominant role (8 patients, 53%) in this series. Although sclerosing injection for hemorrhoids has been emphasized as a possible predisposing factor for PA [31,32], hemorrhoidectomy has not been reported in association with PA in the in the past few decades. The present data also suggest that cirrhotic patients and those receiving hemorrhoidectomy represent other groups of patients susceptible to PA.

Clinical diagnosis of PA is difficult to make by history taking and physical examination because the symptoms and signs of PA are usually variable and not specific. The presenting symptoms of PA could also be referred from other diseases of the urinary tract, such as prostatitis, benign prostate hypertrophy, prostatic cancer, cystitis, and acute pyelonephritis [20]. In this

series, the condition usually presented as an irritant voiding syndrome, with suprapubic pain, fever, and occasionally presented as urine retention. Fluctuation in the prostate is suggestive of abscess formation [12], and is not always found on digital rectal examination.

In the pre-antibiotic era, *Neisseria gonorrhoeae*, a sexually transmitted organism, was the major causative pathogen of PA [4,33]. The microbiology of PA has undergone a complete metamorphosis in the antibiotic era. In recent reports, the common organisms were *E. coli*, *Staphylococcus* species, and other enteric gram-negative bacilli [12,19,20,25,34]. In contrast, more than half of the cases in this series were caused by *K. pneumoniae*, including 5 patients with PA alone and 3 patients with PA and other metastatic infectious lesions. These findings indicate that *K. pneumoniae* can reach the prostate gland via infected urine reflux or a hematogenous route. However, as the prevalence of immunocompromised individuals increases in the modern era, the potential for uncommon fastidious pathogens to infect the prostate gland, particularly mycobacterial, fungal, and anaerobic pathogens, and mycoplasma, in addition to typical gram-negative bacilli, will make the diagnosis of PA more complicated [19,35].

As for the clinical management of small PA (<1.5 cm in diameter), conservative management with antimicrobial therapy alone is recommended [12]. For larger abscesses, the treatment of choice is drainage in conjunction with antimicrobial therapy. Drainage can be achieved by a number of routes and methods, including transperineal or transrectal needle aspiration, open perineal incision and drainage, and transurethral incision (unroofing) or resection (deroofing) of the prostate [12,13,20]. Transurethral resection of the prostate had been recommended as the treatment of choice [22,36]. However, owing to the risk of urethral stricture, retrograde ejaculation, and urinary incontinence [12,37], some authors suggest use of TURP in whom ultrasound-guided drainage has failed or is inadequate, or in cases with bladder outlet obstruction [12,19,37]. By TRUS guidance, needle aspiration can be safely and easily performed via transrectal or transperineal route [12,19,20,37].

It is difficult to evaluate the data on clinical efficacy of chemotherapy for PA from previous studies because the type, dose, and duration of antimicrobial agents were not usually specified. Thus, no consensus has been established on the definitive antimicrobial therapy for PA. Many antibiotics diffuse poorly into the normal prostate, but intense inflammation of the gland may allow ready diffusion of these agents [20,36]. New fluoroquinolones have been shown to have excellent penetration into the prostate, with very low minimum inhibitory concentrations for the potential pathogens of bacterial prostatitis [37,38]. However, data is limited on their penetration into PA.

In conclusion, PA is a rare infectious disease that often occurs in the elderly with diabetes mellitus. It is difficult to make this diagnosis based merely on clinical presentations and physical examinations. Prostatic abscess should be considered in patients with lower urinary tract obstructive symptoms and unexplained fever, and who are unresponsive to optimal management [19]. Transrectal ultrasound and CT scan are reliable tools to establish or to exclude the diagnosis of PA, and also facilitate subsequent appropriate management. *K. pneumoniae* has been well recognized to be the leading causative pathogen of pyogenic liver abscess, endophthalmitis, or pyogenic meningitis in Taiwan [39-41]. This study suggests that *K. pneumoniae* is also the major pathogen of pyogenic PA. Due to the low incidence of PA and the absence of well-designed, prospective clinical studies, it is difficult to recommend a standard therapeutic algorithm. The choice of draining procedure should be individualized, depending on the size and localization of the abscesses, as well as on its extension to the structures in the vicinity of prostate. The need for effective and prolonged antibiotic therapy for PA cannot be overemphasized to achieve a favorable outcome [19].

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