

Retrospective Study

Renal and perinephric abscesses in West China Hospital: 10-year retrospective-descriptive study

Xiao-Qin Liu, Cheng-Cheng Wang, Yan-Bin Liu, Kai Liu

Xiao-Qin Liu, Cheng-Cheng Wang, Yan-Bin Liu, Kai Liu,
Center of Infectious Diseases, West China Hospital of Sichuan
University, Chengdu 610041, Sichuan Province, China

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Correspondence to: Dr. Kai Liu, Center of Infectious Diseases, West China Hospital of Sichuan University, 37 Guoxuexiang, Wuhou District, Chengdu 610041, Sichuan Province, China. liubusiness@163.com
Telephone: +86-28-85423597
Fax: +86-28-85423597

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Abstract

AIM: To elucidate the clinical, radiological and laboratory profiles of renal abscess (RA) and perinephric abscess (PNA), along with related treatment and outcome.

METHODS: Ninety-eight patients diagnosed with RA or PNA using the primary discharge diagnoses identified from the International Statistical Classification of Diseases and Related Health Problems Tenth Edition (ICD-10) codes (RA: N15.101, PNA: N15.102) between September 2004 and December 2014 in West China Hospital were selected. Medical records including patients' characteristics, symptoms and signs, high-risk factors, radiological features, causative microorganisms and antibiotic-resistance profiles, treatment approaches, and clinical outcomes were collected and analyzed.

RESULTS: The mean age of the patients was 46.49 years with a male to female ratio of 41:57. Lumbar pain (76.5%) and fever (53.1%) were the most common symptoms. Other symptoms and signs included chills (28.6%), anorexia and vomiting (25.5%), lethargy (10.2%), abdominal pain (11.2%), flank mass (12.2%), flank fistula (2.0%), gross hematuria (7.1%), frequency (14.3%), dysuria (9.2%), pyuria (5.1%) and weight loss (1.0%). Painful percussion of the costovertebral angle (87.8%) was the most common physical finding. The main predisposing factors were lithiasis (48.0%), diabetes mellitus (33.7%) followed by history of urological surgery (16.3%), urinary tract infections (14.3%), renal function impairment (13.3%), liver cirrhosis (2.0%), neurogenic bladder (1.0%), renal cyst (1.0%), hydronephrosis (1.0%), chronic hepatitis B (1.0%), post-discectomy (1.0%) and post-colectomy (1.0%). Ultrasound (US) and computed tomography were the most valuable diagnostic tools and US was recommended as the initial diagnostic imaging choice. *Escherichia coli* (51.4%), *Staphylococcus aureus* (10.0%) and *Klebsiella pneumoniae* (8.6%) were the main causative microorganisms. Intravenous antibiotic

therapy was necessary while intervention including surgical and nonsurgical approaches were reserved for larger abscesses, multiple abscesses, PNAs and non-responders.

CONCLUSION: Heightened alertness, prompt diagnosis, and especially proper antibiotics in conjunction with interventional approaches allow a promising clinical outcome of renal and perinephric abscesses.

Key words: Renal abscess; Causative pathogens; Perinephric abscess; Diagnosis; Antibiotic resistance; Interventional treatment; Conservative treatment

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Core tip: Renal and perinephric abscesses are uncommon but potentially lethal infectious diseases and the case-fatality rates most frequently cited in previous studies are still high. However, the previous case-fatality rates need to be updated, since prompt diagnosis and appropriate therapeutic strategies have contributed to lower mortality. This article reports the characteristics of patients identified with renal or perinephric abscesses and shares the management experience and outcome in West China Hospital during the last decade.

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INTRODUCTION

Renal abscess (RA) is defined as encapsulated pus confined to the renal parenchyma and is further divided into renal cortical or corticomedullary abscess^[1]. Perinephric abscess (PNA) is a collection of suppurative material located between Gerota's fascia and the renal capsule^[2]. Complications of urinary tract infections (UTIs) and hematogenous seeding from primary infected sites are the common source of infection^[2,3]. Additionally, rupture of renal cortical abscess or renal carbuncle can result in the formation of PNA^[2].

As a result of its anatomical location and potential to spread, RA is potentially lethal and the prognosis can be poor, especially in immunosuppressed and cachectic patients^[1,4]. PNA originates from hematogenous dissemination, and often has an acute presentation with pain and high spiking temperatures^[2], while in most cases, PNA is notoriously silent clinically^[2,3], thereby the diagnosis can be challenging^[2]. It is reported that only 35%-38% of patients with PNA are correctly diagnosed at the time of admission^[5,6]. The mortality rates of RA and PNA in recent series are reported to range from 1% to 14%^[3,7-12], while complicated abscess may carry

a higher mortality^[1]. Due to the above situation, a retrospective-descriptive study was conducted with 98 relevant cases identified with RA and PNA between September 2004 and December 2014 in West China Hospital, in an attempt to recognize the disease and describe our experience with it over the past 10 years.

MATERIALS AND METHODS

The data presented in this study were obtained from medical records of patients selected using the primary discharge diagnoses identified from the International Statistical Classification of Diseases and Related Health Problems Tenth Edition (ICD-10) codes (RA: N15.101, PNA: N15.102) during the last decade in our hospital. Suspected patients were diagnosed based on both clinical and radiological criteria. Abscesses ≤ 3 cm were defined as small, medium 3-5 cm, and > 5 cm large. The rule that culture findings guide selection of an antibiotic regimen was firmly followed, while before the culture results were obtained, initial empirical antibiotics were provided once a clinical diagnosis of RA and PNA was made. Antibiotics typically included piperacillin plus amikacin and metronidazole, piperacillin/tazobactam or third-generation cephalosporin plus metronidazole, or quinolones plus metronidazole. When patients had a severe condition such as sepsis or were prone to infection with extended-spectrum β -lactamase (ESBL)-producing organisms, carbapenem antibiotics (*e.g.*, imipenem/cilastatin) were also included in prescription.

Treatment modes were subdivided into two groups: Conservative treatment and interventional treatment. The latter comprised five categories: Antibiotics plus percutaneous drainage; antibiotics plus double J tube insertion; antibiotics plus nephrostomy; antibiotics plus surgical drainage; and antibiotics plus nephrectomy. Since improvement in clinical manifestations usually precedes that in radiological imaging findings, patients were mainly assessed by their clinical improvement. The clinical outcome was classified as cure, clinical improvement (mainly including remission or disappearance of initial symptoms, shrinkage of the abscess cavity upon imaging, recovery of white blood cell and neutrophil counts, and negative results for blood and urine culture), or death.

Biostatistics

The statistical methods of this study were reviewed by Liang Huang from Center of Infectious Diseases, West China Hospital of Sichuan University, Chengdu, Sichuan Province, China.

RESULTS

Patient characteristics

Among the 98 patients, there were 41 (41.8%) men and 57 (58.2%) women. The age ranged from 18 to 75 years with a mean of 46.49 ± 15.07 years. RA was observed in 68 (69.4%) patients and PNA in 30 (30.6%).

Table 1 Characteristics of patients with renal or perinephric abscesses *n* (%)

Variables	Value	
	Total (<i>n</i> = 98)	
Lumbar pain	75 (76.5)	
Fever	52 (53.1)	
Chills	28 (28.6)	
Anorexia and vomiting	25 (25.5)	
Lethargy	10 (10.2)	
Abdominal pain	11 (11.2)	
Flank mass	12 (12.2)	
Flank fistula	2 (2.0)	
Gross hematuria	7 (7.1)	
Frequency	14 (14.3)	
Dysuria	9 (9.2)	
Pyuria	5 (5.1)	
Loss of weight	1 (1.0)	
Painful percussion of the CVA	86 (87.8)	

CVA: Costovertebral angle.

Fifteen patients (15.3%) had no identifiable systemic or urological disorder that might have been involved in abscess formation, whereas for other patients, the spectrum of predisposing factors remained consistent with conventional predisposing factors: Diabetes mellitus (*n* = 33, 33.7%); lithiasis (*n* = 47, 48.0%) which included renal calculi (*n* = 32, 32.7%), ureteric calculi (*n* = 5, 5.1%), renal and ureteric calculi (*n* = 10, 10.2%); history of urological surgery (*n* = 16, 16.3%); UTIs (*n* = 14, 14.3%); renal function impairment (*n* = 13, 13.3%); liver cirrhosis (*n* = 2, 2.0%); neurogenic bladder (*n* = 1, 1.0%); and other diseases (*n* = 5, 5.1%) including one each with renal cyst, hydronephrosis, and chronic hepatitis B, post-discectomy and post-colectomy.

The most common initial symptoms were lumbar pain (*n* = 75, 76.5%) and fever (*n* = 52, 53.1%). Each grade of fever was observed: 38 °C-39 °C in approximately 31.6%, 39.1 °C-41 °C in approximately 20.4%, and absent or low-grade fever in 48.0%. Painful percussion of the costovertebral angle (*n* = 86, 87.8%) was the most common physical finding (Table 1). Patients with RA in this study were more inclined to experience lethargy than PNA (*P* < 0.05) and there was no statistical significance in other symptoms when compared RA with PNA (*P* > 0.05).

Laboratory data and abscess characteristics

There was no significant difference between RA and PNA in white blood cell count (*W* = 996.5, *P* > 0.05), neutrophil count (*W* = 947, *P* > 0.05), hemoglobin (*W* = 0.9773, *P* > 0.05), blood urea nitrogen (*W* = 992, *P* > 0.05) and serum creatinine (*W* = 1038, *P* > 0.05). Hematuria and leukocyturia were most common findings in urine test (Table 2). Of the 98 patients, 77 (78.6%) patients had a solitary abscess and 10 (10.2%) had multiple abscesses. The right side (55.1%) remained the predominant anatomical site and bilateral abscesses were found in two (2.0%) cases. The average size of

Table 2 Blood and urine analysis

Variables	Value	
	RA	PNA
Blood analysis	64	
WBC (10 ⁹ /L)	10.82 (range: 2.42-29.95)	12.40 (range: 2.68-25.45)
NEUT (%)	81.00 (range: 48.30-96.00)	79.00 (range: 49.30-94.70)
HGB (g/L)	105.75 ± 22.52	101.66 ± 20.13
BUN (mmol/L)	5.26 (range: 1.10-20.30)	5.10 (range: 2.80-23.18)
Serum creatinine (umol/L)	82.00 (range: 25.10-346.00)	86.60 (range: 49.00-560.0)
Urine analysis	64	
No finding (%)	13 (13.3)	3 (3.1)
Hematuria (%)	47 (48.0)	23 (23.5)
Pyuria (%)	16 (16.3)	8 (8.2)
Proteinuria (%)	32 (32.7)	16 (16.3)
Leukocyturia (%)	41 (41.8)	23 (23.5)

RA: Renal abscess; PNA: Perinephric abscess; WBC: White blood cell; NEUT: Neutrophil count; HGB: Hemoglobin; BUN: Blood urea nitrogen.

RA and PNA was 6.25 (range: 0.50-17.00) cm and 8.35 (range: 4.50-20.00) cm, respectively. The average size of abscess was 4.00 (range: 1.80-10.50) cm in the conservative group, and 7.65 (range: 0.50-20.00) cm in the interventional group (Table 3).

Microbiological data

The results of blood, abscess and urine culture were available for 92, 54 and 91 patients, respectively. Blood and urine cultures were positive in 13 (14.1%) and 23 (25.3%) patients, respectively, and pathogenic organisms were isolated from pus in 33 (61.1%) cases. Of all the positive cultures (*n* = 69), the most frequently isolated pathogen was *Escherichia coli* (*n* = 35, 50.7%) followed by *Staphylococcus aureus* (*S. aureus*) (*n* = 7, 10.1%), *Klebsiella pneumoniae* (*K. pneumoniae*) (*n* = 6, 8.7%), *Pseudomonas aeruginosa* (*n* = 3, 4.3%), *Candida spp.* (*n* = 7, 10.1%), *Enterobacteriaceae* (*n* = 6, 8.7%), *Enterococcus faecium* (*n* = 2, 2.9%), *Enterococcus faecalis* (*n* = 1, 1.4%) and *Aspergillus spp.* (*n* = 2, 2.9%). *E. coli* was more frequently found in patients with RA than those with PNA ($\chi^2 = 6.832$, *P* < 0.01), while there was no significant difference in the distribution of *K. pneumoniae* (*P* > 0.05), *S. aureus* (*P* > 0.05) and *Candida spp.* (*P* > 0.05) (Table 4). We detected ESBL in the isolated strains of *E. coli* in 12 (17.4%) cases and *K. pneumoniae* in one (1.4%) case. We analyzed the antibiotic resistance of *E. coli*, *S. aureus* and *K. pneumoniae* isolated from blood, abscess and urine culture (Table 5).

Imaging studies

Imaging results were available for 97 patients. Ultrasound (US) was applied in 80 cases and alone in 31 (31.6%) cases. Computed tomography (CT) was performed in 63 cases and alone in 16 (16.3%) cases. Magnetic resonance imaging (MRI) was applied in three cases and alone in one (1.0%) case. The imaging results are shown in Table 6.

Table 3 Treatment and outcome

Variables	Abscess size (cm)	Hospital stay (d)	No. of Patients (RA/PNA)	Cure (RA/PNA)	Clinical improvement (RA/PNA)	Death (RA/PNA)
Ab	4.00 (range: 1.80-10.50)	20.7	23 (19/4)	2 (2/0)	21 (17/4)	0 (0/0)
Intervention	7.65 (range: 0.50-20.00)	15.9	75 (49/26)	54 (38/16)	20 (10/10)	1 (1/0)
Ab + PCD			8	3	4	1
Ab + pigtails			2	1	1	0
Ab + nephrostomy			4	0	4	0
Ab + SD			29	21	8	0
Ab + NC			32	29	3	0
RA	6.25 (range: 0.50-17.00)		68	40	27	1
PNA	8.35 (range: 4.50-20.00)		30	16	14	0

Ab: Antibiotic; PCD: Percutaneous drainage; SD: Surgical drainage; NC: Nephrectomy.

Table 4 Causative microorganisms isolated from blood, abscess and urine culture

Variables	Culture		
	Blood (Total = 92)	Pus (Total = 54)	Urine (Total = 91)
No finding	79	21	68
Escherichia coli	8	17	10
Staphylococcus aureus	2	4	1
Klebsiella pneumoniae	1	3	2
Pseudomonas aeruginosa	1	1	1
Other			
Enterobacteriaceae	1	3	2
Enterococcus faecium	0	0	2
Enterococcus faecalis	0	1	0
Candida	0	2	5
Aspergillus	0	2	0

Treatment and outcome

The average hospitalization duration was 17 d (range 5-92 d). Of the 98 patients, 23 (23.5%) received conservative treatment and 75 (76.5%) received an interventional procedure. Fifty-seven (58.2%) patients were cured, 40 (40.8%) showed clinical improvement by the time of hospital discharge, and one (1.0%) died of multiple organ dysfunction syndrome. Interventional treatment contributed to a better clinical outcome than conservative treatment ($Z = -3.897, P < 0.01$). The outcome tended to be better in patients with RA than in those with PNA irrespective of the therapeutic mode ($Z = -8.027, P < 0.01$) (Table 3).

DISCUSSION

RA refers to a collection of purulent material within the kidney^[13]. PNA represents an extensive infection in the perinephric space^[2]. It is reported that approximately 30% of PNAs come from hematogenous dissemination^[2], whereas in most cases, they result from rupture of RA^[12,14]. Previous data show that > 80% of PNAs occur secondary to renal tract calculi with ascending UTIs^[15].

RAs and PNAs are seen in all age groups and those aged 42.3-71.62 years were previously reported to be the dominant population^[10-12,16-19]. A similar result was found in the present study. A slight predominance in

Table 5 The antibiotic resistance rate of causative pathogens isolated

Variables	Causative pathogens isolated		
	Escherichia coli (n = 35)	Klebsiella pneumoniae (n = 6)	Staphylococcus aureus (n = 7)
Penicillin (%)	85.0	100.0	62.5
Levofloxacin (%)	46.2	0	50.0
Gentamicin (%)	53.3	0	50.0
Amikacin (%)	5.0	0	-
Cefotaxime (%)	61.1	50.0	50.0
Ceftriaxone (%)	63.2	50.0	-
Imipenem/cilastatin (%)	0	0	60.0
Vancomycin (%)	-	-	0
ST (%)	70.0	0	37.5

ST: Trimethoprim-sulfamethoxazole.

Table 6 Imaging results

Results	Imaging tool		
	US (Total = 80)	CT (Total = 63)	MRI (Total = 3)
Negative (%)	2 (2.0)	1 (1.0)	
Abscess (%)	23 (23.5)	37 (37.8)	1 (1.0)
Hydronephrosis (%)	26 (26.5)	8 (8.2)	
Mass (%)	13 (13.3)	11 (11.2)	2 (2.0)
Echogenic alteration (%)	11 (11.2)		
Cyst (%)	4 (4.1)	4 (4.1)	
Hematoma (%)	1 (1.0)	2 (2.0)	

US: Ultrasound; CT: Computerized tomography; MRI: Magnetic resonance imaging.

women was noted, while in previous studies, the male: Female ratio was reported as 1:3-1:7^[7,18,20], and a female predominance as high as 91.8% was also observed^[16].

Diagnosis of RA or PNA remains challenging because the symptoms can be insidious and obscure^[1,2]. Patients with RA may present with fever, chills, flank or abdominal pain, fatigue, nausea, decreased appetite, weight loss and even persistent hiccups^[7,21,22]. In our study, fever was not always accompanied by chills and the high percentage of absent/low-grade fever might be explained by prior antibiotic therapy. Patients with PNA often present with anorexia, nausea and vomiting, flank

pain, flank mass, signs of sepsis, weight loss, fistula formation and urinary tract complaints^[2,4,15,22]. However, patients with RA were more likely subjected to lethargy in this study.

Consistent with previous studies, lithiasis (48.0%) and diabetes mellitus (33.7%) remained the pre-dominant risk factors in the present study^[3,8,9,12,16,22]. Diabetes mellitus accounts for 33.3%-62.5% of all PNAs^[2,7,23] 43.5%-47% of RAs^[7,16,17] and 28%-50% of RAs and PNAs^[3,7,10,11]. Anatomical malformation of the urinary tract, vesicoureteral reflux and obstructive tumors in renal polycystic disease are other previously described risk factors^[1,18]. There was no significant difference between RA and PNA in white blood cell count, neutrophil count, hemoglobin, blood urea nitrogen and serum creatinine, which suggested that patients with RA and PNA shared similar inflammation reaction level and risk of renal impairment in this study.

US, CT and MRI were necessary to establish reliable preoperative diagnosis. US as the initial and classical imaging modality is utilized to measure renal size, discern focal lesions, and detect the true nature of a fluid-containing mass and obstruction of the collecting system. US is not affected by poor renal function or allergy to contrast material^[24,25]. The accuracy of US in the diagnosis of RA is reported to be 70%-93%^[3,23] with sensitivity and specificity of 78.2% and 88.8%, respectively^[23].

CT has been documented to diagnose RA or PNA with an accuracy of 92%-96.4%^[3,6], with specificity of 88%^[23]. In our study, the accuracy of US and CT was 23.7% and 38.1%, respectively. However, when we combined the imaging results with clinical and laboratory data, the final diagnostic accuracy was 52.0%, and the average duration between admission and diagnosis was 2.16 d. With its convenience, accuracy, availability and low cost, US has made a major contribution to accurate and early diagnosis at our unit.

Since ascending dissemination of UTI has surpassed hematogenous dissemination and become the dominant predisposing factor^[6,18], Gram-negative bacteria, especially *E. coli*, *Proteus* spp. and *K. pneumoniae* have been the most common pathogens in recent years^[3,10,16,18]. In this study, *E. coli* was most frequently isolated from patients with RA than those with PNA. Polymicrobial abscesses have been increasingly frequently observed, ranging from 19.2% to 33.3% in incidence^[7,9]. Two (2.0%) polymicrobial cases were found in the present study. There has been an increasing incidence of abscesses caused by fungi, especially *Candida*, particularly in immunosuppressed patients^[7,12,18], and similar cases were observed in this study.

The selection of antimicrobial therapy ideally should be based on culture findings, however, there is an inevitable delay in obtaining results^[2]. We recommend that empirical broad-spectrum intravenous antibiotics should be initiated for critically ill patients after admission. Once the blood or abscess fluid cultures and bacterial isolation tests are confirmed, targeted antibiotic

regimens should be prescribed accordingly.

There is a consensus that small RAs may resolve with antibiotic treatment alone, and percutaneous or surgical drainage may be suitable for large RAs and PNAs. However there is a continuing argument about the proper treatment of middle-sized abscesses^[3,5,7,16].

Although the option of conservative management of RAs and PNAs seems attractive and feasible and successful cases have been reported^[4,16], those cases were selected and limitations in size, location and number of abscesses were obvious and in Iwamoto's case, the patient had received percutaneous drainage prior to conservative treatment^[4].

In the present study, interventional approaches helped to detect the cause of disease and confirm the diagnosis, and culture of pus/aspirate/debris helped guide selection of an antibiotic regimen. The diagnostic and therapeutic value of percutaneous drainage has been confirmed since early years^[26]. The application of interventional procedures contributed to a lower case-fatality rate and lower risk for intensive care unit (ICU) admission^[6,9]. Patients subjected to interventional treatment achieved a better clinical outcome than those received conservative treatment and the cure rate of interventional treatment was 27 times higher than that of conservative treatment. On the other hand, patients with RA were more likely to achieve a better prognosis than those with PNA irrespective of the therapeutic regimens.

The mean duration of hospitalization in the interventional treatment group was 15.9 d compared with 20.7 d in the conservative treatment group. In 2011-2014, the bed turnover time in the urological department of our hospital was 9.687, 9.623, 8.92 and 8.62 d, respectively. In consideration of the pressure relating to bed turnover time, interventional treatment could be a better alternative mode to meet the social needs.

Several limitations should be noted in the present study. First, the number of patients selected was not large enough, and exclusive reliance on the claims data might have resulted in potential bias. A larger population-based retrospective-descriptive study is needed to extrapolate better and confirm our results. Second, the imaging tools were not manipulated by the same technician, thus there is inevitable error in the imaging results obtained. Finally, the number of causative microorganisms isolated from pus/blood/urine was small. In fact, the isolation rates of ESBLs of *E. coli* and *K. pneumoniae* (excluding ICU) in our hospital in 2013 were 59.8% and 29.7%, respectively. The antibiotic resistance rate of *E. coli* to penicillin, cefotaxime, gentamicin, amikacin, trimethoprim-sulfamethoxazole and imipenem/cilastatin was 88.9%, 60.7%, 44.8%, 3.0%, 56.9% and 0.7%, respectively. The antibiotic resistance rate of *K. pneumoniae* was 78.8%, 26.2%, 16.6%, 4.9%, 25.2% and 1.5%, respectively. The antibiotic resistance rate of *S. aureus* to penicillin, gentamicin, sulfamethoxazole and vancomycin was 94.1%, 29.3%, 20.5% and 0%, respectively.

Since RA and PNA can be lethal^[3,6], to reduce the fatality rate when clinical suspicion is around, we recommend that physicians use US for primary evaluation and proceed to CT for confirmation. For small abscesses, intravenous antibiotics alone seem efficient. Interventional regimens are the first-line treatment for larger RAs, multiple abscesses, PNAs, and non-responders. The mode of therapy for medium-sized abscesses should depend on an individual basis, with due consideration of the clinical scenario and risk factors. However, interventional treatment is more capable of offering a promising clinical outcome and better bed turnover time and social benefits.

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COMMENTS

Background

Renal and perinephric abscesses are severe complications of urinary tract infections. Since their symptoms are insidious, the diagnosis can be challenging. Awareness combined with efficient imaging and laboratory results contribute to timely diagnosis, and appropriate treatments can lead to a good outcome and low mortality.

Research frontiers

Conservative treatment is currently reported to be practical for perinephric abscess (PNA) or larger renal abscess (RA) in certain cases, but in most cases, interventional treatment remains the classical therapy.

Innovations and breakthroughs

This study collected 98 patients diagnosed with RA or PNA in West China Hospital during the past decade. The clinical and laboratory profiles of these patients were described and analyzed. The study revealed the local epidemiological features of RA and PNA, and advocated interventional treatment for PNA and large or medium-sized RA.

Applications

This study sorted the clinical and laboratory data of RA and PNA, aiming to help strengthen the awareness of physicians and share the management experience.

Terminology

Extended-spectrum β -lactamase is an enzyme that can hydrolyze β -lactam antibiotics, including penicillins and cephalosporins. Bacteria that can produce extended-spectrum β -lactamase are resistant to β -lactam antibiotics.

Peer-review

The manuscript presents interesting data regarding the renal and perirenal abscesses for a 10-year period.

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