Renal Abscess: Invasive Treatment or not

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Research article

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Abstract

Objective

To identify possible clinical indicators to guide the choice of treatment in patients with renal abscess.

Methods

According to different treatment methods, 38 patients initially diagnosed with renal abscess and received no prior treatment (antipyretics excepted) in our institution from April 2006 to November 2019 were divided into conservative treatment group and invasive treatment group, with the clinical data of all the cases being analyzed retrospectively.

Results

In the conservative treatment group, 19 patients got success and 1 failed in initial treatment, while in the invasive treatment group, 15 patients got success and 3 failed. Of the 4 patients who failed the initial treatment, 3 had a renal abscess between 3 cm and 5 cm, and 1 failed due to long-term use of bone marrow suppressive drugs. In univariate analysis, there were significant differences between the two groups in the following factors: diabetes mellitus, body temperature ≥ 38.5℃, PLT, RDW, BUN, PLR, AG, WBC in urine, size of abscess. In logistic regression analysis, diabetes mellitus, RDW and size of renal abscess were retained. The cut-off of RDW and size of renal abscess were 14.07% and 3.9 cm respectively.

Conclusions

Size of renal abscess is still the most important factor that determining treatment modalities. Other than size, high RDW and the comorbidity of diabetes mellitus may also be used as the possible clinical indicators for the determination of invasive treatment, especially in patients with renal abscess between 3 ~ 5 cm in size.

Introduction

Renal abscess confined to the renal parenchyma is an uncommon infectious disease of the urinary system, with an incidence of 1 to 10 in 10,000 hospital admissions [1] but mortality reaching up to 8.3% [2, 3]. Ascending infection of lower urinary tract is the most common mechanism of infection [4]. In addition, hematogenous spread and direct spread from an inflamed or infected area in the proximity of the kidney are also the mechanisms [5]. Thus, the empirical antibiotic therapy with Fluoroquinolones, aminopenicillin plus Group 2, 3a cephalosporin or aminoglycoside is necessary [6]. There are four clinical treatment

methods for renal abscess including medical treatment only, percutaneous drainage, surgical drainage, and nephrectomy [7]. The choice of treatment for patients with renal abscess has been studied by many scholars, but the focus has been mainly on the size of the renal abscess and response to antibiotic therapy. It is generally accepted that conservative treatment is effective for renal abscess less than 3 cm and less effective for renal abscess larger than 5 cm. There is still a debate on whether surgical intervention is necessary for renal abscess between 3 ~ 5 cm [2, 4, 8–11]. Since the presence of controversy and the singular concern of size and response to antibiotic therapy, we designed this retrospective study by analyzing the data of patients with renal abscess in our institution to detect factors that may guide appropriate treatment.

Materials And Methods

Patients and diagnosis

The clinical data of 38 patients initially diagnosed with renal abscess and received no prior treatment (antipyretics excepted) at Peking University People's Hospital from April 2006 to November 2019 were reviewed. The patient with no completed image data was not included in this study. This study was carried out in accordance with the ethical standards of the institutional and research committee of Peking University.

Treatments

Presently, there are four clinical treatment methods for renal abscess including medical treatment only, percutaneous drainage, surgical drainage, and nephrectomy [7, 12]. In this study, these four treatment methods were divided into two modalities, conservative treatment (medical treatment only) and invasive treatment (percutaneous drainage, surgical drainage, and nephrectomy). For each patient, the concrete treatment modality was chosen by the physicians after the comprehensive evaluation which involved the severity of infection, imaging presentation and patient's general condition. Both these two modalities received empirical antibiotics treatment (fluoroquinolone, PIPC plus beta lactamase inhibitor, group 3b cephalosporin, or carbapenem) [13] and the antibiotic would be adjusted according to the outcome of the culture of urine or the drainage of renal abscess and the response of empirical antibiotic therapy.

Study Design and Examined Factors

To detect the possible factors that may guide the choice of clinical treatment on admission, the clinical data of patients received conservative treatment and invasive treatment were retrospectively analyzed and compared. The data mainly included three aspects: basic characteristics of patients, laboratory examination results and imaging data. Age, gender, symptom and comorbidity were treated as the basic characteristics of patients. Fever was defined as a body temperature greater than or equal to 37.3℃. The size of single renal abscess was measured in terms of its maximum diameter, while multiple renal abscesses were measured in terms of the sum of their maximum diameters.

Statistical Analyses

All the data analysis was conducted using IBM SPSS Statistics Version 25.0. Univariate and multivariate tests were performed respectively. The independent samples T test and Mann-Whitney U Test were used respectively for the continuous variables. Fisher's Exact Test was used for the classification variables due to the number of cases was less than 40. The *p* value less than 0.05 was viewed as the establishment of statistical significance.

Results

Patient Characteristics

Patient characteristics and comparison of conservative and invasive treatment were represented in Table 1. Briefly, there were 24(63.16%) female patients and 14(36.84%) male patients. The clinical manifestations of renal abscess varied significantly, with fever (76.32%) and lumbago (52.63%) the most common. It could also manifest as chills, abdominal pain, nausea, vomiting, etc. Diabetes and urolithiasis were the most common comorbidities in this study, accounting for 42.11% and 42.11% respectively. 20 (52.63%) patients received conservative treatment and 18 (47.37%) patients received invasive treatment. Compared the basic characteristics of the patients in these two groups, there were significant differences in diabetes and body temperature greater than or equal to 38.5℃, with a *p* value of 0.008 and 0.025 respectively. While no significant differences were found in age, gender, symptom and comorbidity (diabetes excepted).

Table 1
Patient characteristics and comparison of conservative and invasive treatment

Characteristic	Overall(n = 38)	Conservative treatment(n = 20)	Invasive treatment(n = 18)	*P* Value
Age, Mean ± SD	48.87 ± 15.89	46.45 ± 16.69	51.56 ± 14.97	0.330
Gender, N (%)				
Male	14(36.84)	7(35.0)	7(38.89)	0.804
Female	24(63.16)	13(65.0)	11(61.11)	
Symptom, N (%)				
Fever	29(76.32)	15(75.0)	14(77.78)	1.000
Fever ≥ 38.5°C	16(42.11)	12(60.0)	4(22.22)	0.025
Chills	6(15.79)	5(25.0)	1(5.56)	0.184
Abdominal pain	5(13.16)	3(15.0)	2(11.11)	1.000
Lumbago	20(52.63)	8(40.0)	12(66.67)	0.119
Lethargy	6(15.79)	3(15.0)	3(16.67)	1.000
Nausea and vomiting	10(26.32)	6(30.0)	4(22.22)	0.719
Comorbidity, N (%)				
Diabetes	16(42.11)	4(20.0)	12(66.67)	0.008
Urolithiasis	16(42.11)	6(30.0)	10(55.56)	0.188
Hepatitis	6(15.79)	4(20.0)	2(11.11)	0.663
Renal dysfunction	6(15.79)	4(20.0)	6(33.33)	0.083

Laboratory Tests and Imaging

All the patients received blood and urine test on admission. The concrete outcome of laboratory examination was presented in Table 2. Significant differences were found in PLT, RDW%, BUN, PLR, AG and WBC in urine. All the imaging data were collected on CT scans which had a high accuracy rate for diagnosis, advantage of being superior in diagnosis than ultrasound and less cost than MRI [14, 15]. The average size in overall patients, conservative treatment group and invasive treatment group were 4.23 ± 0.27 cm, 2.77 ± 1.48 cm, 5.85 ± 2.67 cm respectively, with a p value < 0.001 (Table 2).

Table 2
Comparison of laboratory examination and imaging parameters in conservative and invasive treatment group

Laboratory examination and imaging parameters[a]	Overall(n = 38)	Conservative treatment(n = 20)	Invasive treatment(n = 18)	*P* Value
Blood test				
HGB	108.22 ± 26.15	115.64 ± 18.45	99.99 ± 31.17	0.065
WBC	8.62	8.62	8.745	0.260
PLT	285.08 ± 129.44	236.90 ± 118.44	338.61 ± 122.56	0.013
RDW, %	13.62	13.150	14.200	0.005
BUN, mmol/L	4.99	4.39	5.69	0.049
CRE, umol/L	69.5	66.5	81	0.084
NLR	3.98	3.3	5.095	0.144
PLR	181.26	146.945	285.105	0.024
TP, g/L	67	68.7	65.8	0.759
ALB, g/L	34.66 ± 6.51	36.16 ± 7.17	32.99 ± 5.40	0.136
AG	1.11 ± 0.27	1.21 ± 0.26	1.01 ± 0.26	0.021
Urine test				
NIT	3(7.89)	1(5.0)	2(11.11)	0.584
WBC in urine[b]	34.5	21	77	0.022

Abbreviation: HGB, haemoglobin; PLT, platelet count; RDW, distribution width of red blood cells; BUN, blood urea nitrogen; CRE, creatinine; NLR, neutrophil to lymphocyte ratio; PLR, platelet to lymphocyte ratio; TP, total protein; ALB, albumin; AG, albumin to globulin ratio; NIT, nitrite; WBC, white blood cell count; RBC, red blood cell.

[a] N (%) for the classification variables; Mean ± SD or Median for the continuous variables.

[b] The WBC in urine was the result per high power lens.

[c] Renal abscess combined with perirenal abscess.

Laboratory examination and imaging parameters[a]	Overall(n = 38)	Conservative treatment(n = 20)	Invasive treatment(n = 18)	*P* Value
RBC in urine[b]	10	8	20	0.428
Location				
Left	22(57.89)	11(55.0)	11(61.11)	0.752
Right	16(42.11)	9(45.0)	7(38.89)	
Number				
single abscess	23(60.53)	12(60.0)	11(61.11)	1.000
Multiple abscess	15(39.47)	8(40.0)	7(38.89)	
Size, cm	4.23 ± 0.27	2.77 ± 1.48	5.85 ± 2.67	< 0.001
Perirenal abscess [c]	13(34.21)	6(30.0)	7(38.89)	0.734

Abbreviation: HGB, haemoglobin; PLT, platelet count; RDW, distribution width of red blood cells; BUN, blood urea nitrogen; CRE, creatinine; NLR, neutrophil to lymphocyte ratio; PLR, platelet to lymphocyte ratio; TP, total protein; ALB, albumin; AG, albumin to globulin ratio; NIT, nitrite; WBC, white blood cell count; RBC, red blood cell.

[a] N (%) for the classification variables; Mean ± SD or Median for the continuous variables.

[b] The WBC in urine was the result per high power lens.

[c] Renal abscess combined with perirenal abscess.

Treatment outcome

In our study, 19 of the 20 patients who received conservative treatment responded to the treatment effectively, presenting with reduction of the size of renal abscess and elimination of clinical symptoms 3 months after the initial treatment. While for the 18 patients who received percutaneous drainage initially, there were 3 patients got no relieve, among which 1 patient received further treatment of surgical drainage and 2 patients got nephrectomy due to nonfunctioning kidney. Of the 4 patients who failed the initial treatment, 3 had a renal abscess between 3 cm and 5 cm, and 1 patient with large abscess failed due to long-term use of bone marrow suppressive drugs.

Urine and Abscess culture

Among 38 patients, there were 21 patients had urine culture, with 14 (66.67.0%) cases showed the outcome of negative. Of the 18 patients treated with invasive treatment, 15 (83.33%) underwent abscess culture, of whom 13 (86.67%) were positive. Five (33.33%) patients had abscesses caused by Escherichia

coli, followed by Klebsiella pneumoniae (20.0%), Pseudomonas aeruginosa (13.33%), Enterococcus faecalis (6.67%) and proteus mirabilis (6.67%).

Logistic Regression Analysis and ROC Curve

Diabetes mellitus (OR:35.22, 95%CI: 1.55 ~ 799.05, *P* = 0.025), RDW (OR:9.48, 95%CI: 1.15 ~ 78.02, *P* = 0.037) and size of renal abscess (OR:2.67, 95%CI:1.00 ~ 7.11, *P* = 0.025) were found to be possible predictors of invasive treatment. ROC curves were then plotted for RDW and size as continuous variables to identify possible thresholds for further clinical guidance, especially for 3 ~ 5 cm renal abscesses (Fig. 1). The cut-off of RDW was 14.07%, with sensitivity 90.00 and specificity 55.56. In addition, the cut-off of size of renal abscess was 3.9 cm, with sensitivity 95.00 and specificity 77.78.

Discussion

Renal abscess with low morbidity but high mortality should be paid more attention by clinician during clinical work. The early and accurate diagnosis was considered as an important factor affecting the outcome of renal abscess [14]. In addition, advanced age, lethargy and some laboratory examinations such as higher C-reactive protein levels and blood urea nitrogen are associated with poor prognosis and high probability of mortality [8, 15]. Although some studies had been conducted to discuss the best choice of treatment for patients with different abscess size, the appropriate choice is still controversial especially on the aspects that abscess size between 3 ~ 5 cm and waiting for a response to antibiotic therapy may delay surgical intervention, thus lead to poor prognosis. In 1996, Siegel proposed that renal abscess should be treated according to the size of the abscess [11]. In his proposal, small renal abscess (< 3 cm) were treated with antibiotics only, large renal abscess (> 5 cm) with invasive treatment, and the choice of treatment for medium renal abscess (3 ~ 5 cm) was determined by the patients' conditions and the response to the antibiotics. Both Lee BE and Brian JL believed that percutaneous abscess drainage should be the primary treatment for renal abscess larger than 3 cm [10, 16]. In a clinical study conducted by Dalla Palma, however, he concluded that four weeks of antibiotic therapy could completely cure renal abscess with a diameter of 5 cm or less, thus avoiding invasive treatment [9]. The similar conclusion was made by Lee SH [3]. Hung et al in their study comparing the outcome of percutaneous and surgical treatment also found that larger abscess size appeared to have poor prognosis, but statistically insignificant [8]. Although there is still a debate on the preference of treatment selection for renal abscess basing on size, we can't deny that size of abscess is still an important factor that determining treatment modalities. In our study, the primary factor for the choice of initial treatment was size, thus, the difference in the size of renal abscess between the two treatment groups was significantly. But whether there are other factors can be used to guide clinical treatment, especially for the patients with renal abscess between 3 ~ 5 cm is still unknown.

In a Korean study [10], 56 patients with renal and perirenal abscesses were analyzed, with a mean age of 53.5 years, a 75% female representation and a 44.6% incidence of diabetes. Lee SH et al conducted a study on 51 patients with renal or perirenal abscess measured 5 cm or less, with 49 abscesses received

intravenous antibiotics alone and successful outcome was presented. In their study, 91.8% patients were women, the mean age was 42.3 years and the incidence of diabetes mellitus was 46.9% [4]. Though rare, renal abscess can also occur in children [17]. In our study, the mean age was 48.87 ± 15.89 years, the ratio of female was 63.16% and 42.11% patients got diabetes mellitus which were conformed to the study preview. No pediatric patient was included in our study. The mean age of patients receiving conservative treatment was slightly younger than that of patients receiving invasive treatment, but no statistical difference was found. While the diabetes mellitus was significantly different between these two groups. Diabetes mellitus is more common in patients receiving invasive treatment. In a research conducted by Ko MC et al, he found that compared to individuals aged ≥ 65 years, younger diabetic patients tended to have a higher risk of renal abscess which might be attributed to the reasons that younger diabetic patients were more likely to have poor blood sugar control, poor health-related behavior, less frequent clinic visits, and irregular assessment of diabetes-related complications [18]. It is knowledgeable that diabetes mellitus can increase the risk of infection [19] and the difficulty of infection control. This may be one reason that why renal abscess patients with diabetes mellitus in our study received more invasive treatment. Ko's study may also explain the phenomenon of higher incidence of diabetes mellitus in patients receiving invasive treatment.

Recently, with the widespread use of antibiotic, the common causative organisms of renal abscess changed from S. aureus to Gram-negative bacteria represented by E. Coli and Proteus spp. [2, 20]. Yamamichi F et al also found the most causative organisms was E. Coli in renal abscess, with a rate of 23% [21]. Our study also found the similar results.

Lin HS et al reported that thrombocytopenia was related with the poor outcome of renal abscess [3]. In our study, the average value of PLT was 285.08 ± 129.44, with patients receiving invasive treatment had higher count of PLT. This may be explained by the risk of bleeding during the procedure of invasive treatment with low count of PLT. RDW as a predictor of severe morbidity and mortality in some chronic diseases such as congestive heart failure was well-known by ICU physicians. The role of RDW in predicting severity and mortality in patients with Gram-negative bacteremia has been reported by some scholars [22]. In the background of Gram-negative bacteria being the foremost pathogenic bacteria in renal abscess, higher value of RDW may indicate the severity of the renal abscess and the difficulty in controlling it. In our study, we found that patients receiving invasive treatment got a higher value of RDW, which was also retained in the multivariate analysis.

Other than that, fever ≥ 38.5℃, BUN, PLR, AG and WBC in urine were also found significant difference between conservative and invasive treatment. But none of them were retained in the multivariate analysis. Only RDW, abscess size and the comorbidity of diabetes mellitus were found to be the significant factors that may affect the choice of treatment for renal abscess. The result of ROC curve revealed that 14.7% and 3.9 cm may be the cut-off for RDW and size, respectively. In general, for patients with RDW > 14.7%, abscess size > 3.9 cm and diabetes mellitus, invasive treatment should be taken into consideration, especially in patients with renal abscess between 3 ~ 5 cm.

However, there are still some limitation in our study. Firstly, our study is a retrospective clinical study. In addition to the size of the abscess and the condition of the patient, the choice of treatment may also be influenced by clinical experience at the time. Secondly, there is a limited number of cases. Since renal abscess is uncommon clinical disease, so more cases and multi-center joint study are needed. Thirdly, some factors such as C-reactive protein, erythrocyte sedimentation rate which were demonstrated to be associated with prognosis were not included in this study due to incomplete data.

Conclusions

Size of renal abscess is still the most important factor that determining treatment modalities. Other than size, RDW and the comorbidity of diabetes mellitus can also be used as the reference factors for the determination of invasive treatment. For patients with RDW > 14.7%, abscess size > 3.9 cm and diabetes mellitus, invasive treatment should be taken into consideration, especially in patients with renal abscess between 3 ~ 5 cm.

Declarations

Funding

Not applicable.

Conflicts of interest/ Competing interests

The authors declare that they have no conflicts of interest.

Ethics approval

This research was approved by the Institutional Review Board of the Peking University People's Hospital, with human participants but no animals.

Consent to participate / Informed consent

The study was done with the patients' consent and written informed consent was obtained from all the participants.

Consent for publication

The article is approved for publication.

Availability of data and material

All data are fully available without restriction.

Code availability

Not applicable.

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None

Author's Contributions

Mingrui Xia: Project development, Data analysis, Manuscript writing

Jun Liu: Data collection, Data analysis

Yang Hong: Data collection, Data analysis

Lizhe An: Data collection

LiuLin Xiong: Data analysis

XiaoBo Huang: Manuscript editing

QingQuan Xu: Project development, Manuscript editing

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Figures

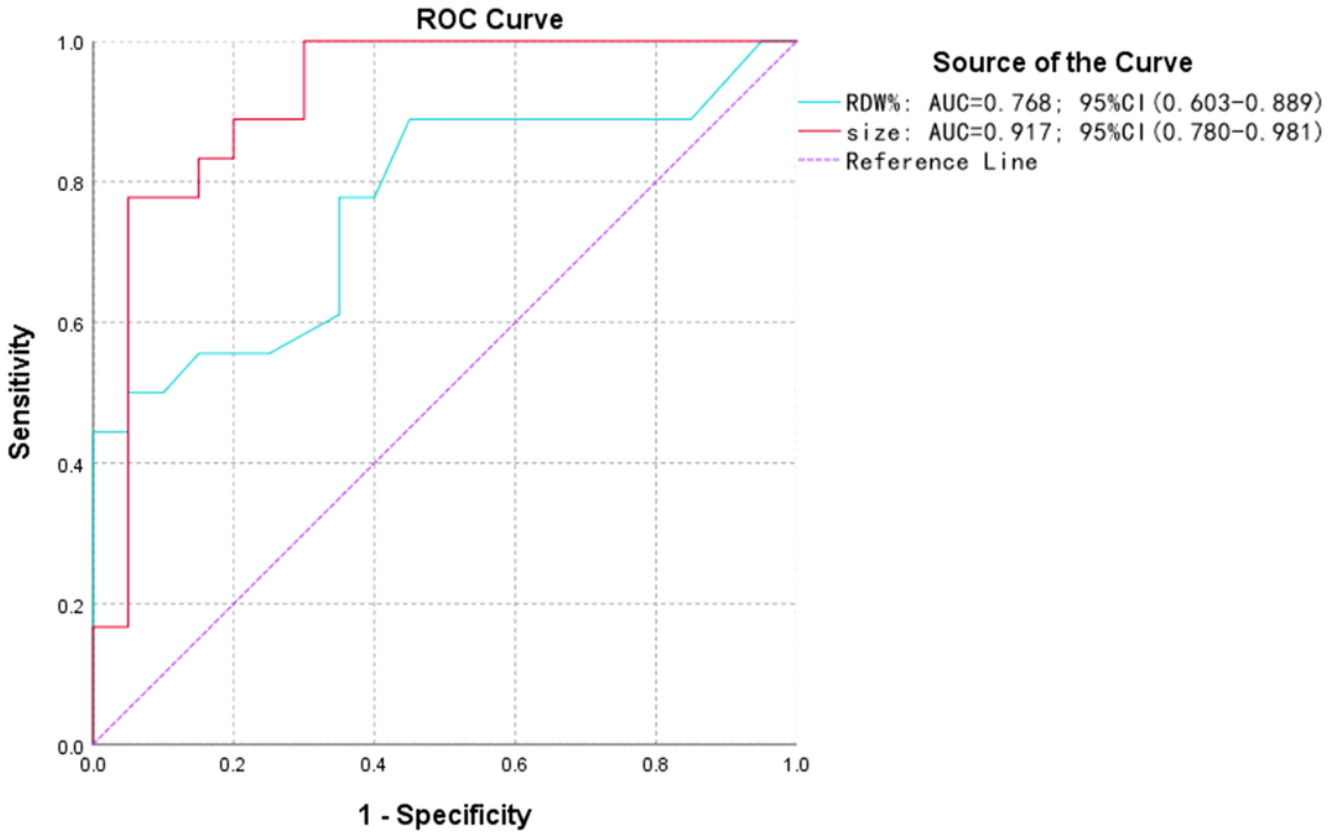

Figure 1

Figure1