

Specifics of the Renal Abscess in Nephrology: Observations of a Clinic from a County Hospital in Western Romania

SILVIA VELCIOV, GH. GLUHOVSCHI, V. TRANDAFIRESCU, LIGIA PETRICA,
GH. BOZDOG, CRISTINA GLUHOVSCHI, F. BOB, F. GĂDĂLEAN, M. BOBU

Nephrology Department, University of Medicine and Pharmacy, Timișoara, Romania

During the last years renal abscesses are being diagnosed with increasing frequency in Nephrology departments. Progresses achieved in imaging procedures permit a timely diagnosis of renal abscesses. At the same time modern antibiotic therapies permit the treatment of this disease in Nephrology departments.

In the current paper we present some specifics of renal abscess management encountered in a Nephrology department in western Romania.

We performed a retrospective analysis of 2793 patients with upper urinary tract infection hospitalised during 2002–2009 in our Nephrology Department, of whom 44 showed renal abscesses.

Uropathic factors were identified less frequently, in 28% of the renal abscess cases, compared to cases in the literature where these have been reported in over 50% of the patients. General predisposing conditions were pregnancy in 7%, postviral cirrhosis in 4%, diabetes mellitus in 4%, surgically single kidney in 2%, polycystic kidney disease in 4% of the patients.

We diagnosed renal abscesses in relatively young patients (mean age 38.73 ± 19.64), fact that could be due to a decreased immune resistance of these patients. Renal function impairment was present in 17% of the patients. Urine cultures were positive in 25% with a predominance of *E. coli* and rarely of other germs (e.g. *Citrobacter* and *Candida albicans*). Therapy consisted of broad spectrum antibiotics applied to all patients. Two patients required the insertion of double J catheter. Five patients (11%) were referred to the Urology Department, where one patient underwent nephrectomy.

Renal abscess was diagnosed and treated in the majority of cases in the Nephrology Department, and only in special cases is a referral to the Urology clinic required.

Key words : renal abscess; diagnosis; treatment.

Upper urinary tract (UTI) infection represents the bacterial inflammation of the renal parenchyma and may take on variable clinical forms, from simple UTI to severe forms with renal abscesses: perirenal abscesses and septic evolution. The episodes of acute pyelonephritis (APN) or active chronic pyelonephritis (CPN) occurring in an anatomically normal urinary tract generally develop without complications. Some of them evolve with urosepsis.

Dissemination of the infection ascendantly causes formation of corticomedullary abscess which includes various intrarenal infectious processes, focal and multifocal pyelonephritis. The germs frequently involved are the gram-negative germs [1].

Hematogenous dissemination of the infection leads to formation of cortical abscess. Evolution towards renal abscess takes place in the presence of predisposing factors: diabetes mellitus, immunodeficiency states, uropathic factors, mainly obstructive forms [2].

In two thirds of the cases, renal abscess is superimposed upon an anatomic malformation of the urinary tract, vesicoureteral reflux, renal lithiasis, neurogenic bladder, obstructive tumors on renal polycystic disease.

Renal abscess results from liquefaction of the focus of the infected area in an acute pyelonephritis or active chronic pyelonephritis [3]. The renal abscess continues the evolution of an acute pyelonephritis or of an active chronic pyelonephritis.

Focal bacterial acute nephritis is a well established renal infection that causes focal interstitial inflammation. It may represent the initial phase of a multifocal bacterial nephritis. Diabetes mellitus is the most frequent risk factor [2].

Renal abscess is most frequently found in urology. In the past, both renal abscess and perirenal abscess showed high morbidity and mortality. Nowadays, with the development of imaging techniques such as ultrasonography and computer

tomography, their diagnosing takes place in initial stages.[4] This is why renal abscess is diagnosed in Nephrology services more and more frequently.

Development of antibiotherapy allows to favorable evolution of renal abscess, the collaboration of the 2 services (medical and urological) being sometimes necessary. In the pre – antibiotic era, hematogenous dissemination of *Staphylococcus aureus* was the most frequent cause of renal and perirenal abscess. Nowadays, with modern antibiotherapy, ascendant dissemination of the urinary tract infection predominates while hematogenous dissemination has become very rare [5].

There is only rare data in the literature on the incidence of renal abscesses in a nephrology service on their therapeutic management and on the nephrologists – urologic relation we have set ourselves to tackle this subject in the light of our own experience.

The aim of the study has been a retrospective analysis of the favoring factors for the evolution of high UTIs towards renal abscess, of the positive diagnostic criteria and of the medical treatment of renal abscess.

MATERIALS AND METHODS

We studied a group of 44 patients, mean age 38.73 ± 19.64 years, 39 (89%) women and 5 (11%) men, diagnosed with renal abscess, hospitalized in the Clinic of Nephrology Timișoara, over a mean duration of 12.69 ± 5.79 days, during the 2002–2009 period.

During this period, 2916 UTI patients were hospitalized, of whom 2793 patients with upper UTI and 123 with low UTI. Of the 2793 patients with upper UTI, 44 (1.57%) showed a severe evolution, complicated by renal abscess.

It was concluded from the history of the patients that the disease evolved as acute pyelonephritis or active chronic pyelonephritis that subsequently evolved towards renal abscess.

The diagnosis of renal abscess was established based on:

- clinical criteria: lumbal pain, abdominal pain, fever, chills, polakidysuria, altered general status.
- biological criteria: non-specific inflammatory syndrome (leukocytosis, increased ESR, fibrinogen, C reactive protein), leukocyturia, urine culture, blood culture.

– paraclinical criteria (renal ultrasound, and or renal CT).

The size of the abscess was imagistically determined by measuring the diameters (longitudinal and transversal).

The patients were monitored clinically, biologically and paraclinically over all their hospitalization period. After hospitalization, the patients were monitored through the specialized out-patient's clinic.

RESULTS

The non-specific inflammatory syndrome (elevated ESR, fibrinogen, C reactive protein) was present in all patients.

Hematuria was present in 9 (20%) patients.

Favoring factors were found in 22 (50%) patients: the uropathic factor (renal lithiasis), diagnosed by ultrasound, was present in 12 (28%) patients, pregnancy in 3 (7%) patients, diabetes mellitus in 2 (4%) patients, postviral hepatic cirrhosis in 2 (4%) patients, surgically acquired single kidney in 1 (2%) patient, polycystic kidney disease in 2 (4%) patients.

Renal abscess occurred in 29 (66%) patients with APN and 15 (34%) patients with active CPN.

In 31(70%) patients the diagnosis of renal abscess was established by ultrasonography and computerized tomography, which revealed the presence of images suggestive for renal abscess: in 1 patient (2%) the images were revealed in both kidneys, in 10 (23%) patients, in the right kidney, and in 20 (45%) in the left kidney.

In 13 (30%) patients, the diagnosis of renal abscess was set by ultrasonographic examination: in 7 (16%) patients the right kidney and in and in 6 (14%) patients in the left kidney.

The sizes of the renal abscess in the patients under study were below 3 cm in diameter in 39 (89%) patients, between 3 and 4 cm in diameter in 3 (75) patients, between 4 and 5 cm in diameter in 1 (2%) patients and over 5 cm in 1 (2%) patient.

The abscess was single on the same kidney in 35 (80%) patients, multiple on the same kidney in 8 (18%) patients and it was present on both kidneys in 1 (2%) patients.

We found a peri-renal evolution of the renal abscess in 2 (5%) patients.

GFR had a mean value of 72.94 ± 28.03 ml/min.

We found a GFR below 60 ml/min, namely 46.03 ± 11.51 ml/min in 10 (23%) of the patients.

5 (17%) patients showed acute kidney injury (AKI).

Urine culture was positive in 10 (23%) patients: *E. coli* 8(80%) patients, *Citrobacter* 1 (10%) patient and *Candida albicans* 1 (10%) patient.

Blood culture was positive in 2(5%) patients, the involved germ being *E. coli* and *Staphylococcus aureus*. Urine culture was sterile in the patient with *Staphylococcus aureus*.

The number of leukocytes had a mean value of $16146.43 \pm 6491.40/\text{mm}^3$.

The number of platelets had a mean value of $287750 \pm 124206/\text{mm}^3$.

The mean value of hemoglobin was 11.06 ± 1.08 g/dl.

The temperature had a mean value of 39.2°C .

Systemic inflammatory response syndrome (SIRS) (a minimum of 2 criteria).

Sepsis was present in 43(98%) patients.

One patient (2%) with ongoing pregnancy showed septic shock.

The patients were hospitalized in the Clinic of Nephrology after a mean number of 8.69 ± 3.84 days since onset of clinical symptomatology (Table I).

7 (27%) patients underwent outpatients treatment with antibiotics: 3 patients took amoxicillin orally, 500 mg, 8 hours apart, 3 patients took quinolone orally, 1 patient took aminoglycoside inj. i.m. 500 mg, 12 hours apart.

The treatment consisted of monotherapy – 20 (46%) patients (Ertapeneme – 6 patients, quinolones – 5 patients, Imipeneme – 5 patients; Tazobactam + piperacillin – 2 patients, cephalosporin – 2 patients) double association in 24 (54%) patients (quinolones + aminoglycosides 10 patients, cephalosporin + aminoglycosides – 10 patients; cephalosporin + quinolones 4 patients) (Table II).

Table I
Characteristics of patients with renal abscesses

Variables	
Age (years)	38.73 ± 19.64
Male (n; %)	5 (11%)
Acute pyelonephritis	29 (66%)
Risk factor:	
Renal stone (%)	12 (28%)
Pregnancy (%)	3(7%)
Diabetes mellitus (%)	2(4%)
Liver cirrhosis (%)	2(4%)
Single kidney (%)	1 (2%)
Polycystic kidney disease(%)	2(4%)
Laboratory findings:	
WBC count/L	16146.43 ± 6491.40
Hemoglobin (g/dl)	11.06 ± 1.08
Platelet count/L	287750 ± 124206
Hematuria (%)	9 (20%)
GFR (ml/min)	72.94 ± 28.03
Imaging:	
Ultrasound	13 (30%)
CT + Ultrasound	31 (70%)
Abscess size:	
<3 cm	39 (89%)
3 – 4 cm	3 (7 %)
4 – 5 cm	1 (2%)
>5 cm	1 (2%)

Table II
Treatment strategies in patients with renal abscess

Treatment	Number of patients
Medical treatment	
Monotherapy:	20 (46%)
Ertapenem	6 (14%)
Imipenem	5 (12%)
Tazobactam+piperacillin	2 (4%)
Quinolones	5 (12%)
Cephalosporins	2 (4%)
Double combinations:	24 (54%)
Quinolones + aminoglycosides	10 (23%)
Cephalosporins + aminoglycosides	10 (23%)
Cephalosporins + quinolones	4 (8%)
Medical treatment + JJ catheter	2

The clinical and biological evolution was favorable in 39 (89%) patients.

5 (11%) patients were transferred to the Clinic of Urology and their clinical evolution under anti-biotherapy was favorable in 4 patients. Nephrectomy was performed in 1 patient alone.

None of the patients studied had an unfavorable evolution towards death.

One of the patients with ongoing pregnancy showed septic shock, being transferred to the Clinic of Obstetrics and Gynecology for interruption of the course of pregnancy.

Under antibiotic treatment the renal function improved in all patients.

GFR was increased at the end of the study to a mean value of 118.40 ± 26.99 ml/min, from 72.94 ± 28.03 ml/min a statistically significant growth, $p < 0.0001$.

In the 10 patients with $GFR < 60$ ml/min, GFR had a mean value of 56.21 ± 17.44 at the end of hospitalization, from 46.03 ± 11.51 ml/min, a statistically significant growth $p < 0.05$.

In 5 patients with $GFR < 60$ ml/min serum creatinine decreased to a mean value of 1.42 ± 0.16 mg%, and GFR increased to a mean value of 49.44 ± 11.58 ml/min, from 38.49 ± 10.49 ml/min, a statistically significant growth, $p < 0.05$.

In the other 5 patients with $GFR < 60$ ml/min, we found at the end of the study an increase in RFG to a mean value of 67.49 ± 22.15 ml/min, from a mean value of 57.70 ± 0.40 ml/min a statistically insignificant increase $p > 0.5$.

After discharge from the Clinic, the patients were followed up in the outpatient's clinic, biologically and sonographically, by the nephrologists.

DISCUSSION

Renal abscess develops at the level of the renal parenchyma through ascending dissemination from a low infection of the urinary tract or through hematogenous dissemination from an extra-renal infectious focus. At present 75% of renal abscesses develop by ascending dissemination and involve in particular the medulla and are caused by gram negative germs. Renal abscess developed by hematogenous dissemination affects especially the cortex and are caused by *Staphylococcus aureus* [1][3][4][6].

In peri-renal abscesses, the festering collection develops in the space between the renal capsule and the Gerota fascia. It results either by hematogenous dissemination or by rupture of the renal abscess into the peri-renal space [7][8].

The mean age of the patients in the group studied by us was 38.73 ± 19.64 years. The mean age of the patients with renal abscesses in the literature is variable. The mean age of the patients in our study was closer to the mean age of the patients in Korean studies performed before 2000 by Jin, Lee and Kim, whose patients' age ranged between 27 and 34 years [9–11].

In a study completed in Brazil, Coelho found the mean age of the patients under study to be of 41.1 years [12]. In recent studies performed after 2000 Lee and Choi found a mean age that was

higher than in other studies but with close magnitudes. That is 53.5 ± 13.8 years [10] and 52.9 years [13].

The men-women ratio in our study was 1:7. Studies in the literature have revealed a quite equal prevalence of the disease in women and men, with a slight predominance in women. The studies carried out by Fowler and Perkins and by Hoverman have revealed a predominance of the disease in women at a ratio of 1:3 [4][6].

Favorising factors were present in 50% of the patients. The uropathic factor represented by renal lithiasis was documented in 28% of the patients. Pregnancy was the following favoring factor, being present in 7% of the patients.

Studies in the literature have revealed an incidence of the uropathic factor in the 50 and 54% range [4][5][14].

The general factors were equally represented in a proportion of 4% by Diabetes, postviral hepatic cirrhosis and polycystic kidney disease.

In his study Lee noticed an incidence of Diabetes mellitus of 44.6% and of hepatic cirrhosis of 12.5% while the uropathic factor was found in 16.1% of the patients [15].

Similar results as regards the presence of the uropathic factor were obtained by Choi (14.5%) [13].

The average duration of symptomatology up to hospitalisation was of 8.69 ± 3.84 days. Similar data has been obtained by Lee [15].

The diagnosis was established by ultrasonography in 13 (30%) patients.

In 31 (70%) patients the diagnosis was established by computerised tomography and ultrasonography.

In the study carried out by Lee the diagnosis was established by computerised tomography in 78.5% of the patients [15]. Previous studies, carried out by Jin and Lee, have revealed the less substantial use of computerised tomography for establishing the diagnosis of renal abscess [9][10].

Although ultrasonography is a non-invasive method, it was documented that computer tomography is better for diagnosing renal and peri-renal abscess, with accuracy ranging between 90 and 100% [4][5][16][17].

Computer tomography can detect small-size abscesses and can distinguish abscesses from other similar lesions. Magnetic resonance has higher sensitivity and specificity than computer tomography but, because of high cost and reduced accessibility, it is not used as a first-line method in diagnosing renal abscess.

Magnetic resonance is used to exclude malignancy in some cases.

Up to 1960, production of renal abscess was achieved hematogenously by bacteriemia with *Staphylococcus aureus*, but the large-scale use of antibiotherapy led to the decrease in the incidence of hematogenous dissemination. In late decades the pathogen agents most frequently involved in the etiology of renal abscess are the gram negative germs [7][8].

In our study, *E. coli* was found in uroculture in 18% of the patients, while *Staphylococcus aureus* was not found in uroculture in any patient.

Hemoculture was positive in only 2 patients. In 1 patient hemoculture revealed staphylococcus aureus but uroculture was sterile.

Modern diagnosis techniques and the development of antibiotherapy led to increase in the rate of complete recovery without surgical interventions of renal and peri-renal abscesses as well as to decrease in mortality rate [6][18][19].

Medical treatment consists in long-term antibiotic therapy [5].

Medical treatment is efficient if it starts before the infection extends beyond the renal capsule.

Usually treatment begins with aminoglycosides associated with fluoroquinolones [20]. Aminoglycosides are administered for 10–14 days, not more, because of the risk of nephro- and ototoxicity. Treatment with fluoroquinolones is continued for several weeks.

Association of cephalosporins and aminoglycosides was administered to 23% of the patients and cephalosporins associated with quinolones to 9% of the patients.

Monotherapy was administered to 46% of the patients. It consisted of Cephalosporines in 2 (4%) patients, Quinolones in 5 (12%) patients, Ertapeneme in 6 (14%) patients, Imipeneme in 5 (12%) patients, Tazobactam + Piperacillin in 2 (4%) patients.

Effectiveness and duration of treatment is assessed based on clinical, radiological, and laboratory criteria. In patients with favorable response to the treatment, the clinical state improves after 4–5 days and fever disappears in one or two weeks. ESR and C reactive protein come back to normal value more slowly. Repetition of ultrasound and/or of CT reveals progressive reduction in the size of the abscess.

The clinical-biological evolution was favorable under antibiotherapy in 39 (89%) patients. The clinical symptomatology, the fever curve, the inflammatory syndrome and the size of the abscess had a favorable evolution.

Nephrectomy was performed in the Clinic of Urology in only one patient.

The total duration of the treatment was conditioned by the clinical response and is about one to two months in most patients. The assessment criteria for the healing of the abscess are: absence of pain, reduction of fever, normalisation of ESR, disappearance of the abscess on ultrasound or on the CT scan which usually reveals a cortical scar.

The antibiotic treatment can be stopped 10 days after the clinical and laboratory parameters come within normal limits. Absence of recurrence of clinical signs and of infection symptoms is the best indicator of healing. The patient must be followed up over an interval of 2 weeks, two or three months after the end of the treatment.

Most patients respond to antibiotic treatment but application of a catheter at the level of the abscess under echographic and tomographic guidance for drainage of the content of the abscess hastens healing and shortens the duration of the treatment [1].

Percutaneous draining is useful, especially in the case of abscesses with a diameter of 3 cm and in patients with surgical indication, which have higher risk factors for such interventions [21].

Abscesses exceeding 5 cm in diameter require repeated drainage by surgical intervention [22].

In general, patients with large size renal abscess and those with peri-renal abscess need invasive treatments, such as percutaneous drainage and surgical intervention. Thus, Coelho found that 95.3% of the patients with peri-renal abscess needed percutaneous drainage and 56.2% of the patients needed surgical intervention, but Lee found that 84% of the patients with peri-renal abscess needed percutaneous drainage and 24% of the patients needed surgical intervention [12][15]. Choi noticed that the dimensions of the abscess in the patients who need percutaneous drainage were larger as compared with the patients treated with antibiotics alone [13]. Other studies show that

percutaneous draining of renal abscesses should be the initial treatment for patients with systemic diseases and/or obstructive factors associated with large size renal abscesses.

Percutaneous drainage of the abscess was not performed in any patient. The JJ probe was applied to 2 patients for drainage of the abscess.

None of the patients under study had unfavorable evolution towards death.

Studies in the literature describe a mortality rate in renal abscess patients ranging between 0 and 7% [8–11][13].

The renal function evolved favorably in all the patients under study. GFR increased statistically significant $p < 0.0001$.

The study performed by ourselves reveals the fact that medical treatment of renal abscess by consistent antibiotherapy in high UTI patients, with renal abscess as an addition, has a favorable evolution in most patients, namely in 98% of the patients. Association of antibiotics in the incipient stages is accompanied by favorable evolution even in AKI patients.

Also our study has revealed the fact that renal abscess is frequent among the young. Although in the young the general favouring factors have low incidence, renal abscess occurred in young females with acute pyelonephritis. Correctly applied antibiotherapy is accompanied by the medical solution of the renal abscess. The evolution of acute pyelonephritis and of the fits of sharpening the chronic pyelonephritis towards renal abscess is an explanation for the fact that renal abscesses are frequently found in the nephrological services too. The patients should be monitored by the nephrologist in collaboration with the urologist so that interventions by surgical maneuvers could be performed if the situation requires them.

Renal abscess represents an important issue in clinical nephrology, requiring rapid and effective therapeutical intervention, in close cooperation with urology services.

În ultimii ani, abcesul renal este diagnosticat frecvent în clinici de Nefrologie. Progresul realizat în domeniul procedurilor imagistice permite un diagnostic precoce al abcesului renal. În același timp, antibioterapia modernă permite tratamentul acestei boli în clinici de Nefrologie.

În lucrarea de față prezentăm câteva particularități ale managementului abcesului renal într-o Clinică de Nefrologie din vestul României.

Am efectuat un studiu retrospectiv a 2793 pacienți cu infecție urinară înaltă, spitalizați în clinica noastră de Nefrologie în perioada 2002–2009, din care 44 au prezentat abces renal.

*Factorii uropatici au fost identificați mai puțin frecvent, respectiv la 28% dintre cazurile de abces renal, comparativ cu literatura de specialitate, unde prezența lor a fost descrisă la peste 50% dintre pacienți. Factorii predispozanți decelați au fost: sarcina la 7% dintre pacienți, ciroza virală la 4% dintre pacienți, diabet zaharat la 4%, rinichi unic chirurgical la 2%, rinichi polichistic la 4% dintre pacienți. Noi am diagnosticat prezența abcesului renal la pacienți relativ tineri (vârsta medie $38,75 \pm 19,64$ ani), fapt ce s-ar datora scăderii imunității acestor pacienți. Alterarea funcției renale a fost prezentă la 17% dintre pacienți. Urocultura a fost pozitivă la 25% dintre pacienți, cu predominantă *E. coli* și rar alți germeni (*Citrobacter* și *Candida albicans*). La toți pacienții s-a aplicat tratament cu antibiotice cu spectru larg. La doi pacienți a fost necesară montarea sondei dublu J. Au necesitat transferul în clinica de Urologie un număr de 5 pacienți (11%), unde la un pacient a fost necesară nefrectomia. Abcesul renal a fost diagnosticat și tratat în majoritatea cazurilor în Clinica de Nefrologie și numai în cazuri speciale s-a impus transferul în Clinica de Urologie.*

Cuvinte cheie: abces renal; diagnostic; tratament.

Corresponding author: Silvia Velciov, MD

Nephrology Department, University of Medicine and Pharmacy,

Timișoara, Romania

E-mail: s_velciov@yahoo.com

REFERENCES

1. DEMBRY L.M., ANDRIOLE V.T., *Renal and perirenal abscesses*. Infect Dis Clin North Am 1997; **11**:663–680.
2. YEN D.H., HU S.C., TSAI J. KAO W.F., CHEM C.H., WANG L.M., LEE C.H., *Renal abscess: early diagnosis and treatment*. Am J Emerg Med 1999; **83**:1065.
3. HUTCHISON F.N., KAYSEN G.A., *Perinephric abscess: the missed diagnosis*. Med Clin North Am 1988; **72**:993–1014.
4. FOWLER J.E. JR, PERKINS T., *Presentation, diagnosis and treatment of renal abscesses: 1972–1988*. J Urol, 1994; **151**:847–851.
5. MENG M.V., MARIO L.A., MCANINCH J.W., *Current treatment and outcomes of perinephric abscesses*. J Urol 2002; **168**:1337–1340.
6. HOVERMAN I.V., GENTRY L.O., JONES D.W., GUERRIERO W.G., *Intrarenal abscess: report of 14 cases*. Arch Intern Med 1980; **140**:914–916.
7. SCHRIER R.W., GOTTSCHALK C.W., *Diseases of the kidney*. Boston, Little brown and company, 1997; 6th ed. p. 947–959.
8. JUNG U.Y., KIM D.H., *A clinical survey on perinephric abscess*. Korean J. Urol., 1985; **26**:7–12.
9. JIN W.Y., LEE J.H., LEE Y.J., JANG I.C., JO D.H., *A clinical review of 16 cases of renal of perirenal abscess*. Korean J Urol 1988; **29**:761–765.
10. LEE J.H., EARM J.H., HAN J.S., KIM S.K., LEE J.S., *Clinical features of renal and perirenal abscess*. Korean J Nephrol 1990; **9**:357–363.
11. KIM Y.S., HONG S.J., *A clinical survey on renal and perinephric abscess*. Korean J Urol 1994; **35**:43–47.
12. COELHO R.F., SCHNEIDER-MONTEIRO E.D., MESQUITA J.L., MAZZUCCHI E., MARMO LUCON A., SROUGI M., *Renal and perinephric abscess: analysis of 65 consecutive cases*. World J Surg. 2007; **31**; **2**:431–6.
13. CHOI J.Y., KIM M.S., KIM Y.K., LEE K.S., CHANG K.H., HUH A.J. *et al.*, *Recent clinical trend of renal and perirenal abscess*. J Korean Soc Chemother. 2002; **20**:91–100.
14. ANGEL C., SHU T., GREEN J., ORIHUELA E., RODRIQUEZ G., HENDRICK E., *Renal and peri-renal abscesses in children: proposed physio-pathologic mechanisms and treatment algorithm*. Pediatr Surg Int 2003; **19**:35–39.
15. LEE B.E., SEOL H.Y., KIM T.K., SEONG E.Y., SONG S.H. *et al.*, *Recent clinical overview of renal and perirenal abscesses in 56 consecutive cases*. The Korean Journal of Internal Medicine 2008; **23**:140–148.
16. CAPITAN MANJON C., TEJIDO SANCHEZ A., PIEDRA LARA J.D., MARTINEZ SILVA V., CRUCEYRA BETRIU G., ROSINO SANCHEZ A. *et al.*, *Retroperitoneal abscesses: analysis of a series of 66 cases*. Scand J Urol Nephrol 2003; **37**:139–144.
17. SUNDARAM M., WOLVERSON M.K., HEIBERG E., PILLA T., VAS W.G., SHIELDS J.B., *Utility of CT-guided abdominal aspiration procedures*. AJR Am J Roentgenol 1982; **139**:1111–1115.

18. LYONS R.W., LONG J.M., LYTTON B., ANDRIOLE V.T., *Arteriography and antibiotic therapy of a renal carbuncle*. J Urol 1972; **107**:524–526.
19. WRIGHT F.W., *Percutaneous diagnosis and treatment of intra-renal abscess*. Br J Urol 1977; **49**:22.
20. MEYRIER A., GUIBERT J., *Diagnosis and treatment of acute pyelonephritis*. Drugs. 1992; **44**:356.
21. DEYOE L.A., CRONAN J.J., LAMBIASE R.E., DORFMAN G.S., *Percutaneous drainage of renal and perirenal abscesses : Results in 30 patients*. AJR Am J Roentgenol 1990; **155**:81.
22. SIEGEL J.F., SMITH A., MOLDWIN R., *Minimally invasive treatment of renal abscess*. J Urol 1996 ; **155** :52.

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