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ORIGINAL ARTICLE

Pediatric renal abscesses: a diagnostic challenge

Absceso renal en Pediatría: un desafío diagnóstico

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What do we know about the subject matter of this study?

A renal abscess is a rare pathology with a non-specific presentation that delays diagnosis, which can lead to serious complications such as kidney loss and death.

What does this study contribute to what is already known?

This study provides data on this pathology in the pediatric population, which allows a better characterization, helping to have a better diagnostic suspicion. It also provides relevant information on the risk factors that may be present in renal abscesses in pediatrics.

Abstract

Kidney abscess is an unusual entity in childhood with few studies about its clinical characteristics. **Objective**: To report the clinical presentation, diagnosis, and therapy used in a cohort of 20 children with kidney abscess. **Patients and Method:** retrospective study of cases of kidney abscess during a 10-year period at the Hospital Roberto del Río. The analysis of clinical, laboratory, and imaging characteristics were evaluated as well as the treatment usedfor this condition. **Results:** 20 cases were reported among which 65% were women with a median age of 3.6 years. The most common clinical presentation was fever, vomit, and dysuria. Eighty percent of patients presented an increase of inflammatory parameters, 88% presented positive urine culture, and the most common organism identified was Escherichia Coli (77.8%). The diagnosis was mostly made through kidney ultrasound (75%) followed by an abdominal CT scan (35%). 93% of abscesses were unilateral. About 95% of the patients only required antibiotic treatment. Vesicoureteral reflux was diagnosed in 28% of the patients with no sphincter control, and only one of them presented high-grade reflux. In patients with sphincter control, bladder and bowel dysfunction (BBD) was diagnosed in 90% of the cases. Forty four percent of the patients with late DMSA renal scintigraphy presented renal scarring. **Conclusions:** In this series, pediatric kidney abscess appears with persistent fever despite the treatment, requiring prolonged antibiotic therapy and rarely surgical drains. We suggest a study aimed at detecting modifiable factors, such as vesicoureteral reflux in patients with no sphincter control and BBD in patients with sphincter control, as well as identifying renal parenchymal sequels in all patients.

Keywords:
Kidney Abscess;
Urinary Tract Malformation;
Urinary Infection;
Bladder and Bowel Dysfunction (BBD);
Renal Scarring

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Introduction

Renal abscesses are an infrequent pathology in childhood[1] with an unknown incidence in pediatrics[2]. Its presentation is non-specific, which delays and hinders the diagnosis[3]. Its clinical manifestations include symptoms such as prolonged fever, flank pain, nausea, vomiting, and non-specific abdominal pain, and may even occur urosepsis[4]. In pediatrics, it is frequently detected as a complication of acute pyelonephritis (APN) and, to a lesser extent, because of hematogenous dissemination[5], with *Escherichia coli* and *Staphylococcus aureus* as the most frequently found pathogens[6].

The importance of its diagnosis lies in the fact that without timely treatment it can lead to septic conditions with loss of the compromised kidney or even death[7]. In addition, it is necessary to consider that it requires antibiotic treatment and prolonged hospitalization, and may even require surgical treatment[8], so its recognition and management should be a pediatric domain.

Internationally, there are few studies on the clinical presentation of renal abscesses. The objective of this study is to describe the clinical presentation of patients diagnosed with renal abscesses and to explore the presence of risk factors such as vesicoureteral reflux (VUR) or voiding dysfunction that may be associated with this pathology.

Patients and Method

Descriptive study, performed by reviewing clinical records of all patients with renal abscess evaluated at the *Hospital Roberto del Río*, both those discharged from hospitalization services and those evaluated in Nephro-urology polyclinics, with ICD-10 diagnosis of renal and perirenal abscess, between January 2009 and March 2020.

Their demographic characteristics (sex and age at diagnosis) and morbid history were evaluated, specifically previous urinary tract infections, age at sphincter control, and symptoms compatible with bowel and bladder dysfunction. The clinical and laboratory presentation of the abscess episode was analyzed. Leukocytosis was defined as a white blood cell count > 15,000 cells/mm^3; elevated C-reactive protein (CRP) > 100 mg/dl; altered complete urine test > 10 leukocytes/mm^3; positive urine culture > 10,000 colony forming units per ml (CFU/ml) in sample obtained by bladder catheterization; urine flow test > 100,000 CFU/ml per second; and positive (identification of the agent) or negative blood culture result.

According to the imaging method (kidney and bladder ultrasound and/or abdominal CT scan), the characteristics of the abscess (size and location) were evaluated, as well as the type of treatment used (antibiotic or percutaneous drainage) and its duration. Data were collected on the subsequent study (serial voiding cystourethrogram, delayed Tc-99m DMSA static renal scintigraphy, urine flow test, and surface electromyography), describing their findings such as renal-urological malformations, VUR, etc. The diagnosis of bowel and bladder dysfunction was made by clinical symptoms defined by constipation in patients older than 4 years or urinary frequency less than 3 or more than 8 times a day; daytime urinary incontinence and/or urinary urgency in patients older than 5 years[9]; suggestive pre- and post-void residual kidney and bladder ultrasound and/or urine flow test with compatible surface electromyography. A delayed Tc-99m DMSA static renal scintigraphy was defined as that performed after 6 months from diagnosis and decreased relative renal function as less than 45%.

Descriptive statistical analysis was performed using median and range for quantitative variables because their distribution was mainly asymmetric. In the case of categorical variables, absolute and relative frequencies were used. Analyses were performed using Stata 13 SE software.

The research protocol was approved by the Ethics Committee of the North Metropolitan Health Service.

Results

In the evaluated period, 20 cases of renal abscesses were identified. The median age was 3.6 years, with most patients being female (65%) (table 1). Among the morbid history identified, urinary tract infections (UTI) (25%) and clinical symptoms of bowel and bladder dysfunction (50%) were observed. Two patients with previous renal abscesses were detected.

All patients presented with fever, with a mean duration of 5.5 days before diagnosis, and 11.6 days in total; the most frequent associated symptoms were vomiting (45%), urinary symptoms such as pollakiuria and dysuria (25%), in addition to other symptoms such as diarrhea, abdominal pain, and poor general condition (table 2). Among the laboratory parameters evaluated, 80% of patients had leukocytosis and increased CRP, 90% had altered urine test compatible with UTI, 88% presented positive urine culture, and *Escherichia coli* was isolated in 77.8%. There were no positive blood cultures (table 2).

Kidney and bladder ultrasound was performed in all cases, but only 75% of them had findings compatible with renal abscess. The median size of the abscess detected by ultrasound was 1.6 cm; only one case presented bilateral abscesses. Abdominal CT scan was

Table 1. Demographic characteristics and premorbid conditions

Variables	n (%)
Number	20 (100%)
Demographic characteristics	
Age (years), Me (min-max.)	3.6 (0.4-13.8)
Female sex	13 (65%)
Male sex	7 (35%)
Premorbid conditions	
UTI	5/20 (25%)
Bowel and bladder dysfunction	5/10 (50%)*

Me: median, UTI: Urinary tract infections. *patients with sphincter control.

Table 2. Clinical and laboratory characteristics

Variables	n (%)
Symptoms and signs	
Fever duration (days), median (range)	5.5 (2-21)
Temperature (ºC), median (range)	39.5 (38-40.3)
Lumbar fossa pain	4 (20%)
Vomiting	9 (45%)
Lower urinary symptoms	5 (25%)
Macroscopic hematuria	1 (5%)
Diarrhea	5 (25%)
Laboratory findings	
Blood leukocytosis (cel/mm^3), median (range)	21300 (12000 - 35600)
Leukocytosis > 15000 cel/mm^3	16 (80%)
CRP (mg/L), median (rank)	179 (4 - 445)
CRP> 100 mg/L	16 (80%)
Altered complete urine test	18 (90%)
Positive urine culture	16 (80%)
Microorganism in urine culture	
Escherichia coli	14 (77.8%)
Pseudomona sp	1 (5.6%)
Klebsiella sp	2 (11.1%)
Staphylococcus aureus	1 (5.6%)

Me: sp: unidentified species.

Table 3. Imaging study

Variables	n (%)
Kidney and bladder ultrasound with abscess	15 (75%)
Abscess size (cm), median (range)	1.6 (0.12-4.6)
Location of the abscess	
Unilateral	14 (93%)
Bilateral	1 (7%)
Abdominal CT scan	7 (35%)
Abscess size (cm), median (range)	2.3 (0.9-7)
Location of the abscess	
Unilateral	6 (86%)
Bilateral	1 (14%)

CT: Computed axial tomography.

performed in 7 cases (35%, table 3); in 5 patients with high clinical suspicion of renal abscess, it was used as a diagnostic method since no lesions were detected by ultrasound; in one patient it was used to characterize the abscesses and, in another patient, to define the need for surgical treatment.

All patients received intravenous antibiotic treatment (table 4), with an average duration of 15 days, subsequently completing the treatment with oral antibiotic therapy adjusted to the antibiogram. The total duration of antibiotic treatment was 23.4 days on average (14-43 days), and the complete resolution of the abscess was verified with ultrasound before its withdrawal. Clinical response was observed in 95% of cases, with resolution of fever on average 5 days (1-23 days) after antibiotic initiation. Aminoglycoside monotherapy was indicated in 40% and combined therapy of aminoglycosides with third-generation cephalosporins in 35%. Only one patient underwent surgical treatment due to her/his torpid evolution with persistent fever, without response to antibiotic therapy, presenting a 7 cm abscess in the abdominal CT scan.

Voiding cystourethrogram was performed in 75% (n = 15) of the patients (table 5). Patients without sphincter control (n = 7) had VUR in 28% (n = 2), one of them of high grade and bilateral. In patients with sphincter control (n = 8), VUR was found in 50% (n = 4), but all of them had associated bowel dysfunction, with low-grade VUR and without a clear relationship with the location of the abscess. Urine flow test with surface electromyography was performed in 54% (n = 6) of the patients with sphincter control; all of them presented alterations compatible with dysfunctional voiding. This was the diagnostic method in 3 cases, in which no alterations suggestive of bladder dysfunction had been identified by symptoms or radiology. 90% of these patients presented bowel and bladder dysfunction detected by symptoms, radiology, and/or urine flow test.

During the follow-up period, delayed Tc-99m DMSA static renal scintigraphy was performed in 42% (n = 9) of the participants 10 months after the event, detecting sequelae alterations and/or decrease in relative renal function in the same location of the abscess in 44% (n = 4). Of these patients, only one had history of UTI, but without DMSA scintigraphy after that event.

Discussion

In pediatrics, a renal abscess is a rare disease[1,4,10] and most studies are based on small series and case reports[2]. Its incidence is unknown[2,6,8], but in one study it was estimated to be close to 0.03%[11]. It affects all age groups equally[2,4,8] and there are no sex differences in its frequency described in the literature[2,6,11].

Several studies describe as associated risk factors urinary tract anomalies (VUR), obstructive disorders (ureteropelvic junction obstruction), neurogenic bladder, recurrent UTI[2,6,8,11,12], and nephrolithiasis, which is the more common in the adult population[11,13]. It should be noted that renal abscesses can also occur in a healthy population, without risk factors such as those mentioned above[8,11,14].

The clinical diagnosis of renal abscess can be a challenge[1,2] since its presentation is variable and non-specific and the duration of symptoms is relatively prolonged[6,8,10]. Diagnosis tends to be delayed[8,15], especially in younger children[8,11]. This series describes fever as the cardinal symptom, a finding commonly described in previous studies. Fever tends to be persistent, despite adequate antibiotic treatment guided by antibiogram; this clinical finding should raise suspicion of a UTI complication such as a renal abscess.

Abdominal pain is a frequently reported symptom[1,2,8,11,13,16,17]; in this study, it was detected in a small percentage of cases, but considering that a percentage of our patients were infants. In our review, lower urinary tract symptoms (polyuria and urinary urgency) are described in 25% of the patients; these symptoms are scarcely reported in different case series[6,10] and are closely related to the age of the patients, being more common in adolescents and adults.

Leukocytosis and elevated CRP are findings frequently described[1,2,6,8,10,15], therefore, some authors suggest that suspicion of renal abscess should be considered in the presence of persistent fever, abdominal pain, leukocytosis, and persistently elevated CRP[8,11]. Other studies describe the presence of leukocyturia with often negative urine cultures[6,14,18]; in this series, we detected 90% of abnormal urinalysis (pyuria, hematuria, positive nitrites) with isolation of pathogens in urine culture in 88% of cases, without positive blood cultures. The results of our review show that ascending UTI was the most prevalent pathophysiologic mechanism in the development of a renal abscess. The findings described are similar to those present in APN; however, in a patient with a torpid clinical course (persistent fever, sepsis, persistent elevated acute-phase reactants) or pre-existing urinary abnormalities, the diagnostic suspicion of infection complicated by renal abscess should be increased.

As in other series[1,2,4,6,11], *E. coli* was the most common bacterium isolated in urine cultures and, unlike what is described in the literature[1,2,4,14,17], *S. aureus* was not a frequent finding. Neither were anaerobic pathogens identified, as in other publications[17,19]. In 4 of our patients (20%) no causal microorganism was identified.

Renal Doppler ultrasound is the most frequently used tool for the diagnosis of renal abscess in children because it does not require sedation and does not generate radiation, being useful as an initial and follow-up study[2,4,5,8,11,16,18,19]. Findings compatible with renal abscess are described as the presence of a well-defined avascular mass, with wall and posterior enhancement, and with hypoperfusion areas observed in the doppler study[20]. The renal Doppler ultrasound has a good performance, it has a sensitivity and specificity of 82% and 94.5%, respectively, for the diagnosis of abdominal abscesses, but it is limited in those very small abscesses[21].

CT scan is the best procedure for the evaluation of renal abscesses; it allows visualization of the parenchymal collection of hypodense pus, which is not enhancing or presenting flows and is well defined by a ring-like enhancing pseudocapsule[20]. It presents a sensitivity of 97.5% and specificity of 95% for the diagnosis of abdominal abscesses[21], however, it has as disadvantages the radiation, besides the need for sedation in some

Table 4. Treatment

Variables	n (%)
Type of treatment	
Exclusive antibiotic therapy	19 (95%)
Antibiotic plus drainage	1 (5%)
Antibiotic used	
Aminoglycoside monotherapy	8 (40%)
Cephalosporins monotherapy	3 (15%)
Aminoglycoside plus cefhalosporins	7 (35%)
Others	2 (10%)
Treatment duration (days), median (range)	
Full treatment	23.45 (14-43)
Intravenous	15.6 (5-43)
Oral	10.4 (0-21)

Table 5. Follow-up studies

Variables	n (%)
Voiding cystourethrogram	
VUR without sphincter control	2 (28%)*
VUR with sphincter control	4 (50%)**
Uroflowmetry with electromyography	6***
Dysfunctional Bladder	6 (100%)
Tc99 DMSA static renal scintigraphy	10
Delayed DMSA	9
Relative renal function < 45%	4 (44%)

*Examination performed in 7 patients without sphincter control. **Examination performed in 8 patients with sphincter control. ***Examination performed in 6 of 10 patients with sphincter control. VUR: Vesicoureteral reflux.

patients. In this series, the diagnosis was made mainly through ultrasound, reserving CT scan for cases where the diagnosis was not reached with the first study method and clinical suspicion was maintained or in those cases in which it was necessary to evaluate a potential surgical resolution.

The time of resolution of the abscess varies according to its size; on average it can take from 2 to 4 weeks for the normalization of the ultrasound imaging and, generally, there is no follow-up with another imaging method[1,4,5,22].

Regarding the use of the DMSA renal scintigraphy, its usefulness in the diagnosis of APN up to 15 days after the onset of fever is well known, with a sensitivity of 92% and specificity of 93.8%[23]; however, in the evolution of APN to acute focal nephritis - renal abscess, it does not differentiate the renal multifocal lesions related to these pathologies[24,25,26], making this test the more useful in the late follow-up of these patients.

Regarding treatment, broad-spectrum antibiotics are most frequently used; percutaneous or open surgery is indicated in exceptional cases. Previous series have described conservative management with good clinical response[4,5,7,12,15,27]. In our series, this type of management was the most commonly used. The clinical response to antibiotic treatment is favorable in most cases, but the latency of clinical response (decrease in febrile curve) is greater than that usually observed in APN.

The total duration of treatment in this study is similar to that described in previous reviews, with treatments prolonged for 2 to 6 weeks[3,6,19]. The use of initial intravenous antibiotic therapy is the most frequent, generally indicated for 10-14 days with subsequent transition to the oral route[1,7]. In this review, 15.6 days of intravenous antibiotic therapy was completed on average, similar to that described.

The most commonly used antibiotics were aminoglycosides since *E. coli* was the main isolated agent. In the studies analyzed, the most commonly used antibiotics were penicillin and second- and third-generation cephalosporins[1,2,5,7,10]; only one study described the use of aminoglycosides[6].

The nephrotoxicity caused by aminoglycosides is well known, with acute tubular necrosis as the most frequent mechanism of toxicity[28]; therefore, their use should be careful and always monitored with plasma levels. Based on the high local susceptibility of *E. coli* to aminoglycosides, these drugs are an efficient therapeutic option for our patients, for this reason, they have been used in our center during the last years, always with the determination of plasma levels and avoiding their use in cases of acute or chronic renal failure.

Some studies have suggested that abscesses larger than 3 cm require surgical management, either percutaneous or open surgery; other indications would be symptoms for more than 48 to 72 hours, despite antibiotic treatment, or in immunocompromised patients[7,12,16,18]. In our study, conservative treatment was successful in most patients, even in abscesses larger than 3 cm; and percutaneous drainage was used in only one patient with a 7 cm abscess and poor clinical evolution. It is important to evaluate the therapeutic response and to follow up by ultrasound until the abscess is resolved.

Regarding associated anomalies, the most documented is VUR[2,3,8,15]. In this study, VUR was observed in 30% of the total cases (n = 6), identified both by structural anomalies and secondary to bladder dysfunction, but only in one of the patients without sphincter control was high-degree reflux. The predominant finding in patients with sphincter control was bowel-bladder dysfunction, which was present in 90% of the cases and which is described in the literature as a risk factor for UTI[29].

Regarding the formation of renal abscesses and their relationship with bowel-bladder dysfunction, we did not find any descriptions in the literature. Abscess formation may be related to late consultation, poor adherence to antibiotic treatment, or bacterial resistance; these factors were not analyzed in this review, so we suggest that they should be considered for evaluation in other studies.

These findings support bladder dysfunction and ascending UTI as the probable etiology of abscesses in older children and adolescents. Therefore, we believe that voiding cystourethrogram is a diagnostic tool that should be considered for the study of patients without sphincter control. In the case of patients with sphincter control, the primary focus should be on bowel dysfunction and, if the clinical picture or history requires it, a more invasive study should be performed.

Parenchymal defects have been documented in up to 90% of patients[3,4,19]. In our study, in 4 of 9 patients with delayed Tc-99m DMSA static renal scintigraphy, decreased relative renal function, and/or cortical uptake defects were observed, so it is also recommended that the study of these patients include this study to detect parenchymal sequelae.

The limitations of this study include its retrospective nature and the lack of a single protocol for subsequent management and follow-up. The strengths lie in the fact that we provide information on an entity of low prevalence in pediatrics, collecting a considerable number of patients compared with what is described in the literature, and considering that it was performed in a single health care center.

In conclusion, a renal abscess is an infrequent pathology in pediatrics, which requires a high index of suspicion, with prolonged fever with lack of response

to antibiotic treatment and the persistence of high inflammatory parameters as some of the clinical findings that should be considered to perform a study aimed at its detection. Regarding risk factors, there is no evidence as to whether the incidence of VUR or bowel-bladder dysfunction is different in APN concerning renal abscess; further studies are suggested to determine this.

Prolonged antibiotic therapy is generally effective, without the need for surgical therapy in most children. For further study, a differentiated evaluation should be performed by serial voiding cystourethrogram in patients without sphincter control; a study of bowel-bladder dysfunction in patients with sphincter control including clinical evaluation, pre- and post-void residual ultrasound, and urine flow test with surface electromyography; and finally, delayed Tc-99m DMSA static renal scintigraphy for the detection of significant renal sequelae.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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References

1. Linder BJ, Granberg CF. Pediatric renal abscesses: A contemporary series. J Pediatr Urol. 2016;12(2): 99.e1-5.
2. Seguias L, Srinivasan K, Mehta A. Pediatric Renal Abscess: A 10-year Single-Center Retrospective Analysis. Hosp Pediatr. 2012;2(3):161-6.
3. Bitsori M, Raissaki M, Maraki S, et al. Acute focal bacterial nephritis, pyonephrosis and renal abscess in children. Pediatr Nephrol. 2015;30(11):1987-93.
4. Comploj E, Cassar W, Farina A, et al. Conservative management of paediatric renal abscess. J Pediatr Urol 2013;9:1214-7.
5. Chaudhry S, Bolt R. Bilateral renal abscess in a previously healthy 11-year-old girl. Eur J Pediatr. 2010;169(11):1423-5.
6. Srinivasan K, Seguias L. Fever and renal mass in a young child. Pediatr Ann. 2011;40(9):421-3.
7. Castillo OA, Vidal I, Portalier P, et al. Drenaje percutáneo de absceso renal en niños: Clinical Case. Rev Chil pediatr. 2010;81(2):155-9.
8. Chen CY, Kuo HT, Chang YJ, et al. Clinical assessment of children with renal abscesses presenting to the pediatric emergency department. BMC Pediatr. 2016;16(1):1-5.
9. Austin F, Bauer S, Bower W, et al. The standardization of Terminology of lower Urinary Tract Function in Children and Adolescents: Update Report From the Standardization Committee of the International Childrens Continence Society. Neurourol. Urodynam. 2016. 35:471-81.
10. Zhang X, Xie Y, Huang G, et al. Analysis of 17 children with renal abscess. Int J Clin Exp Pathol. 2019;12(9):3179-84.
11. Chen CY, Lin MJ, Yang WC, et al. Clinical spectrum of intra-abdominal abscesses in children admitted to the pediatric emergency department. J Microbiol Immunol Infect. 2020;53(2):283-91.
12. Siegel JF, Smith A, Moldwin R. Minimally invasive treatment of renal abscess. J Urol. 1996;155(1):52-5.
13. Barker AP, Ahmed S. Renal Abscess in Childhood. Aust N Z J Surg. 1991;61(3):217-21.
14. Wippermann CF, Schofer O, Beetz R, et al. Renal abscess in childhood: Diagnostic and therapeutic progress. Pediatr Infect Dis J. 1991; 10(6):446-50.
15. Steele BT, Petrou C, de Maria J. Renal abscess in children. Urology. 1990;36(4):325.
16. Angel C, Shu T, Green J, et al. Renal and peri-renal abscesses in children: Proposed physio-pathologic mechanisms and treatment algorithm. Pediatr Surg Int. 2003;19(1-2):35-9.
17. Brook I. The Role of Anaerobic Bacteria in Perinephric and Renal Abscesses in Children. Pediatrics. 1994;93(2):261-4.
18. Dalla Palma L, Pozzi-Mucelli F, Ene V. Medical treatment of renal and perirenal abscesses: CT evaluation. Clin Radiol. 1999;54(12):792-7.
19. Cheng CH, Tsai MH, Su LH, et al. Renal Abscess in Children a 10 year - clinical and Radiologic Experiencie in a Tertiary Medical Center. Pediatr Infect Dis J. 2008;27(11):1025-7.
20. Llopis M, Samuel R, Gonzalez M, et al. Utilidad de la imagen radiológica en las infecciones renales. Hallazgos que el radiólogo debe conocer. SeRam. Disponible en https://piper.espacio-seram.com/index.php/seram/article/view/2212.
21. Knochel JQ, Koehler PR, Lee TG, Welch DM. Diagnosis of abdominal abscesses with computed tomography, ultrasound, and 111In leukocyte scans. Radiology. 1980;137(2):425-32.
22. Meng M, Mario L, McAninch J. Current treatment and outcomes of perinephric abscesses. J Urol. 2002;168:1337-40.
23. Biassoni. L, Chippington. S. Imaging in urinary tract infections: Current Strategies and New Trends. Semnuclmed. 2008;38:56-66.
24. Shimizu M, Katayama K. Evolution of acute focal bacterial nephritis into a renal abscess. Pediatr Nephorl. 2005;20:93-5.
25. Cano F, Strodthoff P, Muñoz O. Nefritis aguda focal. Clinical Case. Rev Chil Pediatr. 2010;81(3):247-52.
26. Agras K, Ortapamuk H, Naldöken S, Tuncel A, Atan A. Resolution of cortical on serial renal scans in children with acute pyelonephritis. Pediatr Radiol. 2007;37:153-58.
27. Pieretti RV, Pieretti-Vanmarcke R, Pieretti A. Renal Abscess in Previously Healthy Girl. Urology. 2009;73(2):297-8.
28. Patzer L. Nephrotoxicity as a cause of acute kidney injury in children. Pediatr Nephrol. 2008;23(12):2159-73.
29. Sjöström S, Sillén U, Bachelard M, et al. Bladder/bowel dysfunction in pre-school children following febrile urinary tract infection in infancy. Pediatr Nephrol. 2021; 36(6): 1489-97.