Pediatric Renal Abscess: A 10-year Single-Center Retrospective Analysis

abstract

OBJECTIVE: The objective of this retrospective series is to describe the demographics and treatment of patients with renal abscesses and to determine if abscess size influences management.

METHODS: We reviewed all pediatric cases of renal abscesses treated over a 10-year period in our medical center. Clinical, laboratory, imaging data, and treatment modalities were analyzed.

RESULTS: Thirty-six patients were evaluated, with renal abscesses found in all age groups. The median age was 9.3 years, and 64% of patients affected were female. Fever and abdominal pain were the most common clinical symptoms. A premorbid genitourinary condition was present in 31% of patients. Previous urinary tract infection was documented in 31% of the cases. Initial elevation of C-reactive protein or erythrocyte sedimentation rate, when obtained, was observed in >80% of cases. Abnormal urinalysis was recognized in two-thirds of encounters. Escherichia coli, the most common microorganism isolated, was found in half the cases. Staphylococcus aureus was isolated in 11%. Ultrasound and computed tomography were the most used diagnostic imaging modalities. Eighty-nine percent of the patients who received intravenous antibiotics alone as an initial treatment regimen did not require percutaneous drainage or surgery.

CONCLUSIONS: Ten of the 14 patients with an abscess size ≥3 cm had an invasive intervention, but only 1 of these 10 had an initial 48-hour trial of antibiotics alone. In contrast, only 2 of the 22 patients who had an abscess size <3 cm received an invasive intervention (Fisher P = .0002). We conclude that conservative treatment with intravenous antibiotics may be a reasonable initial approach.

INTRODUCTION

Although the exact incidence is unknown, renal abscesses in children are thought to be rare. Additionally, no age or ethnic group is known to have an increased risk to develop these abscesses. Historically, case series have reported that Escherichia coli and Staphylococcus aureus are the most frequently isolated bacteria.

Renal abscesses often occur in otherwise healthy patients, but various risk factors that predispose children have been found. Urinary tract conditions and anomalies such as neurogenic bladder, vesicoureteral reflux, and pelvic-ureteral duplications have been implicated.

Patients with renal abscesses may manifest with nonspecific constitutional symptoms, such as fever, general malaise, nausea, decreased appetite, and weight...
loss. Urinary tract complaints such as dysuria or malodorous or cloudy urine are sometimes reported.\(^1\)\(^2\) The child may appear ill on physical examination. Unilateral flank or abdominal pain on the affected side may also be noted and sometimes may radiate to the back. Laboratory findings may indicate elevated inflammatory markers and may be helpful in guiding treatment. Ultrasound and computed tomography (CT) are the commonly used diagnostic imaging modalities\(^4\) (see Fig 1).

Some experts suggest an initial trial of intravenous antibiotics alone, although others favor a more aggressive management, as noted in an algorithm proposed by Angel et al.\(^2\) This makes management of renal abscesses a controversial issue.\(^5\)\(^6\) The objective of this retrospective case series, the largest to date, is to provide a recent review on the demographics and management of this uncommon clinical condition.

**PATIENT AND METHODS**

We performed a retrospective analysis of all children with renal abscesses treated at Children’s Medical Center of Dallas over a 10-year period between January 2000 and April 2010. Based on the primary or secondary discharge diagnosis (International Classification of Diseases, \(^9\)th Revision 590.2), 43 encounters for patients<18 years of age were identified by a computer-assisted search. We did not include International Classification of Diseases, \(^9\)th Revision 599.0 (urinary tract infection) or 590.9 (kidney infection) as part of the query. Additionally, we did not distinguish between intrarenal and perirenal abscesses for the purposes of this review.

Six patient encounters met exclusion criteria because of inaccurate billing (ie, erroneous diagnosis code). In addition, 1 encounter was a readmission within 1 week of an already included case, so the data were analyzed together. No patients were excluded based on any underlying conditions.

The demographics, premorbid genitourinary conditions, and signs and symptoms were analyzed. Microbiology and laboratory data, including white blood cell (WBC) count, Urinalysis, C-reactive peptide (CRP), and erythrocyte sedimentation rate (ESR) were reviewed. Any pertinent imaging studies, including ultrasound and CT, were assessed. Final characterization of abscess size was based upon the CT report. Intravenous antibiotics and any invasive interventions (such as percutaneous drainage) were also evaluated.

**RESULTS**

**Epidemiology**

Renal abscesses were found in all age groups, with a median age of 9.3 years (age range, 0.28–17.5 years). Sixty-four percent of the patients affected were female. White and Hispanic children each represented one-third of the cases in our study (Table 1). A premorbid anatomic or functional genitourinary condition, including vesicoureteral reflux, structural bladder abnormalities, duplicated collecting system, neurogenic bladder, posterior urethral valves, ureteropelvic junction obstruction, or urethral stenosis, was present in 31% of the patients, some of whom had >1 condition (Table 2). History of nephrolithiasis was documented in 3 of the 36 patients.

**Clinical and Laboratory**

Fever and flank/abdominal pain were the most common clinical symptoms (Table 3). Unfortunately, duration of fever data were unable to be retrieved.

**TABLE 1 Demographics**

<table>
<thead>
<tr>
<th>Total included cases</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age, y</td>
<td>9.3</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>23 (64)</td>
</tr>
<tr>
<td>Male</td>
<td>13 (36)</td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>11 (31)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>11 (31)</td>
</tr>
<tr>
<td>African American</td>
<td>9 (25)</td>
</tr>
<tr>
<td>Asian</td>
<td>3 (8)</td>
</tr>
<tr>
<td>Other/unknown</td>
<td>2 (6)</td>
</tr>
</tbody>
</table>

**TABLE 2 Premorbid Genitourinary Conditions**

<table>
<thead>
<tr>
<th>Premorbid Conditions</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genitourinary abnormality</td>
<td>11</td>
<td>31</td>
</tr>
<tr>
<td>Vesicoureteral reflux</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Structural bladder abnormality(^a)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Duplicated collecting system</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Neurogenic bladder</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Posterior ureteral valves</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Ureteropelvic junction obstruction</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Urethral stenosis</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

\(^a\) Extrophy or diverticulum.

**FIGURE 1** Computerized tomography showing a left kidney septated large mass with multiple hypodense lesions suggestive of an abscess.
on a substantial number of cases. When checked, initial elevated WBC count for age was noted in 71% (25/35) of the cases. A significant increase of CRP was considered >5 mg/dL, whereas ESR elevation was considered >30 mm/h. Initial elevation of these acute-phase reactants was observed in >80% of the patients. Urinalysis showing positive leukocyte esterase or nitrites was recognized in almost two-thirds of the cases. Per chart review, a previous history of urinary tract infection(s) was noted in 31% of the cases.

Of note, 1 patient did have sickle cell disease. Another patient had short-bowel syndrome and was receiving total parenteral nutrition via a central line. There were 2 patients with Beckwith-Wiedemann syndrome, one of whom had xanthogranulomatous pyelonephritis with an associated large organizing abscess noted on pathology.

**Microbiology**

The majority of microorganisms isolated were Gram-negative bacteria (Fig 2). *E coli*, the most common microorganism implicated, was found in 18 of the cases (50%). Two of these 18 isolates showed multiple organisms, whereas 16 isolates grew solely *E coli*. Of these 16 *E coli* cases, 11 were from urine cultures, 4 were from an abscess culture (percutaneous), and 3 were from blood cultures (2 of these patients also had a positive urine culture).

Of the 11 patients with premorbid genitourinary conditions, cultures of 4 of the 11 patients grew *E coli* (2 of the 4 showed multiple organisms). Of the remaining 7 cases, 6 had other organisms isolated, and 1 was culture-negative.

*S aureus* was recovered in 4 cases (11%): 3 grew methicillin-sensitive *S aureus* and 1 grew methicillin-resistant *S aureus*. Two methicillin-sensitive *S aureus* isolates were from the urine, and one was from an abscess culture. The methicillin-resistant *S aureus* isolate was from an abscess culture.

Interestingly, none of the *S aureus* isolates were from the blood.

Other pathogens implicated included *Salmonella* sp., *Enterococcus* sp., *Streptococcus viridans*, *Enterobacter aerogenes*, and *Proteus mirabilis*. Anaerobic infection was rare. *Peptostreptococcus* sp. was noted on only one of the multiorganism isolates. In 22% of the cases, no microorganism was isolated.

**Imaging**

Renal ultrasound was performed in 81% of the patients, whereas CT was performed in 97%. Imaging and laboratory studies were used to monitor the child’s progress.

**Treatment**

**Antibiotic Choices and Duration**

All of the patients received antibiotics as soon as infection was suspected. As for antibiotic choice, second- or third-generation cephalosporins were used
in 81% (29/36) of the cases. Other commonly used antibiotics included aminoglycosides and penicillins. The length of treatment was variable, with a median of 14.5 days of intravenous antibiotics. Data available regarding oral antibiotic duration was incomplete, so it was difficult to determine the combined intravenous and oral duration.

**Antibiotics Alone Versus Invasive Intervention**

Seventy-five percent (27/36) of the patients received intravenous antibiotics alone as an initial treatment regimen. Eighty-nine percent (24/27) of these patients did not require percutaneous drainage or surgery. Thus, only 3 were deemed “antibiotic failures.” However, specific antibiotic choices were not factored into this definition.

Twelve patients underwent an invasive intervention (percutaneous drainage and/or surgery). Of these 12 patients, 3 ended up getting both percutaneous and surgical drainage, whereas only one had surgical intervention without percutaneous drainage attempted. Average hospital length of stay for the patients who received an invasive intervention was 10.6 days in comparison with 13.9 days for the noninvasive group (P = .5).

**Invasive Intervention Related to Abscess Size**

Fourteen of the 36 patients had an abscess size <3 cm, with 10 of them having an invasive intervention (Table 4). This is in comparison with only 2 of 22 patients who had an abscess size ≥3 cm receiving an invasive intervention (Fisher exact test P = .0002). Both of these patients were considered “antibiotic failures,” because they had initially received antibiotics alone.

Of the 10 patients with an abscess size ≥3 cm who underwent an invasive intervention, only one had an initial 48-hour trial of antibiotics alone. Of the 5 patients with an abscess size ≥3 cm who had a trial of antibiotics alone, 4 ended up not needing an invasive intervention.

**DISCUSSION**

The great majority of the literature about renal abscesses is based on case reports or small series, with prevalence consequently being uncertain. Previous reports have suggested that boys and girls are equally affected. In addition, no pediatric age group is known to be more prone to develop an abscess. Our case series demonstrated a slight female predominance and median age of 9.3 years.

We observed a relevant relationship between previous history of urinary tract infection and future abscess formation (31% of cases). The presence of a premorbid genitourinary condition was prevalent as well (31% of cases).

Similar to previous case series, our study identified *E. coli* and *S. aureus* as the most commonly isolated bacteria. Although *E. coli* was isolated in half of the cases, *S. aureus* was a distant second, noted in only 11% of cases. Of note, no microorganism was recovered in 22% of the cases. Interestingly, almost two-thirds of the patients with premorbid genitourinary conditions had no *E. coli* isolated.

Bacteremia was not a common finding in our series, with a positive blood culture found in only 6 of 36 cases (17%). *E. coli* was the most commonly isolated pathogen in the blood, noted in 3 of the cases. *S. aureus* was never retrieved from the blood.

One study highlighted the importance of anaerobic bacteria in renal abscesses in children with an isolation of a significant number of *Bacteroides* species. Anaerobic infection was not relevant in our series.

Clinical diagnosis of a renal abscess may be challenging because symptoms are mainly constitutional and often nonspecific. Fever, loin pain, leukocytosis with left shift, and elevated ESR are common presenting findings. In our series, fever (94% of the cases) and flank/abdominal pain (66% of the cases) were the main clinical symptoms.

Previous reports have suggested that leukocyturia may be noted on urinalysis, but urine cultures are often negative. We recognized a high number of abnormal urinalysis (positive leukocyte esterase or nitrites), noted in two-thirds of our cases. A urine culture pathogen was isolated in 53% of cases. Our series findings implicate that ascending infection may have been the most prevalent pathophysiologic mechanism in the development of renal abscess. Although bacteremia was infrequent in our study, previous series have suggested that blood cultures may be positive in up to one-third of cases.

WBC count and acute-phase reactants, including ESR and CRP, were often elevated.

Renal ultrasound was frequently performed. Because it does not require

<table>
<thead>
<tr>
<th>Abscess Size</th>
<th>Antibiotics Alone (%)</th>
<th>Invasive Intervention (%)</th>
<th>Fisher Exact Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 cm</td>
<td>20 (90)</td>
<td>2 (10)</td>
<td><em>P</em> = .0002</td>
</tr>
<tr>
<td>≥3 cm</td>
<td>4 (28)</td>
<td>10 (78)*</td>
<td><em>P</em> = .0002</td>
</tr>
</tbody>
</table>

* One patient had invasive intervention at presentation.
sedation and no radiation is involved, a renal ultrasound is a reasonable initial study and can also be used at follow-up to monitor clinical progress. CT was performed in almost all patients (35/36) either to confirm sonographic findings or to further establish the diagnosis of a renal abscess. Our review of the data was unable to determine if CT imaging supplied information truly distinct from sonography or impacted management.

The treatment of renal abscesses includes broad-spectrum intravenous antibiotics and percutaneous or open surgical drainage. At minimum, antibiotics should cover against *E. coli* and *S. aureus*, the most common pathogens isolated in our study. Second- or third-generation cephalosporins were the antibiotics of choice in our review. Ten to 14 days of intravenous antibiotics followed by 2 to 4 weeks of oral therapy have been recommended by most case series, although a longer course may sometimes be warranted.1,2

Some experts suggest staged management with an initial trial of intravenous antibiotics alone, although others favor a more aggressive management.11 Clinical response may be noted within 48 to 72 hours.1 In our study, 89% of the patients who received intravenous antibiotics alone as an initial treatment regimen did not require percutaneous drainage or surgery.

A few adult studies have suggested that abscesses >3 cm in size may need percutaneous or surgical drainage.9,12 Early drainage is also recommended in immunocompromised hosts.1 In our study, a significant number of patients with a larger abscess size (≥3 cm) underwent an invasive intervention in comparison with those with a smaller abscess (Fisher exact test *P*= .0002). However, it is noteworthy that only 1 of 10 patients with a larger abscess had an initial trial of antibiotics alone.

The algorithm originally proposed by Angel et al9 suggests that prompt initiation of antibiotics and percutaneous drainage is necessary in children with a renal abscess. However, our data suggest that a conservative approach with antibiotics alone may be a reasonable approach, potentially sparing exposure to an invasive intervention.

The average hospital length of stay for the patients who received an invasive intervention was less than those in the noninvasive group. Length-of-stay analysis certainly had its limitations, and no statistical significant difference was noted between the groups. The duration of hospitalization was affected by the availability of outpatient intravenous services (ie, outpatient antibiotics via a peripherally inserted central catheter). For example, 2 of the 12 patients in the invasive group were able to go home with central lines. Additionally, one of the patients in the noninvasive group with a very prolonged hospitalization (109 days) had many other medical problems that were treated during the stay.

Kidney loss in children has been reported to be significant, ranging from 12% to 20% according to previous series.2,4,5,7 Two patients underwent nephrectomy in our series (5%), implicating that early diagnosis and treatment are essential.

We recognize that this case series has its limitations. These include its retrospective nature and the lack of randomization of the treatment modalities. Additionally, finding cases was based on billing code, and there may have been circumstances when the physician or billing team may have miscoded diagnoses.

Although this is the largest case series to date, it is still a relatively small sample size. Furthermore, some assumptions were made in assessing clinical symptoms. For instance, if a child was nonverbal and specific clinical symptoms were not documented, these symptoms were presumed to be absent. Finally, the study would have been strengthened if follow-up data were consistently made available.

**CONCLUSIONS**

Patients with a renal abscess often presented with fever and/or abdominal pain. *E. coli* and *S. aureus* were the most common pathogens implicated. ESR and CRP were typically elevated. Renal ultrasound and CT were the most commonly used diagnostic imaging modalities. Most patients in this series who received antibiotic therapy alone did not require an invasive intervention. Patients with abscesses <3 cm commonly received conservative therapy without any intervention needed. Patients with an abscess size ≥3 cm were likely to have an invasive intervention, but there was no evidence that antibiotics alone would not have been successful. Further studies are needed to determine appropriateness of conservative therapy for this group.

**REFERENCES**


Pediatric Renal Abscess: A 10-year Single-Center Retrospective Analysis
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