Global Pediatric Health
Volume 8: 1–7

DOI: 10.1177/2333794X211022263
journals.sagepub.com/home/gph
SAGE

Salmonella Renal Abscess in an Immunocompetent Child: Case Report and Literature Review

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Abstract

We describe a case of a 10-year-old immunocompetent girl with a left renal abscess due to Group C *Salmonella* (*Salmonella* serovar Oranienburg). Percutaneous drainage of the abscess was done. She also received 2 weeks of intravenous ceftriaxone, followed by 4 weeks of oral co-trimoxazole with resolution seen on ultrasound. A review of pediatric *Salmonella* renal abscesses is also presented.

Keywords

renal, abscess, *Salmonella*, urinary tract infection, pediatric, children

Received April 28, 2021. Received revised May 26, 2021. Accepted for publication May 13, 2021.

Introduction

Renal and perinephric abscesses are uncommon in children.[1] A review done by a pediatric hospital in Taiwan reported only 45 cases over 10 years, while renal abscesses occurred in only 0.4% of pediatric urinary tract infections (UTI) in a Greek hospital.[2,3] Renal abscesses can originate via ascending infections from the urinary tract, inflammation, and infection near the kidney or hematogenous spread.[4] Patients usually present with symptoms similar to UTI, such as dysuria, increase in urinary frequency, costovertebral angle pain tenderness, fever, and elevated inflammatory markers.[5] The diagnosis of renal abscess requires ultrasound or computed tomography (CT) imaging of the kidney, ureters, and bladder.[6] Common organisms associated with renal abscesses include *Staphylococcus aureus* and Gram-negative organisms such as *Escherichia coli, Klebsiella pneumoniae* and *Proteus mirabilis*.[4,6]

Non-typhoidal *Salmonella* (NTS) and *Salmonella typhi* are Gram-negative bacilli which belong to the order *Enterobacterales*.[7] NTS infection typically presents in the form of gastroenteritis (GE). NTS are rarely isolated from the urinary tract with or without concomitant GE.[8,9] Reports of renal abscesses caused by NTS or *Salmonella typhi* are rare, usually occurring in patients with urologic abnormalities, immunosuppression, or diabetes.[10-12] Renal abscesses are generally managed with antibiotics, with concomitant surgical intervention in some cases.[10-14]

Here, we report a rare case of an immunocompetent 10-year-old girl with *Salmonella* renal abscess confirmed by imaging and fluid culture. We also conducted a literature review of the management of pediatric *Salmonella* renal abscesses.

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Table 1. Our Patient's Baseline Laboratory Results That were Taken on Admission.

Laboratory parameters	Results (normal values)	Urine components	Results
Urea, serum (mmol/L)	3.1 (2.6-6.8)	Specific gravity, urine	1.005 (1.016-1.022)
Sodium, serum (mmol/L)	139 (138-145)	RBC microscopy	0/uL (0-2)
Potassium, serum (mmol/L)	3.8 (3.4-4.7)	WBC microscopy	0/uL (0-4)
Bicarbonate, serum (mmol/L)	23 (14-23)	Epithelial cell microscopy	0/uL
Chloride, serum (mmol/L)	103 (98-107)	Casts, urine	Nil
Creatinine, serum (mmol/L)	36 (27-54)	Crystals, urine	Nil
C-reactive protein (CRP) (mg/L)	62.5 (0-5)	Glucose, urine	Nil
Erythrocyte sedimentation rate (ESR) (mm/h)	74 (3-15)	Protein, urine	1+
White blood cell count (WBC) ($\times 10^9$/L)	18.23 (4-13.5)	Nitrite, urine	Nil
Neutrophil (%)	55	Leucocyte, urine	Nil
Neutrophil absolute ($\times 10^9$/L)	10.03 (1.5-8)		

Case Presentation

A 10-year-old girl without significant past medical history presented with 1 week of fever and intermittent vomiting with 1 day of abdominal pain and localized discomfort over the left hypochondrium. Two weeks prior to this presentation, she had 4 days of fever with diarrhea and vomiting which resolved spontaneously. There was no recent history of trauma, sick contact, or travel history, except for a superficial scratch (<2 cm open wound) caused by a household cat 3 months prior, which healed without intervention.

On physical examination during admission, she was alert and non-toxic, had costovertebral angle tenderness on the left side, but did not report any dysuria or increase in urinary frequency. She was febrile at 38.5°C, with other vitals being stable. Laboratory evaluation revealed leukocytosis and elevated inflammatory markers (Table 1). Urinalysis done was unremarkable and no microorganism was isolated from her urine culture. She had microcytic hypochromic anemia and was subsequently diagnosed to have alpha 2—thalassemia minor during this admission.

Due to the concerns of pyelonephritis or colitis, an ultrasound of the abdomen was ordered on the second day of admission. Imaging of both kidneys showed multiple cysts and a heterogeneous structure 4.2 cm × 4.0 cm × 3.1 cm (Figure 1A) extending from the left mid to the lower pole, consistent with a renal abscess, and much of it appeared liquefied. Her parents declined genetic testing for polycystic kidney disease and there was no known family history of kidney cysts.

Intravenous (IV) gentamicin (5 mg/kg/day) was initiated on admission for concerns of pyelonephritis but was switched to IV ceftriaxone (100 mg/kg/day) after a renal abscess was detected, for better abscess penetration. Subsequently, an image-guided drainage of the renal abscess was done, where 15 mL of brown frank pus was aspirated and the drain was left in situ. The fluid culture revealed a group C *Salmonella* species (serotyped as *Salmonella* serovar Oranienburg by Singapore National Public Health Laboratory) that was susceptible to ampicillin, ceftriaxone, and co-trimoxazole. All other microbiological investigations including blood culture, repeat urine culture, acid-fast bacilli smear of the pus, *Mycobacterium tuberculosis* polymerase chain reaction, mycobacterial culture and fungal culture were unremarkable. A stool culture was not performed as her diarrhea resolved prior to admission. As group C *Salmonella* is an atypical cause of renal abscess, an immunological screen consisting of immunoglobulin levels and CD3, CD4, and CD8 T cells count was performed, which was unremarkable.

Serial kidney ultrasounds were done on day 3, day 10, and day 27 post-drainage. Her fever lysed by the second day post-drainage, and by day 3 post-drainage, the renal abscess decreased to 2.0 cm × 1.9 cm × 1.9 cm (Figure 1B). Her C-reactive protein normalized by day 10 post-drainage (4.1 mg/L), with a further decrease in renal abscess size to 2.1 cm × 1.4 cm × 1.6 cm (Figure 1C). Hence, the drain was removed. After receiving 2 weeks of intravenous ceftriaxone, she was discharged with another 4 weeks of oral co-trimoxazole (4 mg/kg/dose twice daily of trimethoprim component). By day 27 post-drainage, the abscess had resolved completely on the ultrasound scan (Figure 1D).

Discussion

Salmonella (NTS and typhoidal) infection commonly presents as gastroenteritis, invasive infection, or metastatic focal infection, but renal involvement, especially in the form of renal abscess, is rare.[8-12,15] A retrospective review done in Spain found only 1.4% of all infections due to NTS presenting as UTI.[16] Characteristics of patients with NTS isolated from the urine are summarized

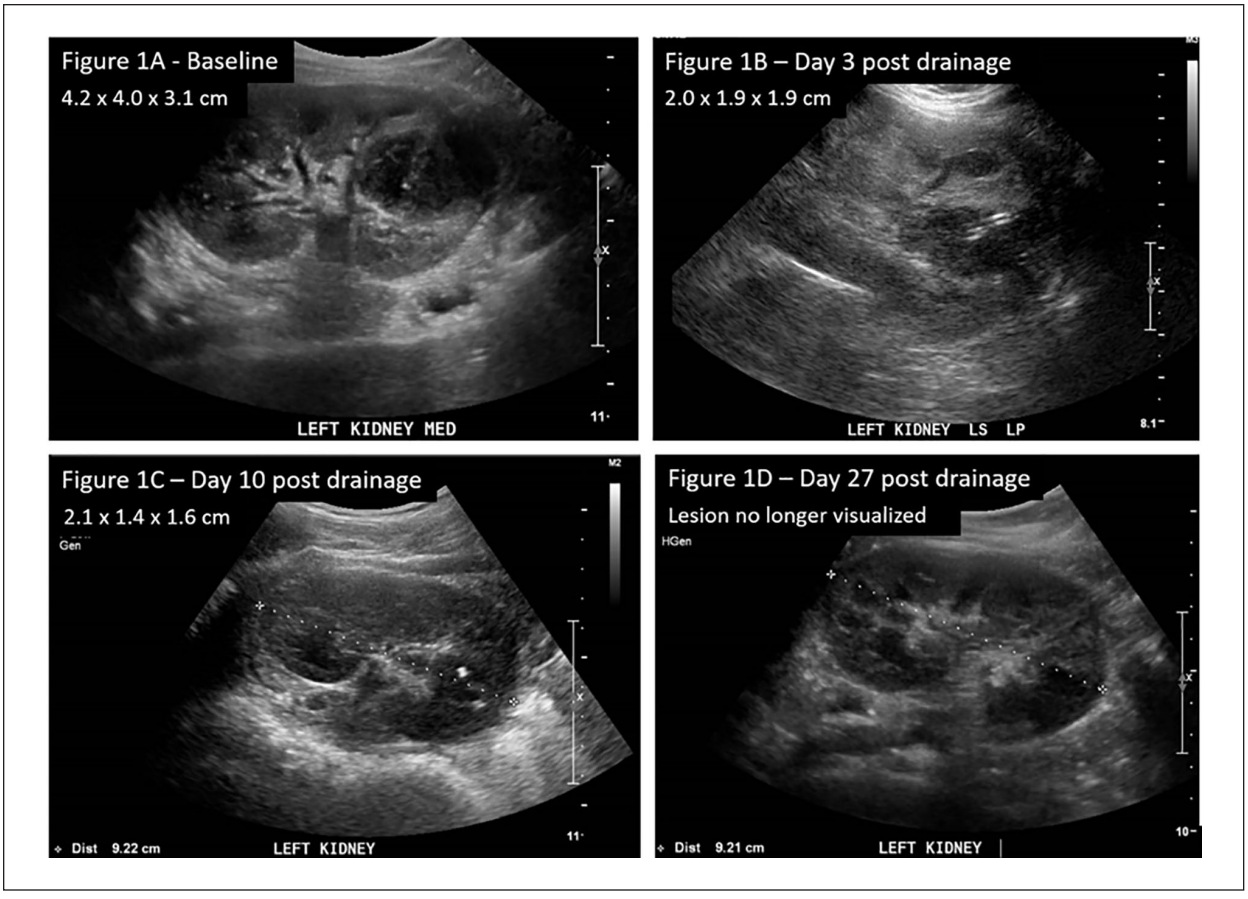

Figure 1. Ultrasound of kidneys, ureters, and bladder. (A) (Baseline) A heterogeneous structure noted in the left kidney extending from the mid to lower pole. This lesion is consistent with a renal abscess and much of it appears liquefied. (B) (Day 3 post drainage) Abscess decreased in size. (C) (Day 10 post drainage) Previously noted abscess smaller in size with catheter in situ. (D) (Day 27 post-drainage) Cystic lesion no longer visualized.

in Table 2. Risk factors for renal abscess include previous urinary tract infection, urologic instrumentation or surgery, urinary tract obstruction, or an immunocompromized state.[17] To our knowledge, only 3 other cases of pediatric *Salmonella* (NTS and typhoidal) renal abscesses have been described,[10,11,18] of which only 1 case had an existing congenital atrophy of the left kidney.[11] In a case series described by Paterson et al,[12] only 3 of 23 patients with NTS UTI had structural abnormalities, and none was immunosuppressed.

Our patient had gastrointestinal symptoms 2 weeks prior that had resolved by the time of admission. This might have been the origin of her Group C *Salmonella* infection. In addition, her suspected underlying polycystic kidney disease may be a possible risk factor for renal infections due to possible outflow obstruction causing retrograde infection from the urinary bladder.[20-22] Although she was incidentally diagnosed to have alpha 2—thalassemia minor, minor forms of the thalassemia trait as a predisposing factor for *Salmonella* infections are not as well described as underlying established hemoglobinopathies, such as sickle cell anemia, thalassemia with high iron load, or previous splenectomy.[23-28] Generally, NTS as a renal pathogen is unusual, and an occult urologic problem or an immunodeficiency should be considered.[16]

Most reported pediatric renal abscess cases were managed with antibiotic therapy as a mainstay, and in some cases, with concomitant abscess drainage (Table 3). Common antibiotic therapy for renal pathogens includes third-generation cephalosporins, co-trimoxazole, fluoroquinolones, and aminoglycosides.[29,30] However, aminoglycosides are not ideal for renal abscesses due to the anaerobic and acidic pH environment of the abscesses.[31] Antimicrobial therapy for our patient was empirically switched from gentamicin to ceftriaxone when a renal abscess was found, which also provided adequate coverage for Group C *Salmonella* when it was subsequently

Table 2. Characteristics of Patients with Non-Typhoidal Salmonella Isolated in Urine Cultures Described in Various Case Series.

Study	Time period	Number of patients with NTS in urine	Mean age in years (age range)	Number of patients ≤18 years old	Most common serovar (n, %)	Medical history/risk factors (n, %)
Allerberger et al[19]	1979-1989	30	52.6 (3-81 years)	3	*S.* typhimurium (n = 8, 26.7%), *S.* Enteritidis (n = 5, 16.7%), *S.* Agona (n = 3, 10%), *S.* Blockley (n = 1, 3%), *S.* Bovismorbificans (n = 1, 3%), *S.* Derby (n = 1, 3%), *S.* Java (n = 1, 3%), *S.* Manhattan (n = 1, 3%), *S.* Muenchen (n = 1, 3%), *S.* Newport (n = 1, 3%), *S.* Ohio (n = 1, 3%), *S.* Panama (n = 1, 3%), *S.* Sandiego (n = 1, 3%), *S.* Schwarzengrund (n = 1, 3%), Serotype not investigated (n = 3, 10%)	Significant underlying disease (n = 24, 80%), urologic conditions (n = 23, 76.7%)
Ramos et al[16]	1978-1992	28	56 (22-82 years)	Nil	*S.* Enteritidis (n = 16, 57.1%), *S.* Typhimurium (n = 5, 17.9%), *S.* Derby (n = 2, 7.1%), *S.* Blockley (n = 1, 3.6%), *S.* California (n = 1, 3.6%), *S.* Heidelberg (n = 1, 3.6%), *S.* Ohio (n = 1, 3.6%), *S.* Tilburg (n = 1, 3.6%)	Severely immunocompromized (n = 17, 60.7%), urologic conditions (n = 14, 50%)
Paterson et al[12]	1995-1996	23	35 (1-89)	7	*S.* Birkenhead (n = 3, 13%), *S.* Muenchen (n = 2, 8.7%), *S.* Virchow (n = 2, 8.7%), Others not stated explicitly	None had organ transplant, HIV infection, immunosuppression. Urologic conditions (n = 3, 13%)
Tena et al[8]	1990-2005	19	62.5 (3-92)	2	*S.* Enteritidis (n = 16, 84.2%), *S.* Typhimurium (n = 3, 15.8%)	Diabetes Mellitus (n = 8, 42.1%), immunosuppressant treatment (n = 7, 36.8%), urologic conditions (n = 8, 42.1%)

Table 3. Characteristics and Management of Pediatric Patients with Salmonella Renal Abscesses.

Study	Age (years)/sex	Past medical history	Important labs	*Salmonella* serotype	Sensitivity	Source of isolate(s)	Abscess size (cm)	Antibiotic therapy	Invasive intervention	Outcome
Rus and Kersnik Levart[10]	14/male	None	CRP (30 mg/L). ESR (74 mm/h). WBC (15.8×10^9/L). Blood urea nitrogen (44.9 mmol/L). Serum creatinine (425 µmol/L)	*S.* Enteritidis	[S] ampicillin, ceftriaxone, co-trimoxazole, ciprofloxacin	Urine culture	First scan – size not stated but imaging showed multiple renal abscesses. Second scan (during relapse) – multiple renal abscesses seen (largest 3.3 cm).	First course: Intravenous ceftriaxone for 12 days, followed by oral co-trimoxazole for 9 days. 2nd course: Intravenous ceftriaxone for 4 weeks, followed by oral ciprofloxacin for 2 weeks.	No	Initially cured but had relapse 13 days after initial treatment. Developed arterial hypertension after 6-month follow-up
Kaur et al[11]	10/male	Congenital atrophy of left kidney	WBC (16.5×10^9/L). Blood urea (11.8 mmol/L). Serum creatinine (61.9 µmol/L)	*S.* Typhi	[S] ceftriaxone, cefoperazone-sulbactam, co-trimoxazole, [R] ciprofloxacin	Fluid culture	4.2 cm × 3.1 cm	Intravenous cefoperazone-sulbactam 1 g TDS for 4 days, followed by 7 days of oral cefixime 200 mg BD.	Aspiration	Cure
D'Cruz et al[18]	17/male	None	WBC (3.6×10^9/L)	*S.* Paratyphi A	[S] ceftriaxone, cefoperazone-sulbactam, ofloxacin, amikacin, gentamicin	Fluid culture	2.5 × 2.6 cm	Amikacin and ofloxacin for 2 weeks, followed by 2 weeks of ofloxacin monotherapy	Aspiration	Cure
Our case	10/female	Nil	CRP (62.5 mg/L). ESR (74 mm/h). WBC (18.23×10^9/L). Blood urea (3.1 mmol/L). Serum creatinine (23 µmol/L)	Group C *Salmonella* (*Salmonella* serovar Oranienburg)	[S] ampicillin, ceftriaxone, co-trimoxazole	Fluid culture	4.2 × 4.0 × 3.1 cm	Intravenous ceftriaxone 100 mg/kg/day for 2 weeks, followed by 4 weeks of oral co-trimoxazole (8 mg/kg/day of trimethoprim twice daily)	Drainage	Cure

[S], sensitive; [R], resistant.

identified. In the setting of renal abscesses, third generation cephalosporins can be considered as empiric therapy.

The optimal criteria and timing for surgical intervention remains unknown.[6] Broad-spectrum parenteral antibiotic coverage and surgical drainage had been recommended due to paucity of evidence regarding safe and effective treatment with antibiotics alone in pediatrics, as compared to adult studies.[4] However, several recent case series on pediatric renal abscesses report success with conservative antibiotic treatment for smaller abscesses (ie, $\leq$3 cm in size).[1,32,33] Our patient's renal abscess measured 4.2 cm $\times$ 4.0 cm $\times$ 3.1 cm. The prompt resolution of our patient's clinical symptoms on day 3 of admission after initiation of appropriate antibiotics and drainage suggests that surgical intervention is likely to be helpful, particularly if done early and in the setting of a relatively large renal abscess.

The optimal duration of antibiotic treatment for renal abscesses remains to be determined. In the treatment of acute lobar nephronia, which may represent early stage of development of renal abscess, 3 weeks of treatment had superior outcomes compared to 2 weeks.[34,35] The need for prolonged antibiotic therapy was also suggested by Rus and Kersnik Levart[10] in a case of a previously healthy 14-year old with a NTS renal abscess complicated by acute renal failure who had a recurrence of infection. The patient was initially conservatively treated with 12 days of intravenous ceftriaxone followed by 9 days of co-trimoxazole. Although there was clinical response with normalization of laboratory parameters and a subsequent negative urine culture at the end of the first course, there was a recurrence 13 days after the completion of the initial treatment. He then completed 4 additional weeks of intravenous ceftriaxone followed by 2 weeks of ciprofloxacin. Both his kidneys showed signs of chronic pyelonephritis on ultrasound 3 years later. The authors then concluded that at least 6 weeks of antibiotic treatment should be considered.

Here, we took a more conservative approach by performing serial ultrasound imaging to ascertain radiological improvement before the child was discharged with oral antibiotics to complete the total 6-week course, to ensure therapeutic success. As there was complete resolution of the renal abscess in our patient by day 27 post-drainage, this suggests that a minimum of 4 weeks of antibiotics (inclusive of at least 2 weeks intravenous) is required, even with early surgical intervention.

Conclusions

In conclusion, renal abscesses in immunocompetent children caused by NTS are rare. A prolonged course of antibiotic therapy of at least 4 weeks with concomitant surgical intervention may be required for the treatment of a large renal abscess.

Author Contributions

CWMP: Contributed to the conception, acquisition, and analysis of data; drafted manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
XFVS: Contributed to the conception, acquisition, and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
CYC: Contributed to the acquisition and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
IG: Contributed to the acquisition and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
MM: Contributed to the acquisition and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
KN: Contributed to the acquisition and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
KQK: Contributed to the acquisition and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.
NWHT: Contributed to the conception, acquisition, and analysis of data; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

Ethical Approval and Informed Consent

Relevant data and material that was required for the write-up was obtained and included in the manuscript. Patient's consent to participate and for publication was obtained. Centralised Institutional Review Board approval is not required for case reports.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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