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Pediatric Citrobacter Urinary Tract Infections: A Case Report Highlighting Emerging Trends

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ABSTRACT

Urinary tract infections (UTIs) caused by Citrobacter species in pediatric patients present a unique and infrequently reported scenario in clinical practice. This case report delves into the clinical presentation, diagnostic challenges, treatment modalities, and overall management of a pediatric UTI caused by Citrobacter. Through a literature review, it becomes evident that while Citrobacter infections are more commonly observed in adults, especially the elderly population, recent studies signal a rising trend in pediatric cases globally. Noteworthy findings from published cases underscore the diverse clinical manifestations and associated challenges. We present the case of a 1-month-old male who presented with feeding difficulties and irritability, subsequently diagnosed with a UTI caused by Citrobacter koseri. Despite lacking typical risk factors or symptoms associated with Citrobacter UTIs, the patient demonstrated a favorable response to antibiotic therapy. This case stresses the evolving nature of Citrobacter infections in the pediatric population and emphasizes the importance of vigilance in recognition and management. Further research is warranted to better understand this emerging trend and its implications for pediatric care.

Introduction:

Urinary tract infections (UTIs) in pediatric patients are not uncommon; however, when the causative agent belongs to the Citrobacter genus, a unique and rare scenario unfolds. Citrobacter species are typically opportunistic pathogens and their involvement in UTIs, especially in the pediatric population, is infrequently reported. This report dives into a remarkable instance where a pediatric patient suffered a UTI caused by Citrobacter, shedding light on the clinical presentation, diagnostic challenges, treatment modalities, and the overall management of this unusual infection.

In the context of pediatric medicine, understanding the specific nuances of Citrobacter-Induced UTIs

becomes imperative as these infections often pose distinct challenges in diagnosis, susceptibility patterns, and the potential for complications. This case study seeks to explore emerging trends that were once predominantly associated with the elderly but are increasingly becoming more prevalent in the pediatric population. Our aim is to contribute valuable insights to the medical community by fostering a deeper understanding of the clinical spectrum and therapeutic approaches associated with Citrobacter-related UTIs in the pediatric population.

Literature review:

To contextualize the rarity of Citrobacter-induced UTIs in pediatric patients, we conducted a literature review encompassing published cases globally. While Citrobacter infections are more commonly reported in adults, recent studies have signaled a shift in the epidemiological landscape, with an increasing number of documented cases in pediatric populations.

Several noteworthy cases have been reported, highlighting the diverse clinical manifestations and challenges associated with Citrobacter-related UTIs in children. In a seminal study conducted by Gill, Michelle et al. (1999), a comprehensive review encompassed 34 patients afflicted with 37 infections. The average patient age was 6.9 years, spanning from 1 month to 18 years with a female predominance noted in 71% of cases. A significant proportion of the patients, amounting to 56%, presented with urinary tract/renal anomalies or neurological impairment, while 26% were indicative of nosocomial infections. Remarkably, 37% of patients were asymptomatic at the time of diagnosis, whereas 63% exhibited a spectrum of symptoms, including gastrointestinal symptoms, dysuria, fever, incontinence, penile/vaginal discharge, frequency, flank pain, and hematuria. Of the isolated strains, Citrobacter freundii constituted 26 cases, while Citrobacter koseri accounted for 11 instances [1]. Similarly, in another study conducted in 1991, among 1441 nosocomial Citrobacter infection patients, 812 had a urinary tract infection, 321 had a surgical wound infection, 226 had pneumonia, and 82 had a bloodstream infection. Among all Citrobacter infections, around one-third to half are polymorphic making it even more virulent [4].

In another study conducted by Kumari, Ritu et al. (2018), in which isolates of urine specimens from pediatric UTI patients were analyzed, it was found that the prevalence of Citrobacter species in UTI patients was 17.3%, higher than most other reported studies. Among the Citrobacter species the most common isolate was *C. koseri* as compared to *C. freundii*. A slight male predominance of 52% was found in this study. This study also conducted antibiogram studies of Citrobacter spp. isolates in order to determine sensitivity and resistance against common antibiotics. Results showed that the most effective antibiotics were: imipenem (89.7% sensitive), amikacin (85.4%), gentamicin (72%), and piperacillin/tazobactam (68.4%).[2]

Multiple studies around the world have shown the virulent nature of Citrobacter and its significance in causing deadly infections. These cases collectively underscore the evolving nature of Citrobacter infections in the pediatric population and the necessity for healthcare practitioners to be vigilant in recognizing and managing such cases. Due to the uniqueness of this bacteria and the need for further research, this specific case has demonstrated its significance, warranting

exploration and presentation to the medical community.

Table 1: CBC

	01/05/24 11:10 01/07/24
White Blood Count	16.86 (H)
(3.98-10.04x10^3/uL)	
Red Blood Count (4.63-6.08x10^6/uL)	3.61 (L)
Hemoglobin (13.7-17.5 g/dL)	11.2 (L)
Hematocrit (40.1-51%)	34.1 (L)
Mean Corpuscular Volume (79-94.8fL)	94.5
Mean Corpuscular Hemoglobin (25.6-32.2pg)	31
Mean Corpuscular Hemoglobin Content (32.2-36.5 g/dL)	32.8
RDW Standard Deviation (35.1-46.3fL)	50.4 (H)
RDW Coefficient of Variation (11.6-14.4%)	14.7 (H)
Platelet Count	TNP
Mean Platelet Volume (9.4-12.4 fL)	11.1
Neutrophils % (34-71.1%)	9 (L)
Lymphocytes % (19.3-53.1%)	63 (H)
Reactive Lymphocytes % (0-5%)	15 (H)
Monocytes % (4.7-12.5%)	11
Eosinophils % (0.7-7%)	1
Myelocytes % (0-1%)	1
Platelet Estimate	In clumps A
Red Blood Cell Morphology	Normocytic/ normochromic
C-Reactive Protein (0-0.9 mg/dL)	0.5

Case Report:

We present the case of a 1-month-old male who arrived at the emergency room (ER) with decreased oral feeding and irritability. The patient's past medical history includes a gestational age of 35 weeks without any significant prenatal complications. Shortly after birth, the infant presented with hyperbilirubinemia of prematurity and received phototherapy in the NICU for three days. Initially, the patient was fed a combination of breast milk and formula for the first six weeks, after which he transitioned to formula feeding exclusively.

Upon arrival at the ER, the patient was consuming 1oz out of his usual 3oz feed and appeared restless. Initial laboratory findings revealed elevated white blood cell (WBC) count (Table 2), positive nitrites, a significant amount of leukocyte esterase, and WBC clumps on urinalysis (Table 3). Subsequent routine testing confirmed a positive SARS-CoV-2 Ag result (Table 4). The patient was hospitalized based on these findings and also due to mild dehydration resulting from inadequate oral intake. Empiric antibiotic therapy was initiated with IV ceftriaxone (50mg/kg/day) to address potential bacterial infections, pending further cultures and sensitivity results. Following admission, the patient began to experience respiratory distress accompanied by congestion, prompting the initiation of respiratory therapy.

Table 2: CMP

Sodium (137-145 mmol/L)	136 (L)
Potassium (3.6-5 mmol/L)	6.6 (H)
Chloride (98-107 mmol/L)	103
Carbon Dioxide (22-30 mmol/L)	23
Anion Gap (10-20 mmol/L)	16.9

Blood Urea Nitrogen (9-20 mg/dL)	**12**
Creatinine (0.70-1.30 mg/dL)	**<0.4 (L)**
BUN/Creatinine Ratio (10-20)	**42.6 (H)**
Glucose Level (75-110 mg/dL)	**85**
Calculated Osmolality (mOsm/kg)	**270**
Calcium (8.4-10.2 mg/dL)	**10.4 (H)**

Table 3: Urinalysis

Urine Color	**Yellow Straw**
Urine Appearance	**Slightly cloudy Clear**
Urine pH (5-8)	**6.0**
Urine Specific Gravity	**1.005 1.002**
Urine Protein	**Negative**
Urine Glucose	**Negative**
Urine Ketones	**Negative**
Urine Occult Blood	**Negative**
Urine Nitrite	**Positive**
Urine Bilirubin	**Negative**
Urine Urobilinogen	**Negative**
Urine Leukocyte Esterase	**Large**
Urine RBC	**Not Reportable**
Urine WBC	**21-50**
Urine WBC Clumps	**Occasional**
Urine Bacteria	**Rare**

Table 4: Infectious Diseases Panel

Influenza A	**Negative**
Influenza B	**Negative**
Respiratory Syncytial Virus Antigen	**Negative**
SARS-CoV-2 Antigen	**Positive**

Two days later, the urine culture revealed growth of *Citrobacter koseri* (previously known as *C. diversus*) (100,000 CFU/ml) with resistance noted against nalidixic acid and ticarcillin (Table 5). Consequently, the patient's treatment regimen was continued with ceftriaxone due to a favorable response. By this point, the patient was exhibiting clinical improvement showing enhanced feeding, improved sleep patterns, and increased alertness. A follow-up urine culture conducted four days later following the detection of *Citrobacter* growth yielded a negative result (Table 6). The patient remained hospitalized for 10 days, during which time he received IV antibiotic therapy and fluids. Throughout the rest of the hospitalization period, the patient remained afebrile and devoid of any discernible clinical symptoms.

Table 5: Urine cultures

Collected 01/05/2024

Organism 1 Citrobacter diversus

Colony count 1 100,000 CFU/ml

Amikacin S	**Sensitive**
Aztreonam	**Sensitive**
Cefazolin	**Sensitive**
Cefepime	**Sensitive**
Cefotetan	**Sensitive**
Cefoxitin	**Sensitive**
Cefpodoxime	**Sensitive**
Ceftizoxime	**Sensitive**
Ceftriaxone	**Sensitive**
Cefuroxime Axet	**Sensitive**
Cefuroxime Sod	**Sensitive**
Cephalothin	**Sensitive**
Ciprofloxacin	**Sensitive**
Ertapenem	**Sensitive**
Gentamicin	**Sensitive**

Imipenem	**Sensitive**
Levofloxacin	**Sensitive**
Meropenem	**Sensitive**
Moxifloxacin	**Sensitive**
Naldixic acid	**Resistant**
Nitrofurantoin	**Sensitive**
Norfloxacin	**Sensitive**
Piperacillin	**Sensitive**
Ticarcillin	**Resistant**
Tigecycline	**Sensitive**
Tobramycin	**Sensitive**
Trimet/Sulfa	**Sensitive**
Pip/Tazo	**Sensitive**

Table 6.

Urine Culture

Collected 01/09/2024

No growth after 48 hours

Discussion:

There are many bacteria that are associated with UTIs, with *Citrobacter* being, although still not as prevalent, an increasing cause. In the past, *Citrobacter* species have been commonly associated with bacteremia, meningitis, diarrhea, and brain abscess [1] with few cases reported in children. This organism is rarely the culprit of UTIs in children, instead most commonly seen in the elderly with a declining immune system. However, recently there have been increased reports worldwide, such as the reported cases in a study conducted in India. Although there are around 18 subspecies of *Citrobacter*, the ones that have been most commonly implicated in pediatric UTIs are *C. freundii* and *C. koseri.*

In a review of pediatric cases, it was seen that the average age of those infected by *Citrobacter spp.* was 6.9 years old. In addition, Citrobacter UTI is associated with medical conditions such as a urinary tract or renal anomaly or neurological impairment [1] along with associated symptoms such as gastrointestinal symptoms, dysuria, urinary frequency, fever, incontinence, hematuria, penile/vaginal discharge, and flank pain [1].

In comparing this case of *Citrobacter* UTI with those found in the literature, we find that this patient does not fit the typical profile of other such cases. This infant has no known underlying condition that has been found associated with *Citrobacter spp.* In addition, he does not present with any symptom that has previously been reported among pediatric cases, instead only presenting with a clinical picture consisting of poor oral intake. The one notable finding in this patient was a positive SARS-CoV-2 antigen test but the patient did not develop any complications.

The purpose of this report is to conduct a thorough literature review on pediatric *Citrobacter spp.* urinary tract infections that have already been reported and compare our case and findings. We wish to add more information in order to provide a better understanding of this infection. We believe it is of great importance to better understand this new trend in infection among pediatrics patients due to the numerous other complications that such bacteria may cause in this population.

Conclusion

The case report highlights the importance of considering Citrobacter species as potential causative agents of urinary tract infections (UTIs) in pediatric patients, despite their rarity in this population. Through a comprehensive analysis of the presented case and a review of existing literature, it be-

comes evident that Citrobacter-induced UTIs in children pose unique challenges in diagnosis and management. While traditionally associated with elderly populations and underlying medical conditions, the increasing incidence of Citrobacter UTIs in pediatric patients demands attention from healthcare practitioners.

This case underscores the necessity for heightened awareness among clinicians, particularly in cases where atypical presentations or absence of predisposing factors are observed. Furthermore, the successful management of the presented case with appropriate antibiotic therapy emphasizes the importance of timely diagnosis and targeted treatment in achieving favorable outcomes.

Moving forward, continued surveillance and research are imperative to elucidate the epidemiological trends, risk factors, and optimal treatment strategies for Citrobacter-induced UTIs in pediatric patients. By enhancing our understanding of this emerging trend, healthcare providers can improve clinical outcomes and contribute to the overall well-being of pediatric populations affected by UTIs caused by Citrobacter species.

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