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Case Report

Infected calyceal diverticulum in pregnancy: A rare case ☆,☆☆

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ARTICLE INFO

Article history:

Received 10 May 2024

Revised 4 August 2024

Accepted 5 August 2024

Keywords:

Calyceal diverticulum

Urinary tract infection

Pyelonephritis in pregnancy

Drainage catheter placement

ABSTRACT

A calyceal diverticulum is a transitional epithelium-lined outpouching of a renal calyx which communicates with the main collecting system through a narrow infundibulum. There are two types of calyceal diverticula: type I, the most common, communicates with the minor calyx, and type II communicates with the major calyx or renal pelvis. Calyceal diverticula are rare and mostly found incidentally; however, they can cause urinary tract infection symptoms (e.g., hematuria, pain, and fever). Diagnosing an infected calyceal diverticulum during pregnancy is particularly challenging due to overlapping symptoms and the limitations of imaging modalities that avoid ionizing radiation. Prompt diagnosis and treatment are necessary to avoid irreversible renal dysfunction and/or urological surgery. Currently, there are no established treatment guidelines for diagnosing and managing infected calyceal diverticula in pregnant patients. The rarity of this condition and the complexities introduced by pregnancy create challenges in standardizing care and determining the optimal treatment strategy, timing of interventions, and the impact on maternal and fetal outcomes. A 29-year-old primigravid woman presented emergently to the hospital at 15 weeks and 4 days gestation with concerns of severe right-sided flank pain and hematuria. Initial renal ultrasound revealed a complex, hypovascular lesion in the interpolar region of the right kidney measuring $6.9 \times 6.8 \times 3.7$ cm, suspicious for mass versus pyelonephritis with associated phlegmon. Further characterization of the lesion by MRI revealed commu-

☆ Competing Interests: There are no conflicts of interest to disclose.

☆☆ Acknowledgments: Dr. Amit R. Patel; Esther I. Ngene; Annette A. Ngene; Enyioma C. Iwuoha; Ikechi C. Iwuoha; William A. Ngene; Jennifer L. Ngene-Platt; Vanessa Anyinofu; Kelechi Anyinofu; Dr. Jasmine Silva; Hadeel Assi; Gbemisola Ajibade; Ajay Naik. No financial support was received for the publication of this case report.

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nication between the lesion and the mid-pole collecting system. Differential diagnoses included infected calyceal diverticulum, hydronephrosis of a duplicated system, renal abscess, and infected urinoma. Through a multidisciplinary approach, including ultrasound-guided placement of a drainage catheter at 16 weeks gestation, and tailored intravenous antibiotic therapy, the patient delivered a 3379 g male at 40 weeks and 0 days gestation. This case highlights the potential for conservative management in the absence of clear guidelines and underscores the importance of collaboration among obstetrics, urology, infectious disease, and interventional radiology teams. The implications of this case extend to increasing awareness of calyceal diverticula as a differential diagnosis in pregnant patients presenting with atypical urinary symptoms. It emphasizes the necessity of a multidisciplinary approach to ensure both maternal and fetal safety and offers valuable insights that could inform future cases, contributing to the development of more concrete guidelines for managing infected calyceal diverticula during pregnancy. Consent was obtained from the patient and IRB approval was not required for this case.

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Introduction

A calyceal diverticulum is a transitional epithelium-lined urine-filled outpouching of a renal calyx which communicates with the renal collecting system through a narrow infundibulum [1–4]. There are two types of calyceal diverticula: Type I, the most common, communicates with the minor calyx, and type II communicates with the major calyx or renal pelvis [1–4]. One prevailing theory suggests that calyceal diverticula originate congenitally due to the incomplete regression of the ureteric buds during the third and fourth generations [5]. Symptomatic calyceal diverticula can present like a urinary tract infection (UTI) with hematuria, pain, and fever [1,3,7].

According to Wulfsohn's 1980 report, calyceal diverticula occur rarely, with an incidence of 2.1–4.5/1000 intravenous urogram examinations; however, with advancements in the urological and radiological fields, this number could now be much higher [4,6,7]. There is currently a lack of established guidelines for the treatment of an infected calyceal diverticulum in pregnancy which warrants the publication of successful cases. Prompt diagnosis and treatment are necessary to

avoid irreversible renal dysfunction and/or urological surgery [3,8].

Case presentation

A 29-year-old primigravida woman at 15 weeks and 4 days gestation presented to the emergency department (ED) with progressively worsening, 10/10 cramping right flank pain for 5 days. Four days prior, the patient presented at an urgent care facility where she was clinically diagnosed with a UTI and prescribed cephalexin. One day after starting cephalexin, the patient reported experiencing flank pain, chills, dysuria, hematuria, nausea, vomiting, and difficulty walking due to pain. Pain was unresolved with acetaminophen, prompting her visit to the ED for further evaluation. Kidney/bladder-ultrasound, shown in Fig. 1, revealed a complex, hypovascular lesion in the interpolar region of the right kidney measuring $6.9 \times 6.8 \times 3.7$ cm. Mild dilation of the upper pole calyces was noted with no dilation of the renal pelvis. Initial differential diagnoses included inflammatory mass/phlegmon, renal abscess, and intrinsic renal neoplasm.

Table 1 – Basic metabolic panel during the first admission^a.

	ED presentation	Day 2	Day 3	Day 4	Day 5	Day 6 (POD 0)	Day 8 (POD 2)	Day 9 (POD 3)
Glucose	93	84	87	83	83	85	83	82
Sodium	135	137	138	139	139	135	136	135
Potassium	3.1	3.4	3.2	3.5	3.4	3.8	3.7	3.8
Chloride	100	104	104	107	105	102	102	100
CO ₂	24.0	24	25	26	26	29	28	29
Anion Gap	11	9	9	6	8	4	6	6
BUN	3	3	3	2	2	2	3	2
Creatinine	0.64	0.47	0.5	0.44	0.46	0.5	0.43	0.4
BUN/Creat Ratio	4.7	6.4	6	4.5	4.3	3.9	7	5
Calcium, Total	8.8	8.4	8.1	8.2	8.1	8.3	8.4	8.6
Calculated Osmolality	276	280	282	283	283	275.00	278	275
GFR	121	134	131	137	135	130	138	141

^a There were no BMPs done on day 1 and day 7 of admission.

Table 2 – Temperatures during the first admission in Fahrenheit.

Presentation	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6 ^a	Day 7 (POD ^a 1)	Day 8 (POD 2)
98.6	98.5	98.3	98.4	97.8	100.9	98.9	100.2	98.7

^a The drainage catheter procedure was done on day 6.
POD, postoperative day.

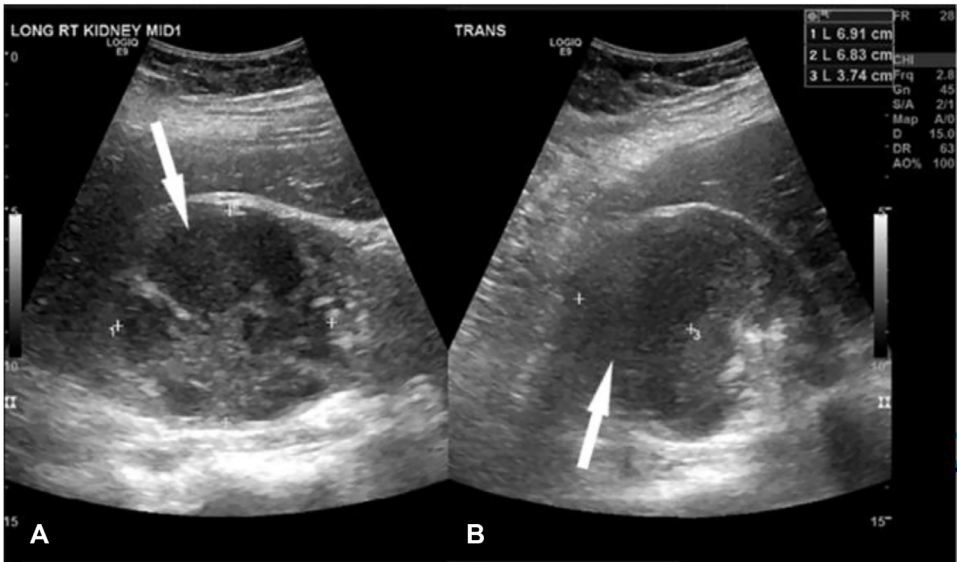


Fig. 1 – Kidney/Bladder ultrasound on admission showed a large lesion in the right kidney. (A) Long axis view of the right kidney. (B) Transverse view of the right kidney.

The patient was started on piperacillin/tazobactam and admitted with consultation to urology, infectious disease (ID), OB/GYN, and interventional radiology (IR). The patient experienced electrolyte imbalances, as shown in Table 1, which were corrected with intravenous and oral supplementation. A repeat kidney/bladder ultrasound on day 4, Fig. 2, revealed a larger hypoechoic, complex right renal lesion measuring 8.0 × 7.5 × 6.1 cm. This indicated a possible renal abscess developing supported by a 100.9F fever on day 5, as shown in Table 2. This prompted exploring other imaging modalities for further characterization of the complex right renal lesion.

Abdominal/pelvic MRI, shown in Fig. 3, revealed moderate bilateral hydronephrosis and an 8 cm-diameter complex cyst with a branch-shaped internal morphology that appeared to connect with the mid-pole collecting system. As shown in Fig. 4, the lesion contained material hypointense to urine in the inferior pole of the right kidney, though it had rapidly increased in size during admission consistent with an abscess. Ultrasound-guided drain placement into the inferior pole fluid collection was then performed to avoid exposing the fetus to ionizing radiation. OB/GYN routinely monitored fetal heart tones pre- and postprocedure. About 100mL of purulent fluid was aspirated from the lesion and sent for culture and sensitivity testing. Initial culture results revealed *Streptococcus anginosus* and later, *Prevotella bivia*. After 7 days of inpatient IV piperacillin/tazobactam, antibiotics were then changed to IV ceftriaxone for daily outpatient transfusion.

Postprocedure kidney ultrasound, Fig. 5, showed improvement of the right renal lesion after drainage with mild residual hydronephrosis and worsening left-sided hydronephrosis, which was likely secondary to physiological changes in pregnancy [9]. On the postoperative day (POD) 1, labs showed leukocytosis with neutrophilia, which was resolved by POD 3. The patient's symptoms improved, and she was discharged on day 9 of admission with recommendations for close outpatient follow-up. After discharge, the patient continued receiving daily IV ceftriaxone via PICC at an outpatient infusion center with weekly PICC care and lab draws to monitor infection. Imaging revealed improvement in the complex right renal lesion 4 days after discharge. Due to patient discomfort, the drainage catheter was removed at this time. However, the patient reported symptom recurrence 9 days after drainage catheter removal and was readmitted.

During the replacement of the drainage catheter—with informed consent and OB/GYN consultation—fluoroscopy was utilized, and contrast injection confirmed communication between the drainage cavity and the renal collecting system. At this point, the diagnosis of calyceal diverticulum was confirmed. After 4 days the patient was discharged on intravenous antibiotics. Once the antibiotic course was completed, symptoms continued to recur. Outpatient urine culture from the drainage catheter grew *Acinetobacter baumannii*, *Enterobacter cloacae* complex, and *Stenotrophomonas maltophilia*. Prophylactic meropenem was started with weekly PICC care and labs

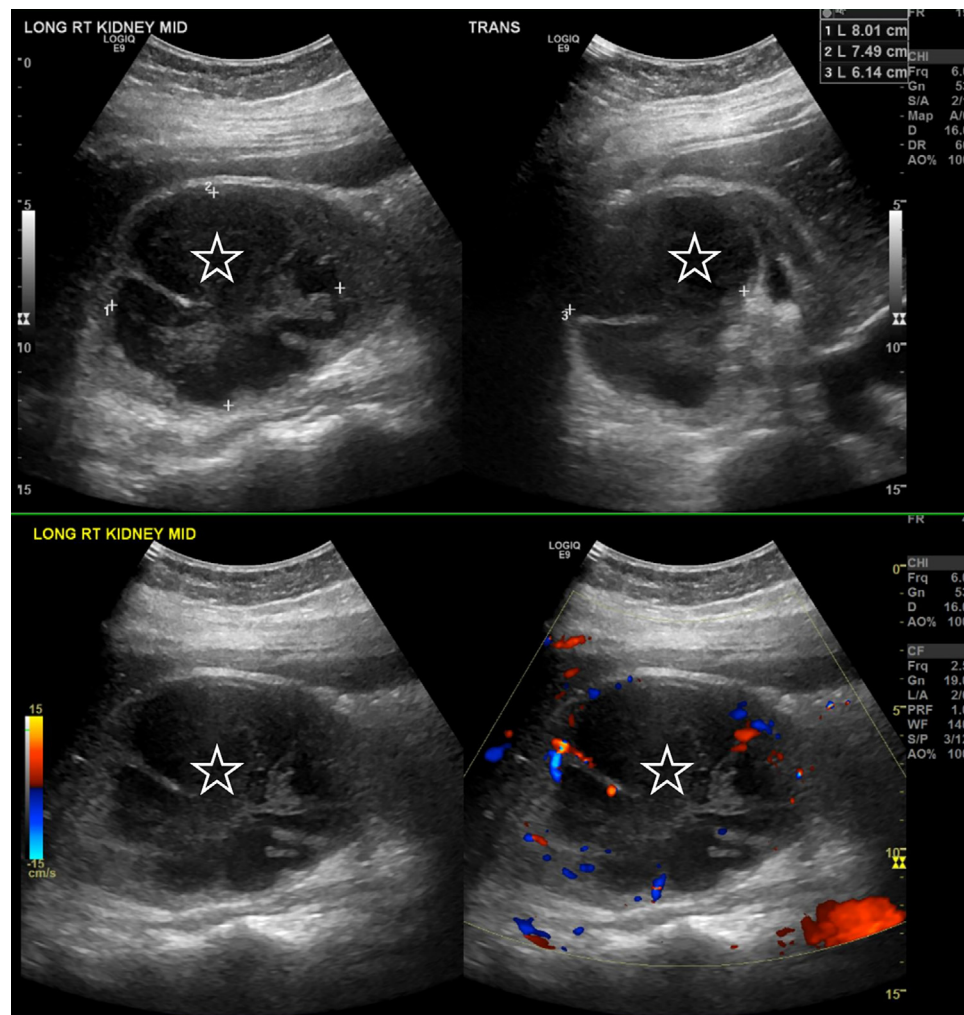


Fig. 2 – Kidney/Bladder ultrasound on day 4 of admission shows an increase in the size of the right kidney lesion (top image) with Doppler showing hypovascularity of the lesion (bottom image).

until delivery. The patient had an elective induction and successfully delivered a healthy 3379 g male at 40 weeks vaginally. Labs and CT confirmed clearance of the infection in the calyceal diverticulum. The drainage catheter and PICC were removed at the bedside on postpartum day 2. The patient was advised to follow up with urology as an outpatient if she experienced any complications.

Discussion

Initially, the patient was suspected of having a renal abscess, so a drainage catheter with a JP drain was placed into the suspected abscess. As the infection cleared, the patient reported an increased volume of urine in the JP drain to the IR team. As a result, the JP drain was substituted with a nephrostomy gravity drainage bag while keeping the drainage catheter in place.

A calyceal diverticulum communicates with the renal collecting system through a narrow infundibulum [10]. Therefore, placement of a catheter into the renal pelvis—as is done

in a standard percutaneous nephrostomy (PCN)—would restrict flow [10]. In this case, a drainage catheter was placed in the calyceal diverticulum and functioned as a percutaneous nephrostomy tube.

Frequent reintervention in pregnant patients with PCN tubes

According to the literature, pregnant patients with PCN tubes require more frequent, unplanned exchanges, replacements, or flushing due to frequent obstruction, infection, pain, or displacement than nonpregnant patients [11,12]. A retrospective study on the success and complication of PCN tubes in pregnancy showed that pregnant patients with PCN tubes required almost 2 times more frequent tube changes compared to nonpregnant patients (3.4 weeks vs. 5.7 weeks) [12]. Additionally, 80.4% of pregnant subjects required reintervention before the scheduled 6-week exchange compared to 21.6% of nonpregnant patients [12]. In practice, these frequent changes can be anticipated and scheduled as routine 3-week PCN tube checks and/or changes to avoid complications caused by the PCN tubes [12].



Fig. 3 – Axial T2 HASTE FS MRI shows a complex cyst in the right kidney with a branched-shaped internal morphology.

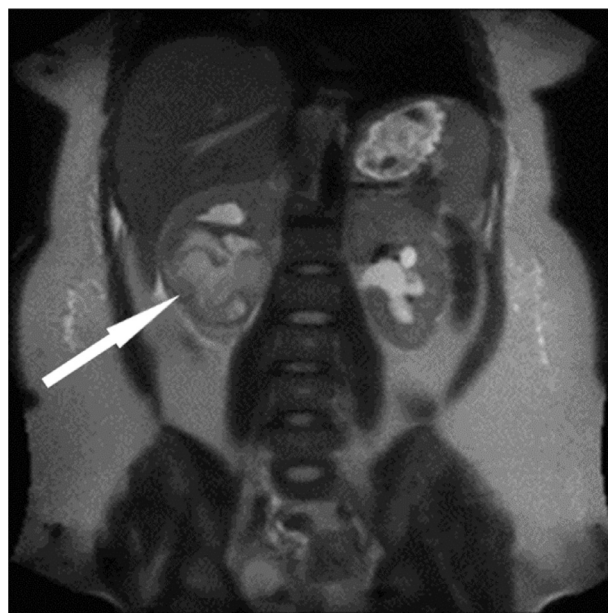


Fig. 4 – Coronal T2 HASTE FS MBH MRI highlights the presence of material hypointense to urine.

Physiological renal changes in pregnancy

Physiologically, hydro-ureter and hydronephrosis during pregnancy occur due to increased vasodilation by the hormone relaxin [13]. The growing gravid uterus rotates and mechanically compresses the right ureter, leading to more prominent hydronephrosis on the right in 80% of pregnant women [13]. These changes promote an increased risk of acute pyelonephritis during pregnancy [13,14]. Pregnant patients who undergo PCN placement often have them placed in the right kidney [12]. Although it cannot be concluded with certainty that these physiological changes predisposed the pa-

tient in this case to infection, it should be considered as a contributing factor.

Importance of prompt diagnosis

Lack of familiarity with calyceal diverticula can lead to misdiagnosis and delayed treatment, as seen in this patient before ED presentation. Based on current guidelines, the patient's urinalysis report during the first admission, Table 3, may lead to an uncomplicated UTI diagnosis without further investigation [15]. In this case, delay in diagnosis can complicate

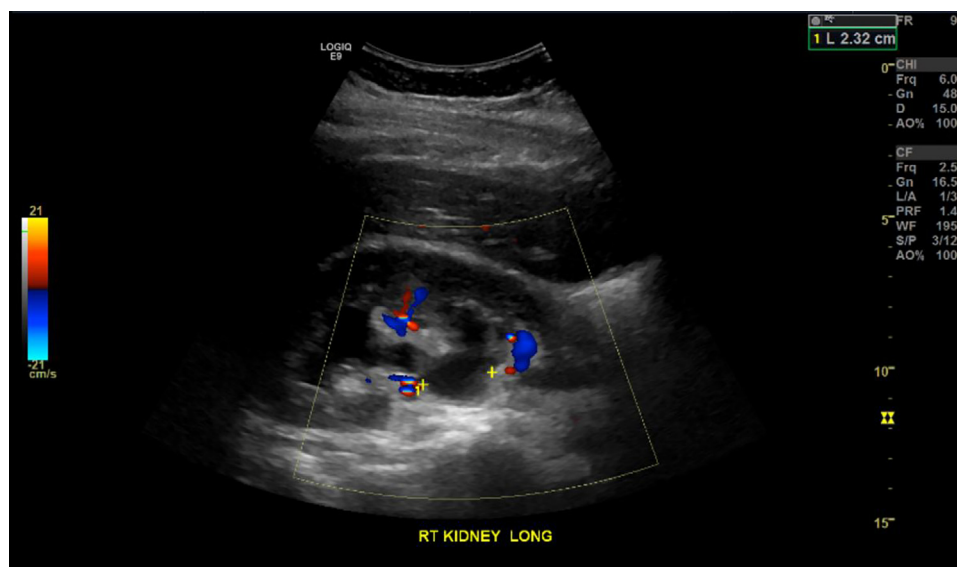


Fig. 5 – A long axis view of the right kidney after drainage shows a decrease in the size of the right kidney lesion.

Table 3 – Urinalysis on presentation in ED before first and second admission.

	First admission	Second admission
Color	Yellow	Yellow
Clarity	Cloudy	Hazy
Specific Gravity	1.003	1.014
Glucose	Negative	Negative
Bilirubin	Negative	Negative
Ketones	Negative	Negative
Blood	Moderate	Negative
pH	7.0	6.0
Urobilinogen	<2.0	<2.0
Protein	30	Negative
Nitrite	Negative	Negative
Leukocyte	Large	Small
Esterase		
WBC	>50	11-20
RBC	>10	0-2
Bacteria	1+	None seen
Squamous Epi.	Few	Few
Cells		
Ascorbic Acid	Negative	20
Other	None reported	Hyaline casts present

the ability to undergo necessary diagnostic testing and procedures as pregnancy advances.

During the preparation of this work, the authors used ChatGPT in order to improve the readability of the abstract. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Patient consent

Consent was obtained from the patient and IRB approval was not required for this case.

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