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Case Report

Infected Calyceal Diverticulum: Imaging Findings and Clinical Implications

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Abstract

Calyceal diverticulum is a rare congenital anomaly of the renal collecting system, characterized by an outpouching of the calyceal wall, which communicates with the collecting system through a narrow neck. While often asymptomatic, secondary infection of the diverticulum can lead to significant clinical complications, including fever, flank pain, and recurrent urinary tract infections. Imaging modalities such as ultrasonography, computed tomography (CT), and magnetic resonance urography (MRU) play a crucial role in diagnosis, revealing a cystic lesion filled with urine, pus, or debris. The management of an infected calyceal diverticulum depends on the severity of symptoms, ranging from conservative antibiotic therapy to interventional procedures, such as percutaneous drainage, endoscopic marsupialization, or even nephrectomy in severe cases. This review discusses the pathophysiology, clinical presentation, imaging findings of infected calyceal diverticulum, emphasizing the importance of early diagnosis and appropriate intervention to prevent complications.

Keywords: *Calyceal Diverticulum; Renal Anomaly; Urinary Tract Infection; Percutaneous Drainage; Nephrectomy*

Introduction

A calcific diverticulum of the kidney refers to a small, epithelial-lined outpouching that arises from the renal calyceal system, often filled with urine and potentially containing calcified material such as milk of calcium or stones [6]. These diverticula, also known as calyceal diverticula, are relatively rare and usually asymptomatic, often discovered incidentally during imaging for unrelated conditions. They can, however, serve as a nidus for stone formation due to urinary stasis and poor drainage.

In certain cases, a calcific diverticulum may become superinfected, meaning that bacteria colonize the stagnant urine within the pocket, leading to a localized infection. This superinfection can manifest with symptoms such as fever, flank pain, hematuria, and occasionally recurrent urinary tract infections. If left untreated, it may progress to more serious complications such as abscess formation, pyelonephritis, or urosepsis.

The diagnosis is typically established through imaging modalities such as ultrasound, computed tomography (CT), or intravenous urography, which demonstrate the presence of a diverticulum and associated calcification [3]. Management strategies vary depending on

symptom severity and may range from conservative treatment with antibiotics to surgical or endoscopic intervention for drainage and stone removal. Early identification and appropriate treatment are crucial to prevent recurrent infections and preserve renal function.

Clinical Case and Discussion

We report the case of a 24-year-old female patient with a history of urinary tract infection, admitted to the emergency department with back pain, fever and cloudy urine.

On clinical examination, the patient was febrile at 40 degree, with a heart rate of 84 cpm, blood pressure of 130/70 mmHg and respiratory rate of 22 cpm. His systemic examination revealed right lumbar pain. The initial laboratory work-up showed WBCs of 15800, CRP of 93 and a positive ECBU with cloudy urine.

A uroscanner was performed without and with injection of PDC revealed a rounded formation, evenly contoured, inferiorly polar, water-toned, progressively filling with contrast medium.

Late sections showed a staggered filling of the formation with contrast medium, with an intralesional level corresponding to the calcium sediment (milk of calcium).

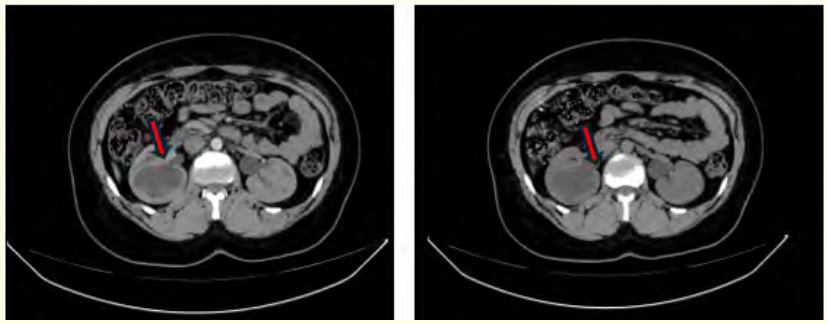

Figure 1: *An axial section CT without injection showing a rounded formation with regular contours inferiorly polar, hydric in tone (red arrow).*

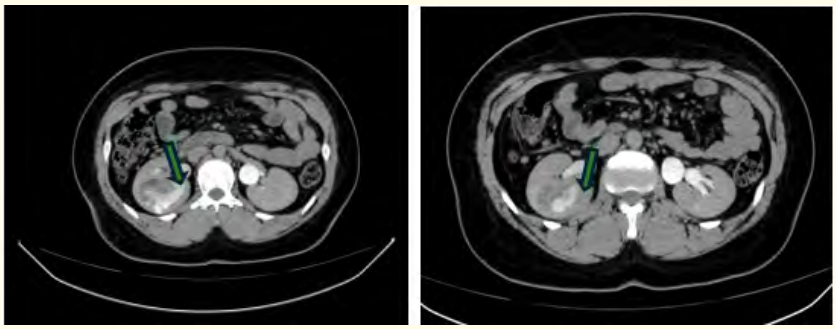

Figure 2: *An axial section CT with injection showing gradual filling of the caliceal cavity with the contrast medium (green arrow).*

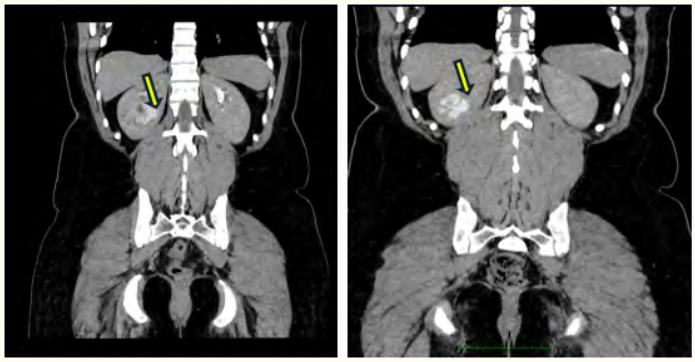

Figure 3: *A coronal section CT showing staggered filling of the formation with contrast medium, with an intralesional level corresponding to the calcium sediment (milk of calcium) (Yellow arrow).*

Pathogenesis

The calcific diverticulum is a rare congenital anomaly of the renal collecting system, corresponding to a herniation of the urothelial mucosa through the renal parenchyma, forming a cystic cavity communicating with a calyx via a narrow neck [2]. Superinfection is the result of a multifactorial process involving several pathophysiological mechanisms, such as urinary stasis and retention, bacterial colonization, stone formation, inflammatory reaction and complications [1].

Symptoms of a superinfected calcific diverticulum may include: Back pain, Fever and chills, Nausea and vomiting, Hematuria and Recurrent urinary tract infections [4].

Diagnosis of a superinfected calcific diverticulum may include:

- Urinalysis: To detect the presence of bacteria or blood.
- Renal ultrasound: To visualize the internal structures of the kidney.
- Computed tomography (CT scan): To obtain detailed images of the kidney and urinary tract.
- Intravenous urography (IVU): A special X-ray with an injected dye to see the flow of urine.

Medical imaging plays a crucial role in the diagnosis and management of calcific diverticula, especially when they are superinfected [11]. This may include:

1. **Renal ultrasound:** Ultrasound is often the first imaging modality used to evaluate the kidneys. It can reveal the presence of calcific diverticula as anechoic or hypoechoic structures located in the renal calyces. Ultrasound can also help identify signs of infection, such as debris or internal echoes in the diverticulum.

2. **Computed tomography (CT scan):** Computed tomography (CT scan) is a more detailed and accurate imaging method for evaluating calcific diverticula:

a. Non-contrast CT: Can identify associated urinary calculi or structural abnormalities in the kidney.

b. CT with contrast (CT urography): Allows better visualization of the urinary tract and calcific diverticula, showing how contrast is distributed in renal structures. This can help differentiate diverticula from renal cysts and identify signs of infection, such as thickening of the diverticulum wall and surrounding inflammation [10].

3. **Intravenous urography (IVU):** Intravenous urography (IVU) is a radiographic technique using a contrast agent injected into the bloodstream. It enables visualization of the renal collecting system and urinary tract:

a. Calcific diverticula appear as pockets of contrast retained in the renal calyces.

b. It can show the drainage of these diverticula and detect associated anomalies, such as obstructions or reflux.

4. **Magnetic resonance imaging (MRI):** Although less commonly used for calcific diverticula, it can be employed in some cases to provide detailed images without radiation exposure. MRI can be particularly useful for assessing soft tissue and surrounding structures.

Importance of imaging

Imaging is essential not only for initial diagnosis, but also for treatment planning and follow-up[7,9]. It enables physicians to:

- Confirm the presence and size of calcific diverticula.
- Identify associated complications, such as infections or obstructions.
- Evaluate the effectiveness of treatments undertaken.

Signs of infection on imaging

When a calcific diverticulum is superinfected, certain signs may be visible on images [4], including:

- Thickening of the diverticulum wall.
- Presence of debris or hydroaerosal levels in the diverticulum.
- Inflammation of surrounding tissues, visible as increased tissue density or enhancement after contrast injection.
- Pus accumulation (abscess) in or around the diverticulum.

Management of an infected calyceal diverticulum

The treatment of an infected calyceal diverticulum requires a combination of medical and interventional approaches**,** guided by the severity of infection, presence of calculi, and patient comorbidities. Initial management typically involves broad-spectrum intravenous antibiotics targeting common uropathogens, with subsequent de-escalation based on urine and blood culture results. In patients with localized infection, imaging-guided percutaneous drainage of the diverticulum may be necessary to evacuate purulent content and relieve symptoms [5]. If obstructing or infected calculi are present, definitive management includes surgical or endoscopic intervention, such as percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), or laparoscopic excision of the diverticulum. These procedures aim to remove the source of infection and improve drainage. In recurrent or refractory cases, especially when renal function is compromised, partial nephrectomy may be considered. Long-term follow-up with imaging and urinalysis is essential to monitor for recurrence and ensure resolution of infection. Early urologic consultation is crucial for optimal outcomes.

Risk factors

Certain risk factors may increase the likelihood of developing calcific diverticula:

- Family history.
- Previous urological problems.
- Chronic diseases: such as diabetes or calcium metabolism disorders.

Conclusion

Calcific diverticulum formation is often multifactorial, involving a combination of congenital and acquired factors. Understanding the etiologies and risk factors associated with this condition is essential for effective management and prevention of complications.

Ethics Approval

Our institution does not require ethical approval for reporting individual cases.

Patient Consent

Written informed consent was obtained from the patient for their anonymized information to be published in this article.

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