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Right Horseshoe Kidney: A Case Report

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ABSTRACT

Horseshoe kidney is a congenital renal fusion anomaly, occurring in approximately 1 in 400–600 individuals. It results from abnormal fusion of the lower poles of the kidneys during embryological development, forming a U-shaped structure. This anatomical variation leads to malrotation, high ureteric insertion, and impaired urinary drainage, predisposing patients to complications such as nephrolithiasis, urinary tract infections, and hydronephrosis. We report a case of a 35-year-old male who presented with flank pain and was a known case of horseshoe kidney with right renal calculi. The patient had previously undergone right percutaneous nephrolithotomy (PCNL) with residual calculi and was admitted for further management. Imaging revealed calculi at the right pelviureteric junction with mild hydronephrosis and inflammatory changes. The patient subsequently underwent retrograde intrarenal surgery (RIRS) with DJ stenting. Postoperative recovery was uneventful, and the patient was discharged on appropriate medications. This case highlights the challenges in managing renal calculi in anomalous renal anatomy and emphasizes the effectiveness of minimally invasive procedures such as RIRS in achieving favorable outcome.

KEYWORDS: Horseshoe kidney, Renal calculi, PCNL, RIRS, Congenital anomaly

I. INTRODUCTION

Horseshoe kidney is the most common congenital renal fusion anomaly, occurring in approximately 1 in 400–600 live births (prevalence 0.2-0.25%), with a male predominance of approximately 2:1. In this condition, the lower poles of both kidneys fuse during embryonic development, forming a characteristic U-shaped or “horseshoe” appearance. The fusion usually occurs anterior to the great vessels, preventing normal ascent and rotation of the kidneys during fetal development.

Although many patients remain asymptomatic, horseshoe kidney is associated with several urological complications including hydronephrosis, recurrent urinary tract infections, vesicoureteral reflux, ureteropelvic junction obstruction, and nephrolithiasis. Renal calculi are among the most common complications due to urinary stasis and abnormal drainage caused by altered anatomy of the collecting system.

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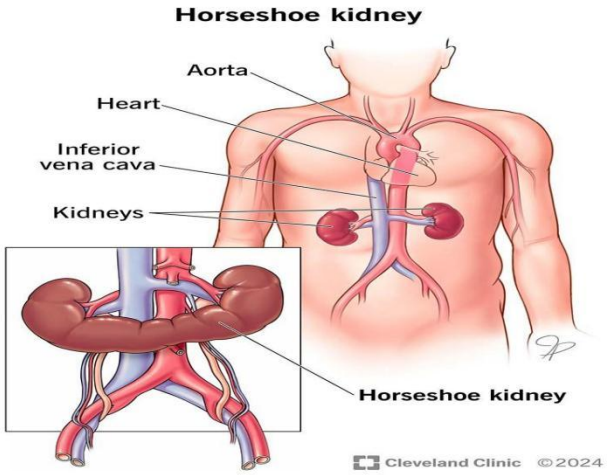

ETIOLOGY

Horseshoe kidney is a congenital condition that develops during fetal life. It occurs when the two developing kidneys fuse at their lower poles before they ascend from the pelvis to their normal position in the abdomen. This fusion usually takes place between the fourth and sixth weeks of embryonic development. As the fused kidneys ascend, the connecting isthmus becomes trapped beneath the inferior mesenteric artery, preventing normal upward movement. The exact cause is not known, but it is believed to result from abnormal embryological development influenced by genetic and environmental factors. In some individuals, horseshoe kidney is associated with congenital syndromes such as Turner syndrome, Down syndrome, and Trisomy 18. However, in most cases, it occurs as an isolated developmental anomaly without an identifiable cause.

RISK FACTORS

Horseshoe kidney is primarily a congenital anomaly rather than an acquired disease; therefore, the major risk factors are related to abnormal fetal development. The condition is more common in males than females. Individuals with chromosomal disorders such as Turner syndrome, Down syndrome, and Trisomy 18 have a higher incidence of horseshoe kidney. A family history of congenital renal anomalies may also increase the risk. Due to abnormal renal position and malrotation, affected individuals are more likely to develop urinary stasis, which predisposes them to recurrent urinary tract infections, kidney stone formation, hydronephrosis, and ureteropelvic junction obstruction. Poor fluid intake, recurrent urinary infections, and metabolic disorders that promote stone formation further increase the risk of complications.

PATHOPHYSIOLOGY OF HORSESHOE KIDNEY

Step 1 – Abnormal Fusion During Embryogenesis
During the 4th to 6th week of fetal development, the lower poles of the metanephric kidneys fuse in the midline before the kidneys ascend from the pelvis.
Step 2 – Failure of Normal Ascent
The fused kidney becomes trapped beneath the inferior mesenteric artery, preventing complete upward migration and normal rotation.
Step 3 – Malrotation and Altered Drainage
Abnormal renal rotation leads to anterior displacement of the renal pelvis and ureters, causing impaired urinary drainage and urinary stasis.
Step 4 – Urinary Stasis and Stone Formation
Urinary stagnation promotes crystal aggregation, recurrent infections, and stone formation, especially calcium-based renal calculi.
Step 5 – Hydronephrosis and Inflammation
Obstruction at the pelviureteric junction may result in hydronephrosis, recurrent infection, periureteric inflammation, and renal damage if untreated.
The diagnosis of horseshoe kidney is commonly confirmed through imaging modalities such as ultrasonography, CT urography, MRI, or intravenous pyelography. CT urography is particularly useful for identifying associated renal calculi, hydronephrosis, and anatomical abnormalities.
Management depends on the associated complications. Conservative management includes hydration, pain control, and infection management, whereas interventional procedures such as percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), ureteroscopy, and DJ

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stenting are commonly used in patients with nephrolithiasis or urinary obstruction.
This report presents a case of horseshoe kidney with residual right renal calculi following percutaneous nephrolithotomy, managed successfully with retrograde intrarenal surgery and supportive pharmacotherapy.

CLINICAL MANIFESTATIONS

Many individuals with a horseshoe kidney remain asymptomatic, and the condition is often discovered incidentally during imaging studies performed for other reasons. When symptoms are present, they are usually related to urinary tract obstruction, infection, or kidney stone formation. Common symptoms include dull or intermittent pain in the flank, lower back, or abdomen. Patients may experience painful urination (dysuria), increased urinary frequency, urgency, and fever when a urinary tract infection is present. Hematuria (blood in the urine) may occur due to renal calculi or infection. Nausea and vomiting may accompany severe flank pain caused by ureteric obstruction or renal colic. Recurrent urinary tract infections, passage of kidney stones, and decreased urine output may also be seen in some patients. In severe cases with hydronephrosis or significant urinary obstruction, progressive impairment of renal function may develop.

DIAGNOSIS

Diagnosis is primarily established through imaging studies. Ultrasonography is often the initial investigation and may demonstrate fused lower poles and a low-lying kidney. Contrast-enhanced computed tomography (CT) and magnetic resonance imaging (MRI) provide detailed information regarding renal anatomy, vascular supply, and associated complications. CT urography or intravenous urography may be used to assess urinary drainage and identify obstruction. Renal function tests, urinalysis, and urine culture help evaluate renal function and detect infection when clinically indicated.

TREATMENT

NON - PHARMACOLOGICAL TREATMENT

The management of a horseshoe kidney depends on the presence of symptoms and associated complications. Individuals without symptoms usually do not require specific treatment but should undergo regular medical follow-up to monitor kidney function. Adequate fluid intake is recommended to maintain good urine flow and reduce the risk of kidney stone formation. Patients should maintain proper personal hygiene and seek early treatment for urinary tract infections to prevent complications. A balanced diet with controlled salt intake and moderation of foods high in oxalate may help reduce the risk of renal stone formation in susceptible individuals. Regular physical activity and maintaining a healthy body weight support overall kidney health. Contact sports or activities that may cause direct abdominal trauma should be avoided or performed with appropriate protective equipment because the fused kidney lies lower in the abdomen and is more vulnerable to injury. Periodic imaging studies and renal function tests are advised to detect complications such as hydronephrosis, obstruction, or stone formation at an early stage. Patient education regarding the recognition of symptoms such as flank pain, fever, painful urination, or blood in the urine is important so that prompt medical attention can be sought.

PHARMACOLOGICAL TREATMENT

There is no specific medication to treat a horseshoe kidney. Drug therapy is aimed at managing associated complications such as urinary tract infection, pain, and renal stone disease.
1. Antibiotics (for Urinary Tract Infection)

- Nitrofurantoin: 100 mg orally twice daily for 5 days (uncomplicated lower UTI; avoid if severe renal impairment is present).
- Trimethoprim–Sulfamethoxazole: 160/800 mg orally twice daily for 3–14 days, depending on the severity of infection and culture results.
- Ciprofloxacin: 500 mg orally twice daily for 7 days when indicated and based on local antimicrobial susceptibility.

Antibiotic selection should be guided by urine culture and sensitivity whenever possible.
2. Analgesics (for Flank Pain or Renal Colic)

- Paracetamol (Acetaminophen): 500–1000 mg orally every 6 hours as needed (maximum 4 g/day in adults with normal liver function).
- Ibuprofen: 200–400 mg orally every 6–8 hours with food as needed, provided renal function is adequate and there are no contraindications.

3. Antiemetics (if Nausea or Vomiting is Present)

- Ondansetron: 4–8 mg orally or intravenously every 8–12 hours as required.

4. Medical Management of Kidney Stones (When Appropriate)

- Tamsulosin: 0.4 mg orally once daily to facilitate the passage of distal ureteric stones when clinically indicated.

5. Hydration Therapy
Patients should maintain adequate oral fluid intake. Intravenous normal saline may be required in patients

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with dehydration, persistent vomiting, or inability to tolerate oral fluids.

COMPLICATION

Most individuals with a horseshoe kidney remain asymptomatic; however, several complications may occur because of impaired urinary drainage and abnormal renal anatomy. Recurrent urinary tract infections are common due to urinary stasis. Kidney stone formation is frequently observed and may cause renal colic or hematuria. Obstruction at the ureteropelvic junction can result in hydronephrosis and progressive renal damage if left untreated. Vesicoureteral reflux may occur, increasing the risk of recurrent infections and renal scarring. In severe or untreated cases, chronic kidney disease may develop because of repeated infections or persistent obstruction. Individuals with horseshoe kidney also have a slightly increased risk of developing certain renal malignancies, including Wilms tumor in children and transitional cell carcinoma or renal cell carcinoma in adults. The abnormal position of the kidneys also makes them more susceptible to injury following blunt abdominal trauma.

II. CASE REPORT

A 35-year-old male patient was admitted to the Urology department with complaints of flank pain and history of horseshoe kidney with right pelvic and lower calyceal calculi. He had undergone right supine mini percutaneous nephrolithotomy with right long duro DJ stenting on 10/2/2026 for renal stone removal. However, residual calculi persisted, and the patient was admitted for right retrograde intrarenal surgery (RIRS) with right DJ stenting under general anesthesia.

There was no significant family history, social history, personal history, or past medical history. On admission, the patient was conscious and oriented. His vital signs included temperature 98.6°F, blood pressure 120/80 mmHg, pulse rate 72 beats/minute, respiratory rate 20 breaths/minute, and oxygen saturation within normal range. Cardiovascular examination revealed normal heart sounds (S1S2 positive), bilateral air entry was equal in lungs, neurological examination showed no focal neurological deficit, and abdomen was soft and non-tender.

Laboratory investigations revealed hemoglobin levels of 12.4 g/dL and 13.1 g/dL during hospital stay. White blood cell count was within normal range. Renal function tests showed normal urea and creatinine levels. Electrolyte values were also within normal limits. A decline in lymphocyte count was noted.

CT urography demonstrated lower poles of both kidneys fused medially, confirming horseshoe kidney. Imaging also revealed right pelviureteric junction calculus with mild hydronephrosis, right lower pole calyceal calculi, minimal right perinephric and periureteric wall thickening, and minimal perinephric fat stranding suggestive of inflammatory changes.

The patient received perioperative and postoperative treatment with cefoperazone-sulbactam, pantoprazole, ondansetron, tamsulosin, mirabegron, amikacin, and supportive medications. General anesthesia was administered using midazolam, fentanyl, propofol, vecuronium, glycopyrrolate, and lignocaine. Pain and urinary symptoms were managed effectively during hospitalization.

Following clinical improvement and stabilization, the patient was discharged with oral cefpodoxime proxetil, pantoprazole, tramadol-paracetamol combination, tamsulosin, and mirabegron. He was advised adequate hydration, dietary modifications, medication adherence, and follow-up evaluation.

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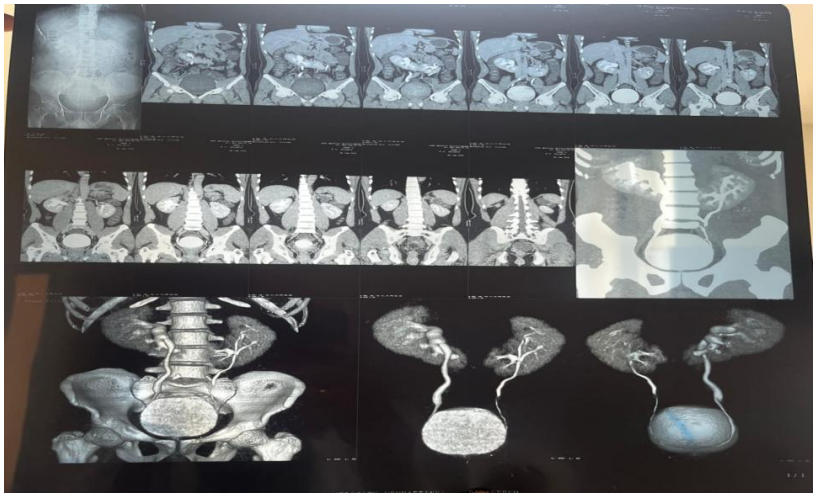

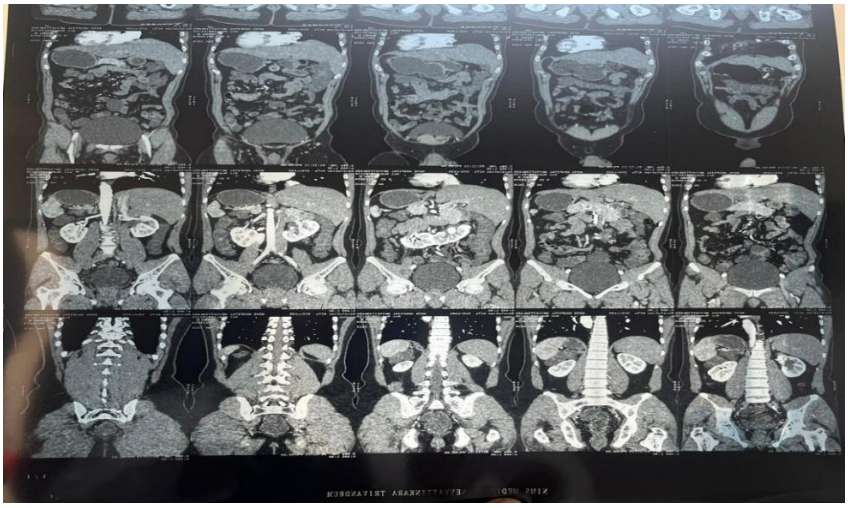

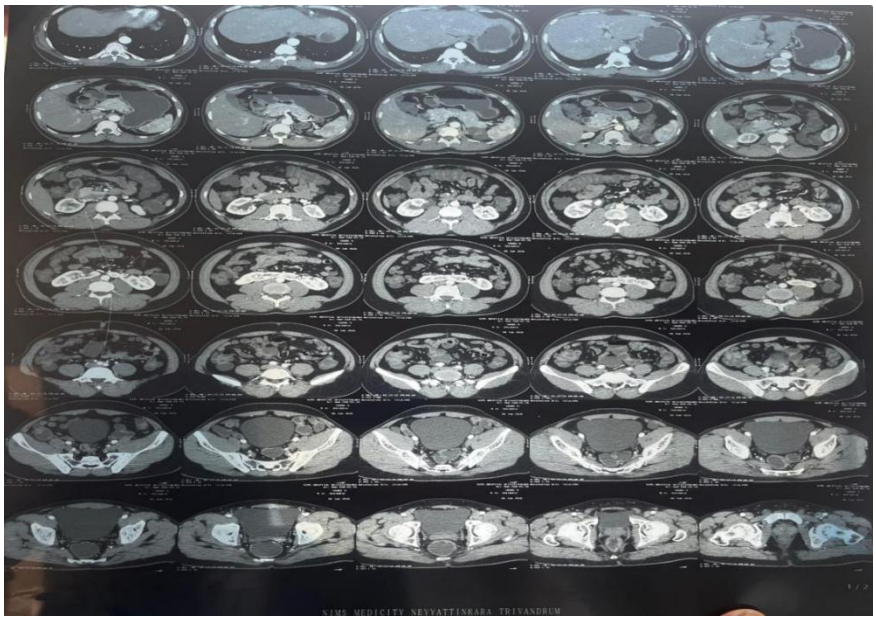

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III. DISCUSSION

Horseshoe kidney is the most common congenital renal fusion anomaly, with an incidence of approximately 1 in 400–600 live births. Glenn et al. reported that although many individuals remain asymptomatic, patients are predisposed to urinary tract obstruction, recurrent urinary tract infections, hydronephrosis, and nephrolithiasis because of abnormal renal ascent, malrotation, and impaired urinary drainage. These anatomical abnormalities promote urinary stasis, increasing the likelihood of stone formation.

Yohannes and Smith demonstrated that nephrolithiasis is one of the most frequent complications of horseshoe kidney and emphasized that altered renal anatomy makes endourological management technically challenging. They reported that minimally invasive procedures such as percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), and flexible ureteroscopy provide good stone clearance with acceptable complication rates when carefully planned.

Eryildirim et al. compared different treatment modalities for renal stones in horseshoe kidneys and concluded that the choice of intervention should depend on stone size, location, and renal anatomy. They observed that PCNL is preferred for large stone burdens, whereas RIRS is an effective alternative for residual or smaller calculi because it is less invasive and associated with favorable postoperative outcomes.

Similarly, Nechita et al. highlighted that modern imaging techniques, particularly CT urography, are essential for identifying anatomical variations and planning surgical management in horseshoe kidney patients. They also emphasized that individualized treatment strategies and long-term follow-up are necessary to prevent recurrent stone formation, urinary obstruction, and progressive renal impairment.

The present case is consistent with these published reports. The patient had residual right renal calculi following PCNL and was successfully managed with RIRS and DJ stenting. Postoperative recovery was uneventful with appropriate antimicrobial therapy, urinary drainage, and supportive care, demonstrating the effectiveness of a multidisciplinary and minimally invasive approach in managing renal calculi associated with horseshoe kidney.

IV. CONCLUSION

Horseshoe kidney is a congenital renal anomaly frequently associated with nephrolithiasis and urinary tract complications. This case highlights the importance of appropriate imaging, timely surgical intervention, and multidisciplinary management in achieving favorable outcomes. Combined approaches such as PCNL and RIRS can effectively manage complex and residual renal calculi in horseshoe kidney patients. Patient education regarding hydration, medication adherence, dietary modifications, and regular follow-up is essential to minimize recurrence and improve long-term renal health.

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