Superselective embolization in management of remnant renal moiety and vessels after radical nephrectomy in horseshoe kidney

Fahad Sheckley a,*, John Sheng b, Joshua Ng c, Michael Stifelman a, d

a Department of Urology, Hackensack University Medical Center, Hackensack, NJ, USA
b Division of Urology, Department of Surgery, Rutgers New Jersey Medical School, Newark, NJ, USA
c Department of Radiology, Hackensack University Medical Center, Hackensack, NJ, USA
d Hackensack Meridian School of Medicine, Nutley, NJ, USA

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ABSTRACT

Horseshoe kidney is a congenital disorder in which two kidneys are fused together in the isthmus. The anatomy could lead to increased risk of urinary tract infections and renal cancers. When performing a hemi-nephrectomy, it is important to identify all blood supply and ensure total excision of parenchyma and collecting system of the moiety operated upon. We present a case of left heminephrectomy complicated by urinoma secondary to residual tissue in the left moiety. We discuss the role of superselective embolization and other technologies in management of this complication and challenges faced due to aberrant vascularity and abnormal anatomy.

1. Introduction

Horseshoe kidney is the most common renal fusion anomaly accounting to 90% of renal fusion. It occurs in 3% of population with incidence rate of 1:400, twice as likely in men than women. It occurs during sixth week of gestation with fusion of inferior portions of metanephric blastema forming the isthmus, connection of the two kidneys in the lower poles causing malrotation more inferomedially than normal kidneys. Blood supply of horseshoe kidney becomes atypical with isthmus receiving separate supply with 65% originating from the aorta and 35% from surrounding vessels. 45% of horseshoe kidneys have isthmus at midline and 55% is more lateral. Majority of horseshoe kidneys are asymptomatic, found incidentally with imaging. However, horseshoe kidneys can present with obstructive symptoms due to high ureteric insertion leading to ureteropelvic obstruction. There are few case reports of renal tumors in horseshoe kidneys, 50% of cases reported are due to renal cell carcinoma.

2. Case report

68 year-old male presented with right 3.5 cm renal mass, nephrometry score 9p, discovered while evaluated for abdominal pain. Horseshoe kidney with poorly functioning left hydronephrotic kidney was identified, Fig. 1A. Patient underwent uncomplicated right partial nephrectomy in March 2020, final pathology RCC T1a. Six months later he presented for left flank pain and fever, urine culture grew E. Coli. Imaging revealed complex fluid in left moiety, Fig. 1B. Percutaneous nephrostomy tube placed in left moiety by Interventional Radiology (IR) with 4.5 L of purulent output. Culture of the drained fluid confirmed E. Coli. Patient was discharged with 14 days of Cefuroxime and drain. At that time, patient opted for left heminephrectomy given lack of parenchyma and risk of reinfection. 3D imaging was performed to ascertain renal arterial and collecting system anatomy. There noted to be 3 renal arteries supplying left kidney, with early branching and duplicated collecting system. Robotic left hemi-nephrectomy was performed in January 2021. Three separate renal arteries were identified and ligated, left ureter was divided, and an abdominal drain placed intraoperatively. Patient was discharged with drain. Histology showed no malignancy markedly atrophic kidney with diffuse dense collagenous fibrosis and chronic inflammation.

During follow up, patient was complaining of left flank pain and fluid Creatinine was >25 mg/dL. CT Angiogram revealed a 14 × 14 cm fluid collection in the left nephrectomy bed suggesting urinoma, Fig. 1C/D. Drain was not within collection, new 8.5 Fr drain was placed draining 400 cc. In addition, using 3D reconstructive CT imaging software, two arteries were identified supplying a remnant left moiety and isthmus of

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* Corresponding author.
E-mail address: fahad.sheckley@hmhn.org (F. Sheckley).

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horseshoe kidney, Fig. 2. Decision made for superselective embolization of remaining blood supply, Fig. 3.

A week later, repeat imaging showed complete resolution of fluid with minimal output from drain. Drain was removed; renal ultrasound few days later confirmed fluid resolution. No fluid collection was seen at 3-month follow up CT, GFR was 57.

3. Discussion

This case reports a challenging management of persistent parenchyma and urinoma s/p attempted hemi-nephrectomy for atrophic left horseshoe kidney. The presence of aberrant vascularity, early arterial branching and shifting of isthmus lateral to midline made it difficult intra-operatively.

The isthmus is composed of parenchymal tissues that can be cut during heminephrectomy. Normally, remaining small parenchymal stump imposes no issues, however, in our case it had remaining active urine-producing nephrons with supply from aberrant vessels that were not appreciated intra-operatively leading to development of urinoma.

Potential option to avoid complication of leaving remnant tissues is...
using Near Infrared Fluorescence (NIRF) technology to delineate left from right collecting systems. NIRF assists with delineation based on vascular distribution of fluoroscopic tracer for example Indocyanine Green (ICG). 3D imaging assists with identifying vessel distribution. Clamping these vessels causes ischemia to the targeted kidney. One minute after administration of ICG intravenously, the ischemic kidney will not show green fluorescence. This way, all remaining tissue of the targeted kidney can be identified and removed.

Another option is to inject ICG into the ureter. ICG distribution into the collecting system will show a strong fluoroscopic signal using the NIRF technology and help with removing it without leaving tissue behind.

Options to manage this complication:

1) Re-operation with robotic vs. open resection of remaining tissue.
2) Embolizing the remaining blood vessel while avoiding damage to healthy right renal tissue, superselective embolization.

Preference was directed toward less invasive procedure with help of better radiologic techniques, like 3D technology to delineate the left from right tissues and what vessel is supplying the remnant tissue. IR was able to use these images and angiograms to successfully embolize aberrant left renal vessels with coiling, Fig. 3. Drain output was then significantly reduced after this procedure and fluid Creatinine became consistent with serum Creatinine of 1.2 mg/dL, indicating successful intervention without invasive measures.

The first reported use of selective renal artery embolization was done in a hemorrhagic stab wound injury in 1973 by Bookstein et al. Initially, these procedures resulted with large volume of renal tissue loss from terminating their blood supply. Advancement of techniques helped with focused embolization with preserving as much tissue as possible. Superselective embolization is a technique first used in the 80s to embolize a branch of renal artery in order to target a small vessel and its distribution. In our case, the goal was to cause ischemia to the remaining tissues supplied by specific two arteries. The procedure was successful and following imaging showed no further production of urine with preservation of renal function.

4. Conclusion

In this study, the complicated anatomy of horseshoe kidney and challenges it imposes on heminephrectomy are presented. This report shines a spotlight on the importance of preoperative and intraoperative imaging technologies like 3D CT and NIRF in delineating the collecting system from the parenchyma of the isthmus to identify the line of resection to prevent cutting through collecting system. In addition, superselective embolization is a successful technique with significant risk reduction of damage to healthy tissue. Although superselective renal artery embolization is typically used for renal hemorrhage, it should be considered as an option for residual renal tissue.
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