Endovascular Rescue for Renal Artery Pseudoaneurysms following Minimally Invasive Robot-Assisted Partial Nephrectomy—A Case Series

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Abstract

Keywords
- robotic partial nephrectomy
- renal pseudoaneurysm
- super-selective embolization

Nephron sparing surgery or partial nephrectomy has been employed ever since in cases of renal tumors with an aim to preserve the function of residual kidney. Lately, there has been increasing adoption in robot-assisted techniques for partial nephrectomy. However, renal surgeries of any kind have always been a hazard for postoperative vascular complications owing to high vascularity of the renal tissues, of which renal artery pseudoaneurysm is one of the most fatal complications. We present a case series where highly super-selective embolization rescues the patient and augments the nephron sparing nature of the precise robot-assisted partial nephrectomy.

Introduction

Robotic partial nephron sparing surgery (RPN) offers a minimally invasive surgical option, especially for patients presenting with smaller renal mass, and is being employed recently even for larger and complex lesions.1 Postoperative massive hemorrhage, urine leak, and urinoma formation are few of the known complications following RPN. Renal artery pseudoaneurysms (RAP) are a relatively rare complication following nephron sparing surgery.2 Development of RAP has been reported to be seen in the immediate postoperative period and also as a delayed presentation (>3 weeks).2 With increasing utilization of nephron sparing surgery, the incidence is expected to be on rise. Here, we present a series of four cases presenting with RAP following RPN treated with super-selective endovascular measures with aim to preserve as much normal renal tissue as possible without jeopardizing the nephron sparing nature of surgery.

Case 1

A 62-year-old diabetic and hypertensive male presenting with multiple vomiting episodes was found to have an exophytic mass in the interpolar region of right kidney. Imaging showed no vascular thromboses and no distant metastases. He underwent RPN. Renorrhaphy was done in two layers. Warm ischemic time of 20 minutes and estimated blood loss (EBL) of 150 mL, RENAL score3 9xh were noted. On postoperative day 17, he presented with high-grade fever, chills, multiple episodes of vomiting, and generalized weakness. He was investigated and found to have leukocytosis and hyponatremia. Despite aggressive medical treatment, he...
had high-grade fever and one episode of gross hematuria resulting in drop in hemoglobin levels. After being transfused with two units of packed cell red blood cells, he was taken up for angiography.

Angiogram of the right renal artery through a 5F vascular sheath (Radifocus Introducer II Standard Kit A, Terumo Medical Corporation, United States) and 4F Cobra C1 catheter (Glidecath, Terumo Medical Corporation, Corporation 265 Davidson Avenue Somerset, NJ 08873, United States) showed 23 × 19 mm pseudoaneurysm in the interpolar region. Super-selective embolization was done using 2.4F microcatheter (Direxion, Boston Scientific Corporation, United States) and microcoil of size 5 mm × 7 cm (Nester Embolization coil, Cook Medical LLC, United States). Postembolization angiogram showed no filling of the pseudoaneurysm (Fig. 1). Patient was eventually discharged in a satisfactory condition with no similar episodes later.

**Case 2**

Screening ultrasonography (USG) of a 43-year-old male detected an incidental left renal mass that on contrast enhanced computerized tomography (CT) was a well-defined heterogeneously enhancing lesion in the interpolar region of left kidney suggesting a neoplasm, renal cell carcinoma. Patient underwent RPN. Renorrhaphy was done in two layers. Warm ischemia time of 34 minutes and EBL of 200 mL, and renal score 10X were noted. Nineteen days after the surgery, patient had few episodes of fever, dysuria, and hematuria. Patient was evaluated with CT renal angiogram and was found to have a pseudoaneurysm.

He was referred to the department of interventional radiology for further management. Angiogram of the left renal artery showed active contrast extravasation from the segmental branch in the interpolar region, which was seen to fill a large, 22 × 11 mm pseudoaneurysm (Fig. 2). Super-selective embolization was done using 2.7F microcatheter (Progreat, Terumo Medical Corp., United States), 0.2 cc of n-butyl cyanoacrylate (NBCA) glue with lipiodol in the ratio of 1:2 and a coil of size 3 mm × 5 cm. Postembolization angiogram showed no active contrast extravasation and no filling of pseudoaneurysm (Fig. 2). Patient was followed up till 8 months and had no similar episodes.
Case 3

Routine health screening of a 43-year-old male revealed bilateral renal mass on USG. Contrast-enhanced CT (CECT) showed a 4.6 × 4.6 cm well-defined mass in the interpolar region of left kidney involving cortex and medulla with no vascular thromboses and a similar smaller 1.9 × 1.8 cm lesion in the upper pole of right kidney. Patient underwent RPN for the left renal mass. Renography was done in two layers. Warm ischemic time of 35 minutes and EBL of 150 mL, and RENAL score 10x were noted. Fourteen days after the surgery, patient presented with complaints of dysuria, fever, and hematuria. Patient was referred for angiography.

Angiogram of the left renal artery showed actively filling multiple pseudoaneurysms from the anteroinferior and posterior segmental branches in the lower and interpolar, largest measuring 22 × 11mm. Super-selective embolization of anteroinferior branches was done using 2.7F microcatheter and coils of size 6mm × 7cm and 4mm × 7cm. Posterior segmental branches were super-selectively embolized subsequently with coils of size 3mm × 3cm and 5mm × 5cm. Technical success was confirmed with a postembolization angiogram showing no contrast extravasation (Fig. 3). Clinical success was confirmed with no episodes of hematuria, fever, and dysuria on follow-up beyond 6 months.

Discussion

RAP is one of the most common vascular complications with etiologies ranging from trauma, iatrogenic causes like percutaneous biopsy, nephrostomy, and following surgical procedures like partial nephrectomy. Yamashita et al in their prospective study reported a significant 18% incidence of RAP following RPN. However, the study showed that smaller (<10mm) asymptomatic pseudoaneurysms can be managed conservatively and may resolve spontaneously. On the other hand, symptomatic and larger lesions need to be promptly intervened, failing which can even result in renal failure over time.

Endovascular rescue for RAP following minimally invasive robot-assisted partial nephrectomy was evaluated in our series. Three patients presented within 21 days and only one patient presented late after 39 days. Affirmative reason for development of RAP is still a matter of study.
The anatomy of renal artery and its divisions reveals that renal parenchyma supplied by the segmental artery can be isolated and managed independently without affecting the other segments if embolization is done super-selectively engaging the segmental branches. Additionally, review of preoperative CT angiogram and use of intraoperative cone beam CT can help in identifying bleeding sites and can help in isolating the involved segments.12

With a wide variety of embolic agents available currently, preferred agent for management of different types of hemorrhage is indicated in Table 2.13,14 Endoluminal stent-graft (covered stent) can be used to isolate the pseudoaneurysm and percutaneous USG-guided thrombin/NBCA injection can be attempted in a failed endovascular rescue.15

Studies have dismissed any apprehensions of renal artery embolization causing renal function failure and have shown to cause no long-term adverse effect on the renal function and blood pressure control.16

In conclusion, development of pseudoaneurysms post-RPN is not an unknown entity but careful evaluation of preoperative imaging, multidisciplinary team meetings, accurate identification of origin of hemorrhage/pseudoaneurysm, and super-selective segmental approach to endovascular management would result in preserving as much as functional renal parenchyma as well as rescue the patient from fatal hemorrhagic complication.

<table>
<thead>
<tr>
<th>Type of hemorrhage</th>
<th>Angiographic finding</th>
<th>Choice of embolizing agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudoaneurysm</td>
<td>Contrast filling of an irregular outpouching in communication with vessel lumen</td>
<td>Coils</td>
</tr>
<tr>
<td>Pseudoaneurysm with active extravasation</td>
<td>Contrast filling of an irregular outpouching in communication with vessel lumen associated with brisk contrast extravasation</td>
<td>Coils and/or NBCA (glue)</td>
</tr>
<tr>
<td>Arteriovenous or arteriocalyceal fistula</td>
<td>Early filling of vein/calyx adjacent to the contrast-opaciﬁed artery and could be associated with a pseudoaneurysm</td>
<td>NBCA (glue)</td>
</tr>
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</table>

Abbreviation: NBCA, n-butyl cyanoacrylate.

Table 2 Preferred embolic agent for the management of various causes of hemorrhage
Conflict of Interest
None declared.

References