

# Delayed renal artery pseudoaneurysm after robotic partial nephrectomy

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## Introduction

Renal artery pseudoaneurysm (RAP) is a rare complication of partial nephrectomy occurring with a frequency of 2% [9, 11]. While most RAPs occur within 2 weeks post-operatively, there are a limited number of reports in the literature describing delayed presentation (>25 days). We report two cases of delayed RAP after robot-assisted laparoscopic partial nephrectomy (RPN) and propose changes in surgical technique to decrease this complication.

## Case presentation: patient 1

A 25-year-old female underwent an RPN in April 2016 for a left renal mass (RENAL nephrometry score 8x). Warm ischemia time was 22 min, a bolster of oxidized cellulose polymer was placed in the resection defect, a sliding clip renorrhaphy was performed, and estimated blood loss (EBL) was 50 mL. Pathology revealed pT1aNx clear cell renal cell carcinoma (RCC) with negative surgical margins. The patient's hospital stay was unremarkable, and she was discharged home on post-operative day (POD)#2. She subsequently developed asymptomatic gross hematuria with the passage of clots on POD#24. The patient was hydrated and monitored for 24 h over which time her hematuria resolved and serial hemoglobin (Hgb) values remained stable. She was discharged to home but presented

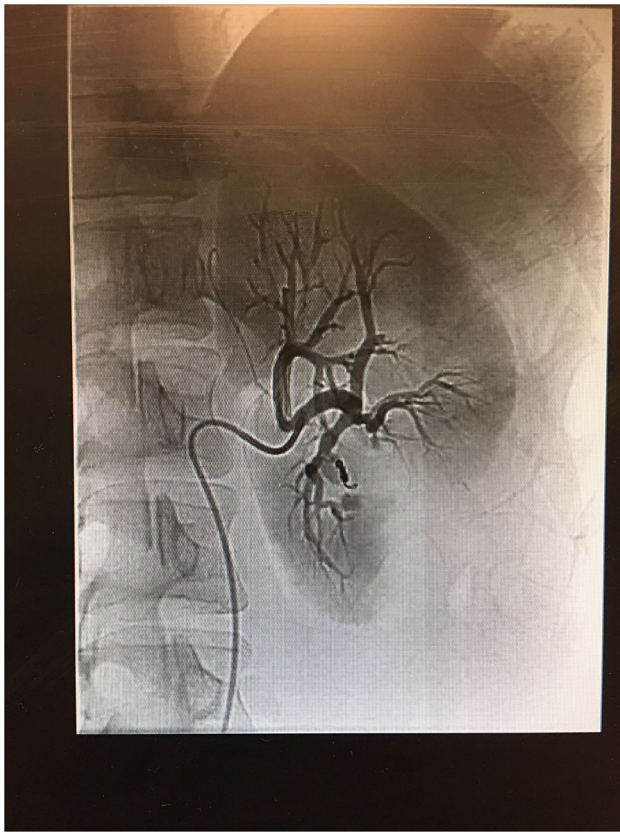
weeks later (POD#60) with gross hematuria, left flank pain, and the passage of clots. Upon this presentation, her vital signs were stable, and at baseline (heart rate 80–90 s, blood pressure 90–110 s/50–70 s), Hgb was 8.6 g/dL from 12 g/dL. A CT-scan abdomen/pelvis revealed a delayed left nephrogram indicating obstruction, likely due to ureteral clots. Renal arteriography revealed a small RAP, and coil embolization was performed with complete resolution of her hematuria. Cystoscopy and left ureteral stent placement were performed with resolution of her flank pain (Fig. 1).

## Case presentation: patient 2

A 56-year-old male who underwent a left RPN in January 2016 for a left renal mass (RENAL nephrometry score 8p). Warm ischemia time was 20 min, a bolster was placed in the resection defect, a sliding clip renorrhaphy was performed, and EBL was 100 mL. Pathology showed a pT1aNx clear cell RCC with negative surgical margins. The patient's hospital stay was unremarkable, and he was discharged home on POD#2. On POD#26, the patient complained of gross hematuria and clot retention. A computerized tomography (CT) scan abdomen/pelvis with contrast and renal ultrasound did not identify active bleeding or extravasation but did suggest the presence of multiple blood clots within the urinary bladder. The patient was taken to the operating room for cystoscopy and clot evacuation. The patient's hematuria improved, and he was discharged home after a successful void trial. Three days later (POD#29), he was readmitted for recurrent hematuria at which time his vital signs were stable and at baseline (HR 50–90 s, BP 120–150 s/60–80 s) and his Hgb was 10.1 g/dL from a baseline of 12.9 g/dL. A renal arteriogram revealed a 7 mm left RAP and arterial-venous

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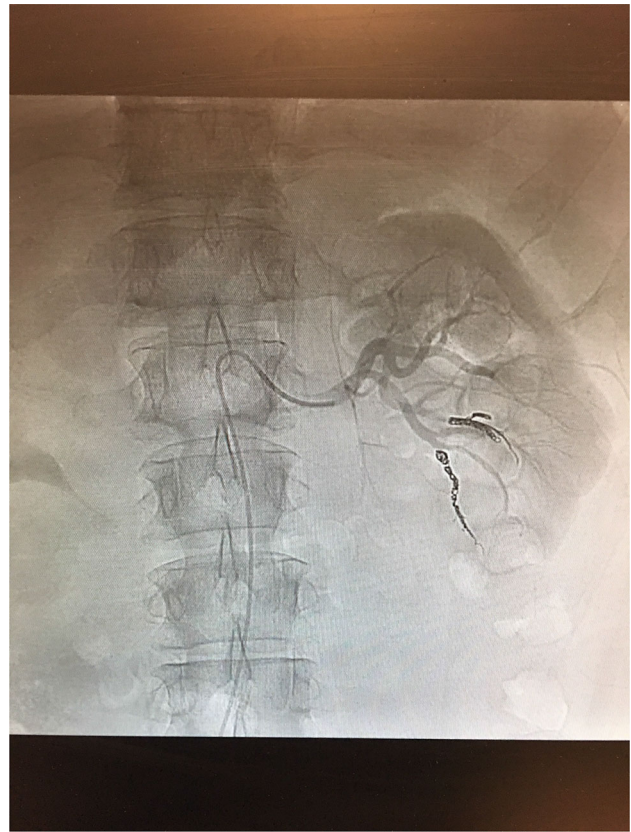


**Fig. 1** Patient 1 left renal arteriogram and interventional radiological renal arterial branch coiling for a small segmental branch renal artery pseudoaneurysm

fistula (AVF) from a lower pole segmental renal artery branch. Coil embolization was performed with complete resolution of his hematuria Fig. 2.

## Discussion

RAP has been reported following trauma, renal biopsy, percutaneous nephrostomy, and partial nephrectomy [1]. Multiple studies have shown that RAP is the most common cause of post-operative hemorrhage following partial nephrectomy regardless of surgical approach [2, 3, 13, 15]. An RAP forms when a compromised artery or arterial branch bleeds into surrounding tissues, forming a dilated cavity that has the radiologic appearance of an aneurysm [14]. Hemorrhage from an RAP may temporarily or intermittently cease due to coagulation and stabilization from surrounding tissue [4]. Indeed, both patients presented above experienced intermittent complete resolution of gross hematuria. In rare cases, conservative management may produce permanent resolution of bleeding due to RAP, as reported by various authors—Hyams et al. reported an 11% rate of resolution with conservative management alone [9, 10].



**Fig. 2** Patient 2 left renal arteriogram and interventional radiological lower pole segmental renal arterial coiling for 7 mm pseudoaneurysm and arterial-venous fistula

A high index of suspicion for the diagnosis of RAP is necessary, as patients may present with non-specific symptoms. Gross hematuria and flank pain are commonly seen, and other reported symptoms include dizziness, syncope, and fever [1, 4]. While some patients present in extremis with cardiovascular compromise and sense of impending doom, other patients may report only slight painless gross hematuria. The cases detailed above illustrate that not all cases of RAP produce immediate, life-threatening bleeding, or distress. In fact, neither of our patients required a blood transfusion, but the indication to embolize was instead repeated clot retention.

The time from surgery to presentation of symptoms from RAP is variable. Cohenpour et al. [4] found a mean time to presentation of 12.2 days after surgery, and Netsch et al. [7, 8] reported median time of presentation as 12.5 days post-operatively. In a review of 998 patients undergoing minimally invasive partial nephrectomy, 17 cases of RAP occurred with none presenting after POD#24 [10]. Our reported cases, however, represent delayed presentations of RAP—both occurring after POD#25. Other reports in the literature chronicle delayed presentation, with one case presenting 5 months after surgery [5].

Angiography is the gold standard for diagnosis of RAP, and it also provides the means for therapeutic intervention [6]. This notwithstanding, some clinicians recommend that renal ultrasound, CT angiography, or magnetic resonance imaging should first be performed in the hemodynamically stable patient with post-renal surgery hematuria. While patients may undergo these studies initially should they present to an emergency room setting, these studies are less sensitive in diagnosing RAP. If imaging studies are inconclusive or the patient is hemodynamically unstable, percutaneous angiography with potential embolization is indicated [4, 6]. Percutaneous selective angioembolization (SAE) has been shown to be more efficacious when compared to open surgical exploration [1, 4, 6], with success rates of 82–100% [6, 7]. Long-term follow-up also demonstrates prevention of recurrence of RAP in patients treated with SAE [1]. Open surgical exploration is more likely to lead to complete loss of the bleeding renal unit via emergency nephrectomy versus SAE [9]. Indeed, Strobl and colleagues found a mean 25.2% reduction in renal parenchymal mass after SAE—preferable to a 50% reduction in nephron mass from emergency nephrectomy [12].

Both our patients underwent an oxidized cellulose polymer bolster placement at the base of the renorrhaphy defect. We posit that placement of this oxidized cellulose bolster within the partial nephrectomy defect may prevent the healing process by separating the cut edges of renal parenchyma. We have since modified our technique to include only placement of sliding clip absorbable renorrhaphy sutures after collecting system closure and argon beam coagulation of the base of the partial nephrectomy defect. A bolster of oxidized cellulose polymer is then pressed on top of the closed renorrhaphy and secured in place with Tisseel fibrin glue. This approach allows for both close tissue apposition and compression while avoiding the introduction of foreign material into the renorrhaphy. Since this technical modification, we have not seen further cases of RAP after RPN.

In conclusion, RAP should be suspected in any patient with a history of nephron-sparing surgery regardless of time elapsed since the initial operation or degree of hemorrhage. While diagnosis can be performed using non-invasive imaging in a stable patient, angiography  $\pm$  angioembolization is more sensitive and remains the gold standard diagnostic and therapeutic procedure. We recommend against the placement of hemostatic material between the cut edges of renal parenchyma during renorrhaphy. Hemostatic materials and maneuvers that do not interfere with parenchymal apposition should continue to be used.

#### Compliance with ethical standards

**Funding** None.

**Conflict of interest** The authors report no conflicts of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

**Informed consent** Written informed consent was obtained from the patients for publication of this case report/any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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