Ultrasound Diagnosed Rare Partial Nephrectomy Complication

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Abstract

Keywords

- ▶ partial nephrectomy
- ▶ renal artery pseudoaneurysm
- ▶ duplex sonography
- ▶ “to-and-fro” waveform
- ▶ acute renal injury
- ▶ coiling
- ▶ postoperative complications

Renal artery pseudoaneurysm (RAP) is a serious complication that can lead to severe hematuria, blood loss, and life-threatening hemorrhagic shock. A pseudoaneurysm is defined as an arterial wall deficiency that results in the accumulation of oxygenated blood in the nearby extraluminal region. Partial nephrectomy, a parenchymal sparing method, carries a lower risk of postoperative development of chronic kidney disease than total nephrectomy but a higher risk of iatrogenic vascular lesions such as RAP or arteriovenous fistulas. Pseudoaneurysms may develop secondary to arterial transection during tumor resection or due to arterial puncture during suture ligation of the resection bed. Emergency transarterial embolization is an effective treatment modality for patients with hemodynamic instability that does not lead to significant worsening of renal function. The recent literature reports an incidence of 2.7 to 21.7% of RAP or arteriovenous fistulas after partial nephrectomy. We report a case of severe bleeding with massive hematuria due to RAP, which was detected with duplex sonography.

We describe the case of a 46-year-old female patient transferred from a rehabilitation clinic 27 days after an open partial nephrectomy due to clear cell carcinoma of the kidney (pT1b, N × M × G₁L₀V₀R₀, 2.8 cm). The obese patient (obesity stage III, 158 cm, 102 kg, body mass index 40.1 kg/m²) presented with a temperature of 40°C and evidence of sepsis (C-reactive protein [CRP] 287.45 mg/dL, procalcitonin 4.6 µg/L, leucocytes 6.8 × 10⁶/L). Acute kidney injury stage 3 (according to the Kidney Disease: Improving Global Outcomes guidelines) with serum creatinine of 3.3 mg/dL was observed and anemia with hemoglobin levels of 7.9 g/L was apparent. Urine testing detected a urinary tract infection with *Escherichia coli* bacteria. Ultrasound examination in our emergency department revealed hemorrhagic tamponade of the bladder and a cyst-like structure measuring 3 to 4 cm

within the anterior-inferior segment of the left kidney. Intravenous antibiotic therapy was initiated followed by transurethral removal of blood clots from the bladder and intensive catheterization with fluid. The urine cleared and the CRP level decreased slowly, but renal function worsened (serum creatinine 5.5 mg/dL).

The patient was transferred to the department of angiography on day 3 after admission with decreasing hemoglobin levels (6.8 g/L) and hemodynamic instability (blood pressure 80/50 mm Hg, heart rate 125/min, use of vasopressors). Ultrasound again revealed the cyst-like structure in the center of the left kidney with maximal dimensions of 3.6 × 4.5 × 3.4 cm. Duplex ultrasound was performed using a Philips iu22 ultrasound console (Philips, Amsterdam, Netherlands) with a curved array transducer (2–5 MHz frequency

range). Color Doppler ultrasound showed a high rate of arterial perfusion inside the cyst-like structure, leading to the diagnosis of renal artery pseudoaneurysm (RAP). We observed a connecting channel from an intrarenal artery to the aneurysm with the typical “to-and-fro” appearance (maximal systolic velocity 120 cm/s) in the channel, confirming this diagnosis (►Fig. 1A and B). The right kidney was normal in size and we could not detect any pathologies with duplex ultrasound and computed tomography (CT) scan.

Multidisciplinary team decision for an endovascular treatment of the pseudoaneurysm was made due to the young age of

the patient. Further, no signs of inflammation in the left kidney could be detected in the CT scan and the ultrasound examination. If so, a surgical approach would have been necessary. Our goal was to preserve as much renal parenchyma as possible.

Emergency angiography via right femoral access with selective catheterization and microcoiling of the RAP was then performed using two framing coils (20/50 and 14/34; Terumo Azur, NJ), six packing coils (60 cm, 45 cm, 4 × 30 cm, Penumbra Inc., CA), and four soft coils (2 × 8/60, 6/30, 6/20; Penumbra Inc.) followed by closure of the three culprit vessels of the left renal artery feeding the lesion with 3 × 3/3 pushable

Fig. 1 (A) Color duplex ultrasonography of the left kidney in longitudinal view, showing the pseudoaneurysm and its inflow from intrarenal arteries. (B) Color duplex ultrasonography of the left kidney in transversal view, showing the pseudoaneurysm. (C) Angiographic imaging of the left intrarenal arteries using microcatheter technique, showing the origin and size of the pseudoaneurysm. (D) Angiographic imaging after treatment with coils, showing a completely filled pseudoaneurysm. (E) Angiographic imaging after successful treatment with coils. There is no perfusion left in the pseudoaneurysm. (F) Angiographic imaging of the left kidney and its arteries, showing no perfusion in the treated pseudoaneurysm. The pseudoaneurysm is completely filled with coils.

coils (Boston Scientific, MA) (► **Fig. 1C–F**). Following intervention, hemodynamic stability was achieved.

After a stable period of 6 days, the patient presented again with massive hematuria. Coiling was successfully repeated in a small peripheral vessel of the left renal artery, which still had connection to the pseudoaneurysm ($2 \times 3/3$ pushable coils; Boston Scientific). The patient received a total of 4 units of concentrated erythrocytes. Improving renal function was not affected by the second bleeding episode. Within 18 days, renal function had nearly normalized (serum creatinine 0.8 mg/dL), hemoglobin was stable at 8 g/L, and the CRP level had dropped to 63 mg/L. Upon extensive laboratory testing after the second bleeding, we found no evidence of a bleeding disorder of the coagulation system. The patient was discharged 9 days after the second embolization in stable condition.

In an analysis of 5,229 patients undergoing nephron-sparing partial nephrectomy, those having symptomatic RAP or arteriovenous fistula (nearly 90% of whom had gross hematuria) presented with symptoms on average 15 days after surgery (ranging from 1 to 90 days).^{1–3} Our patient presented with typical symptoms on postoperative day 27. Several diagnostic approaches are suitable for confirming the diagnosis of RAP. Contrast-enhanced CT is used most frequently.^{1,4} Alternatively, contrast-enhanced ultrasound or magnetic resonance (MR) imaging is performed.^{4,5} A patient with severely impaired renal function, however, should not be exposed to further risk by using contrast media. In addition, use of CT scan or MR imaging is often not available in an emergency or ambulant situation.⁶

Ultrasound imaging with duplex ultrasonography plays a key role in the diagnosis of vascular diseases.⁷ This non-invasive method can show the degree of clotting, the culprit vessels feeding the RAP, and blood flow patterns corresponding to the “to-and-fro” waveform (systolic and diastolic turbulent blood flow in the communicating channel in the spectral Doppler).⁷ Accurate diagnosis of a RAP by spectral Doppler is based on the documentation of this characteristic sign. The main advantages of ultrasound are that it is non-invasive, there is no use of ionizing radiation, and the examination is inexpensive and readily available.⁷

In conclusion, our case suggests that patients undergoing a partial nephrectomy, at least those with the most common

risk factors related to the development of a RAP (tumor size, high nephrometry score, renal sinus exposure, or opening of the collecting system),^{8,9} should be followed up closely with duplex ultrasound, a method that is readily available and applicable even in patients with impaired renal function.

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