From the Eastern Vascular Society

# Abdominal aortic aneurysm and bilateral pelvic kidneys

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## ABSTRACT

A 61-year-old man presented with a 5.8-cm abdominal aortic aneurysm with bilateral pelvic kidneys incidentally discovered by computed tomography angiography. Given the complex anatomy, an open approach was favored over an endovascular approach to address the aneurysm and preserve renal function. Renal perfusion was achieved with a short clamp time of 29 minutes and intermittent boluses of cold renal perfusion solution delivered into each renal artery via a Fogarty infusion catheter. We describe a rare case of bilateral ectopic kidneys in the setting of open abdominal aortic aneurysm repair using the described technique. (J Vasc Surg Cases Innov Tech 2023;9:1-4.)

**Keywords:** Abdominal aorta; Aortic aneurysm; Pelvic kidneys

Bilateral pelvic kidneys are rare anatomic anomalies, seen in ~10% of ectopic kidney cases. Abdominal aortic aneurysms are rarely associated with renal ectopia. Pelvic kidneys are at risk of injury given the ischemia that results with clamping during repair. Although no single approach is preferred, we describe our experience with an abdominal aortic aneurysm repaired using an open approach and preservation of the bilateral pelvic kidneys using intermittent cold renal perfusion. The patient provided written informed consent for the report of his case details and imaging studies.

## CASE REPORT

A 61-year-old man presented with a centerline diameter abdominal aortic aneurysm (AAA) of 5.8 cm, with an incidental finding of bilateral ectopic kidneys. His medical history includes hypertension, hypercholesterolemia, and coronary artery stenting.

Computed tomography angiography of the chest, abdomen, and pelvis revealed a fusiform aneurysm of the distal abdominal aorta and pelvic kidneys with aberrant vasculature (Fig 1). The main right renal artery (RA) originated from the right common iliac artery (CIA). Smaller accessory RA branches originated from the distal right CIA and internal iliac arteries. The main left RA originated from the left CIA. A larger accessory left RA branch originated from the left CIA. Smaller accessory branches were seen arising from the internal iliac arteries (Fig 2). Given his young age and anatomic anomalies, the patient was offered open repair.

A transperitoneal approach allowed for better access to the pelvis and iliac arteries. After midline laparotomy, the abdominal aorta was dissected superiorly to the level of the pancreas, where a normal aortic neck was noted. Dissection was continued inferiorly along the anterior surface of the aorta to the right CIA. An anterior right RA was identified and controlled. Dissection along the left CIA exposed an accessory branch of the left kidney originating from the anterior surface of the CIA. The origin of the left main RA originating posteriorly was identified; however, complete isolation of this vessel was difficult given its deep location within the pelvis (Fig 3). After heparinization with appropriate proximal and distal control, the aortic sac was entered. Fogarty occlusion catheters were placed into bilateral main RAs, which were identified via backbleeding. The catheters were flushed at 5-minute intervals with 10 mL of renal preservation solution (Table) without a change in the core temperature, measured via a nasal temperature probe. The AAA was repaired using an 18-mm straight Dacron tube graft in standard fashion with 3-0 Prolene suture. The Fogarty occlusion catheters were removed before completion of the anastomosis. The aortic sac was closed over the repair using 2-0 Vicryl suture. The total aortic clamp time was 29 minutes. His postoperative course was complicated by ileus, which resolved with conservative management. His postoperative creatinine levels and urine output remained normal (Fig 4). The patient was discharged from the hospital on postoperative day 9. At 4 weeks of follow-up, he was doing well without complaints. Repeat imaging performed at the 6-month follow-up revealed an intact aortic repair, without any further aneurysmal disease progression.

## DISCUSSION

Ectopic kidneys arise from failure of ascent during embryogenesis and are mostly located in the pelvis.

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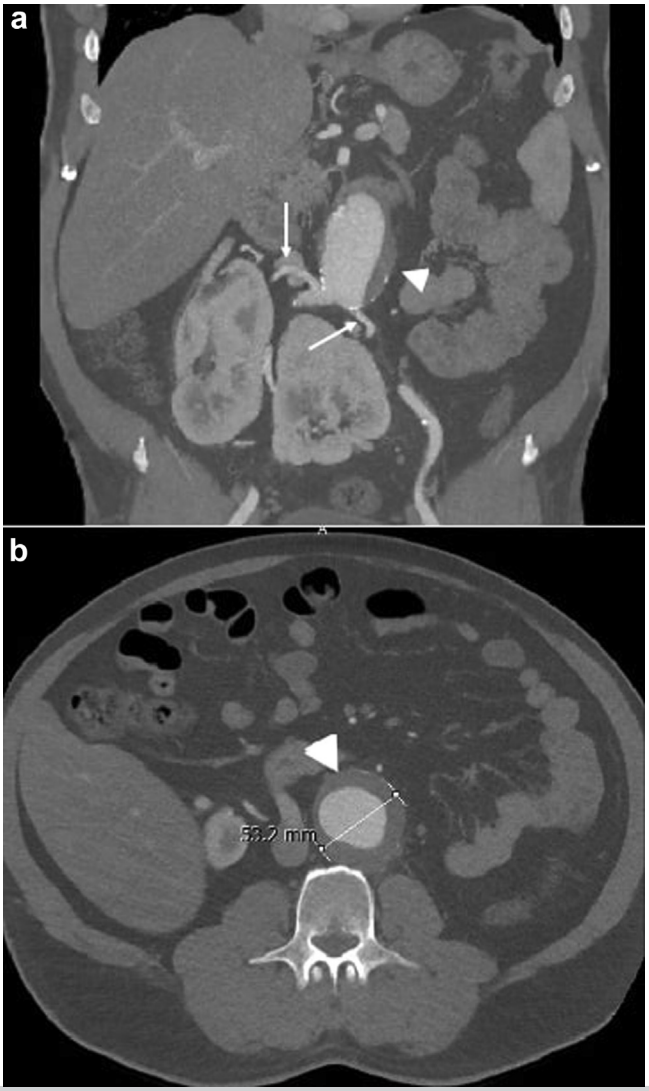


**Fig 1.** Computed tomography angiogram demonstrating one right-sided renal artery (RA) and one left-sided RA (**a**; *arrows*) and a 5.8- × 5.3-cm abdominal aortic aneurysm (AAA; **b**; *arrowhead*).

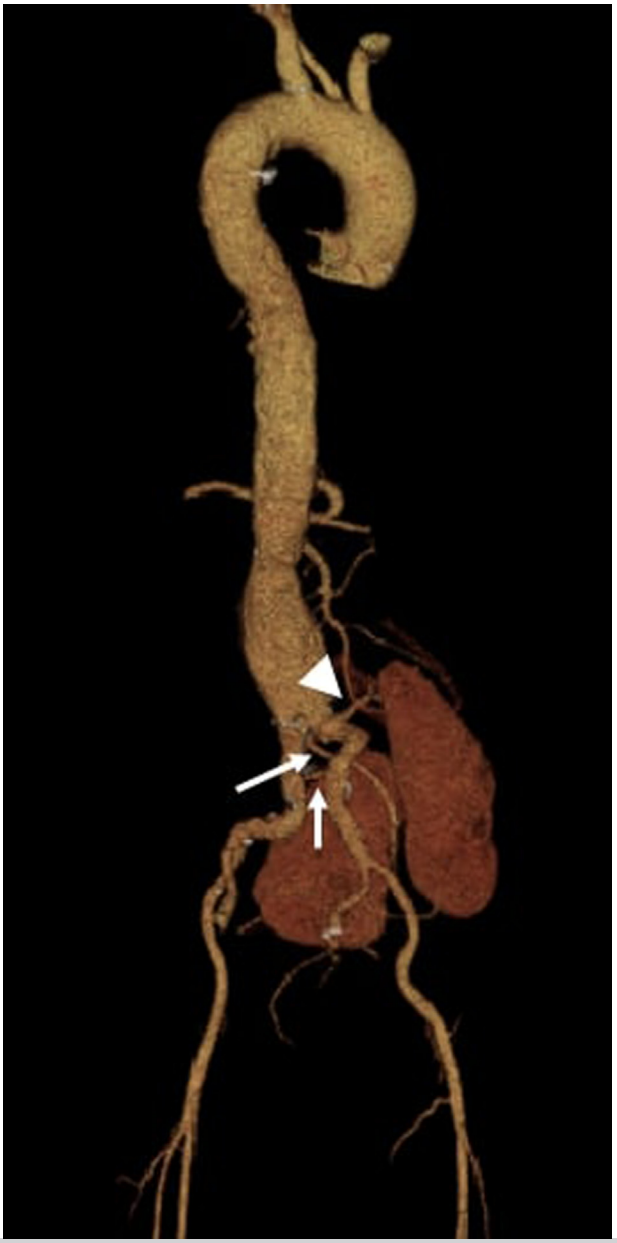

**Fig 2.** Computed tomography angiogram with three-dimensional reconstruction demonstrating one right-sided renal artery (RA; *arrowhead*), and two left-sided RAs (*arrows*).

They are usually unilateral; bilateral pelvic kidneys are rare, only seen in 10% of cases. Although most cases are asymptomatic, renal ectopia leads to reduced renal function. This predisposes patients to urinary tract complications, including vesicoureteral reflux, urinary tract infections, obstruction, and renal calculi.[1,2]

Anatomic distortion during development also leads to an inconsistent blood supply, because the fetal vasculature can be retained, leading to multiple vessels supplying one kidney. The blood supply can originate from the aorta, iliac, mid-sacral, and/or hypogastric vessels.[1,2]

Preprocedural planning is especially important for open repair of AAAs in the presence of pelvic kidneys because a critical step is obtaining proximal and distal control of the aorta. When kidneys are in the pelvis, suprarenal aortic clamping is inevitable, prolonging the renal ischemia time with a resultant potential decline in renal function.

To the best of our knowledge, only one case of an AAA in a patient with bilateral pelvic kidneys has been reported. However, the case was from Brazil and reported in Portuguese and, therefore, could not be included in our discussion.[3]

In cases of AAA in patients with a unilateral pelvic kidney, different techniques have been described. Hollis et al[4] reported two methods of renal preservation during

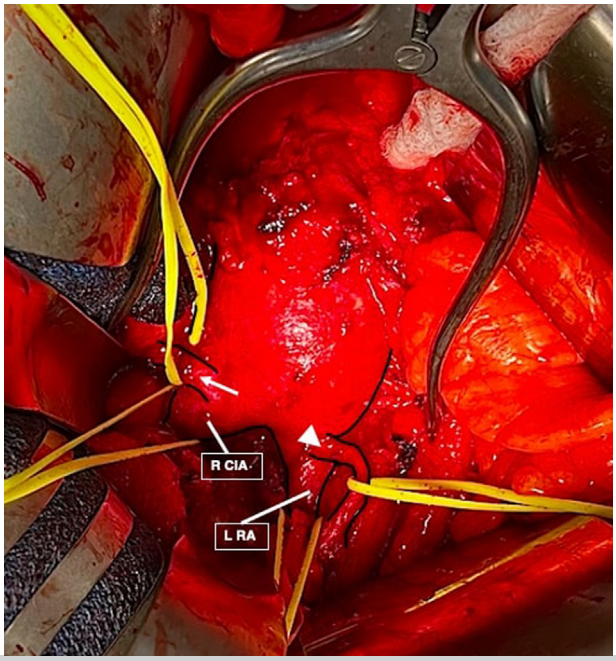


**Fig 3.** Anterior right renal artery (RA; *arrow*) branching off the right (*R*) common iliac artery (CIA). Accessory branch of the left kidney (*arrowhead*) arising anteriorly from the left (*L*) RA.

aortic repair. The first included double proximal clamping. This allowed for adequate inflow control during proximal aortic anastomosis and did not sacrifice renal perfusion (RP) because blood flow was delivered via retrograde flow from lumbar collateral vessels within the aneurysm. This method minimized the absolute renal ischemic time. The second method involved the use of a cold perfusion solution or simply surrounding the affected kidney with ice. Cooler temperatures decrease renal metabolism, reducing kidney injury during clamp time.[4] Hanif et al[5] described the use of a Javid shunt (Bard Peripheral Vascular) placed in the axillary artery to perfuse a right pelvic kidney during open AAA repair. Although this technique had immediate success, no follow-up was reported to monitor long-term efficacy.[5]

Unilateral pelvic kidneys are usually associated with a normal contralateral kidney, reducing the operative risks of renal ischemia and renal failure.[6] Makris et al[7] described the case of a congenital solitary pelvic kidney and AAA. In their case, the solitary kidney was supplied by two RAs originating from the aortic bifurcation and the proximal right CIA. To avoid renal ischemia, two separate extra-anatomic bypasses were created. The first shunted blood from the right axillary to the right femoral artery, and the distal femoral artery was subsequently clamped to promote retrograde perfusion. A second shunt allowed blood to flow from the right CIA to the origin of the left RA, providing direct perfusion. They reported no changes in renal function at 24 months postoperatively.[7]

**Table.** Renal preservation solution

| Component | Amount |
|---|---|
| Mannitol, mg | 25 |
| Furosemide, mg | 100 |
| Heparin, U | 10,000 |
| Ringer's lactate, mL | 1000 |

RP with a cooled solution allows for a longer clamp time and decreased ischemic insult. Murakami et al[8] described a case of an AAA with a congenital solitary pelvic kidney, which was supplied by two aberrant RAs originating from the aortic bifurcation and left CIA. Renal preservation was achieved using cold lactated Ringer's solution and ice slush for direct, topical cooling.[8] In most cases, selective cold perfusion was the preferred method during suprarenal clamping when clamp times >60 minutes were anticipated. Cold perfusion can be performed using bolus infusions every 20 to 30 minutes or continuous infusions.[9]

After careful consideration and anatomic review, cold perfusion boluses seemed the most appropriate to maintain adequate RP during open AAA repair for our patient. This method was preferred given the abnormal anatomic origin of the renal vessels. Creation of an extra-anatomic bypass with multiple anastomoses necessary for RP can be disadvantageous, given the longer operative time required in certain cases. In addition, the inability to appropriately isolate the posteriorly originating left main RA makes shunting unfeasible. Double proximal clamping was another possible technique. However, adequate lumbar circulation for retrograde flow must be established. This would require direct manipulation of the aneurysmal sac, increasing the risk of distal embolization.[7] The approximate clamp time was uncertain at the beginning of our case owing to the multitude of aberrant vessels and difficulty with vessel isolation. Therefore, we used cold perfusion in case the aortic clamp time exceeded 30 minutes.

## CONCLUSIONS

Although multiple methods to ensure adequate RP to a single pelvic kidney associated with open AAA repair have been described, reports of bilateral pelvic kidneys remain rare. We conclude that fastidious bolus infusion of cold preservation solution and a short clamp time during open AAA repair in the setting of bilateral pelvic kidneys is a safe and efficacious method.

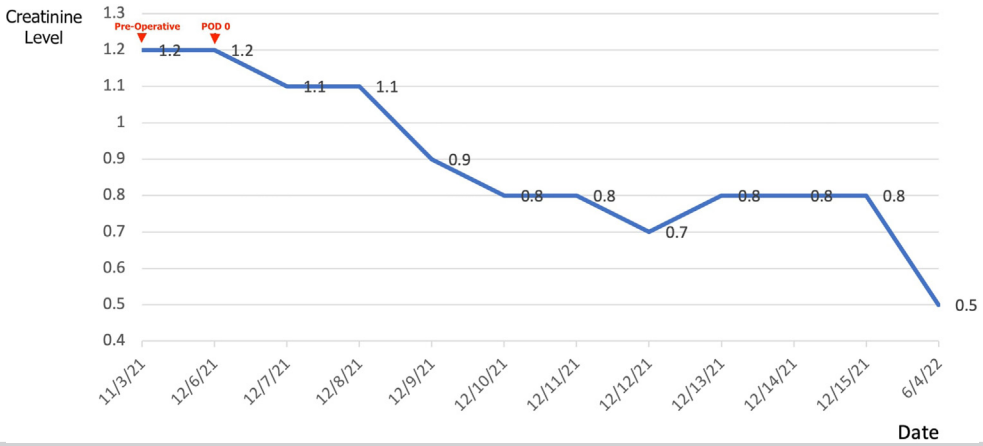


**Fig 4.** Graph showing creatinine levels pre- and postoperatively. *POD,* Postoperative day.

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