Mid-term follow-up of renal artery reimplant in open surgical repair for abdominal aortic aneurysm with a crossed-fused renal ectopia

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ABSTRACT

Crossed-fused renal ectopia is an uncommon congenital condition, and its association with abdominal aortic aneurysm can present a complex surgical scenario. We present a case of a 71-year-old male with abdominal aortic aneurysm and crossed-fused renal ectopia who underwent open surgical repair with renal artery reimplantation, using mannitol infusion and cold crystalloid perfusion for renal protection. Postoperatively, after transient creatinine rise, renal function normalized without dialysis. At 24 months follow-up, the reimplanted renal artery remains patent with normal renal function. This case illustrates open surgical repair's effectiveness in addressing complex vascular anatomy, ensuring durable outcomes, and preserving vessel patency and renal function. (J Vasc Surg Cases Innov Tech 2025;11:101751.)

Keywords: Abdominal aortic aneurysm; Congenital abnormalities; Renal artery; Renal ectopia; Vascular surgical procedures

Crossed-fused renal ectopia (CFRE) is characterized by a complete or partial fusion of both kidneys[1] with variable vascularization patterns.[2] It's association with an abdominal aortic aneurysm (AAA) poses a challenge to the vascular surgeon due to the wide surgical options to treat the AAA while preserving the kidney's arterial blood supply and long-term functionality.

Although endovascular aortic repair (EVAR) for complex AAAs (juxta/pararenal) has demonstrated good mid- and long-term outcomes, rates of long-term renal function impairment[3] remain a concern. In contrast, low rates of long-term chronic kidney decline have been reported with open surgical repair (OSR) for complex AAAs.[4]

Based on the above, we present a patient with an AAA associated with CFRE treated with OSR and renal artery (RA) reimplantation. The patient has provided written consent to publish the case and images.

CASE REPORT

A 71-year-old male patient, a smoker and with benign prostatic hyperplasia, was in follow-up via abdominal ultrasound on a distant regional hospital for an AAA associated with a CFRE. When the AAA reached surgical criteria, the patient was transferred to our vascular surgery unit for surgical resolution due to the high complexity of the case. Upon admission, physical examination evidenced a midline abdominal pulsatile mass and a palpable, less mobile mass on the right flank. Bilateral femoral and distal pulses were present.

Preoperative computed tomography angiography showed a 5.8 cm AAA associated with a CFRE on the right side of the abdomen (Fig 1). The "main" RA originated from the anterior aortic wall and branched into two "principal renal arteries" that accounted for the major proportion of renal mass perfusion. An accessory RA (ARA) (<2.5 mm in diameter) was also identified (Fig 2), perfusing a minor portion of the upper lobe. Preoperative laboratory tests were within normal range, including creatinine and blood urea nitrogen (BUN) (0.84 mg/dL [0.72-1.25]; 14.1 mg/dL [8.4-25.7], respectively; estimated glomular filtration rate, 90 mL/min/1.73 m^2). Electrocardiogram showed sinus rhythm, and echocardiography revealed an ejection fraction of >60% with no structural or functional anomalies. After preoperative risk assessment and cost evaluation, OSR was chosen.

METHODS AND RESULTS

Through a transverse laparotomy, the proximal neck, common iliac arteries, RA, and ARA were controlled (Fig 3). Under systemic heparinization (non-fractioned intravenous heparin [100 IU/kg] to achieve an activated clotting time >250 seconds) and mannitol (0.5 g/kg), intravenous infusion (as a renal protection measure) suprarenal aortic clamping was performed. Once the aneurysm sac was opened, the RA was excised and isolated with a Carrel patch. Intermittent perfusion with cold (4°C) heparinized crystalloids (0.9% saline solution; 150 mL every 15-20 minutes) was instilled into the RA until the reimplantation stage.

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Fig 1. Axial image of the preoperative computed tomography angiogram, showing the origin of the "main" renal artery (RA) arising from the right antero-lateral aneurismatic abdominal aorta (*arrowhead*), perfusing the cross-fused renal ectopia (CFRE).

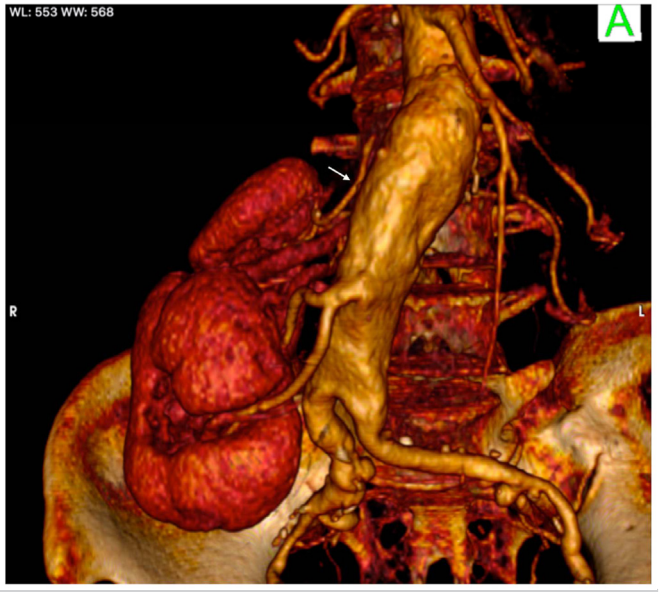

Fig 2. Three-dimensional reconstruction of the preoperative computed tomography angiogram illustrating the anatomical relation of the abdominal aortic aneurysm (AAA) and vascularization of the cross-fused renal ectopia (CFRE). The accessory renal artery (ARA) arises proximal to the "main" renal artery (RA) (*arrow*).

Once proximal anastomosis to the graft (24 mm Dacron) was completed, the posterior wall of the distal anastomosis was sutured (to accurately measure the reimplantation site of the RA). Then, a 6 × 6 mm fenestration was cut into the graft, and, after meticulous Carrel patch preparation, the RA was reimplanted

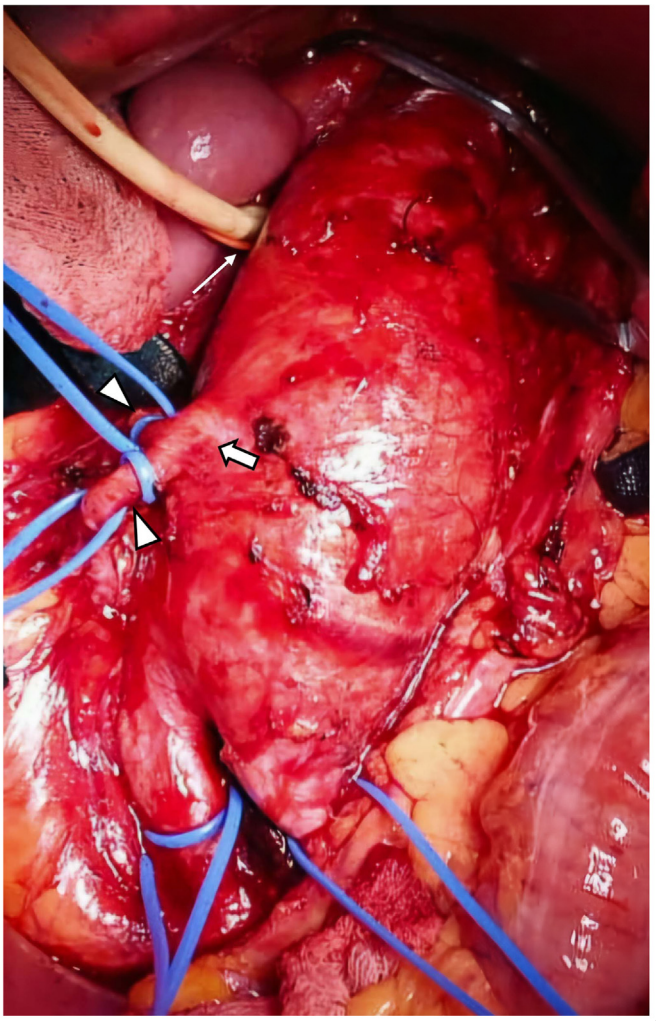

Fig 3. Intraoperative view. Selective vascular control of the "main" renal artery (RA) (*thick arrow*) and its two branches (*arrowheads*). The accessory renal artery (ARA) (*thin arrow, red thin vessel-loop*) is in direct situation of the aortic clamping site.

using 4/0 polypropylene running suture. Once reimplantation was completed, infrarenal graft clamping was achieved, and the distal anastomosis of the aorto-aortic bypass was completed (Fig 4). Due to the ARA's reduced diameter and its anatomical origin (near the aortic clamping site and suture line), we decided to not revascularize it. Intraoperative Doppler confirmed immediate patency of the reimplanted RA and its branches, with a suprarenal clamping time of 70 minutes.

The postoperative course was uneventful, with admission pulses preserved. A peak creatinine value of 2.38 mg/dL was evidenced on postoperative day 1, maintaining normal urinary output. No dialysis was required, and the patient was discharged on postoperative day 7

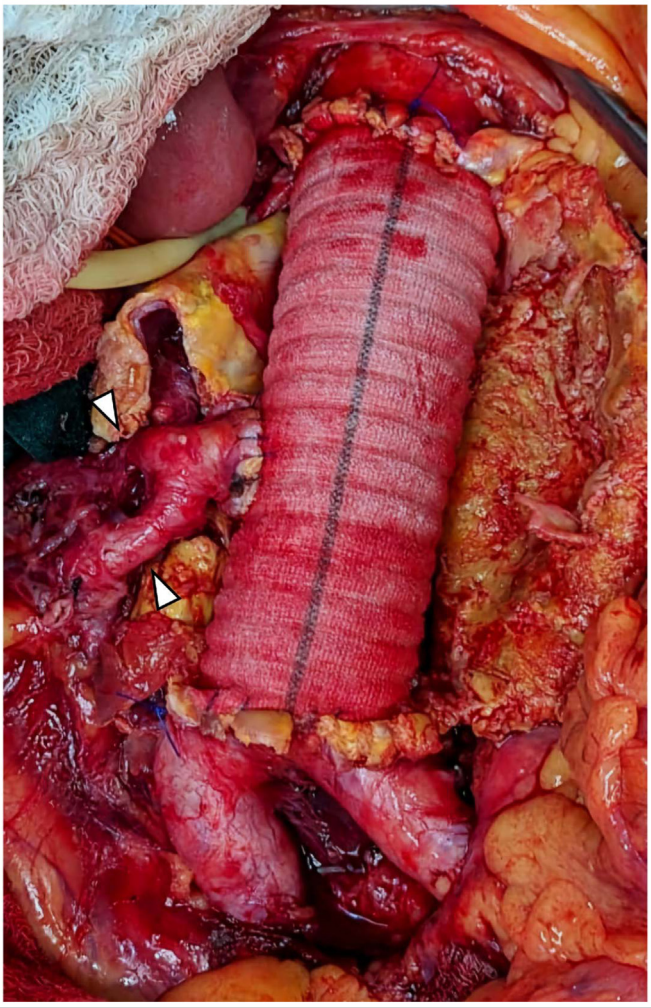

Fig 4. Finished aortic reconstruction with the aorto-aortic bypass and the reimplanted renal artery (RA) on the right side of the Dacron graft. Final disposition of the RA's main branches (*arrowheads*) is depicted.

with creatinine (1.18 mg/dL) and BUN (18.4 mg/dL) within normal range.

At 24-month follow-up, the patient presents a patent RA, normal creatinine and BUN values (1 mg/dL and 18 mg/dL, respectively), and no signs of stenosis (Fig 5).

DISCUSSION

CFRE (incidence of 1/7000 autopsies)[5] is the second most common fusion abnormality of the urinary tract (after horseshoe kidney). It is more predominant in men (3:2), generally on the right side of the abdomen, and mostly asymptomatic.[6] Its concurrence in the setting of an AAA is infrequent, and, due to its highly variable anatomical vascularization,[2] treatment options vary as well.

Preoperative risk evaluation in complex AAAs (juxta/pararenal) is critical to assess the risks and benefits of elective repair (OSR or complex EVAR).[7] Despite the good mid- and long-term outcomes of endovascular treatment,[8] the UK-COMPASS[9] trial reported that long term reintervention rates were significantly higher and overall survival rates were lower in fenestrated EVAR (FEVAR) when compared with OSR at similar baseline perioperative risk. Particularly, in patients with a solitary functional kidney (SFK), FEVAR (and/or branched EVAR [BEVAR]) can provide good mid-term outcomes[10] at an expense of increasing the risk of acute and/or chronic renal failure (up to 25%).[4]

The presence of ARAs increases the complexity of an endovascular approach. Intentional coverage or embolization of ARAs during EVAR can elevate the risk of postoperative acute kidney injury (AKI)[11] Therefore, when feasible, is recommended to preserve them.[12] Management of ARAs during OSR is less controversial. According to European guidelines, ARAs <4 mm in diameter can be ligated[7] without elevating the postoperative AKI risk.

During OSR for juxta/pararenal AAAs, renal protection measures may be used to decrease the risk of AKI. Although mannitol has been described as protective in aortic surgery requiring suprarenal clamping,[13] its use should be selective, according to the center's experience and patient's clinical features.[14] When RA revascularization is required, reimplantation or bypass have similar long-term outcomes and patency rates,[15] even in patients with SFK.[16] Renal preservation strategies, traditionally involving hypothermic[17] solutions with cold crystalloid fluids (continuous or intermittent perfusion[18]), have been widely used and studied with good results in renal transplant[17] as well in aortic surgery requiring suprarenal clamping.[19] Specific solutions like Custodiol have been reported with good outcomes during OSR of thoracoabdominal aneurysms.[20] We chose reimplantation of the RA due to its anatomical proximity to the fenestration performed on the graft, achieving a free tension result. Our use of mannitol is selective (suprarenal clamping), and, despite the good and safe results of Custodiol,[20] it is not available at our institution, making cold crystalloids a cost-effective measure.

Regarding cost-effectiveness, no differences have been described between OSR and F/BEVAR[21] Due to the lack of randomized studies and diverse health financing systems, the choice for approach remains a combination of local experience and economic viability.[21]

There is a wide range of open,[22-24] hybrid,[25,26] and endovascular[27-30] reported solutions in patients with AAA and congenital (or acquired) renal variations behaving as SFK. We decided on OSR and RA reimplantation according to the patient's surgical risk (absence of cardiac or renal contraindications), abnormal renal anatomy (one "main" RA, like SFK), costs, and geographic

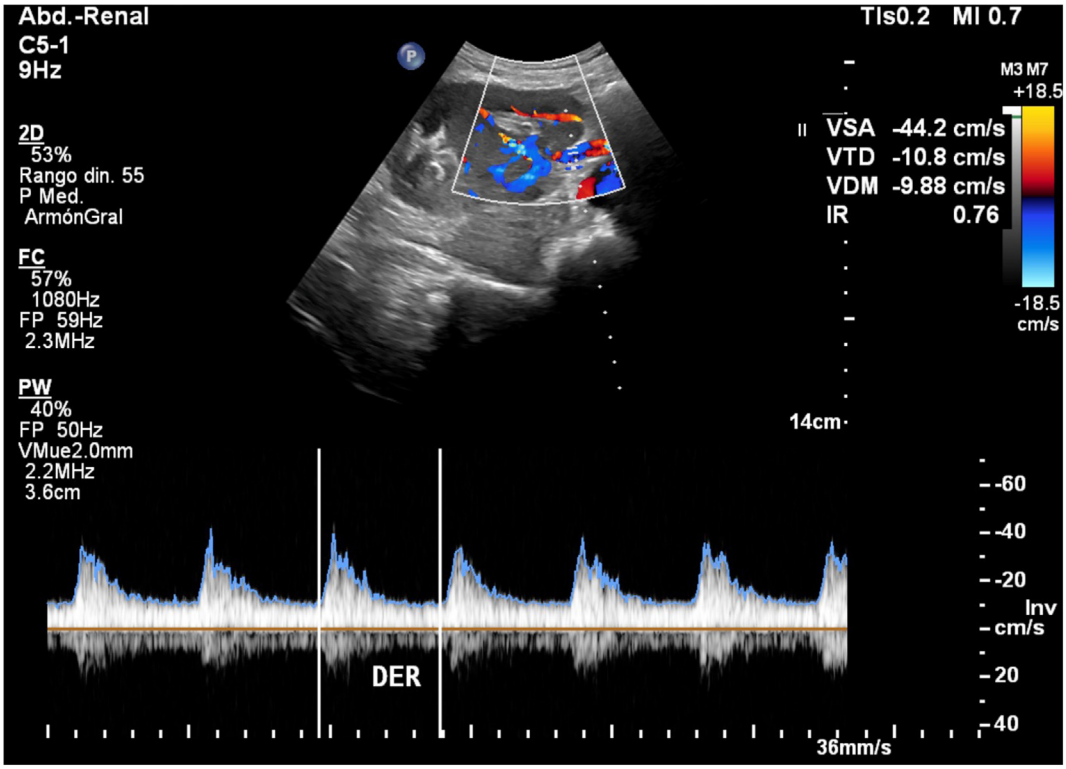

Fig 5. Twenty-four-month follow-up renal duplex ultrasound confirming the adequate patency of the renal artery (RA) with hemodynamic parameters within normal range.

residence, which could have hindered follow-up of a complex EVAR with a single functional RA.

CONCLUSION

This case illustrates that a patient-specific tailored solution can offer the best achievable results according to the center's and surgeon's experience. Despite the wide range of feasible complex endovascular solutions that may have been technically possible (F/BEVAR; chimney; physician-modified endograft), OSR for AAA with surgical revascularization of the RA (reimplant) remains an effective surgical skill with good mid- and long-term outcomes.

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DISCLOSURES

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