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CASE REPORT

Ex vivo revascularization of renal artery aneurysms in a patient with solitary kidney: A case report

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Author contributions: Chen XY reviewed the literature, contributed to manuscript drafting, and acted as first assistant in the surgical procedure; Zhao JC was the patient's vascular surgeon and reviewed the literature; Huang B contributed to manuscript drafting and the surgical procedure; Yuan D and Yang Y were responsible for revision of the manuscript and interpreted the imaging findings; all authors gave final approval for the manuscript version to be submitted.

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Abstract

BACKGROUND

Multiple renal artery aneurysms (RAAs) involving multiple branches in a solitary kidney are rare and present a major challenge to surgeons. *Ex vivo* or *in situ* repair combined with renal artery revascularization is the classical procedure for these complicated cases, which are not suitable for endovascular repair. The choice of bypass graft remains controversial because of the risk of aneurysmal degeneration for autologous graft.

CASE SUMMARY

A 39-year-old female patient presented with left lumbar pain for more than 3 mo. Computed tomography angiography showed congenital absence of the right kidney and three left RAAs involving multiple distal branches. This patient met the criteria for surgical repair due to symptoms of threatened rupture. According to the anatomy and location of multiple RAAs, *ex vivo* revascularization with saphenous vein graft (SVG) was performed. At the 3-year follow-up, computed tomography angiography demonstrated the aneurysmal degeneration of the Y-shaped SVG. The patient remained asymptomatic and follow-up ultrasound showed no continuous growth of SVG aneurysm.

CONCLUSION

SVG aneurysm in RAA revascularization causes us to reflect on the choice of graft, especially for solitary kidney patients.

Key words: Renal artery aneurysm; Bypass; *Ex vivo* repair; Aneurysmal degeneration; Case report

Core tip: This rare case of complicated left renal artery aneurysms (RAAs) with absence

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of right kidney presented a major challenge for the surgeon. From a technical aspect, most RAAs are treated by endovascular procedures, and such complicated surgical repair could give surgeons more confidence with complex renal artery revascularization. Although saphenous vein graft is considered the first choice for auto-renal bypass graft, the risk of restenosis and aneurysmal degeneration remains unresolved. For the RAAs without evidence of inflammation, prosthetic graft may be the alternative choice for patients.

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INTRODUCTION

Renal artery aneurysm (RAA) is uncommon with an estimated incidence around 0.1% in the general population. Although the incidence is low, once ruptured, the mortality can reach 80%. Isolated RAA is dominant, and multiple RAAs are seldom reported[1,2]. Treatment of RAA includes surgical repair with revascularization of the RA by *ex vivo* or *in situ* repair with or without cold preservation. As the development of percutaneous techniques, endovascular repair with coils and stents has increasingly been used[3-5]. This case of triple left RAAs with absence of the right kidney and involvement of multiple branches is extremely rare, and it was a major challenge for the vascular surgeon. We here report the details of the procedure and long-term follow-up results.

CASE PRESENTATION

Chief complaints

A 39-year-old female patient presented to the clinic of our hospital complaining of left lumbar pain for > 3 mo.

History of present illness

The patient's symptoms started 3 mo ago with left lumbar pain, which had worsened in the previous 2 wk.

History of past illness

The patient had no previous medical history.

Personal and family history

The patient had no personal and family history.

Physical examination upon admission

After admission to our department, the patient's temperature was 36.7 °C, heart rate 73 beats/min, respiratory rate 16 breaths/min, blood pressure 130/70 mmHg, and oxygen saturation in room air 98%. Physical examination revealed percussion tenderness over the left kidney region. No abdominal or rebound tenderness was detected.

Laboratory examinations

Blood analysis revealed normal white blood cell counts, neutrophils, hematocrit, and platelet count. Prothrombin and partial thromboplastin times were normal. Serum C-reactive protein, erythrocyte sedimentation rate, and other immunological tests were all negative. Creatine was 69 μmol/L (normal range 44-133 μmol/L), and estimated glomerular filtration rate was slightly decreased at 80 mL/min/1.73 m^2 (normal range > 90 mL/min/1.73 m^2). Electrocardiogram and chest X-ray were also normal.

Imaging examinations

Renography demonstrated that renal index was 38.06% (normal range > 45%). Computed tomography angiography (CTA) showed congenital absence of the right

kidney and three left RAAs. The first two aneurysms were located on the twisted main trunk of the left RA with a size of 3 cm and 4 cm, respectively, with a branch originating from the second aneurysm. Another distal small aneurysm of 1.8 cm was located on the distal bifurcation involving two branches (Figure 1A).

FINAL DIAGNOSIS

The final diagnosis of the present case was threatened rupture of left triple RAAs and congenital absence of right kidney.

TREATMENT

Left triple RAAs resection and *ex vivo* revascularization with saphenous vein graft (SVG) were performed. Surgical exposure was achieved with a wide left subcostal incision *via* a transperitoneal approach. As multiple distal branches were involved in the aneurysms, *ex vivo* repair was considered. Full mobilization and dissection of the left kidney, RAAs, and proximal and distal branches of the RA were performed. The renal pedicle and ureter were mobilized to the pelvic brim. After systemic heparinization (unfractionated heparin 0.5 mg/kg), the main left RA and vein were divided. The left kidney was then placed in ice slush with cold perfusion (4 °C Ringer's solution). After resection of the distal aneurysm, two residual distal branches were conjoined as a patch, and distal anastomosis was performed end-to-end between the patch and a reversed SVG (Figure 2A). Another branch originating from the second aneurysm was anastomosed end-to-side to the lateral wall of the SVG (Figure 2B). After branch reconstruction, the left kidney was put back into the orthotopic renal fossa. The proximal SVG was anastomosed end-to-end to the proximal main RA, and the renal vein was anastomosed with the original orifice of the inferior vena cava. Intraoperative renal ultrasound identified patency of the anastomosis and distal branches. Whole blocking time for renal vessels was 80 min.

OUTCOME AND FOLLOW-UP

The patient had an uneventful postoperative clinical course and was discharged from hospital 5 d after the operation. Three-year follow-up CTA demonstrated aneurysmal degeneration of the SVG (with a maximum graft diameter of 2.2 cm), and all distal branches were clearly visible (Figure 1B). We carried out further ultrasound follow-up every 6 mo that revealed no continuous growth of SVG aneurysm, and the patient remained asymptomatic. Update renography showed that the renal index of the left kidney increased to 72.06%.

DISCUSSION

Multiple RAAs involving multiple branches in a solitary kidney are rare and present a major challenge to surgeons. Open surgical repair has been the predominant method for treatment of these lesions; however, currently, endovascular techniques have offered less invasive treatment options in selected cases[4-6].

Currently accepted indications for RAA intervention include size > 2 cm; women within childbearing age; symptoms such as pain, hematuria, and medically refractory hypertension, including that associated with functionally important RA stenosis, thromboembolism, dissection, and rupture[5]. Several approaches are adopted for revascularization of RAA including *in situ* or *ex vivo* surgical repair and endovascular therapy.

It is reported truncal aneurysms can be treated by covered stent and intrarenal aneurysms by coil embolization. However, with RAAs involving multiple distal branches, current endovascular techniques do not warrant complete exclusion without renal infarction[7-10]. In the present case, endovascular repair was designed as isolation of the first two RAAs with covered stents, and the last small aneurysm was left behind as the size did not reach the indication for intervention. However, as a branch originated from the second aneurysm, isolation of the first two aneurysms could have blocked the blood flow of this branch, which may have caused partial infarction of the left kidney. Although the diameter of the third RAA involving distal branches did not reach the indication for intervention, we could not leave the risk of future aneurysm development as the patient was young, and it would be much more

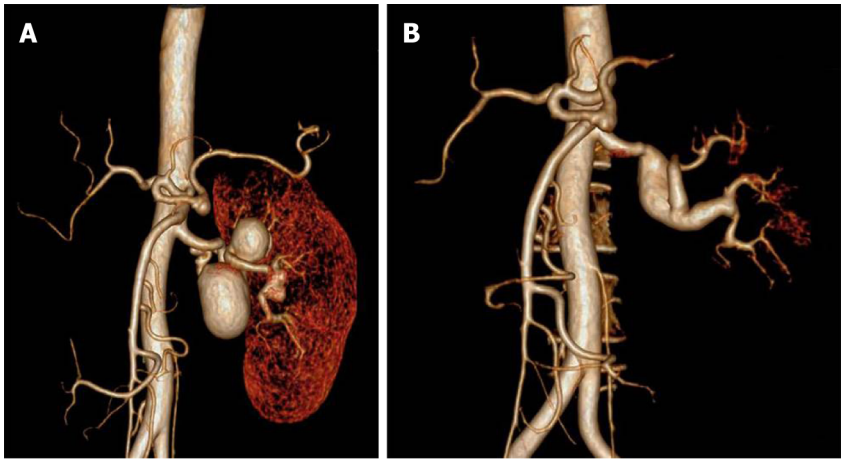

Figure 1 Computed tomography angiography. A: Preoperative computed tomography angiography. Triple complicated multiple renal artery aneurysms with a maximum size of 4 cm, distal renal artery bifurcation, and branches were involved; B: Three-year follow-up computed tomography angiography. The saphenous vein graft was patent with aneurysmal degeneration.

difficult to deal with the third RAA. The preliminary results of the endovascular treatment are not very informative. For the above reasons, surgical repair was performed on this patient.

It is reported that *ex vivo* repair ensures good protection of the renal parenchyma. In contrast, *ex vivo* surgical repair of RAA has the advantage of facilitating reconstruction of distal branches, especially those with multiple branches involved[10,11]. Several studies have already reported a satisfactory result of *ex vivo* surgical repair with low morbidity and patency rates of 82%–99%[12,13]. To date, there is no report of randomized controlled trial comparing *ex vivo* and *in situ* repair of RAAs. Considering the reconstruction of multiple distal branches, and *in situ* surgical repair is more challenging, *ex vivo* repair was performed for this patient.

For the choice of bypass graft, the saphenous vein is the most common conduit for revascularization. Most current studies have preferred to use SVG with good durability and patency. Follow-up patency (mean, 33 mo; range, 1–118 mo) was determined for 64 (91%) RA reconstructions. Product-limit estimate of primary patency at 48 mo was 96%[13,14]. Although the aneurysmal degeneration of SVG is widely reported in coronary artery disease, it is less frequently reported in the RAAs with revascularization by SVG, especially in noninflammatory RA disease. Besides SVG, branched and unbranched internal iliac artery autografts have been used as bypass grafts for the RA, and no aneurysmal degeneration of the internal iliac artery graft has been reported. To prevent risk of SVG aneurysmal degeneration, a tubular SVG supported by external Dacron mesh was adopted, presented to be a suitable graft material for renal reconstruction in pediatric population. With an average follow-up of 4.3 years, no SVG aneurysm was detected[15]. For RAAs without evidence of inflammation, considering the risk of aneurysmal degeneration of SVG, prosthetic grafts may be an alternative, as no aneurysmal degeneration was present in our patient with a solitary kidney, although more stable long-term results are needed.

Three-year follow-up CTA revealed aneurysmal degeneration of the SVG, with a maximum diameter of 2.1 cm. Because there was no growth of the aneurysm during follow-up under ultrasound surveillance, we chose to continue observing the size change.

CONCLUSION

This rare case of complicated RAAs with absence of the right kidney presented a major challenge to the surgeon. Successful results give us more confidence for *ex vivo* surgical repair of complicated RAA. Aneurysmal degeneration of SVG in RAA revascularization causes us to reflect on the choice of graft, especially for solitary kidney patients who need more stable long-term results.

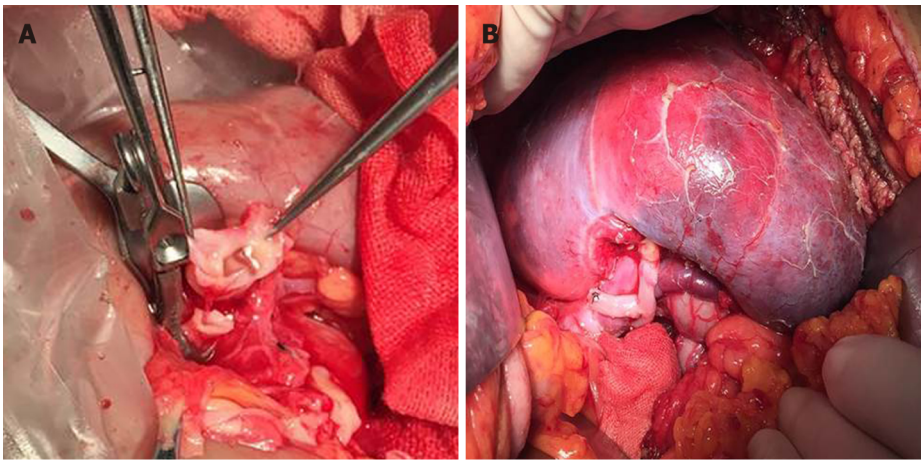

Figure 2 Surgical images. A: Two residual distal branches were conjoined, creating a common patch; the distal anastomosis was performed end-to-end between the common patch and a reversed saphenous vein graft; B: Another branch originating from the second aneurysm was anastomosed end-to-side to the lateral wall of the saphenous vein graft.

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