» **Case Report** «

Surgical Treatment of Abdominal Aortic Aneurysm with Congenital Solitary Pelvic Kidney and Superior Mesenteric Artery Stenosis

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We report the rare case of a 54-year-old man with uncontrolled renovascular hypertension, who was found to have an abdominal aortic aneurysm with congenital solitary pelvic kidney and superior mesenteric artery stenosis. A single renal artery branched from aneurysmal aortic bifurcation, and both the renal artery and the superior mesenteric artery (SMA) had severe stenosis at their origins. The aneurysm was repaired with a bifurcated Dacron graft, to which the renal artery was anastomosed. SMA bypass was created between the graft's left limb and the SMA using another Dacron graft. The operation was successful, with improvement in renal functions and control of hypertension.

Keywords: abdominal aortic aneurysm, congenital solitary pelvic kidney, renovascular hypertension

Introduction

Abdominal aortic aneurysm (AAA) with a congenital solitary pelvic kidney is an extremely rare clinical pathology.¹⁾ To the best of our knowledge, there are no reports in literature about such cases presenting with concomitant uncontrolled renovascular hypertension. Surgical repair is the only curative option for AAA with congenital solitary pelvic kidney. Herein, we report a case of AAA with congenital solitary pelvic kidney successfully treated with open repair of AAA and revascularization of the kidney.

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Case Report

A 54-year-old man was referred to our hospital with the diagnosis of AAA, and he presented with renovascular hypertension, renal anemia, and impaired renal function. He was 170 cm tall and weighed 54 kg. His hypertension was uncontrolled despite receiving daily doxazosin (alpha blocker) 4 mg, and nifedipine 80 mg. He has been a tobacco smoker for more than 40 years (20 cigarettes a day). He had no surgical history. Preoperative multidetector computed tomography (MDCT) scan showed a fusiform AAA with a maximum diameter of 45 mm, and a functioning congenital solitary pelvic kidney (Fig. 1A). A single renal artery branched from the aneurysmal aortic bifurcation, which showed 90% stenosis at its origin (Fig. 1B). The renal vein drained directly into the inferior vena cava. With regard to preoperative kidney function, serum creatinine level was 2.65 mg/dl, creatinine clearance rate was 30 ml/min, technetium-99m-mercaptoacetylglycylglycylglycine (^{99m}Tc-MAG) clearance rate was 52.8 ml/min, hemoglobin level was 11.5 g/dl, and serum renin level was 6.6 ng/ml/hr. Additionally, the superior mesenteric artery (SMA) showed 70% stenosis at its origin, but without abdominal symptoms (Fig. 1A).

Open repair of AAA was performed. In the abdominal cavity, there were no anomalies other than the solitary pelvic kidney. During aortic clamping, renal flow was maintained with a temporary bypass between the right brachial and renal arteries by using Brewster's method (Fig. 2A).²⁾ Under heparinization, the activated coagulation time was controlled at about 200 s. AAA was repaired with a 20 × 10 mm bifurcated Dacron graft with revascularization of the solitary kidney. Before anastomosing the renal artery to the graft, the kidney was injected with 200 ml of a renal protective solution (500 ml cold Ringer's lactate, 200 ml 20% D-mannitol, 500 mg methylprednisolone, and 1000 units heparin) through the external shunt catheter. The renal artery was directly anastomosed to the right leg of the bifurcated graft. The duration of shunt perfusion was 80 min, and the total renal ischemia time was 11 min. SMA bypass

Fig. 1 (A) Preoperative computed tomography scan showing a 45-mm fusiform aortic artery aneurysm not involving the aortic bifurcation and a functioning congenital solitary pelvic kidney. In addition, the SMA shows 70% stenosis. (B) The course of the single renal artery and vein. SMA: superior mesenteric artery

Fig. 2 Brewster's method. (A) Arrows indicate antegrade arterial flow. (B) Operative picture after revascularization. SMA: superior mesenteric artery

was then created using an 8-mm Dacron graft with an end-to-side anastomosis from the right iliac limb of the bifurcated graft to SMA (Fig. 2B). After revascularization, graft and intestinal blood flow were confirmed by Doppler ultrasonography and indocyanine green fluorescence (ICG) angiography.³⁾

Postoperative follow-up was continued in our outpatients' clinic. During the first year postoperatively, the patient's serum creatinine level steadily decreased to 1.9 mg/dl and serum renin level to 3.8 ng/ml/hr (Fig. 3A). Furthermore, other renal functions also improved, with ^{99m}Tc-MAG clearance rate increasing to 124.4 ml/min and hemoglobin level to 13.1 g/dl (Fig. 3). In particular, symptoms of renovascular hypertension were alleviated, and the dose of antihypertensive drugs was reduced to daily amlodipine 5 mg only. Follow-up computed tomography (CT) performed 6 months after surgery showed good patency of both renal artery and SMA bypasses (Fig. 3B).

Discussion

Congenital pelvic kidney is considered to occur from failure of embryological kidney to ascend during gestation.⁴⁾ The prevalence of the solitary pelvic kidneys was reported to occur in 1 in 22000 autopsies,⁵⁾ and their occurrence in combination with AAA should be extremely rare. Hence, there is a limited number of reports in literature about AAA with a congenital pelvic kidney and one normal-positioned kidney.¹⁾ Among these, to the best of our knowledge, this is the first case report for treatment of AAA with

Fig. 3 (A) Transition of serum creatinine level and renin activity. (B) Postoperative computed tomography scan.

solitary congenital kidney, which had preoperative impairment of renal function.

Atherosclerotic renovascular disease is an increasingly recognized cause of severe hypertension and declining kidney function. Open and percutaneous revascularizations are similarly efficacious for treatment of hypertension associated with renal artery stenosis. Early identification and management of this disease are mandatory. However, in patients with ectopic solitary kidney, the treatment strategy must take into consideration factors such as shortening of renal ischemia time, a pathway for the bypass graft, and a method of renal protection. Furthermore, the ectopic kidney is more likely to develop hydronephrosis or ureteral calculi than normally positioned kidney.⁵⁾

For planning a surgical strategy, MDCT scan is thought to be the most useful modality to understand the anatomy of AAA with pelvic kidney. The scan comprises arterial, intermediate, and venous phases, which help to minimize the dose of nephrotoxic contrast agents.

In patients with a solitary kidney, the renal artery mostly originates from the terminal aorta or the common iliac artery.¹⁾ During AAA repair, numerous maneuvers were reported to protect renal function such as permanent or temporary axillofemoral bypass before aortic clamping, use of temporary aortofemoral or axillofemoral Gott's shunts, partial cardiopulmonary bypass, *in situ* cold perfusion, double proximal clamping technique,⁶⁾ and radial-renal artery bypass (Brewster's method).²⁾ In our patient, we chose Brewster's method because the renal artery was single and the arterial diameter was sufficient for direct anastomosis to a synthetic graft. This method is easy and does not interfere with the surgical field. Moreover, this method enables injection of the renal protective solution to flow through the shunt catheter.

Surgical correction of atherosclerotic renovascular disease can result in blood pressure benefit and improvement of renal function in patients with hypertension.⁷⁾ In our patient, surgical treatment for renovascular disease was as important as AAA repair. The treatment of SMA stenosis is controversial. The prevalence of concomitant stenosis of both SMA and renal artery is unknown. However, Hansen et al. reported that 12.8% of patients with SMA stenosis had concomitant renal artery stenosis.⁸⁾ The American College of Cardiology/American Heart Association 2005 practice guidelines recommended that revascularization of asymptomatic intestinal arterial obstructions may be considered for patients undergoing aortic/renal artery surgery for other indications (Class IIb).⁹⁾ Because one-staged revascularization surgery of both renal artery and SMA is less invasive and more beneficial than two-staged surgery in a low-risk patient, we performed SMA bypass surgery simultaneously with AAA repair. After the revascularization of both arteries, application of ICG angiography was useful to confirm intestinal and renal blood flow by obtaining good fluorescence signals from visceral tissue. We previously reported using ICG angiography to assess free jejunal graft perfusion without using nephrotoxic contrast agents during surgery.¹⁰⁾ This technique may be beneficial in assessing all revascularization surgeries of visceral arteries.

Conclusion

We reported an extremely rare case of AAA with congenital solitary pelvic kidney. Surgical repair of the AAA with a bifurcated Dacron graft was performed, and the kidney was revascularized by anastomosing the renal artery to the graft limb. A radial-renal artery bypass was temporarily

used to ameliorate ischemic damage to the kidney. These procedures successfully improved both renal function and hypertension postoperatively.

Disclosure Statement

The authors have no conflict of interest to disclose.

Author Contributions

Study conception: HT, NU

Data collection: TS, HT, NY, KI, MS

Analysis: TS

Investigation: TS, HT, NY, NU

Writing: TS

Funding acquisition: NU

Critical review and revision: all authors

Final approval of the article: all authors

Accountability for all aspects of the work: all authors

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