CASE REPORT

Surgical repair of a complex renal artery aneurysm through bench surgery and autotransplantation

Hung-Yi Chen a, Cheng-Chia Lin a, Pin-Fu Huang b, Shian-Shiang Huang a, Cheng-Feng Lin a, Wen-Hsiang Chen a, Chun-Te Wu a,*

a Division of Urology, Department of Surgery, Chang Gung Memorial Hospital, Keelung, Taiwan
b Division of Cardiovascular Surgery, Department of Surgery, Chang Gung Memorial Hospital, Keelung, Taiwan

Received 3 February 2016; received in revised form 7 April 2016; accepted 16 May 2016
Available online 12 November 2016

KEYWORDS
autotransplantation; bench surgery; ex vivo repair; renal artery aneurysm

Abstract A 58-year-old woman with underlying medically controlled hypertension presented after an episode of sudden-onset chest pain. Chest computed tomography imaging revealed a left renal artery aneurysm (RAA) measuring 1.6 cm in diameter with mural thrombi in the distal left renal artery at bifurcation level. An interval enlargement of approximately 0.4 cm in diameter was noted within a 6-month period; however, endovascular intervention was not feasible because of the complex RAA pattern. She was hospitalized and received a hand-assisted laparoscopic nephrectomy, ex vivo repair of the RAA, and autotransplantation into the left iliac fossa. The procedure was successful, and the postoperative course went smoothly. The kidney graft was evaluated using a magnetic resonance angiography 1-year postoperatively, which showed no signs of surgical complications or RAA recurrence.

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1. Introduction

A renal artery aneurysm (RAA) is a rare vascular lesion with an incidence rate of approximately 0.1% based on reported studies, although the true incidence and natural history remain elusive.1,2 Currently accepted indicators of an RAA requiring intervention include a lesion size of >2 cm, interval enlargement, occurrence in a female of childbearing age, and a pulsatile mass.3,4 The present RAA was large and complex, with mural thrombi and size increase within a short period, which may lead to catastrophic hemorrhage if left untreated.

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age, hematuria, medically refractory hypertension associated with renal artery stenosis, renal thromboembolism, dissection, and rupture. Management options include conservative treatment, endovascular intervention, or surgical reconstruction; however, endovascular intervention and \textit{in vivo} repair are difficult to perform with complex RAAs because of the size and location of the aneurysm. Previous studies have described successful extracorporeal bench aneurysmectomy followed by reconstruction with or without autotransplantation. In the present study, we report a complex RAA case that was managed using hand-assisted laparoscopic nephrectomy, followed by \textit{ex vivo} repair of the aneurysm and autotransplantation into the iliac fossa.

2. Case Report

A 58-year-old woman with underlying medically controlled hypertension presented to the emergency department because of sudden-onset tearing chest pain. Computed tomography (CT) was performed to rule out aortic dissection. A complex RAA at the bifurcation of left renal artery was noted, measuring 1.6 cm in diameter (Figure 1). No abdominal pain, flank pain, or hematuria was indicated by the patient, and her creatinine (Cr) level was measured as 1.13 mg/dL. The patient was subsequently referred to a urologist for further evaluation. CT angiography and a three-dimensional reconstruction revealed a fusiform RAA, located where the left renal artery splits into the anterior and posterior branches (Figure 2A). Because the RAA was asymptomatic without impaired renal function or medically refractory hypertension, regular follow-up examinations were recommended. However, during the 6-month CT follow-up, the aneurysm showed interval enlargement to 2.0 cm × 1.7 cm with mural thrombi in the left renal artery at bifurcation (Figure 2B). As there was an absence of a distinctive narrow neck, and because of the location of the RAA in the left renal artery at bifurcation, endovascular interventions such as coil embolization or stent graft placement were not deemed feasible. Similarly, \textit{in vivo} aneurysm resection with angioplasty reconstruction presented a surgical challenge because of the morphology and anatomical location of the RAA. Kidney sparing was also considered because of the presence of chronic kidney disease. The patient elected to receive hand-assisted laparoscopic nephrectomy, combined with backbench \textit{ex vivo} repair and followed by autotransplantation.

Under general anesthesia, the patient was placed in a lateral decubitus position with the affected side up. A low midline incision was made, and a hand-assisted device disk was introduced at the incision site. After establishing the pneumoperitoneum, two 12-mm laparoscopic ports were placed as usual for donor nephrectomy. Using a hand-assisted technique, laparoscopic dissection was initiated by reflecting the descending colon and gaining access to the retroperitoneum; standard donor nephrectomy was subsequently performed. The renal artery and vein were then separated laparoscopically and ligated using hemoloks beyond the fusiform RAA and over the bifurcation of the left renal artery (Figure 3A). The ureter was divided till the common iliac vessel level and the kidney was then extracted through the hand-assisted port and infused with a cold solution (University of Wisconsin, Madison, Wisconsin, United States) for renal preservation; the total warm ischemia time was 3 minutes. Bench preparation (\textit{ex vivo} resection of RAA and primary reanastomosis) was subsequently performed by the vascular surgeon (Figures 3B and 3C), and the patient was placed in a supine position in preparation for simultaneous autotransplantation. Open surgical dissection of the external iliac artery, vein, and urinary bladder was performed. Kidney autotransplantation was relatively straightforward, using end-to-side anastomosis with the external iliac vessels extending into the left iliac fossa (Figure 3D). Ureteroneocystostomy was then performed through an extravesical approach, with one double J ureteral stent left in place. Finally, the kidney was placed in a hilum medial position, and the wound was closed in standard fashion. The cold ischemic time was approximately 180 minutes, and the overall operation time was 6.5 hours. The intraoperative blood loss was 400 mL without transfusion.

Postoperative care occurred on an ordinary surgical ward to monitor the patient’s vital signs and urine output. The recovery course was smooth and without complications. A mild interval increase in her Cr level occurred after surgery, but returned to baseline after a few days.
The patient’s urine amount was adequate, and no lower urinary tract symptoms were indicated. A color Doppler renal ultrasonography on POD3 revealed a patent renal artery flow and a low resistance index (0.75) of the grafted kidney. Neither active bleeding nor signs of infection were noted during hospitalization. Surgical drains were removed on POD6, and the patient fully recovered and was discharged on POD8. The pathological report revealed marked atherosclerosis change with stenosis and vessel wall destruction; no evidence of fibromuscular dysplasia change was found.

The ureteral stent was removed 5 weeks postoperatively under local anesthesia. A serial renal function test at the outpatient department follow-up was within the normal range. Magnetic resonance imaging of the graft kidney 1 year after surgery also revealed patent renal blood flow, and no obvious stricture over the anastomosis site. Additionally, the patient’s blood pressure was under improved control following the operation.

3. Discussion

The RAA was first discovered during the autopsy of a large ruptured aneurysm in 1770; since then, numerous case reports and series have revealed its epidemiology and pathophysiology. Indicators for intervention in a patient with RAA include the following: rupture or acute dissection, symptomatic RAA (renal artery stenosis-related medically refractory hypertension, recurrent flank pain, or hematuria), renal thromboembolism, occurrence in a pregnant woman or a woman contemplating pregnancy, and a lesion >2 cm or with excessive interval growth.3 Notably, there is no consensus about the repair of large RAAs in asymptomatic patients; in one study, RAAs with diameters ranging from 1.5 cm to 3 cm were recommended for repair, although most surgeons suggested 2 cm.3 In another study, asymptomatic patients with RAAs smaller than 1.5 cm were recommended regular follow-ups without operative treatment because of the infrequency of RAA-related complications.10 In our patient, the RAA measured 1.6 cm in diameter and was treated conservatively at first; however,
interval growth to 2.0 cm was noted at the 6-month follow-up, and surgical intervention was subsequently advised to prevent further complications.

The first reported case of RAA repair using an extracorporeal technique for renovascular hypertension was described by Ota et al in 1967; several techniques have been described since then. Endovascular interventions such as coil embolization or stent graft placement are minimally invasive procedures for RAA management and can be used to treat extraparenchymal or intrarenal aneurysms. Excellent short-term results have been observed for simple saccular RAAs with narrow necks, and occasionally in broad-neck cases; notably, long-term outcomes have not been well defined. In our patient, the fusiform RAA was located in the left renal artery at bifurcation, and because of the complex RAA pattern, coil embolization or a stent graft was not a feasible option. Although in situ repair can be performed with relatively no restriction caused by the RAA morphology through an open approach with or without a free kidney and ureter, the surgical wound would need to be extended for proper display, which entails significant incisional morbidity. Concerning minimally invasive techniques, in situ repair under a laparoscopic or robotic procedure and control of warm ischemic time to <30 minutes would be a challenge for a surgeon in this case. Ex vivo repairs provide surgeons with a clear and bloodless surgical field, enabling them to perform the procedure with less effort and in sufficient cold ischemic time, under infusion with a renal preservation solution. One study examined seven cases of saccular RAAs (size, >2 cm) treated using laparoscopic nephrectomy followed by ex vivo repair of the renal artery and autotransplantation; the outcomes were satisfactory. No study of fusiform RAA management with a similar surgical technique has been reported.

Laparoscopic donor nephrectomy is widely used in renal transplantation, and the benefits of reduced invasion, reduced blood loss, less pain, and improved recovery are well documented. Through hand-assisted laparoscopic donor nephrectomy, we harvested the affected kidney and extracted it through a 7-cm sized incision wound created for a hand-assisted port. During ex vivo RAA reconstruction by the vascular surgeon, a urologist simultaneously performed standard prepping and draping of the left pelvic area for autotransplantation, then dissected and exposed the external iliac vessels. Multidisciplinary teamwork facilitated acquiring the short cold ischemic time of approximately 180 minutes, which, because of the fusiform morphology of the RAA, rendered the aneurysmectomy more difficult than a saccular aneurysm would be. The location of the aneurysm at the bifurcation of the left renal artery, and marked atherosclerosis change also required greater effort for vessel reconstruction. Moreover, atherosclerosis with renal artery stenosis is the most common cause of renovascular hypertension. In our patient, control of blood pressure improved during further follow-up visits.

We report a rare case of complex distal fusiform RAA at the bifurcation of the left renal artery, for which endovascular intervention was not viable. Using hand-assisted laparoscopic nephrectomy combined with backbench repair and autotransplantation (which is a feasible, safe, and

Figure 3 Perioperative findings. (A) Dissection of the kidney and exposure of the renal artery aneurysm (RAA) at the main renal artery (m-RA), divided into the anterior (RA-a) and posterior (RA-p) branches. (B) Post ex vivo aneurysmectomy and primary reconstruction. (C) Aneurysm with yellowish plaque and lumen stenosis. (D) Autotransplanted kidney regaining perfusion after vessel anastomosis.
tolerable procedure), we combined the advantage of minimally invasive surgery with the effectiveness of ex vivo aneurysm repair.

References