

Surgical Procedures for Renal Artery Aneurysms

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Objective: The aim of this study was to assess the strategy and surgical procedures for treating a renal artery aneurysm (RAA).

Patients and Methods: We retrospectively reviewed the surgical strategy for 21 cases with RAA between 2001 and 2010 at this institution. Treatment was indicated for patients with an RAA larger than 2 cm and/or symptoms. Surgical treatment was the initial strategy, and coil embolization was indicated in the case of narrow-necked, saccular, extraparenchymal aneurysms.

Results: Fifteen patients in 21 cases received an aneurysmectomy and renal artery reconstruction with an in-situ repair. One patient underwent an unplanned nephrectomy, and coil embolization was performed in 5 patients.

Conclusion: In-situ repair was safe and minimally invasive. RAA, even in the second bifurcation, could be exposed by a subcostal incision, and the transperitoneal approach permitted the safe treatment of an RAA with acceptable results, in our simple preservation of renal function.

Keywords: renal artery aneurysm, patch angioplasty

INTRODUCTION

Renal artery aneurysms (RAAs) are uncommon. They are often identified incidentally during abdominal computed tomography (CT) screening for other diseases. In recent years, coil embolization or stent-graft with the coil embolization was successful for treating RAAs, but complex aneurysms may require aneurysmectomy and renal artery reconstruction by in-situ repair or ex-vivo. The aim of this study is to assess the strategy and surgical procedures for RAA in this institution.

PATIENTS AND METHODS

This study retrospectively reviewed the surgical strat-

egy applied in 21 cases with RAAs between 2001 and 2010 in the department of Vascular Surgery of Tokyo Medical and Dental University. RAAs were diagnosed using CT and angiography, to assess the type of aneurysm, size, lesion, and association with branches of the renal artery. Renal function was evaluated using serum creatinine (Cr), the estimated glomerular filtration rate (eGFR) and renogram. Surgical treatment was indicated for patients with RAAs larger than 2 cm in diameter and/or symptoms (hematuria, back pain, uncontrolled hypertension in patients using antihypertensive drugs) and coil embolization was indicated in that case of narrow-necked, saccular, extraparenchymal aneurysms. The operation in in-situ repair was performed by subcostal incision and transperitoneal approach, and mannitol (0.5 g/kg) was administered before renal artery cross-clamping to preserve renal function.

The branches of the renal artery were reconstructed using the pantaloon technique or end-to-end and end-to-side fashion when that case of the diameter of the renal artery branch with two branches was greater than 2 mm, and renal artery branch was sacrificed when the diameter of the branch was less than 2 mm. Operating time, blood

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Table 1 The profile in 21 patients

	(n = 21)
gender (m:f)	11 : 10
Location	right: 10, left: 11
Size (mm)	28 ± 12
Asymptomatic patients	16
Symptom	pain: 5

Table 2 Operative procedures

Procedures	(n = 21)
ex-vivo repair→unplanned nephrectomy	1
in-situ repair	15
patch plasty	6
primary closure	2
end-to-end anastomosis with pantaloon	2
end-to-end anastomosis with side-to-end	2
end-to-end anastomosis	1
end-to-end anastomosis with ligation	1
aorto-ePTFE graft interposition	1
coiled embolization	5

loss, warm ischemic time, cold ischemic time and renal function between pre-operation and post operation were evaluated. All values are expressed as the mean ± SD. The Mann-Whitney U test and paired t-test were used to evaluate the differences in variables. A p value less than 0.05 was considered to be a statistically significant difference.

RESULTS

There were 21 cases that included 11 males and 10 females with an average age of 62 ± 10 years, (range: 37–72 years). The RAAs ranged from 12 mm to 60 mm in diameter. All were saccular aneurysms (**Table 1**).

In-situ repair was done in patients with the RAA, even if the RAA was located at the second bifurcation. Fifteen patients underwent an aneurysmectomy and renal artery reconstruction with in-situ repair via a subcostal transverse incision. Moreover, an ex-vivo operation was initially attempted in one patient. However, an unplanned nephrectomy was performed because the RAA had a diameter of 60 mm and involved four second branches and renal hypertension could have developed if renal branches were reconstructed.

Surgical procedures were assessed. Many aneurysms

Table 3 Procedures

procedures	in-situ repair (n = 15)	Patch plasty (n = 6)
operation time (min)	209 ± 49	237 ± 38
operative blood loss (ml)	368 ± 261	447 ± 259
warm ischemic time (min)	27 ± 20	26 ± 9

were located between the first and second bifurcation. An aneurysmectomy and primary direct closer or patch angioplasty were usually performed if the renal artery aneurysm did not involve many renal branches (**Table 2**).

The operating time, warm renal artery clamping time and blood loss were 209 ± 49 min (median: 212), 27 ± 20 min (median: 25) in fifteen cases, excluding the unplanned nephrectomy and 368 ± 261 mL, respectively (**Table 3**). The postoperative course was uneventful in all cases. Moreover, Crs before and after the operation were 0.78 ± 0.2 and 0.75 ± 0.3 mg/dl, and eGFRs, 71 ± 16 , 78 ± 28 mL/min/1.73m², in 15 cases that underwent a aneurysmectomy and renal artery reconstruction. Renal dysfunction was not significantly different. In addition, the primary patency rates in 15 reconstructed renal arteries with RAA were 100%, during a mean follow-up period of 32 ± 19 months (range, one month to 71 months).

Coil embolization was performed in 5 patients due to narrow-necked, saccular renal artery aneurysms, which were located at the first bifurcation of the renal artery. Those aneurysms were treated by coil exclusion of the aneurysmal sac using platinum Guglielmi detachable coils (GDCs 18 Boston Scientific, USA) or Interlocking detachable coils (IDCs Boston Scientific, USA) delivered through a microcatheter and no stents were used in five cases. An assisted balloon catheter (Attendant™ 4.5 × 10 mm) was used to decrease blood flow in one case. Five patients were successfully treated without complications, renal insufficiency, or nephrectomy. The Cr values before operation and after operation were 0.78 ± 0.2 and 0.75 ± 0.3 mg/dl, respectively. There was a mean follow-up period of 24 ± 25 months (range, one month to 67 months).

DISCUSSION

The RAAs were relatively rare, and the prevention of rupture was the most common indication for treatment of an asymptomatic RAA. Generally, the repair of a renal artery aneurysm has been recommended for aneurysms greater than 2.0 cm in diameter, with symptoms such as

flank pain or hematuria, or renovascular hypertension due to the aneurysm.¹⁻⁴⁾ The RAAs of this studies were located in all but the first bifurcation to second bifurcation most of the patients in this series as well as in the reports by and another group.^{2,5-7)} And we could expose renal arteries by subcostal incision and transperitoneal approach much easily than by median incision.

An end-to-end anastomosis or graft interposition was used depending on the location, and an end-to-end anastomosis with pantaloon, side-to-end anastomosis or branch ligation is used in case the artery feeds a small area or the diameter of the branch is less than 2 mm. Sometimes, the aortorenal bypass is done using a saphenous vein or ePTFE graft to shorten renal warm ischemic time.⁸⁾

This patch angioplasty was done in another group.^{9,10)} Pfeiffer et al.⁹⁾ reported no recurrence of aneurysms to be observed after tailoring in their series, and this may be because the aneurismal parts of the vessel wall were resected, leaving almost normal arterial wall next to the orifices of the branches. However, the mean follow-up period in the tailoring group was only 34.9 months, in comparison to 46 months for the entire series; therefore, tailoring could not be assessed sufficiently in terms of recurrent aneurismal dilatation with the current data. Patch angioplasty was applied in 6 cases in our study. This study was small numbers' group but warm ischemic time was 27 ± 20 min ($n = 6$), so these operations were accomplished with acceptable results in patch angioplasty and another way in this study. Patch angioplasty might be acceptable to prevent a portion of the suture to be narrow, in cases where the aneurysm is located in the first to second bifurcation of the renal artery.

A cold (4°C) renal perfusate of lactated Ringer's solution and administration of mannitol was used to cool the kidney and reduce the risk of acute renal tubular necrosis.^{2,9,11)} Our study also did as well for renal preservation. Moreover, cooling of the kidney should be repeated if the reconstruction requires more than 30 minutes of ischemic time. A cold (4°C) Ringer's solution of 40 mL was administered into the artery and 20–30g mannitol(0.5 g/kg) was administered before declamping the renal artery to reduce acute renal tubular necrosis in our study as well as in another study.¹¹⁾ Renal function could be preserved in these simple procedures.

There have been few recent reports of coil embolization for RAA, though the standard therapeutic method for IVR has been established.¹²⁻¹⁷⁾ Endovascular therapy with coil embolization and preservation of renal blood flow may be considered as a realistic alternative surgery

in narrow necked, saccular, or extraparenchymal aneurysms.¹²⁾ However, there are no reports that confirm an RAA was thrombosed, whether or not the expansion or rupture of RAA was prevented. The long-term results of coil embolization are not reported. So our follow-up period was only 19 ± 28 months, we need to follow-up for many years. In addition, occlusion of the renal artery from migration of coils is a major complication associated with embolization.¹⁴⁾ There has been no rupture, enlargement of the RAA and no renal dysfunction in the current series, and renal flow has been maintained. However, a careful follow-up is required for such RAAs.

CONCLUSION

This study assessed the surgical treatment of RAAs in this institution. RAA, even in second bifurcation, could be exposed by a subcostal incision, and the transperitoneal approach permitted the safe treatment of an RAA with acceptable results in our simple preservation of renal function.

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