Clinical Case Report

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The diagnosis and endovascular therapy of renal artery aneurysm

A 32-patient case report

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Abstract

Rationale: Renal aneurysm is a rare disease with the atypical symptoms and mostly diagnosed by imaging modalities. Endovascular therapy is a one of treatment methods.

Patient concerns: A retrospective analysis of 32 patients with renal artery aneurysm, from June 2010 to May 2016 in our hospital, was made in our study. All of them underwent therapy, and the effects and perioperative characteristics of it were analyzed.

Diagnosis: 32 patients were taken contrast-enhanced CT and diuretic renal dynamic imaging to evaluate the state of illness.

Interventions: The preoperative blood creatinine, perioperative hemoglobin and relief of hypertension were performed.

Outcomes: The preoperative blood creatinine was slightly increasing, while the perioperative hemoglobin was slightly decreasing. The relieving hypertension was performed in 9 of patients.

Lessons: Endovascular therapy is a mature and feasible treatment method. There is little effect on hemoglobin and renal function in postoperation, while it can also decrease the blood pressure.

Abbreviations: CT = computed tomography, IQR = interquartile range, MRA = magnetic resonance angiography.

Keywords: endovascular therapy, intervention therapy, postoperative blood pressure, renal artery aneurysm

1. Introductions

Renal artery aneurysm is a rare disease, and the general incidence of it is from 0.01% to 0.1% in foreign reports,[1,2] accounting for about 1% of all aneurysms. In the past, the detection rate of the disease is not high because of its clinical atypical symptoms.

But in recent years, the awareness of the disease is increasing, and there is also a wide use of computed tomography (CT), magnetic resonance angiography (MRA), digital subtraction angiography, and other imaging studies; the detection rate of renal artery aneurysm is also rising. On the contrary, renal artery aneurysm rupture is also a critical clinical situation, due to its deep vascular anatomy, poor vision in the surgical field, uncontrolled bleeding problems, and so on, which is life-threatening and has an increased mortality.

Editor: N/A.

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The authors declare no conflicts of interest.

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Medicine (2017) 96:47(e8615)

Received: 6 April 2017 / Received in final form: 18 October 2017 / Accepted: 23 October 2017

http://dx.doi.org/10.1097/MD.0000000000008615

However, most of the domestic and foreign literature describes case reports with different therapy. With the improvement of endovascular equipment and technology, endovascular therapy is becoming the mainstream because of its little postoperative discomfort and rapid recovery. Considering the advantage of endovascular therapy of renal artery aneurysm, we report here a single-center 32-patient experience in our study retrospectively. We also sought to analyze the feasibility and effectiveness of interventional therapy in renal artery aneurysm treatment.

2. Patients and methods

2.1. Study population

From June 2010 to May 2016, 32 patients with renal artery aneurysm underwent therapy in our institute. Data were collected on patient demographics, lesion characteristics, and clinical biochemical tests. Of 33 patients with median aged 45 years (17–72 years), 8 (25.0%) were male and 24 (75.0%) were female. The number of left renal artery aneurysm was 14 (43.8%), right was 16 (50.0%), and 2 (6.2%) were bilateral. Their symptoms were as follows: hypertension (12, 37.5%); backache (9, 28.1%), and hematuria (2, 6.3%). Twenty-eight patients (87.5%) underwent balloon-assisted coiling, whereas 4 patients (12.5%) underwent stent grafting. Patients were recommended to take contrast-enhanced CT and diuretic renal dynamic imaging to evaluate the state of illness.

2.2. Endovascular repair

2.2.1. Renal artery angiography. Patients in supine position were disinfected in groin area, and then anesthetized by 2% lidocaine locally. The femoral artery was punctured with the Seldinger method. A 7-F sheath was used, catheter select the renal artery, and arteriography was taken.

2.2.2. Coil placement. The proximal renal branch artery was blocked by balloon catheter. Then, the coil was released to emblaze the feeding artery. After embolization, angiography was taken.

2.2.3. Renal artery stenting. The guide wire was made to tread into the distal renal artery branch. Thereafter, the catheter was withdrawn and put in the ball-type stent along the filament. After repeating precise positioning, the stent was released. The angiography is taken again for confirmation.

2.3. Statistical analyses

Continuous variables were analyzed using Student *t* test (normally distributed data) and Mann–Whitney *U* test (non-normally distributed data). $P < .05$ was considered to be statistically significant. All data were collected and analyzed by SPSS 22.0 software (IBM Corp, Armonk, NY).

2.4. Research involving human participants

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or National Research Committee, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required. Informed consent was obtained from all individual participants included in the study.

3. Results

In all, 32 patients underwent therapy successfully, and there was no perioperative death. Baseline clinical characteristics of patients with renal artery aneurysm were shown in (Table 1). The preoperative blood creatinine was 76.5 μmol/L (interquartile range [IQR] 61.25–85.75 μmol/L), compared with 83.0 μmol/L (IQR 64.65–104.25 μmol/L) after operation ($P = .012$). Also, the perioperative hemoglobin was 135.5 g/L (IQR 120.3–146.3 g/L), compared with 129.0 g/L (IQR 113.0–142.0 g/L) after operation. Patients were made to undergo rehydration therapy, anti-infection, and other symptomatic therapies in the postoperation period. The average length of postoperative hospital stay was 4.0 days (IQR 3.3–6.0). The endovascular therapy also showed significant benefit on relieving the hypertension (12 vs 3 patients; $P = .003$) (Table 2).

Table 1

Baseline clinical characteristics of patients with renal artery aneurysm.

Characteristics	Total (n = 32)
Age, y, median (IQR)	45 (17–72)
Female sex, n (%)	24 (75.0%)
Backache, n (%)	9 (28.1%)
Left side, n (%)	14 (43.8%)
Preoperative presence of hypertension, n (%)	12 (37.5%)
Hematuria, n (%)	2 (6.3%)
Postoperative hospital stay, d, median (IQR)	4.0 (3.3–6.0)

IQR = interquartile range.

4. Discussion

4.1. Etiology and classification

In 1957, Poutasse[3] was first to demonstrate a rare disease—renal artery aneurysm, the incidence of which was only 1%. Its main cause consists of atherosclerosis, congenital dysplasia, trauma, arteritis, iatrogenic injury, and so on.[4] Renal artery aneurysm can affect anywhere in the renal artery, but mainly involves the main branch of the renal artery, which might be due to the weak arterial wall caused by the discontinuity of the internal elastic layer.[5] Bastounis et al[6] classified it into 4 types: cystic, spindle-shaped, dissecting aortic aneurysm, and aneurysm in renal parenchyma. On the contrary, Orion and Abularrage[7] classified it into true aneurysm, pseudoaneurysm, and dissecting aneurysm in terms of pathophysiological mechanism. True aneurysm is defined as a 3-layer artery wall with diameter >1 cm. About 75% of true aneurysms is cystic and 25% is spindle-shaped. Pseudoaneurysm is composed of fibrous tissue and it is often associated with trauma, such as lumbar impact injury, catheterization-induced iatrogenic injury, and even transplanted renal artery.[8] Dissecting aneurysm is the damage of arterial intima and then affects the arterial wall. Dissection aneurysm in kidney, which can be the primary lesion or caused by the spread to the renal artery, is more rare in clinic.[7]

4.2. Clinical manifestations and examination

Renal aneurysms often have no obvious symptoms, but hypertension, hematuria, low back pain, and other symptoms may appear with the progress of the disease.[9] Some studies have shown that about 55% of patients have no obvious symptoms and about 40% is associated with hypertension.[5] The remaining symptoms are abdominal pain, back pain, backache, and hematuria, and other atypical symptoms. In our study, 12 cases had hypertension, accounting for 37.5%. There were 9 cases with low back pain, 2 cases with hematuria, and others were found in physical examination.

Because of its atypical symptoms, this disease is difficult to be detected, and it is usually diagnosed accidentally while examining other diseases by imaging method. Ultrasound, CT, or MRA is often used in the detection of renal aneurysms. Radionuclide renography is used for the subrenal function in the preoperative examination, which could roughly predict the decreasing of overall kidney function caused by occlusion, failure of renal artery reconstruction, and other reasons in perioperation.

4.3. Treatment

Treatment of renal aneurysms includes drug and surgical treatment. Drug therapy is mainly used in some smaller-diameter

Table 2

Relationship between preoperation and postoperation in clinical factors.

Characteristics	Median (IQR) or n	*Z*	*P*
Serum creatinine, μmol/L		−2.503	.012
Preoperation	76.50 (61.25–85.75)		
Postoperation	83.00 (64.65–104.25)		
Hemoglobin, g/L		−2.276	.023
Preoperation	135.5 (120.3–146.3)		
Postoperation	129.0 (113.0–142.0)		
Presence of hypertension		−3	.003
Preoperation	12		
Postoperation	3		

IQR = interquartile range.

renal aneurysms and in cae of no surgical indications of patients. The drug therapy includes controlling blood pressure, and taking aspirin and statins. The patients should be followed up every year, focusing on the changing size, number, and shape of the aneurysm.[10] There is still some controversy about the surgical indications of renal aneurysm. The more accepted surgical indications include: greater than 2 cm in diameter or pregnancies. The operation includes traditional renal artery aneurysm resection and reconstruction, endovascular therapy, and other methods. At present, opening surgery is still a safe and effective method, whereas the advantages of endovascular therapy is simple—less perioperative bleeding, shorter operative time, and so on. Also, the renal artery anatomy plays an important role in the choice of surgical methods. Tsilimparis et al,[11] performing a follow-up of up to 12 years in 40 patients with renal aneurysms, found that perioperative complications were not significantly different, but interventional therapy had fewer lengths of hospitalization. In a study of 215 patients in New York state, open surgery was associated with more complications such as cardiovascular and cerebrovascular complications, and infections.[12] Therefore, the choice of surgical methods is dependent on both surgical indications and the actual situation.

Endovascular therapy is suitable for patients who cannot have open surgery. But the anatomical variation of blood vessels is the key factor to decide whether a patient should undergo interventional therapy or not. The purpose of interventional therapy is to treat renal artery aneurysm, but not to embolize renal artery trunk. A typical renal aneurysm often affects more than 1 branch of the renal artery, and the clinician must distinguish which arterial minor branch lesions may affect renal function seriously.

Interventional treatment includes stent implantation, coil embolization, and embolization of liquid embolization.[13–16] Stent implantation is often used in the treatment of aneurysms in the main branch of the renal artery. Coil embolization uses the catheter to release a coil into the aneurysm, which applies in the case of cystic narrow neck,[17] easy to fill the spring coil. Stent implantation assisted coil embolization is suitable for the situation that the ratio of neck to width is greater than 2/3, irregular tumor shape and the aneurysm which is needed to retain the artery and the adjacent branches.[18]

4.4. Treatment-related assessment

In this study, we found an average increase of creatinine by about 6.5 μmol/L and decrease in hemoglobin concentration by 6.5 g/L on average, which were both mild changes, considering the impact of endovascular therapy on renal artery blood flow to affect the kidney function firstly. Secondly, the serum creatinine and hemoglobin values were measured on the first day after surgery. However, previous studies[19] showed there is a transient increase in serum creatinine in the postoperation period immediately, which may be related to contrast agent metabolism, and it would drop back to normal after 2 weeks. So, our study needs to consider the possibility of a transient change in serum creatinine. Despite the slightly elevated serum creatinine on the first day after operation, the values are within the normal range, which may be the reason why we did not review later. Finally, it can not be completely excluded from the development of the disease. According to the results, these 2 factors are in the controllable normal range and have no significant impact on the patient's life and disease prognosis.

In this study, 12 patients have hypertension, accounting for 37.5%. There are 2 main hypotheses about the causes of hypertension in renal aneurysms: one hypothesis is that the renal artery can be distorted and narrowed by the increasing size of aneurysm, which may affect the hemodynamics, and another is that the renal aneurysm can lead to renin-angiotensin-aldosterone pathway system changing.[10] Some people consider that the hemodynamic changes are caused by embolus ulcerate or renal artery oppressed by the aneurysm.[20] Henke et al[5] hold the position that the greater size of the renal artery aneurysm can cause increased blood pressure. However, the majority of the renal artery aneurysms is of smaller diameter (<2 cm). So, from this aspect, it does not seem to explain the mechanism and characteristics of hypertension. Some people think that renal artery embolization is 1 of the possible mechanisms, but it did not show the renal artery terminal infarction by angiography; some scholars found the occurrence of renal artery stenosis caused by renal artery aneurysm by the angiography, but mostly it also had rich collateral circulation to compensate for lack of renal blood supply at the same time. There are many studies on the mechanism of hypertension in renal aneurysms. However, there is no direct evidence that renal aneurysms can lead to high blood pressure, or hypertension can lead to renal aneurysms.[10]

Some studies have shown that the blood pressure decreased significantly after operation,[21,22] even without the use of antihypertensive drugs to control. However, Henke et al[5] noted that compared with patients undergoing no surgery, 60% of patients' blood pressure can be significantly decreased postoperatively through the study of 40 patients with renal aneurysm resection. Whereas the patients with endovascular therapy had a certain increase in blood pressure.[23] In our study, 9 of the 12 patients with preoperative hypertension symptoms had postoperative blood pressure decrease, accounting for 75.0%. These results support that the postoperative blood pressure can be reduced to normal by the endovascular treatment. But the reason failed to explain currently. The authors suggest that the possible reason may be due to the effects of hemodynamics, which could put blood flow smoothly to restore the normal flow and flow direction, and the effect of renin-angiotensin-aldosterone pathway system was also reduced accordingly. At present, related studies are small sample size and the mechanism of hypertension in renal aneurysms is still not clear. Whether endovascular therapy can improve symptoms of hypertension or not is under discussion. Therefore, the impact of blood pressure after renal aneurysm resection or interventional treatment and the mechanism of it is not fully understood at present, which needs further basic research and large sample clinical trials in the future.

With the gradual improvement of endovascular treatment, it has also brought a series of problems. Possible complication of the embolization about using the steel ring has been reported, including renal pedicle vascular injury, peripheral renal ischemic infarction, ectopic embolization, and so on.[24] There is no operation related complications during postoperative observation and follow-up. Another problem is that intervention is more expensive than open surgery in China. This cost consists of disposable medical consumables and long-term follow-up. Short-term and long-term costs of both therapies need further statistical analysis.

5. Conclusions

In summary, renal aneurysm is a rare disease with atypical symptoms and mostly detected by imaging examination. Trans-

catheter arterial embolization of the renal artery is a mature and feasible treatment. Postoperative hemoglobin and renal function are less changing and can make patients with preoperative hypertension symptoms decrease blood pressure. The mechanism of renal artery aneurysm effects on blood pressure is also urgent to be studied in large sample clinical trials and basic science.

Acknowledgments

There is no source of financial grants and other funding for this research. The authors thank the entire staff of the Department of Urology, Peking University First Hospital.

References

[1] Orion KC, Abularrage CJ. Renal artery aneurysms: movement toward endovascular repair. Semin Vasc Surg 2013;26:226–32.
[2] Bulbul MA, Farrow GA. Renal artery aneurysms. Curr Urol Rep 2014;115:217–24.
[3] Poutasse EF. Renal artery aneurysm: report of 12 cases, two treated by excision of the aneurysm and repair of renal artery. J Urol 1957;77:697–8.
[4] Rossi M, Rebonato A, Greco L, et al. Endovascular exclusion of visceral artery aneurysms with stent-grafts: technique and long-term follow-up. Cardiovasc Intervent Radiol 2008;31:36–42.
[5] Henke PK, Cardneau JD, Welling TH3rd, et al. Renal artery aneurysms: a 35-year clinical experience with 252 aneurysms in 168 patients. Ann Surg 2001;234:454–62.
[6] Bastounis E, Pikoulis E, Georgopoulos S, et al. Surgery for renal artery aneurysms: a combined series of two large centers. Eur Urol 1998;33: 22–7.
[7] Orion KC, Abularrage CJ. Renal artery aneurysms- movement toward endovascular repair. Semin Vasc Surg 2013;26:226–32.
[8] Wang CX, Zhao L, Chen LZ, et al. Diagnosis and treatment of renal pseudoaneurysm after renal transplantation: a literature review. Acad J Sun Yat-Sen Univ Med Sci 2002;23:89–91.
[9] Elaassar O, Auriol J, Marquez R, et al. Endovascular techniques for the treatment of renal artery aneurysms. Cardiovasc Intervent Radiol 2011; 34:926–35.
[10] Zhang J, Jing ZP. The current and development of diagnosis and treatment in renal artery aneurysm. Acad J Second Military Med Univ 2009;30:573–6.
[11] Tsilimparis N, Reeves JG, Dayama A, et al. Endovascularvs open repair of renal artery aneurysms: outcomes of repair and long-term renal function. J Am Coll Surg 2013;217:263–9.
[12] Hislop SJ, Patel SA, Abt PL, et al. Therapy of renal artery aneurysms in New York state: outcomes of patients undergoing open and endovascular repair. Ann Vasc Surg 2009;23:194–200.
[13] Bisschops RH, Popma JJ, Meyerovitz MF. Treatment of fibromuscular dysplasia and renal artery aneurysm with use of a stent-graft. J Vasc Interv Radiol 2001;12:757–60.
[14] Liguori G, Trombetta C, Bucci S, et al. Percutaneous management of renal artery aneurysm with a stent-graft. J Urol 2002;167:2518–9.
[15] Karkos CD, D'Souza SP, Thomson GJ, et al. Renal artery aneurysm: endovascular treatment by coil embolisation with preservation of renal blood flow. Eur J Vasc Endovasc Surg 2000;19:214–6.
[16] Abath C, Andrade G, Cavalcanti D, et al. Complex renal artery aneurysms:liquids or coils. Tech Vasc Interv Radiol 2007;10:299–307.
[17] Zhang Z, Yang M, Song L, et al. Endovascular treatment of renal artery aneurysms and renal arteriovenous fistulas. J Vasc Surg 2013;57: 765–70.
[18] Liu DH, Yuan F, Xia XW, et al. The interventional treatment and effect of renal artery aneurysms. Chin J Urol 2015;36:
[19] Wang LN, Song XS, Yang DY, et al. Isolated renal aneurysm: one case report and literature review. Chin J Urol 2014;35:
[20] Stanley JC, Rhodes EL, Gewertz BL, et al. Renal artery aneurysms: significance of macroaneurysms exclusive of dissections and fibrodysplastic mural dilatations. Arch Surg 1975;110:1327–33.
[21] Iii RSM, Meacham PW, Ditesheim JA, et al. Renal artery aneurysm: selective treatment for hypertension and prevention of rupture. J Vasc Surg 1989;9:26–34.
[22] Chandra A, O'Connell JB, Quinones-Baldrich WJ, et al. Aneurysmectomy with arterial reconstruction of renal artery aneurysms in the endovascular era: a safe, effective treatment for both aneurysm and associated hypertension. Ann Vasc Surg 2010;24:503–10.
[23] Moreira N, Pêgo M, Carvalheiro V, et al. Renal artery aneurysm: an endovascular treatment for a rare cause of hypertension. Rev Port Cardiol 2012;31:667–70.
[24] Soga Y, Sakai K, Nobuyoshi M. Renal artery aneurysm treatment with coil embolization. Catheter Cardiovasc Interv 2007;69:697–700.