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Technical Report

# Strategy of endovascular treatment for renal artery aneurysms

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## Introduction

Renal artery aneurysm (RAA) is a rare disease. The incident rate detected upon autopsy was 0.3–0.7%. The incidence is almost 1% for the population undergoing renal artery angiography.<sup>1</sup> In recent years, with increasing use of ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), and digital subtraction angiography (DSA) for renal artery, asymptomatic RAA has been widely recognised and treated.<sup>2</sup> In the last century, RAA was most commonly treated with surgical resection. Now, with the development of interventional microcatheter-guidewire systems and new embolic materials, endovascular treatment has become the first-line therapy for RAA because of its minimal invasiveness and because it is associated with minor complications and low mortality.<sup>3</sup> The aim of the present study was to describe the authors' experience with RAA, focusing on the outcomes of different therapeutic modalities for RAA and to provide a scientific approach to the treatment for RAA.

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## Materials and methods

### Patients

This is a cohort study conducted as a retrospective analysis of a prospective database in a single institution. Seventeen consecutive patients who had RAAs and underwent endovascular treatment were enrolled from December 2009 to October 2016. Written informed consent was obtained from all the patients, and the study protocol was approved by the institutional ethics committee.

### Angiography and endovascular treatment

All patients underwent renal artery angiography to affirm the location, size, shape, and artery involved in the RAA. After comprehensive consideration of the above information, different therapeutic procedures were selected (single or combination). Potential endovascular treatment included simple coil embolisation of the aneurysm, stent-graft exclusion of the aneurysm, stent-assisted coil embolisation, and simple embolisation with coils or polyvinyl alcohol (PVA) particles with sacrifice of the aneurysm parent artery. The final goal of treatment was to exclude the aneurysm from the circulation. During the procedures, the percentage of distal renal infarction was estimated and recorded by experienced operators.

## Assessment and follow-up

Complications such as haemorrhage, renal abscess, and renal infarction were assessed after the therapy. Patients were followed until loss to follow-up, death, or 31 October 2016. Blood pressure, renal function (e.g., creatinine, blood urea nitrogen), related symptoms, and complications were recorded. Colour Doppler ultrasound, and/or CT angiography was performed to evaluate whether the RAA was enlarged or ruptured. When recurrence was recognised, patients were retreated by endovascular treatment.

## Results

Patient demographics, symptoms, aetiology, vascular risk factors, aneurysm characteristics, endovascular technique, and major complications are summarised in [Tables 1 and 2](#).

### Patient demographics

Seventeen patients who received endovascular treatment were enrolled in this study. Women outnumbered men 9 to 8. The mean patient age was 46.5 years (range 20–67 years). Nine patients had the symptom of flank pain and four patients had gross haematuria including, one patient with haemorrhagic shock. Four patients were asymptomatic. Regarding aetiology, three patients were diagnosed with atherosclerosis, one with fibromuscular dysplasia, one with arteritis, and the other 12 patients had no known cause for RAA. Regarding vascular risk factors, three patients were heavy tobacco users, three had hypertension, three had hypercholesterolaemia, and two had diabetes.

**Table 1**  
Patients demographics.

| Patient characteristic  | No. of patients |
|-------------------------|-----------------|
| Age                     |                 |
| <50 years old           | 10              |
| >50 years old           | 7               |
| Gender                  |                 |
| Male                    | 8               |
| Female                  | 9               |
| Symptom                 |                 |
| Flank pain              | 9               |
| Haematuria              | 4               |
| Asymptomatic            | 4               |
| Aetiology               |                 |
| Arteriosclerosis        | 3               |
| Fibromuscular dysplasia | 1               |
| Arteritis               | 1               |
| Unknown                 | 12              |
| Vascular risk factors   |                 |
| Tobacco consumption     | 3               |
| Hypertension            | 3               |
| Hypercholesterolaemia   | 3               |
| Diabetes                | 2               |

## RAA characteristics

Eight of the 17 patients had multiple RAAs, and 26 RAAs in total were included in this study. RAAs were classified into three main therapeutic types: saccular, fusiform, and intralobar based on Rundback criteria.<sup>4</sup> The majority of RAAs (73.1%,  $n=19$ ) were saccular in morphology; six RAAs were fusiform (23.1%), and only one RAA (3.8%) was intralobar. The average RAA diameter was 19.2 mm (range: 5–42 mm). There were four cases with RAAs in both kidneys. Eighteen RAAs (69.2%) arose from segmental arteries, and eight RAAs (30.8%) were located at the main renal artery stem or bifurcation.

### Endovascular treatment and follow-up

Twelve RAAs were treated by simple coil embolisation of the aneurysm sac, and nine RAAs were treated by coil embolisation with sacrifice of the aneurysm parent artery. Two RAAs were treated by stent graft, two cases were treated by stent-assisted coil embolisation, and one intralobar RAA was treated by embolisation with PVA. In total, 17 patients with 26 RAAs were treated by a total of 186 coils, two bare stents, and two graft stents. One underwent use of PVA.

Three patients were lost to follow-up, and one patient died due to unrelated disease before the end of the study. Mean follow-up was 31.3 months (range 5–68 months). The symptoms, such as loin pain and haematuria, resolved in 7 days after treatment. Five patients had mild post-embolisation syndrome for 1–5 days after treatment. Renal parenchyma loss was observed in 10 patients (infarction area of all cases was <20% of one kidney), and no significant renal failure occurred during follow-up. One patient with multiple aneurysms accepted a second embolisation due to RAA recurrence. No major complications occurred during follow-up.

## Discussion

### Characteristics of RAAs

In this group, the incidence of RAA was similar independent of age or gender. Flank pain and haematuria were typical clinical symptoms for RAAs. RAAs may arise from renal artery stem, branch, or intralobar parenchyma, and the majority occur in the bifurcation of the arteries. Multiple aneurysms or bilateral kidneys are not uncommon. The aetiology of RAAs is varied and mostly unknown; some RAAs may be due to congenital diseases, such as fibrodysplasia, or acquired diseases, such as atherosclerosis. Vascular risk factors, such as smoking, hypertension, diabetes, and hypercholesterolaemia, also play important roles in RAA development.<sup>2,5</sup>

### Indication of RAAs

The optimal treatment threshold for asymptomatic RAAs is not established. It was clear that symptomatic RAAs

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