Coil embolization of renal artery bifurcation and branch aneurysms with flow preservation

Hanfei Tang, MD, PhD,[a] Xiao Tang, MD,[a] Weiguo Fu, MD,[a] Jianjun Luo, MD,[b] Zhenyu Shi, MD,[a] Lixin Wang, MD,[a] Fei Liu, MD, PhD,[a] *and* Daqiao Guo, MD,[a] *Shanghai, China*

ABSTRACT

Objective: Coil embolization is one of the most common endovascular approaches to treatment of renal artery aneurysms (RAAs). The purpose of this retrospective study was to compare complications, mortality, and morbidity associated with sac packing, coil trapping, and inflow occlusion.

Methods: The records of all patients with RAAs treated with coil embolization at our center from June 2003 to May 2017 were retrospectively reviewed. Demographics of the patients, aneurysm characteristics, management strategies, perioperative and long-term outcomes, and complications were analyzed.

Results: A total of 52 patient records were reviewed; 28 patients received sac packing and 24 patients underwent coil trapping/inflow occlusion. There was no significant difference in patients' demographics or RAA characteristics between the groups. The mean aneurysm diameter was 25.6 ± 8.4 mm in the sac packing group and 31.1 ± 16.8 mm in the coil trapping/inflow occlusion group ($P = .130$). Most aneurysms in the sac packing group originated from the main renal artery bifurcation (67.9%), whereas in the coil trapping/inflow occlusion group, most aneurysms originated from the renal segmental branch arteries (54.2%). The immediate technical success rate was 100%, and the in-hospital mortality rate was 0% in both groups. Sac packing was more likely to be associated with endoleak immediately after the procedure (28.6% vs 8.3%; $P = .065$). The overall perioperative complication rate was not statistically different between the groups (7.1% vs 16.7%; $P = .284$). The mean duration of follow-up was 37.67 ± 29.84 months and 49.35 ± 28.11 months in the sac packing and coil trapping/inflow occlusion groups, respectively ($P = .192$). No deaths related to RAAs or aneurysm rupture occurred in either group. The overall morbidity rate was similar between groups (12.5% vs 25%; $P = .284$). Partial renal infarction occurred in two and five patients in the sac packing and coil trapping/inflow occlusion groups, respectively (8.3% vs 25%; $P = .132$). Impaired renal function was more frequent after coil trapping/inflow occlusion (0% vs 15%; $P = .049$). A single patient in the sac packing group required further intervention for reperfusion of the aneurysmal sac at 4 months (4.2% vs 0%; $P = .356$).

Conclusions: Sac packing might be a safe and effective way to treat RAAs located at the main bifurcation or in branch arteries and may be preferable to coil trapping/inflow occlusion, considering the potential loss of functional renal mass. (J Vasc Surg 2018;■:1-8.)

Renal artery aneurysms (RAAs) are a rare entity, with an estimated incidence of 0.1% to 1.3% in the general population.[1-4] The majority of RAA patients are asymptomatic at the time of discovery.[5] The increased rate of incidental discovery is largely attributable to the widespread use of noninvasive imaging for evaluation of other conditions.[6] Current indications for repair are an aneurysm size >3 cm (larger than the previously agreed on indication of >2 cm), symptomatic aneurysms (hypertension, hematuria, and flank or abdominal pain), and aneurysms of any size in women of childbearing age.[7,8]

Endovascular repair, including transcatheter embolization, stent-assisted coiling, and stent graft repair, has been widely described for the treatment of RAAs. Compared with open repair, endovascular repair has been shown to be associated with a significantly shorter length of hospital stay and lower morbidity and mortality.[8] However, few retrospective studies have investigated stratification based on endovascular repair variables.

In the endovascular era, coil embolization is one of the most common approaches to RAA treatment. The purpose of this retrospective study was to compare complications, mortality, and morbidity between sac packing (in which only the aneurysmal sac is filled with embolization material), coil trapping (in which coils are deployed distal and proximal to the aneurysm neck to occlude the proximal and distal ends of the parent arteries or the arteries originating from the aneurysms), and inflow occlusion (occlusion proximal to the aneurysm neck to occlude the proximal ends of the parent arteries).

From the Department of Vascular Surgery, Institute of Vascular Surgery,[a] and Department of Radiology,[b] Zhongshan Hospital, Fudan University.

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Correspondence: Daqiao Guo, MD, Department of Vascular Surgery, Institute of Vascular Surgery, Zhongshan Hospital, Fudan University, 180 Fenglin Rd, Shanghai, China 200032 (e-mail: guodaqiaoau@hotmail.com).

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METHODS

A retrospective review was conducted of patients who were diagnosed with and treated for RAAs with coil embolization at Zhongshan Hospital, Fudan University, from June 2003 to May 2017. Exclusion criteria were RAAs after renal transplantation and with concomitant diagnoses of aortic aneurysms or dissection. The perioperative and follow-up outcomes of RAAs treated by coil embolization were reviewed for analysis. Demographics, comorbidities, and other clinical data were collected retrospectively from medical records. Cross-sectional imaging studies were reviewed by two endovascular specialists and one interventional radiologist to collect anatomic data, including aneurysm laterality (unilateral or bilateral), presence of other arterial aneurysms (including iliac, splanchnic, superior mesenteric, and celiac), RAA location (main renal artery bifurcation, segmental branch artery, and accessory renal artery), aneurysm morphology (saccular vs fusiform), and maximum aneurysm diameter. This study was approved by the Committee for the Protection of Human Subjects at Zhongshan Hospital, Fudan University. All patients participating in the study signed an informed consent form.

Although the exact indications are controversial, our study's indications for treatment included an aneurysm size >2 cm, symptomatic aneurysms (hypertension, hematuria, and flank or abdominal pain), and aneurysms of any size in women of childbearing age.[7] There were no absolute contraindications to endovascular management. Relative contraindications included infection within the target vasculature, impaired renal status, coagulopathy, known allergy to contrast media, and hemodynamic instability unresponsive to resuscitation and requiring immediate surgical intervention.[9]

The treatment strategy and approach were decided on the basis of the patients' comorbidities, aneurysm location, anatomic variation, and physicians' preference. Planning for the repair was based on preoperative radiologic assessment. Coil embolization approaches included sac packing, coil trapping, and inflow occlusion with platinum or stainless steel coils. If it is possible to preserve blood flow in the vessels arising from the aneurysm or at which the aneurysm is located, sac packing may be used. Otherwise, coil trapping or inflow occlusion may be needed.[10]

The follow-up protocol of RAA patients after endovascular repair consisted of clinical assessment, serum creatinine concentration, radioisotope nephrography, duplex ultrasound examination, and computed tomography angiography or magnetic resonance angiography at 3 months, at 12 months, and annually thereafter.

The study's primary end point was RAA-related mortality and RAA rupture. Secondary end points included target lesion reintervention, defined as requiring an additional procedure (open surgical or percutaneous) because of target lesion recurrence; renal infarction, defined as renal ischemia diagnosed during follow-up by computed tomography angiography or magnetic resonance angiography; and impaired renal function, defined as a 30% reduction in glomerular filtration rate (GFR).[11] Technical success was defined as the successful exclusion of the aneurysmal lesion from the systemic circulation, confirmed by selective digital subtraction angiography at the end of the procedure. Perioperative complications were defined as access site complications, renal ischemia, secondary aneurysm rupture, deep venous thrombosis or pulmonary embolism, myocardial infarction, and stroke.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective multicenter cohort study
- **Take Home Message:** In 52 patients with renal artery aneurysm, endovascular treatment was safe, but coil trapping and inflow occlusion resulted in significantly worse renal function than with sac packing.
- **Recommendation:** The authors suggest sack packing, whenever possible, for endovascular treatment of renal artery aneurysms because of less chance of renal function deterioration than after coil trapping and inflow occlusion.

Statistical analysis. The results were analyzed with SPSS statistical software (version 23; IBM Corp, Armonk, NY). Data were assessed for normality and expressed as number (%) for categorical variables and mean ± standard deviation for continuous variables. The two-tailed Student *t*-test was used to analyze continuous variables. Categorical variables were compared using the χ^2 test or Fisher exact test. Survival analyses were conducted with Kaplan-Meier models. A *P* value of <.05 was considered statistically significant.

RESULTS

Patient demographics and comorbidities. A total of 71 patients with RAAs treated with percutaneous endovascular therapeutic modalities from June 2003 to May 2017 were identified. Of these patients, 11 received covered stent repair and 8 underwent stent-assisted embolization. The remaining 52 patients (25 women; mean age, 51.06 ± 13.91 years; range, 19-76 years) were treated with coil embolization with platinum or stainless steel coils. Of these, 28 patients (mean age, 51.71 ± 13.11 years) received sac packing (Fig 1) and 24 patients (mean age, 50.29 ± 15.03 years; *P* = .717) underwent coil trapping/inflow occlusion (Fig 2). The patients' sex, preoperative comorbidities, and presence of extrarenal aneurysms were comparable between the sac packing and coil trapping/inflow