

# Systematic Review and Single-Center Experience for Endovascular Management of Visceral and Renal Artery Aneurysms

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## ABSTRACT

**Purpose:** To report a systematic review of endovascular management of visceral and renal artery aneurysms (VRAA) and results at a tertiary referral center.

**Materials and Methods:** A literature review was performed via a comprehensive electronic search of PubMed, MEDLINE, EMBASE, and Cochrane databases, followed by retrospective analysis of all VRAAs treated at a tertiary referral center from January 1999 to December 2015.

**Results:** The systematic review included 22 studies published between 2005 and 2016 describing endovascular treatment of VRAA. In the systematic review cohort, 646 aneurysms (432 true, 151 false, 63 unclassified) were treated using endovascular methods with 93.2% technical success, 99.3% visceral preservation, 3.5% major complication (classified based on Society of Interventional Radiology criteria), 1.5% 30-day periprocedural mortality, and 4.6% reintervention rates. In the local cohort, 19 aneurysms (12 true, 7 false) were treated with 100% technical success, 94.7% visceral preservation, and 10.5% major complication rates. There was no periprocedural mortality. Over mean follow-up of 31.9 months (range, 2–170 months), there were 2 aneurysm reperforations, which required no further treatment. Results incorporating data from the systematic review and local cohorts (665 aneurysms) showed 93.6% technical success, 99.1% visceral preservation, 3.7% major complication, 1.5% periprocedural mortality, and 4.4% reintervention rates.

**Conclusions:** Endovascular treatment of VRAA is associated with excellent technical success and visceral preservation rates. Major complication and periprocedural mortality rates are comparatively low. A few VRAA (4.4%) required future reintervention suggesting that imaging follow-up is essential after initial treatment.

## ABBREVIATIONS

NBCA = N-butyl cyanoacrylate, VRAA = visceral and renal artery aneurysms

Visceral and renal artery aneurysms (VRAA) are uncommon aneurysms of the splanchnic and renal arterial

branches (1). Although VRAA can be symptomatic from rupture, many lesions are incidentally detected on imaging studies performed for other reasons. The increase in use of computed tomography (CT) and magnetic resonance (MR) imaging has led to detection of more VRAA (2).

Traditionally, VRAA have been subdivided into true and false (pseudo) aneurysms, and this distinction reflects differences in etiology, natural history, rupture risk, and consequent management approaches (3). The reported prevalence of true VRAA is 0.1%–2%, and most are detected incidentally (1,3). It has been suggested that approximately 20% of aneurysms rupture with a mortality rate of 20%–100% and that this risk is increased in pregnancy (1,4–7). The rupture risk of

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pseudoaneurysms is greater at approximately 70% and is not related to aneurysm size because of a lack of a structural wall with these lesions—therefore all pseudoaneurysms should be treated (2,8). In the past decade, there has been a shift toward endovascular management over surgical repair of VRAA because of advances in interventional materials and techniques, avoidance of general anesthesia, shorter hospital stays, and lower complication rates (3). Nevertheless, published studies evaluating endovascular treatment of VRAA consist of retrospective cohorts because of the rarity of these lesions using a variety of interventional techniques with variable follow-up data. The aim of this study was to systematically review current endovascular techniques focusing on technical success, complications, and intermediate-term to long-term results following endovascular management of VRAA. In addition, our experience in a tertiary referral hospital is reported.

## MATERIALS AND METHODS

### Study Design

A systematic review based on guidelines from the Cochrane Database of Systematic Reviews was performed to summarize current experience with endovascular management of VRAA.

### Search Strategy and Data Sources

An electronic search was performed using the PubMed, MEDLINE, EMBASE, and Cochrane databases without language restrictions over a 12-year period from 2005 through 2016. Both free text and medical subject headings were used to enhance search sensitivity and consisted of the following terms: “visceral artery,” “renal artery,” “aneurysm,” AND “endovascular.” Two authors (H.K.K., H.A.) performed the search independently in May 2016. The reference lists of articles were also manually searched for additional citations. Results were validated by manual search through 4 journals that contributed the largest number of articles in this review (*Journal of Vascular Surgery*, *Journal of Vascular and Interventional Radiology*, *Annals of Vascular Surgery*, and *Cardiovascular and Interventional Radiology*).

### Study Selection

Selection criteria were developed before the literature search as follows: studies that included only visceral and/or renal artery aneurysms, described the use of endovascular methods to treat VRAA, were published between 2005 and 2016 in English, and included  $\geq 3$  patients treated by endovascular means. Abstracts from identified citations were compared against the previously defined criteria to determine suitability for inclusion. Because of the relative paucity of literature in this area, case series and studies incorporating both an

endovascular and a surgical treatment arm were also included. Animal or in vitro studies were excluded.

### Data Extraction

For all identified studies, a primary evaluation of the title and abstract was done followed by review of the full text if suitable for inclusion. The search, review, and selection process was summarized into a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow chart, and exclusion decisions were recorded (Fig). Identical technical and follow-up parameters to those analyzed in the local cohort were extracted and recorded to improve comparability of results.

### Local Experience

To compare local experience with the published literature, a retrospective review of all VRAA treated at a tertiary referral institution over a 17-year period (January 1999 to December 2015) was performed. Because this was a retrospective review of current medical practice in our institution and it did not influence individual patient management, it was categorized as a service evaluation and was exempted from institutional review board approval. During the 17-year period, 19 VRAA in 19 patients were treated (Tables 1, 2). Data were extracted from hospital medical records and radiology information systems.

### Definitions

Technical success was defined as successful exclusion of the treated aneurysm from the parent artery. Visceral preservation was defined as maintenance of normal target organ function at follow-up, based on combined clinical, biochemical, and imaging assessment. Complications were classified into minor and major categories according to the Society of Interventional Radiology (SIR) criteria (9).

### Statistical Analysis

The data from all included studies were used to calculate the total aneurysm number; type; size; location; and composite means of outcome measures including technical success, visceral preservation, complications, periprocedural mortality, and reintervention rates as well as follow-up details. Continuous variables were expressed as mean  $\pm$  SD unless specified. All statistical analyses were performed using IBM SPSS Statistics 22 for Windows (IBM Corporation, Armonk, New York).

## RESULTS

### Systematic Literature Review

There were 22 eligible studies included; all were retrospective in nature and published between 2005 and 2016 (Table 3) (2,10–30). Most studies were cross-sectional (19 studies), and the remainder were case series (3 studies).

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