



ORIGINAL RESEARCH PAPER

Vascular Surgery

RENAL ARTERY ANEURYSM IN CLOVERLEAF CONFIGURATION: CASE REPORT AND EVIDENCE REVIEW 1A

KEY WORDS: Renal Artery Aneurysm, Visceral Aneurysm, Endovascular Treatment, Renovascular Hypertension.

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ABSTRACT	Renal artery aneurysms (RAAs) represent a rare but clinically relevant vascular pathology due to the risk of rupture, embolization, and their association with secondary hypertension. We present the case of a 51-year-old woman with poorly controlled hypertension treated with three medications, in whom three renal aneurysms were identified, one of them with an unusual cloverleaf morphology, documented by renal computed tomography angiography and 3D reconstructions. Level 1A evidence regarding management, intervention criteria, and follow-up is discussed.
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INTRODUCTION Renal artery aneurysms have an estimated incidence of 0.1–1% on imaging studies. Most are asymptomatic, although they can be associated with resistant hypertension, abdominal pain, hematuria, or renal complications. International guidelines (AHA/ACC, ESVS 2023) and several meta-analyses constitute the highest level (1A) evidence available to guide management . 1. General Information About Aneurysms An aneurysm is defined as a focal and permanent dilation of a blood vessel that exceeds its normal diameter by at least 50% . This definition, accepted by international cardiovascular guidelines, allows us to distinguish a true aneurysmal dilation from ectasia or pseudodilation . Classification by Wall Structure - True aneurysm - It involves all three layers of the arterial wall: intima, media, and adventitia. - It is the most common type in visceral arteries. - False aneurysm or pseudoaneurysm - Result of a partial rupture contained by perivascular or connective tissue. - Associated with invasive procedures, trauma, or inflammation. Classification by Morphology - Saccular : focal and asymmetric dilation, like a "bag"; greater risk of rupture. - Fusiform : diffuse and circumferential dilation.	- Multilobed : with several cavities; complex morphology, as observed in this case ("clover"). General Etiology of Aneurysms The causes include: - Atherosclerosis (the most common in older adults). - Connective tissue diseases (Marfan, Ehlers–Danlos). - Vasculitis (such as polyarteritis nodosa). - Fibromuscular dysplasia (especially in middle-aged women). - Infections ("mycotic aneurysms"). - Trauma or iatrogenesis . - Hemodynamic factors : turbulent flow, bifurcations, prolonged hypertension. General Pathophysiology Aneurysms result from an imbalance between the synthesis and degradation of the extracellular matrix , mediated by: - overexpression of metalloproteinases, - loss of elastin, - thinning of the stocking, - microinflammation . This process weakens the arterial wall and facilitates its progressive dilation. 2. Theory and Generalities of Renal Artery Aneurysms (RAA) AARs represent a rare variant within visceral aneurysms, but are clinically relevant due to potential complications (rupture, embolization, secondary hypertension, renal ischemia).
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Epidemiology

- Estimated incidence: 0.1–1% in imaging studies.
- Higher prevalence in women ($\approx 70\%$), especially between 40–60 years old.
- Up to 40% are associated with fibromuscular dysplasia, although they can also be related to atherosclerosis or vasculitis.

Location Anatomical

AARs can appear in:

- Main trunk of the renal artery ($\approx 15\%$)
- Renal bifurcation or hilum ($\approx 50\%$)
- interlobar branches ($\approx 35\%$)

Distal aneurysms are usually smaller, while proximal aneurysms have a greater hemodynamic impact.

Classification

AARs are classified according to:

1. Morphology
 - Saccular (more frequent)
 - Fusiform
 - Multilobed (like the "cloverleaf" aneurysm in this case)
 - Dissecting
 - Pseudoaneurysm
2. Number
 - Solitary ($\approx 80\%$)
 - Multiple ($\approx 20\%$), as in this case
3. Etiology
 - Fibromuscular dysplasia
 - Atherosclerosis
 - Prior embolization
 - Infection
 - Iatrogenesis
 - Vasculitis

Pathophysiology Specific

The renal artery, with its multiple bifurcations and abrupt changes in diameter, is particularly susceptible to turbulence.

The main mechanisms include:

- Structural deficiency of the media (due to fibromuscular dysplasia or degeneration).
- Chronic hemodynamic stress (especially in persistent hypertension).
- Microtrauma at bifurcations, where wall tension is greater.
- Endothelial inflammation that alters vascular homeostasis.

In multilobulated aneurysms, the anatomical irregularity increases turbulence, which accelerates progression or favors partial thrombosis.

Presentation Clinic

Most are asymptomatic (about 70%). When symptoms are present, they include:

- Resistant arterial hypertension, due to activation of the renin-angiotensin axis.
- Lower back or abdominal pain.
- Hematuria.
- Suspected pulsatile mass (rare).
- Distal embolic events.
- Rupture (more common in pregnant women).

In the case presented, there is resistant hypertension, one of the most relevant clinical signs.

Risk of Breakage

The literature identifies specific factors:

- Aneurysms > 2 cm
- Pregnancy (highest incidence)
- Saccular or multilobulated aneurysms
- Uncontrolled hypertension
- Aneurysms in the main trunk
- Accelerated growth

The "cloverleaf" aneurysm in this case:

- It has a diameter > 30 mm,
- multilobed morphology,
- coexistence of hypertension, which implies a high relative risk according to guideline evidence.

Diagnosis

The methods of selection include:

- CT angiography $\rightarrow$ current gold standard for its resolution and ability to perform 3D reconstructions.
- Magnetic resonance angiography (MRA).
- Doppler ultrasound (less sensitive for segmental aneurysms).
- Invasive angiography (used when endovascular treatment is planned).

The images provided correspond to CTA with multiplanar and 3D reconstructions, appropriate for advanced morphological evaluation.

3. Management According to Evidence

International guidelines recommend intervention in the following cases:

Instructions Strong (1A)

- Aneurysm > 2 cm
- Women of reproductive age
- Renovascular hypertension
- Complex morphology (multilobed saccular)
- Symptomatic aneurysm
- Documented growth
- Expected risk of loss of functional renal mass

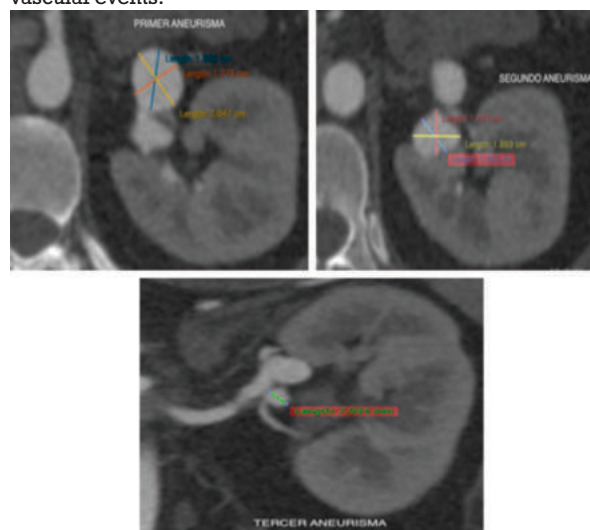
Modalities Therapeutic

- **Endovascular**
 - o Coils
 - o Covered stents
 - o Ball-remodeling technique
 - o Distal branch occlusion
- **Surgical**
 - o Patch reconstruction
 - o Arterial reimplantation
 - o Renal-renal bypass
 - o Ex vivo surgery (rare but useful in complex anatomies)

Given the cloverleaf pattern and size > 3 cm, this case likely requires surgical or hybrid treatment, although the decision depends on multidisciplinary analysis.

Case Presentation

A 51-year-old female patient with a long history of hypertension, treated with three antihypertensive medications. No history of connective tissue disease, smoking, or previous vascular events.



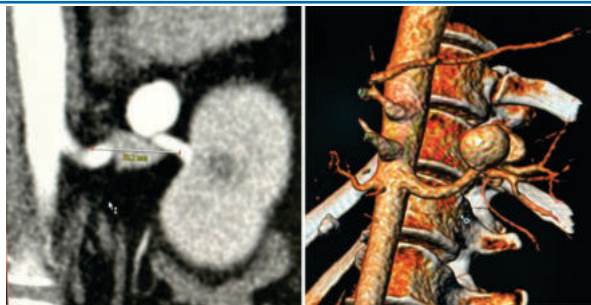


Image Findings :

1. First aneurysm: 1,880 cm, 1,775 cm, 2,047 cm.
2. Second aneurysm: 1,422 cm, 1,869 cm, 1,365 cm.
3. Third aneurysm: 7.934 mm.

Dominant cloverleaf aneurysm: ≈ 32 mm, multilobulated, in a main segmental branch.

DISCUSSION

The multilobulated morphology, diameter greater than 2 cm, and coexisting resistant hypertension place this patient at high risk of complications. International guidelines recommend intervention when an aneurysm > 2 cm, renovascular hypertension, symptoms, or complex morphology are present. Level 1A evidence supports endovascular or surgical management depending on the anatomy.

CONCLUSIONS

The patient presents with multiple renal artery aneurysms, including a multilobulated cloverleaf aneurysm approximately 32 mm in diameter. This, along with resistant hypertension, meets the criteria for intervention according to level 1A evidence. Multidisciplinary evaluation is recommended to determine optimal management.

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