ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (*IJMSIR*)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 10, Issue – 6, December – 2025, Page No. : 104 – 111

Stopping the Leak: Endovascular Control of Renal AV Fistulas - A Case Series

[1]Dr Alok Verma, Assistant Professor, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

[2]Dr Naresh Mangalhara, Associate Professor, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

[3]Dr Shashank Sharma, Assistant Professor, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

[4]Dr Ayush Khandelwal, Senior Resident, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

[5]Dr Meenu Bagarhatta, Senior Professor, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

Corresponding Author: Dr Alok Verma, Assistant Professor, Department of Interventional Radiology, SMS Medical College and Hospital, Jaipur

Citation this Article: Dr Alok Verma, Dr Naresh Mangalhara, Dr Shashank Sharma, Dr Ayush Khandelwal, Dr Meenu Bagarhatta, "Stopping the Leak: Endovascular Control of Renal AV Fistulas - A Case Series", IJMSIR - December – 2025, Vol – 10, Issue - 6, P. No. 104 – 111.

Type of Publication: Case Series

Conflicts of Interest: Nil

Abstract

Renal arteriovenous fistulas (AVFs) are uncommon vascular malformations, frequently iatrogenic following biopsies or other procedures, presenting with hematuria, pain, high-output cardiac failure or hypertension.

Purpose: To evaluate the clinical presentations, imaging findings, embolization techniques, clinical and technical outcomes of endovascular embolization in patients with renal arteriovenous fistulas.

Materials and Methods: A retrospective review was conducted of patients with renal AVFs treated with endovascular embolization at our center between January 2024- November 2025. Patient demographics, etiology, clinical presentation, imaging findings, embolization techniques and outcomes were analyzed. Technical and clinical success rates, complications, and renal function preservation were assessed.

Results: All achieved complete occlusion, symptom resolution with no major complications. These findings reinforce endovascular embolization as a first-line, kidney-sparing therapy for renal AVFs.

Conclusion: Endovascular embolization is a safe and effective first-line treatment for renal AVFs, offering high technical and clinical success rates with minimal complications.

Keywords: Endovascular therapy, Endovascular embolization, Interventional radiology, Renal arteriovenous fistula, Transarterial embolization.

Introduction

Epidemiology and Etiology of Renal Arteriovenous Fistulas

Renal arteriovenous fistulas (AVFs) involve direct, aberrant connections between renal arteries and veins, bypassing the capillary bed and causing high-flow shunts. Acquired AVFs are most frequently iatrogenic, with percutaneous renal biopsy being the leading cause, particularly in transplant kidneys. Other prominent iatrogenic causes are percutaneous nephrolithotomy, and renal surgery.[1] Traumatic AVFs may result from blunt or penetrating renal injury, while spontaneous AVFs are associated with underlying vascular pathology such as aneurysms or fibromuscular dysplasia. Congenital renal AV fistula accounts for ~25% of cases and idiopathic RAVF is the least common (3–5%).[2] The incidence of renal AVFs after a native kidney biopsy varies from 0.3-5-6%, while in transplanted kidneys it can be up to 10-16%[3]

Clinical Presentation and Complications

The majority of renal AVFs are small and asymptomatic and may be detected incidentally during imaging for unrelated indications. When symptomatic, clinical manifestations are determined by the size, location, and flow dynamics of the fistula. Common presentations include gross hematuria, flank pain, anemia, renal insufficiency, hypertension, and, in rare cases, high-output cardiac failure due to significant left-to-right shunting. In transplant recipients, AVFs may compromise graft function and increase the risk of graft loss if not promptly managed.[4] Physical examinations may reveal a continuous abdominal bruit or palpable thrill over the affected kidney.

Rationale for Embolization

Conservative management suits small, asymptomatic fistulas, but intervention is warranted for hemodynamic instability or renal decline.

Historically, surgical ligation or nephrectomy was the mainstay of treatment for symptomatic or large renal AVFs. However, these approaches are associated with significant morbidity and loss of renal parenchyma. The advent of endovascular embolization has revolutionized the management of renal AVFs, offering a minimally invasive, organ-preserving alternative with high technical and clinical success rates. Embolization allows for targeted occlusion of the fistulous communication while sparing uninvolved renal tissue, thereby preserving renal function and reducing perioperative risk[5]. In this study we plan to evaluate the technical and clinical success of renal AVF embolization along with the type of embolizaing agent used.

Materials and Methods

Patient Selection and Inclusion Criteria

This retrospective case series included all patients diagnosed with renal AVF and treated with endovascular embolization at a tertiary care center between January 2024 to December 2025

Inclusion criteria were:

1. Radiologically confirmed renal AVF by CT angiography,
2. Clinical indication for intervention: symptomatic hematuria, hypertension, cardiac failure, or risk of renal dysfunction

Exclusion criteria included:

1. Patients with small arteriovenous fistula managed conservatively,
2. Patients who previously underwent surgical or endovascular treatment for the same renal AV fistula.

3. Patients with incomplete clinical, imaging, or procedural records precluding analysis.
4. Patient refusal

Diagnostic Workup: Imaging Modalities and Findings

The diagnosis of AVF was made as follows:

- **Ultrasound with Doppler:** Initial screening tool, revealing turbulent color flow and arterialized waveform in the draining vein. Spectral Doppler demonstrates high-velocity, low-resistance arterial flow and pulsatile venous flow.
- **Contrast-Enhanced CT Angiography (CTA):** Gold standard for anatomical delineation, showing early opacification of the renal vein in the arterial phase, dilated feeding artery, and draining vein. Associated aneurysms or pseudoaneurysms may be visualized.
- **Digital Subtraction Angiography (DSA):** Performed as part of the embolization procedure

Embolization Techniques and Devices

The choice of embolic agent and technique was individualized based on AVF anatomy, flow characteristics, and operator preference. The following embolic materials were utilized:

Embolic Agents

- **Coils:** Pushable platinum coils were used for super selective occlusion of feeding arteries. Coils were oversized by 20–30% relative to the target vessel to prevent migration. In case of migration due to high flow, further oversizing was done on a case to case basis.
- **n-Butyl Cyanoacrylate (NBCA) Glue:** Used in high-flow AVFs or when rapid occlusion was required. NBCA was mixed with Lipiodol in varying concentrations (20–75%) depending on flow dynamics.

Procedures followed standardized protocols: femoral arterial access under local anesthesia, using 5F sheaths and 0.035-inch guide wires. Super selective catheterization employed 2.7F micro catheters (Progreat, Terumo) advanced to the AVF site via coaxial systems. Technical success required occlusion of the fistulous communication with no opacification of the vein. Post-procedure, patients received hydration, antiemetics, and monitoring for 24-48 hours. Complications were graded per SIR classification.

Results

A total of 8 symptomatic patients were included in this case series who presented to the department of interventional radiology for embolization of renal arteriovenous fistula on CT angiography.

Table 1: Patient demographics, CT findings and Embolizing agent

Case	Age	Sex	Etiology	Location	Agents Used
1	56	M	Traumatic	Upper pole	Coil and glue
2	33	M	Renal biopsy	Lower pole	Coil
3	20	M	Traumatic	Upper pole	Coil
4	37	F	PCNL	Lower pole	Coil
5	21	M	Renal biopsy	Lower pole	Coil and glue
6	30	F	Renal biopsy	Lower pole	Coil
7	19	M	Traumatic	Mid pole	Coil and Glue
8	41	M	PCNL	Mid pole	Coil

The mean age of the patients was 32.1 yrs. There were 6 males and 2 females. The mean procedure time was 43 minutes.

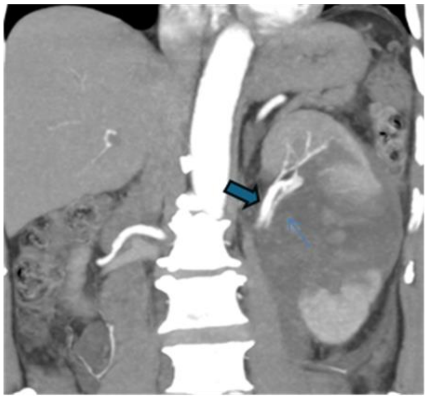

Figure A:

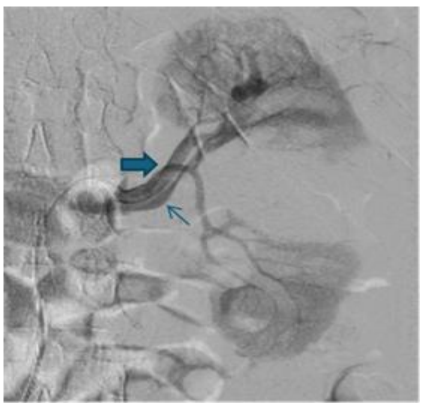

Figure B:

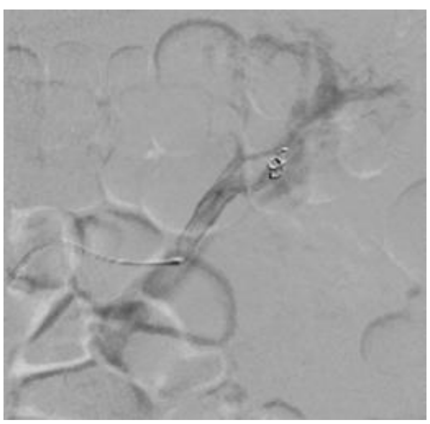

Figure C:

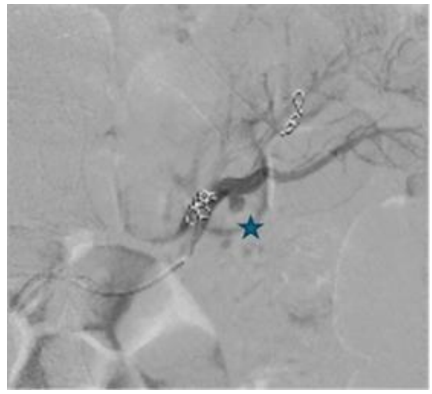

Figure D:

Figure E:

Figure 1 :Patient 1: A 56 year-old male developed gross hematuria after being hit by a car

A: CTA revealed large hematoma at mid pole of the kidney with opacification of renal vein and two pseudoaneurysms at the upper pole

B: DSA showing the same finding,

C: A coil oversized 20-30% was dislodged due to high flow,

D: After decrease in flow, another pseudoaneurysm became apparent,

E: After super selective cannulation with microcatheter, coil and glue Embolization done and the AVF closed. The rest of the renal parenchyma show normal enhancement suggestive of preserved renal perfusion. Thin arrow: segmental renal artery, thick arrow: renal vein, star: pseudoaneurysm

Figure A:

Figure B:

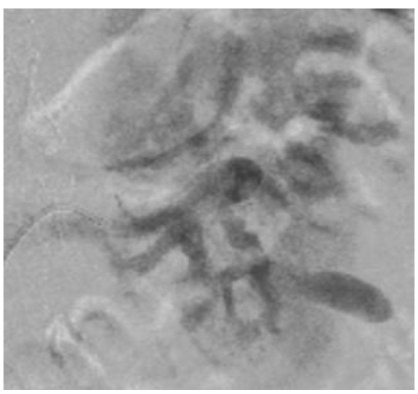

Figure C:

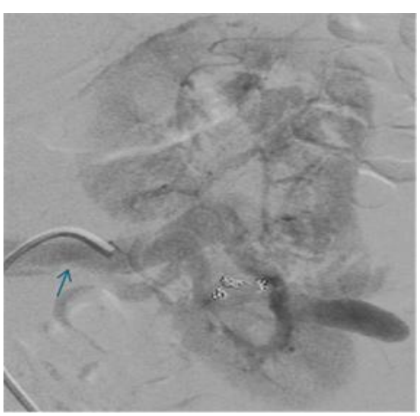

Figure D:

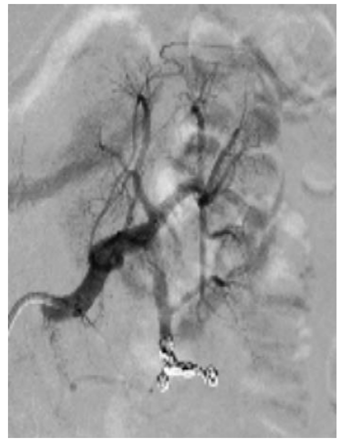

Figure E:

Figure 2: A 37 year old female presented with persistent heamturia post PCNL requiring multiple blood transfusions.

A: CT angio shows a pseudoaneurysm with

B: early opacification of left renal vein in arterial phase,

C, D: intraprocedural pictures,

E: After placement of few more coils and waiting for few minutes, there was complete embolization of the renal AV fistula. Thin arrow: renal vein

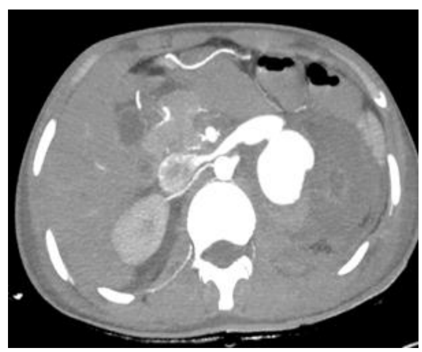

Figure A:

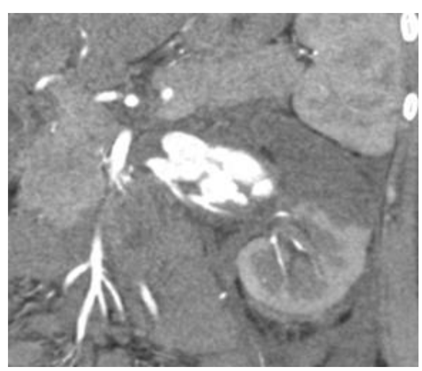

Figure B:

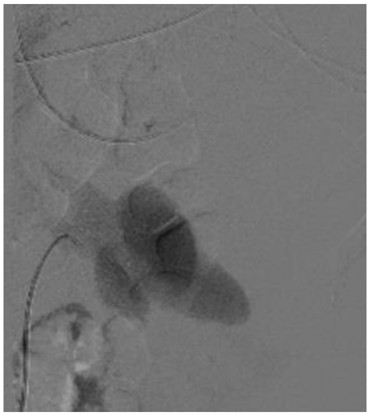

Figure C:

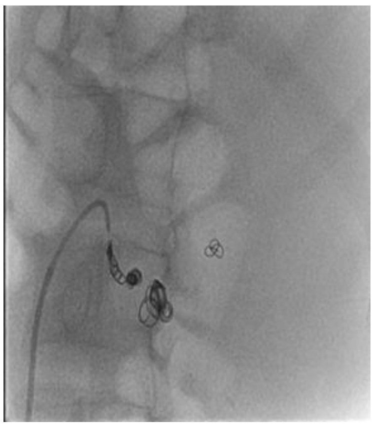

Figure D:

Figure 3 Details: A 19 year old male with stab wound presented with history of recurrent transfusion and hematuria.

A, B: A very high flow renal AVF with multiple sites of fistulous communications arising from main real artery on CT angiography.

C: No renal parenchymal opacification is seen due to very high flow in the fistula.

D: Multiple coils and glue was used. Stent graft could not be placed as there were multiple fistulous sites of fistula could not be delineated.

Embolization Techniques and Technical Outcomes

- **Coils** were used in all 8 patients, with superselective catheterization of the feeding artery. In very high-flow AVFs, oversizing of approx. 70-80% had to be done due to high flow
- **NBCA glue** was used in 3 patients, including one with a large, high-flow AVF.
- **Another concomitant pseudoaneuysm** was noted after occlusion of AVF and two pseudoaneurysms in one patient

Technical success, defined as complete occlusion of the AVF on post-embolization angiography, was achieved in all patients after the first attempt.

Clinical Outcomes and Complications

Clinical success, defined as resolution of symptoms and no need for further intervention, was achieved in all patients. Minor complications included transient post-embolization syndrome (vomiting, flank pain) in 2 patients, managed conservatively.

One patient in which main renal artery had to be embolized due to inability to place stent graft and urgent need for embolization due to the condition of the patient.

Renal function, assessed by serum creatinine and eGFR, remained stable in all patients

Discussion

Clinical Outcomes, Success Rates, and Complications in Literature

The findings of this case series are consistent with published literature, which report high technical and clinical success rates for endovascular embolization of renal AVFs

In a study on renal AVF by Guo H, the technical and clinical success rates were 100% and 96.3%, respectively, with 1 patient requiring a second embolotherapy at the third postoperative day.[6] Similarly, embolization in transplant recipients has demonstrated high efficacy and preservation of graft function.[7]

Complications of embolization are rare but may include non-target embolization, coil or plug migration, renal infarction, and, in high-flow AVFs, pulmonary embolism. The risk of non-target embolization can be minimized by superselective catheterization, appropriate sizing of embolic devices, and use of adjunctive techniques such as balloon occlusion or the pressure cooker technique

Comparison of Embolic Agents and Decision Algorithm

Coils

Coils are the most commonly used embolic agents for renal AVF embolization, particularly in low- to moderate-flow fistulas with accessible feeding arteries. Detachable coils offer precise deployment and retrievability, while pushable coils are cost-effective but less controllable.[8] Coils should be oversized by 20–30% to prevent migration, and tight packing density is associated with lower recanalization rates.

NBCA Glue

NBCA glue is preferred in high-flow AVFs or when rapid occlusion is required. Its use requires technical expertise due to the risk of proximal or distal migration and non-target embolization. Balloon occlusion or flow arrest techniques can enhance safety and efficacy.[9]

Vascular Plugs

Vascular plugs, such as the Amplatzer device, are effective in large, high-flow AVFs, offering rapid and secure occlusion with a single device. Plugs are retrievable prior to detachment, allowing for precise positioning. They are particularly useful when the feeding artery is large or tortuous, or when coil packing would be inefficient or risky.[10]

Stent-Grafts

Stent-graft placement is reserved for AVFs involving the main renal artery or when preservation of arterial flow is critical, such as in transplant kidneys. Covered stents can exclude the fistula while maintaining perfusion to the renal parenchyma.

Adjunctive and Advanced Techniques

- **Balloon-Assisted Embolization:** Reduces flow and risk of migration during coil or glue deployment, especially in high-flow AVFs.
- **Transvenous Approach:** Useful in AVMs or AVFs with a single draining vein, allowing for retrograde embolization and reduced risk of arterial ischemia.[11]

Table 2: Summary of Embolic Agents

Embolic Agent	Advantages	Limitations/Considerations
Coils	Precise deployment, retrievable (detachable), effective for small/medium vessels	Risk of migration in high-flow, may require multiple devices, less effective in coagulopathy
NBCA Glue	Rapid occlusion, effective in high-flow, works in coagulopathy	Risk of non-target embolization, requires expertise, difficult to control in high-flow
Vascular Plug	Single device, retrievable before detachment, effective in large/high-flow vessels	Requires larger delivery system, cost, may not be suitable for small/tortuous vessels
Stent-Graft	Preserves arterial flow, suitable for main renal artery AVF	Requires suitable landing zone, risk of stent thrombosis, antiplatelet therapy needed

The choice of embolic agent is dictated by the angioarchitecture of the AVF, vessel size, flow dynamics, and operator experience. Coils remain the mainstay for most AVFs, but in high-flow or large-vessel fistulas, plugs or glue may be preferred.

Limitations

This case series is limited by its retrospective design, small sample size, and single-center experience. Larger, prospective studies are needed to further refine embolization strategies and long-term outcomes. Nonetheless, the findings are consistent with published literature and provide practical insights into the management of renal AVFs.

Conclusions

Endovascular embolization is the treatment of choice for symptomatic or large renal arteriovenous fistulas, offering high technical and clinical success rates with minimal morbidity. Careful patient selection, individualized choice of embolic agent, and use of adjunctive techniques are critical for optimizing outcomes and preserving renal function.

Refrences

1. Y. H. Rhee et al., 'Endovascular occlusion of a renal arteriovenous fistula with renal vein aneurysm formation for rupture prevention', Case Rep Vasc Med, vol. 2019, 2019, p. 8530641.
2. S. Vignesh, B. Madhumitha and T. Mukuntharajan, 'Endovascular embolization of idiopathic renal arteriovenous fistula – A case report and literature review', Case Rep Clin Radiol, vol. 1, 2023, pp. 28-31.
3. M. Lubomirova et al., 'Incidence of A-V Fistulas after Renal Biopsy of Native and Transplanted Kidney - Two Centers Experience', Open Access Maced J Med Sci, vol. 3, no. 2, 2015, pp. 241-4.
4. S. K. Choi, G. E. Min and D. G. Lee, 'Congenital Renal Arteriovenous Malformation: Diagnostic Clues and Methods', Medicina (Kaunas), vol. 57, no. 12, 2021, p. 1304.
5. M. Van den Broecke, E. Vereecke and P. De Visschere, 'Renal Arteriovenous Fistula', J Belg Soc Radiol, vol. 104, no. 1, 2020, p. 10.
6. H. Guo et al., 'Management of iatrogenic renal arteriovenous fistula and renal arterial pseudoaneurysm by transarterial embolization: A single center analysis and outcomes', Medicine (Baltimore), vol. 96, no. 40, 2017, p. e8187.
7. L. M. Serna-Higuita et al., 'Treatment of Post-biopsy Arteriovenous Fistula of a Renal Graft by Selective Embolization', Indian J Nephrol, vol. 31, no. 2, 2021, pp. 201-4.
8. D. K. Sundarakumar et al., 'Embolization of a large high-flow renal arteriovenous fistula using 0.35″ and 0.18″ detachable coils', Indian J Radiol Imaging, vol. 23, no. 2, 2013, pp. 151-4.
9. T. Suzuki et al., 'Renal arteriovenous malformation treated using glue embolization under inflow and outflow control by balloon occlusion', Radiol Case Rep, vol. 19, no. 5, 2024, pp. 2035-8.
10. D. Castellano et al., 'Use of a 4 mm Amplatzer Vascular Plug II in the treatment of a renal arteriovenous fistula: a case report', CVIR Endovasc, vol. 4, no. 1, 2021, p. 40.
11. D. Markoutsas et al., 'Embolisation of a high-flow renal arteriovenous fistula with the use of simultaneous transvenous and transarterial approach and balloon-assisted coil embolization', CVIR Endovasc, vol. 7, no. 1, 2024, p. 37.