

A Comparative Observational Study of Dialysis Access-Associated Steal Syndrome, AVF-Associated Subclavian Steal Syndrome without Stenosis, and Red hand syndrome- Spectrum of Hemodynamic Complications Following Arteriovenous Fistula Creation

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Abstract: Arteriovenous fistula (AVF) is the most common type of vascular access for patients who need for long-term haemodialysis. AVF can lead to change in the blood flow resulting in high blood pressure in the veins, and in some cases, blood flow to the brain can be reduced. It is very important to recognize them accurately and conduct proper vascular assessments for correct diagnosis and treatment. The goal of this study was to look at the different kinds of haemodynamic problems that can happen after an AVF creation. This study followed 100 consecutive patients who had AVFs created at Sri Lakshmi Narayana Institute of Medical Sciences in Puducherry for haemodialysis. Patient who had symptoms underwent Duplex ultrasound. Out of the 100 patients, five (5.0%) had significant haemodynamic complications after AVF creation. Three patients had red-hand syndrome. AVF-associated subclavian steal syndrome without subclavian artery stenosis and DASS were each reported in one patient. It is important to differentiate between these conditions for further treatment strategies.

Keywords: Arteriovenous fistula; dialysis access-associated steal syndrome; subclavian steal syndrome without stenosis; red-hand syndrome; vascular access complications.

1. Introduction

Arteriovenous fistulae (AVFs) are the preferred permanent vascular access for patients undergoing maintenance haemodialysis. By creating a low-resistance vascular circuit, an AVF alters arterial inflow, distal tissue perfusion, and venous drainage, potentially resulting in distinct haemodynamic complications. Dialysis access-associated distal ischaemia, also known as dialysis access steal syndrome (DASS) or haemodialysis access-induced distal ischaemia (HAIDI), occurs when distal extremity perfusion becomes inadequate.

Rarely, an AVF may cause vertebral artery flow reversal and symptomatic subclavian steal in the absence of fixed subclavian stenosis, with high fistula flow producing a haemodynamic gradient that diverts blood through the vertebral circulation and may result in vertebrobasilar hypo perfusion.

Another complication is venous hypertension due to impaired peripheral or central venous outflow, which may present as a red, warm, swollen and congested hand, described as the “red hand” phenomenon. As these conditions may have

overlapping clinical features despite differing underlying mechanisms, this study describes five symptomatic cases identified among 100 patients with AVFs and compares their clinical presentation and haemodynamic mechanisms.

2. Methodology

Study design and setting

A prospective observational study involving 100 consecutive patients who underwent AVF creation for hemodialysis access at Sri Lakshmi Narayana Institute of Medical Science during the study period from January 2026 to August 2026.

Study population

Patients undergoing AVF creation were eligible for inclusion. Patients were followed-up for new symptoms or signs suggestive of arterial hypo perfusion, venous hypertension, or abnormal upper-limb/vertebrobasilar hemodynamics.

Clinical assessment

Assessment included inspection of the access limb for colour change, swelling, temperature, ulcers and tissue loss; palpation of radial and ulnar pulses; capillary refill; neurological examination of the limb; blood pressure

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measurement in both upper limbs where feasible; assessment for dialysis-associated symptoms; and screening for neurological symptoms such as dizziness, syncope, vertigo, diplopia or ataxia.

Vascular assessment

Duplex ultrasonography done to assess AVF flow, arterial waveforms, distal perfusion, venous obstruction, abnormal venous flow, and vertebral and subclavian arteries flow.

3. Result

Out of 100 patients, five developed vascular complication. Red hand syndrome was diagnose in three patients with two having right brachiocephalic fistula and one with left brachiocephalic fistulae (fig:1& fig:2). Similarly, AVF associated SSS without stenosis and DASS diagnosed in one patient each.

Complication	Number	Incidence among 100 AVF'S	Symptoms	Investigation Finding (Duplex Ultrasound)
Red-Hand Syndrome	3(2 right sided & 1 left sided)	3.0%	Red, warm, swollen/congested hand	- Dilated prominent superficial veins - Increased venous flow
AVF-associated SSS without stenosis	1	1.0%	Dizziness, headache, nausea, syncopal attack	- Reversal of flow in ipsilateral vertebral artery - Decreased reversal flow in vertebral artery on manual compression of AV fistulae - No stenosis of subclavian artery
DASS	1	1.0%	Pain in the right upper limb, tingling sensation with associated pallor	Arterial duplex show decreased distal arterial flow and decreased digital arterial flow



Figure 1: Red Hand Syndrome in left hand. Left hand appears red, warm and swollen compared with right hand



Figure 2: Dilated superficial veins in the right forearm with brachiocephalic fistulae suggesting Red Hand Syndrome.

4. Discussion

This study highlights the heterogeneous hemodynamic complications that may occur following AVF creation. Among 100 AVFs, five patients developed clinically significant symptoms: three presented with venous hypertension and a red-hand phenomenon, one with AVF-associated subclavian steal without fixed subclavian stenosis,

and one with dialysis access-associated distal ischemia (DASS).

DASS results from inadequate distal arterial perfusion and may range from coldness and paresthesia to rest pain and tissue loss. In contrast, AVF-associated subclavian steal may result from high-flow access producing vertebral flow reversal without an obstructive subclavian lesion. Venous hypertension represents a separate mechanism caused by impaired venous outflow, often related to peripheral or central venous stenosis, producing erythema, warmth, edema and venous congestion.

These findings emphasize the importance of a mechanism-based clinical assessment. A cold, painful hand warrants evaluation of distal arterial perfusion, whereas a red, warm, swollen hand should prompt assessment of venous drainage. Vertebrobasilar symptoms in patients with high-flow AVFs warrant evaluation of vertebral and subclavian hemodynamics. Accurate differentiation may help guide appropriate management while preserving vascular access whenever possible.

5. Conclusion

AVF creation can result in distinct hemodynamic complications involving distal arterial perfusion, the vertebral-subclavian circulation, or venous outflow. Recognition of these different phenotypes is important because their clinical features, vascular investigations and management strategies differ.

6. Future Scope

This study highlights the haemodynamic complication and emphasize the importance of differentiating the condition. Larger multicentre studies with standardized Doppler and haemodynamic assessment are needed to define the incidence, risk factors, and clinical significance of AVF-related haemodynamic complications.

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