

Acute upper limb ischaemia complication of thrombosed arteriovenous fistula

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SUMMARY

Thrombosed arteriovenous fistula is usually uncomplicated and adherent to the wall. Thrombosed vascular access causing acute limb ischaemia is rare, with only 16 cases reported in the literature. Varying treatment modalities such as percutaneous catheter-directed thrombolysis, aspiration, embolectomy, segmental aneurysm resection and ligation have been described in the literature for acute limb ischemia secondary to thrombosed fistula. The surgical approach aims to restore vascular patency, arterial stenosis and recurrence of acute limb ischaemia. This case series describes three cases of acute limb ischaemia due to a thrombosed fistula with a embolectomy via arterialized vein graft and ligation of the fistula at juxta-anastomosis. The clinical management and learning experience are shared within the report. This case report would timely contribute to the growing literature on thrombosed vascular access associated with acute limb ischaemia.

INTRODUCTION

Acute limb ischaemia (ALI) is a surgical emergency requiring urgent intervention. Upper limb ALI is commonly due to cardiac embolism and steal syndrome following vascular access creation. With the increasing global incidence of end-stage renal failure (ESRF) patients and advancement in medical care, multiple venous access creation prevails to be a necessary measure following aneurysmal degeneration and thrombosis of vascular access.¹ Chronic thrombosis of vascular access routinely does not require routine intervention unless associated with other complications. ALI is an infrequent complication of thrombosed vascular access, which occurs following multiple cannulations, fistula massage, dislodged free-floating thrombus and retrograde propagation to the arterial anastomosis. There are only 16 reported cases, with digital ischaemia being the most typical presentation.^{2,4} We presented three cases of upper limb ALI secondary to a thrombus involving a brachial fistula. These cases would contribute to the growing literature on thrombosed vascular access associated with ALI with an alternative surgical approach.

CASE PRESENTATION

Case 1

A 66-year-old man presented following 24-hour symptoms of the right hand and distal forearm coldness and pain. He had

a right brachiocephalic fistula (BCF) created 7 years ago, which failed to mature. Right brachio-basilic fistula was followed by transposition 6 years ago and was functional for 3 years. He was on regular dialysis via the right cuffed catheter.

There was an aneurysmal venous limb, and no thrill felt. His fingers, thenar and hypothenar eminence appear cyanosed (Figure 1a). He had a weak grip test and intact sensation, and prolonged capillary refill time was observed.

Computed tomography angiography (CTA) upper limb shows a thrombosed right BCF. Patent brachial artery down to a proximal third of radial and ulnar artery on delayed images. Faint opacification is seen distal to it due to heavy calcification.

We performed embolectomy in this case series via venotomy adjacent to juxta-anastomosis and ligation of venous limb. He had a stormy recovery requiring intensive care unit care, most likely due to reperfusion injury. His upper limb had a poor recovery, and the patient was counseled for above elbow amputation, which he refused. He passed away at home 1 month later.

Case 2

A 68-year-old woman presented with acute onset of right-hand pain and coldness while undergoing regular haemodialysis in our facility. She had multiple failed venous access and was dialysing using the right BCF, which was created 8 years ago and used for 6 years. She was on regular dialysis via right cuffed catheter when she complained of sudden pain and coldness 2 hours through her dialysis. Her dialysis was stopped due to worsening symptoms, and she was referred immediately to the surgical team.

Her fingers were cold with delayed capillary filling. Fingers appear cyanosed with peripheral capillary oxygen saturation ranging from 60 to 80% (Figure 1b). She had no muscle weakness; however, there was numbness over her fingers. The thrombosed arteriovenous fistula (AVF) had a pseudoaneurysm with no palpable thrill.

CTA shows thrombosed right BCF with non-opacification in the distal brachial artery measuring 2.7 cm in length with circumferential calcification of the right radial and ulnar arteries. Faint opacification is seen in the radial and ulnar

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Table 1: Perioperative Outcome

	Case 1	Case 2	Case 3
Pre-op CK	7685 U/L	31 U/L	679 U/L
Thrombus	A short segment from the radial artery and distal brachial artery	Short segment thrombus at the distal brachial artery segment	6cm long thrombus from distal brachial and ulnar
Post embolectomy Backflow:			
Brachial	Good	Good	Good
Radial	Poor	Minimal	
Ulnar	Poor	Minimal	Good
Intra-op Finding	Unable to pass beyond 10cm from bifurcation likely due to heavy calcification	-	Unable to locate the radial artery due to collaterals formation
Post-op Pulse:			
Brachial	2+	2+	2+
Radial	Absent	2+	Absent
Ulnar	Absent	1+	Absent
Post-op HDS:			
Brachial	Biphasic	Biphasic	Biphasic
Radial	Absent	Biphasic	Biphasic
Ulnar	Absent	Monophasic	Biphasic
CRT Post-op	No Improvement	Improved	No improvement
Post-op CK	Improved	Improved	Improved
Compartment syndrome	No	No	No

Creatinine Kinase (normal range 26-192 U/L)

arteries with normal opacification of the right axillary and subclavian artery.

Following embolectomy, patient discharged well with no motor or neurological deficit 1 year following surgery.

Case 3

A 76-year-old woman, ESRF since 2007, complained of left-hand pain and coldness. She presented to the emergency department 24 hours following her symptoms. She had a left radio-cephalic fistula created 12 years ago, which lasted for 8 years, and left BCF 4 years ago, which thrombosed 3 years later. She has been on dialysis via right radiocephalic fistula since then.

On examination, her left hand was perishing cold with mottling of fingers, thenar and hypothenar eminence up to the mid-forearm. There was evidence of aneurysmal degeneration over the cubital fossa and pseudoaneurysm at the forearm with no palpable thrill (Figure 1c). She complained of pain during passive movement and could move her fingers but could not perform a grip test.

Given Rutherford IIb, she was advised for urgent embolectomy with a possible need for below-elbow amputation. However, she refused surgery then; hence, we proceeded with an imaging investigation and intravenous heparin infusion.

Duplex ultrasound showed thrombosis of the left brachial artery arising from BCF (at its bifurcation) extending distally with no flow to the radial and ulnar arteries.

The patient refused surgery as amputation was the primary concern. She was pharmacologically treated with intravenous heparin infusion and adequate analgesia. She

revised her decision after 48 hours as there was no improvement, and an embolectomy was attempted to salvage her limb. Risk of ischaemic reperfusion injury, compartment syndrome and amputation was explained.

Postoperatively, no pulse was palpable; however, the radial and the ulnar signal were biphasic. The hand remained cold, and motor function remained the same. Two days after the embolectomy, she developed acute coronary syndrome during haemodialysis, which gradually deteriorated and succumbed.

All patients had creatinine kinase (CK) taken pre-operatively. An echocardiogram for all three patients did not show any evidence of cardiac thrombus. Computed tomography angiography of upper limb was done for Cases 1 and 2 (Figure 2).

Upon clinical diagnosis of acute limb ischaemia, heparin loading (80 unit/kg) and infusion (18unit/kg) were initiated. Lazy-S-incision was made with a proximal longitudinal incision along the medial border of the biceps, curve at cubital fossa skin fold to join medial border of brachioradialis distally, to expose distal brachial artery, bifurcation, and juxta-anastomosis. Brachial artery proximal to AVF anastomosis, radial, ulnar artery, and juxta-anastomosis were encircled with a vessel loop and vascular clamp (Figure 3).

Bolus heparin (40 unit/kg) was given before venotomy over the juxta-anastomosis, approximately 1 cm away from the anastomotic junction. Embolectomy of the brachial, radial and ulnar arteries was performed with assisted manipulation of Fogarty catheter Size 2 and 3. Heparin saline was flushed into the radial and ulnar arteries. Adjacent to venotomy, a non-absorbable suture was used to ligate close to the



Fig. 1: Described cases of acute limb ischaemia. Brachio-cephalic fistula (BCF) failed to mature, brachio-basilic fistula transposition with evidence of aneurysmal vein (A), BCF with pseudoaneurysm at the site of needling (B), RCF with forearm pseudoaneurysm and BCF with an aneurysmal vein

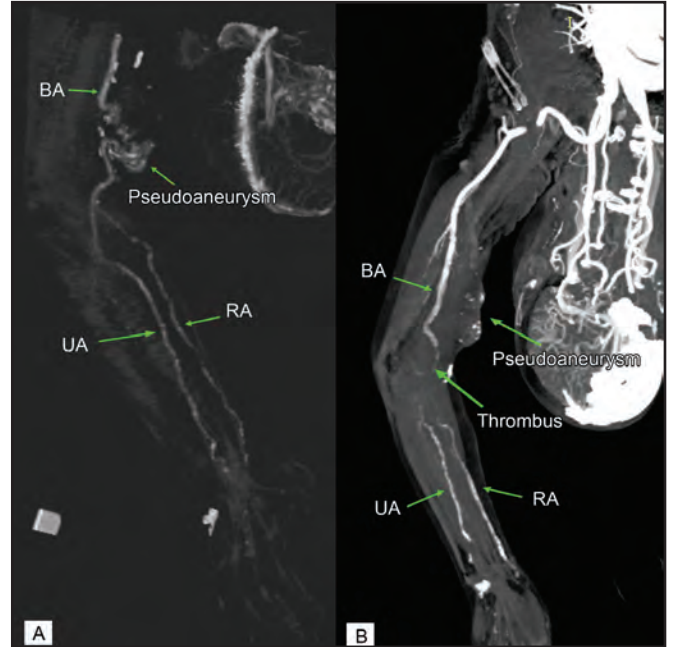


Fig. 2: CTA Images showing thrombosed right BCF. Patent brachial artery down to a proximal third of radius ulnar artery on delayed images. Faint opacification was seen distal to it due to heavy calcification (A), thrombosed right BCF with non-opacification in distal brachial artery measuring 2.7cm in length (B)

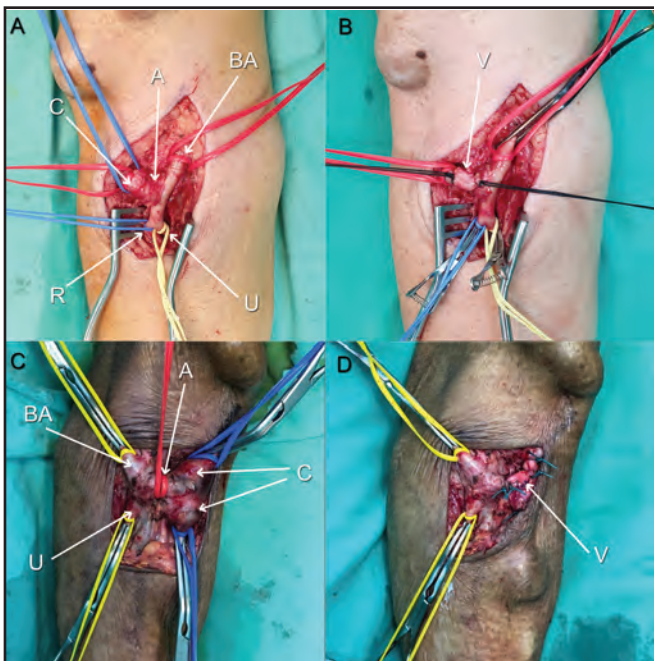


Fig. 3: Exposed vessel at cubital fossa, including arteriovenous anastomosis and juxta-anastomosis. Pre and post embolectomy images and site of venotomy at juxta-anastomosis. Case 2 (A, B) and Case 3 (C, D). BA: brachial artery; U: ulnar artery; R: radial artery; C: cephalic vein; A: anastomosis; V: venotomy

anastomotic junction. In our setting, we used coated polyester (Ethibond Excel) or Silk 1 to ligate approximately 2 mm from the anastomotic junction (Figure 3).

Refer to Table I for perioperative outcome findings.

DISCUSSION

Acute upper limb ischaemia is commonly associated with steal syndrome following vascular access creation and cardiac emboli. ALI associated with thrombosed AVF is under-reported, with the postulated hypothesis being it is due to significant aneurysmal venous degeneration causing distal arterial emboli. In ESRF patients with multiple comorbidities, a degenerative atherosclerotic vessel with collaterals and aneurysmal degeneration are common.^{1,4}

Based on the PubMed literature search, 11 publications were related to our described cases, with 14 cases of ALI in thrombosed native fistula and 2 cases in polytetrafluoroethylene grafts.^{2,4} All cases are thrombosed brachial fistula except two, from radial cephalic fistula. Most fistula were spontaneous ALI except in three cases following fistula massage and one after multiple cannulations.^{3,5,6}

ALI is a surgical emergency requiring urgent intervention. Early intervention is of paramount importance than imaging investigation, as irreversible tissue damage may result in amputation. However, in early presentation and ambiguous scenarios, imaging investigation is warranted.

Multiple treatment patterns have been observed from the literature for the management of thrombosed AVF-causing ALI. Measures such as percutaneous catheter-directed thrombolysis, aspiration, embolectomy, segmental aneurysm

resection, and ligation have been described.⁷ Catheter-directed thrombolysis has the benefit of being a less invasive procedure and is an ideal choice for distal limb ischaemia. However, there has been a concern about significant haemorrhage associated with thrombolysis. We opted for a surgical approach in our case series as we have no available intervention radiology services at our centre, and through this measure, we were able to intervene in the source of an embolus from a thrombosed fistula.

Elective ligation of the fistula is proven beneficial in high flow steal syndrome, heart failure and post-renal transplant patients.⁸ Thrombosed fistula does not typically cause complications that require ligation. Jasinski et al. described a case of ALI following AVF ligation. The learning point from this case is ligation leaving a long stump is a precursor for thrombus and shower embolus. Ligation of the fistula should ideally be 2 mm from the anastomosis.⁹

Surgical embolectomy is the ideal intervention option as it is approachable at the extremity, and the lumen patency can be restored immediately. Embolectomy approach through the arteriased vein graft leaves the native artery undisturbed from potential stenosis. Also, following ligation of the fistula, potential recurrent limb ischaemia is preventable as the cause of such cases is from a thrombosed venous limb.

CK should be sent in a delayed presentation as a guide for intervention. High CK has a high predictor of compartment syndrome, ischaemic reperfusion injury and amputation.¹⁰ As in our case, two patients who presented 24 hours following the onset of symptoms with high CK and distal vessel calcification contributed to poor outcomes despite surgical intervention.

CONCLUSION

Thrombosed AVF is usually uncomplicated and adherent to the wall. However, there is a high risk of thrombus dislodgement and embolism is largely underestimated. Early presentation and intervention are vital for good surgical outcome.

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DECLARATION

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CONFLICTS OF INTEREST

On behalf of all authors, the corresponding author states no conflict of interest.

ETHICAL APPROVAL

This manuscript is in line with local ethics protocol.

CONSENT TO PARTICIPATE

Patient and next of kin participation is entirely voluntary for this case report.

CONSENT FOR PUBLICATION

Written consent was obtained from the patient and next of kin for publication of their clinical details along with accompanying images.

CONTRIBUTORS

JM was involved in clinical care, conceptualisation and drafting of the manuscript. MTY and RH were involved in clinical care, revision of the manuscript for intellectual content and approval of the manuscript. YTT and TP are involved for the important intellectual content of the manuscript. All the authors read and approved the final manuscript.

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