



The rare complication caused by thrombus shedding during arteriovenous fistula thrombolysis: a case report

Jiali Liu^{1#^}, Tong Zhou^{1#^}, Kun Lai^{2^}, Zhouting Ren^{1^}, Zhiqiang Duan^{3^}, Heping Zhang^{4^}

¹Department of Clinical Medicine, North Sichuan Medical College, Nanchong, China; ²Department of Vascular Surgery, Affiliated Hospital of North Sichuan Medical College, Nanchong, China; ³Department of Nephrology, Western Theater Air Force Hospital, Chengdu, China; ⁴Department of Nephrology, Affiliated Hospital of North Sichuan Medical College, Nanchong, China

#These authors contributed equally to this work and should be considered as co-first authors.

Correspondence to: Dr. Heping Zhang, Department of Nephrology, Affiliated Hospital of North Sichuan Medical College, 1 Maoyuan Road, Nanchong 637000, China. Email: 867801115@qq.com.

Background: Arteriovenous fistula is the lifeline of maintenance for patients requiring hemodialysis, with thrombosis being a common complication of this procedure. Traditionally, thrombi have been removed via thrombectomy. In recent years, it has been reported that newly occurring thrombi can be treated by urokinase thrombolysis. However, the thrombus shedding in the process should be valued, which may cause the distal limb ischemia syndrome. The complication of thrombolysis is rare but serious. Patients will experience pain and numbness, and possibly even extremity necrosis may occur without diagnosed or treated timely. There are not any reports about the occurrence or treatment of distal limb ischemia syndrome caused by thrombus shedding during thrombolysis.

Case Description: Considering the thrombosis volume and texture of this case, we attempted to use urokinase thrombolysis to resolve the thrombus in fistula. During thrombolysis, thrombus shedding occurred in the distal limb. The patient's fingers of the limbs on the side of the internal fistula were pale, numb, and painful in the case. Fortunately, we solved the problem ultimately by continuously pumping urokinase. The heparin, urokinase, infusion pumps, ultrasound, and infrared therapy devices were obtained from the Affiliated Hospital of Chuanbei Medical College. Their usage and dosage are described in the relevant literature and China's 2020 blood purification standard operating procedures.

Conclusions: In the process of thrombolysis of arteriovenous fistula, attention should be paid to thrombus shedding. Distal limb ischemia syndrome is a rare but serious complication of thrombus shedding. Continued pumping of urokinase may be effective for this complication.

Keywords: Hemodialysis; arteriovenous fistula; thrombus; distal limb ischemia; case report

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Introduction

Thrombosis is a common complication of arteriovenous fistula. In this case, the thrombus was large but fresh. Considering the recency of the thrombosis and texture, we pumped the urokinase into the internal fistula to resolve the

thrombus. This approach was approved by the guidelines (1). However, rare complication was arosed in the process. We recorded the occurrence and treatment of distal limb ischemia caused by thrombus shedding during thrombolysis to provide reference for vascular access surgeons, since the

[^] ORCID: Jiali Liu, 0000-0001-5937-5112; Tong Zhou, 0000-0002-8029-6424; Kun Lai, 0000-0002-4832-5133; Zhouting Ren, 0000-0002-5207-6782; Zhiqiang Duan, 0000-0002-7487-2712; Heping Zhang, 0000-0002-3616-5531.



Figure 1 Tracing diagram of the internal arteriovenous fistula of the patient (stripes indicate thrombus, and arrow indicates the main stenosis of fistula vein).

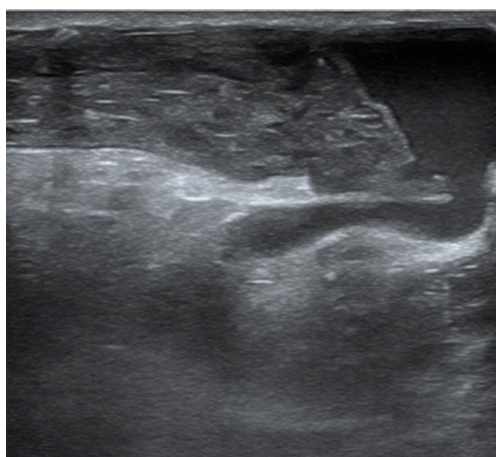


Figure 2 Ultrasonic image of the anastomotic stoma before thrombolysis.

similar situation had not been reported so far. We present the following article in accordance with the CARE reporting checklist (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-864/rc>).

Case presentation

The patient, a 45-year-old female, was hospitalized in the Affiliated Hospital of North Sichuan Medical College on April 23, 2021, because the “thrill” of the arteriovenous fistula had disappeared for 6 hours. The patient was

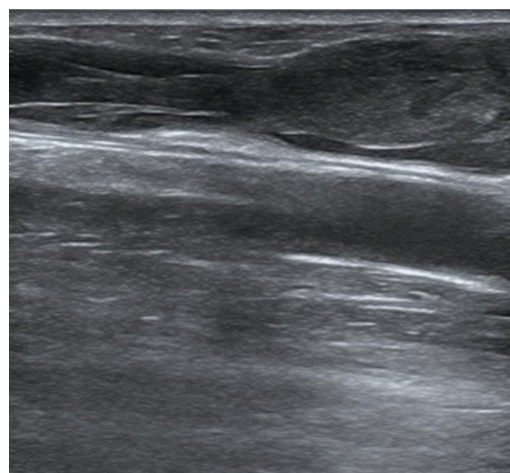


Figure 3 Ultrasound image of the fistula before thrombolysis.

diagnosed as stage 5 chronic kidney disease with the primary disease of chronic glomerulonephritis. Eight years ago, she underwent radio-cephalic arteriovenous fistula and maintenance hemodialysis in our hospital. Six years ago, an internal fistula thrombotic occlusion occurred, which was recanalized after systemic intravenous thrombolysis with urokinase. However, the internal fistula thrill disappeared again 6 hours before hospitalization.

Physical examination revealed that the internal arteriovenous fistula of the left wrist had no thrill, the anastomotic pulse was quickened, and there was no vascular bruit (*Figure 1*).

April 23, 2021, the laboratory testing results were the following: hemoglobin 123 g/L, platelet $245 \times 10^9/L$, total protein 91.3 g/L, albumin 48.3 g/L, creatinine 777.8 $\mu\text{mol/L}$, and uric acid 295.6 $\mu\text{mol/L}$. The plasma prothrombin time (PT) was 10.3 s, the partial thromboplastin time (APTT) was 28.7 s, the thrombin time was 18.7 s was 0.83, and the plasma fibrinogen concentration was 4.19 g/L, the international ratio of plasma prothrombin (INR).

April 23, 2021, ultrasonic vascular examination revealed 3 tumor-like dilations in the internal arteriovenous fistula vein of the left wrist and the presence of thrombus filling in the lumen from the anastomosis of the internal fistula to the median cubital vein, with a range of about 22 cm. The diameter of the median cubital vein was about 1.0 mm and the range was about 3 cm (*Figure 2* and *Figure 3*).

Combined with the above physical examination and examination results, this patient was diagnosed as: arteriovenous fistula thrombotic occlusion.

April 23, 2021, after evaluating the coagulation function



Figure 4 Distal limb ischemia on the side of the internal fistula.



Figure 5 Aggravated distal limb ischemia on the side of the internal fistula.

and characteristic bleeding of the patient, the surgical scheme was designed to include thrombolytic therapy with urokinase and percutaneous transluminal angioplasty after recanalization or volume reduction. Before thrombolysis, 3,000 u of low molecular weight heparin calcium was injected subcutaneously for anticoagulation. Under the guidance of ultrasound, a 20-g indwelling needle was used to puncture the fistula vein against the blood flow at a distance of about 3 cm from the anastomosis. The needle tip entered the anastomotic thrombus head and continuously pumped urokinase through the indwelling needle cannula.

Normal saline (20 mL) plus urokinase (200,000 u) was used as once therapeutic dose of thrombolytic drugs, which was micropumped into the blood vessel at the speed of 10 mL/h, and the thrombolytic related complications were closely observed during this period.

The treatment was divided into 3 parts, and urokinase was continuously pumped into the anastomotic port of internal fistula in each part of the treatment for two hours. At the end of treatment in part 1, there was thrill at the anastomosis and pulsation at the aneurysm. The patient had no bleeding. The second part lasted half an hour. The fingers of the limbs on the side of the internal fistula were pale, numb, and painful (*Figure 4*). At the same time, the patient did not have symptoms such as coughing, dyspnea, chest tightness or pain. Electrocardiogram monitoring showed that the patient was in sinus rhythm and with a pulse oxygen saturation of 100%. There was no way to get an angiogram quickly, but we performed a point-of-care vascular ultrasound instead. Vascular ultrasound examination showed that the anastomotic thrombus was loose. The fistula still had a large number of blood clots, but blood was able to pass through. The radial artery at the distal anastomotic port was about 1.2 mm in diameter and had a thrombotic blockage. The diameter of the wrist ulnar artery was about 1.3 mm, and with significantly calcified.

Combined with the patient's clinical manifestations and examination results, we updated the diagnosis as: distal limb ischemic syndrome and arteriovenous fistula thrombotic occlusion.

Next, we focused on both distal limb ischemia symptoms and fistula thrombosis. Continuous thrombolytic therapy with 10 mL/h of urokinase and infrared local hyperthermia on the distal limb of the internal fistula side were applied. At the end of part 2, the color of the palms and fingers changed from pale to dark purple (*Figure 5*). The patient still experienced significant pain and numbness and simultaneously. The fistula thrill and vascular bruit had been recovered. The vascular ultrasound showed thrombosis inside the radial artery of the wrist had disappeared, but there was no improvement in the distal limb ischemia of the patient. We don't know if the thrombus fell into the more distal vessels, but the shedding of the thrombus seems to suggest that urokinase may be working. A small amount of thrombus was still present in the anastomotic stoma and fistula vein, but blood was able to flow through. Fortunately, there was no bleeding of the patient. In part 3, the treatment continued. Halfway through, the patient's fingers began to recover a ruddy complexion, and the numbness and pain had



Figure 6 Ischemic relief of the distal limb on the side of the internal fistula.



Figure 7 Ischemic recovery of the distal limb on the side of the internal fistula.

reduced (*Figure 6*). At the end of the treatment in part 3, the color of the distal limb of the internal fistula side had recovered, and the numbness and pain had disappeared completely (*Figure 7*). The whole process of fistula in the vein thrilled obviously. We stopped the thrombolytic treatment and immediately applied percutaneous transluminal angioplasty to relieve stenosis (*Figure 8*). We successfully resolved the patient's arteriovenous fistula thrombotic occlusion and thrombolytic complication with 600,000 u urokinase during 6 hours (*Figure 9*). The

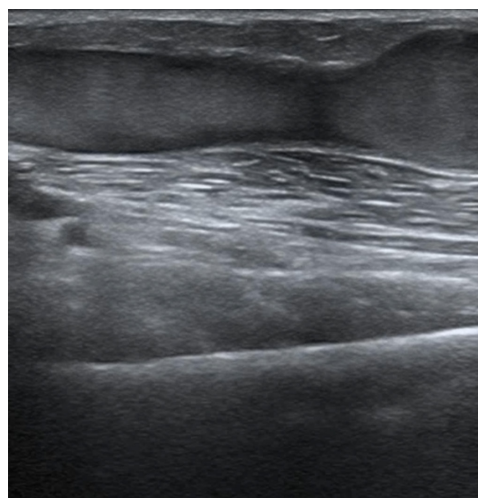


Figure 8 Ultrasound image of the fistula vessel at the end of thrombolysis.

patient trusted and respected us all the way. She underwent hemodialysis with the fistula the next day opportunely and had no abnormality in the distal limb on the fistula side.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

Arteriovenous fistula thrombosis is the primary cause of internal fistula occlusion. For fresh thrombi, China's 2020 standard operating procedures for blood purification indicate local urokinase thrombolysis as the first choice for arteriovenous fistula thrombus within 24 hours (1). In recent years, it has been reported that ultrasound-guided local urokinase thrombolysis in internal fistula is more effective (2). However, complications such as thrombus shedding may occur but are not mentioned more.

We should review the hemodialysis access-induced distal ischemia (HAIDI) firstly. HAIDI is a series of ischemia-related after the establishment of an arteriovenous fistula. The main mechanisms include all the reverse flow of palmar arch blood flow into the internal fistula, especially in high-flow internal fistulas. Arterial stenosis at the

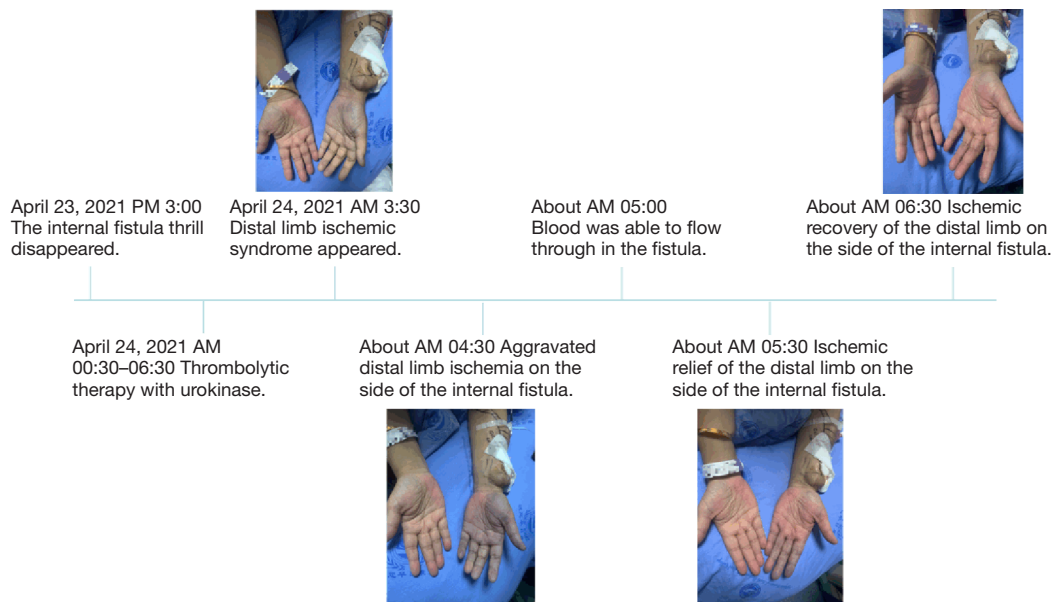


Figure 9 The timeline of the occurrence and treatment of distal limb ischemia syndrome caused by thrombus shedding during thrombolysis.

proximal end of the anastomosis or severe calcification or even occlusion of the arteries at the distal end, resulting in distal limb hypoperfusion (3). HAIDI is mainly manifested as coolness, paleness, pain, paresthesia, ulceration and even ischemic necrosis of distal limbs on the side of internal fistula. According to clinical manifestations, HAIDI can be divided into 4 grades. Patients with grades 1–2a can be treated conservatively, patients with grades 2b–4b need internal fistula surgical intervention or even amputation according to the severity (4). HAIDI is one of the long-term complications of arteriovenous fistula, which can last for several months or years, and the incidence rate is about 1–8% (5). However, the distal ischemia in our case was an acute process, with pallor, numbness, and pain within minutes. No related reports are found so far and there is no clear guideline or consensus in China or internationally concerning the optimal method for managing this thrombolysis complication for us to refer to. The distal ischemia in this case is different and similar to HAIDI. To avoid aggravation of ischemia and progression to limb necrosis, we need to remove the blockage of distal vessels as soon as possible to improve blood supply. Since the patient had no bleeding, we adopted continuous urokinase thrombolysis and local hyperthermia. Fortunately, the distal thrombus and limb ischemia were resolved.

We need to analyze the reason for the thrombus dislodging in this case. When the tip of the thrombolytic needle is located at the anastomotic thrombus head, where

the concentration of urokinase is relatively large, thrombus loosens easily, but the proximal stenosis and thrombus are not relieved, and the loose thrombus falls off to the distal radial artery, with the caliber and inner wall of the ulnar artery being poor. Thus, distal limb ischemia occurs. It is particularly important to evaluate the situation of thrombosis and formulate a treatment plan. If the thrombus head is at or near the anastomotic orifice and there is severe stenosis or large-volume or long-segment thrombus near the cardiac end, clinicians should be alert to the shedding of the thrombus at the anastomotic orifice.

Conclusions

In the process of thrombolysis of arteriovenous fistula, attention should be paid to thrombus shedding. Distal limb ischemia syndrome is a rare but serious complication of thrombus shedding. Continued pumping of urokinase may be effective for this complication.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://apm.amegroups.com>.

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-864/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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