Kidney Res Clin Pract 35 (2016) 59–62

Kidney Research and Clinical Practice

journal homepage: http://www.krcp-ksn.com
Contents lists available at ScienceDirect

Case Report

An unusual case of fistula formation and thrombosis between arteriovenous graft and a native vein

Young Sub Kim, Seung Ok Choi, Jisun Choi, Changjo Im, Byoung Geun Han*

Division of Nephrology, Department of Internal Medicine, Yonsei University Wonju College of Medicine, Wonju, Korea

Article history:
Received 5 March 2015
Received in revised form
19 June 2015
Accepted 9 July 2015
Available online 26 July 2015

Keywords:
Graft thrombosis
Graft to vein fistula
Prosthetic graft complication

Abstract

Arteriovenous graft for hemodialysis vascular access is a widely used technique with many advantages. However, it has crucial complications with graft thrombosis and infection. We recently experienced an unusual case of arteriovenous graft complication involving graft thrombosis related to fistula formation between the graft and the natural vein with infection. We diagnosed this condition using Doppler ultrasound and computed tomography angiography. Successful surgical treatment including partial graft excision and creation of a secondary arteriovenous fistula using an inadvertently dilated cephalic vein was performed. The dialysis unit staff should keep this condition in mind and try to prevent this complication.

Introduction

Vascular access for the patient on hemodialysis (HD) is so important as to be called a lifeline. Although native arteriovenous fistula (AVF) remains a preferred conduit for dialysis access, arteriovenous graft (AVG) using polytetrafluorethylene is a widely used technique with many advantages such as a short duration between placement of the AVG and initiation of cannulation, easy placement, and no need for an adequate superficial vein [1]. However, AVG has crucial complications with graft thrombosis and infection. Vascular access failure caused by thrombosis or infection represents a leading cause of hospitalization in the HD patients, and it is very important to solve these problems to maintain HD.

We report an unusual complication of AVG involving graft thrombosis related to the fistula formation between graft and underlying adjacent vein in the setting of graft infection, and leading to the successful creation of secondary native AVF.

Case report

A 63-year-old man on maintenance HD visited our emergency department for fever and AVG malfunction. He had been previously diagnosed with end-stage renal disease, atrial fibrillation, and hypertension. The patient also underwent AVG with a 6-mm polytetrafluorethylene in his left upper extremity (brachial artery–axillary vein straight type) 23 months earlier. Physical examination showed a blood pressure of 129/60 mmHg, pulse of 84 bpm, respiratory rate of 25 times/min, and body temperature of 38.2°C. The skin surrounding the arterial cannulation site of AVG has cutaneous erythema, swelling, tenderness, and pus discharge. Graft thrill was noted on the arterial limb of AVG, but it was felt weakly on the vein limb. Laboratory testing revealed a white blood cell count of 11,600/mm^3, hemoglobin of 9.0 g/dL, and platelet count of 145,000/mm^3. Arterial blood gas analysis showed pH 7.532, pO_2 59.6 mmHg, pCO_2 24 mmHg, HCO_3 19.7 mmol/L, and O_2 saturation 91%. C-reactive protein was elevated to 18.3 mg/dL.

Vital signs and laboratory findings were consistent with systemic inflammatory response syndrome, and methicillin-

* Corresponding author. Yonsei University Wonju College of Medicine, 20, Ilsan-ro, Wonju, Gangwon, 220-701, Korea.
E-mail address: neptune@yonsei.ac.kr (BG Han).

http://dx.doi.org/10.1016/j.krcp.2015.07.001

resistant *Staphylococcus aureus* was documented both in the blood and pus discharge. Therefore, we believed that sepsis was caused by AVG infection. At that time, it was not possible to perform HD using the AVG because the venous site of the AVG was occluded with thrombus. Systemic vancomycin and rifampicin was prescribed for bacteremia, and a temporary double-lumen catheter was placed in the right jugular vein for regular HD.

Imaging studies were performed to evaluate AVG occlusion. Doppler ultrasound (US) identified a subcutaneous abscess around the graft in the antecubital area and a fistula tract between the AVG and the natural cephalic vein at the arterial cannulation level of the AVG. The connected cephalic vein ran parallel to and just under the AVG and was dilated to 13 mm in diameter. The superior aspect of the postfistula graft was totally occluded with thrombus, and intragraft blood flow from brachial artery entirely ran to the connected cephalic vein through the fistula, as shown in Fig. 1. We then noticed that the thrill felt weakly over the upper arm for the first time came from the underlying dilated cephalic vein, not from AVG. Computed tomography (CT) angiography showed the same findings more clearly, as illustrated in Fig. 2. Perigraft infiltration and extravasation of contrast fluid were not shown on CT images. In US and CT images, we could not evaluate the outflow stenosis between graft and axillary vein because the venous limb of AVG had been totally occluded.

Surgical exploration was performed to treat the AVG infection and repair the fistula. Dissection was very difficult because of severe adhesions of the graft and vessel to the soft tissue. After isolating the AVG and vessels, a 2-mm-sized fistula was identified between the posterior wall of the graft and the underlying cephalic vein, as shown in Fig. 3. The fistula tract was separated, and we confirmed that the thrill on the upper arm disappeared. This indicated that the flow to the cephalic vein originated from the fistula.

Partial graft excision from the arterial anastomosis site immediately distal to the fistula and removal of infected tissue were performed. We created a new autogenous AVF by anastomosing the natural dilated cephalic vein to the distal part of the brachial artery (end-to-side anastomosis). We expect that the newly formed AVF will soon be functional because the cephalic vein is already dilated, and the flow is greater than 1,400 mL/min as measured by US Doppler on the 7th day after operation.

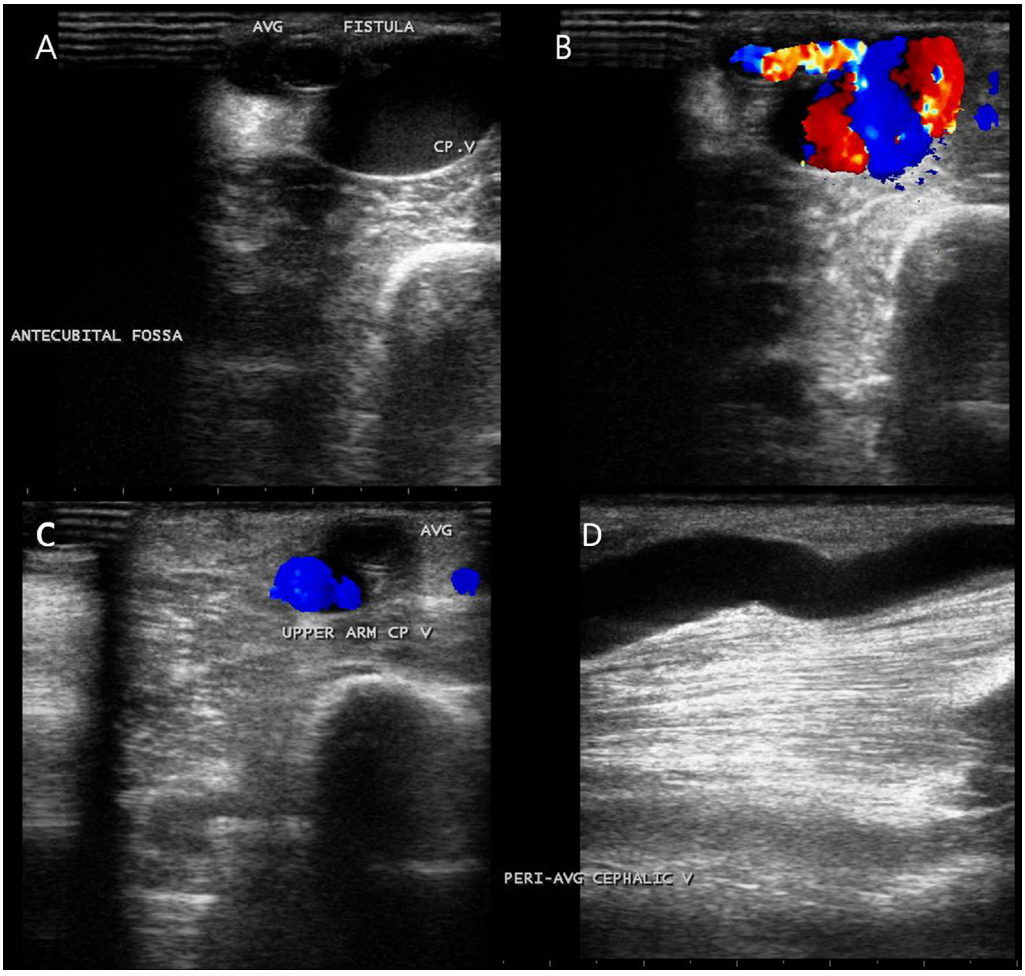

Figure 1. Doppler US findings. (A) Doppler US reveals that the cephalic vein under the AVG was dilated to 13 mm in the antecubital area. (B) It shows blood flow from the AVG to the cephalic vein. (C) On the upper arm, there was no flow in the AVG. (D) In the longitudinal image, the postfistula cephalic vein on the upper arm is dilated to almost 6.9 mm in diameter.
AVG, arteriovenous graft; CP, cephalic; US, ultrasound; V, vein.

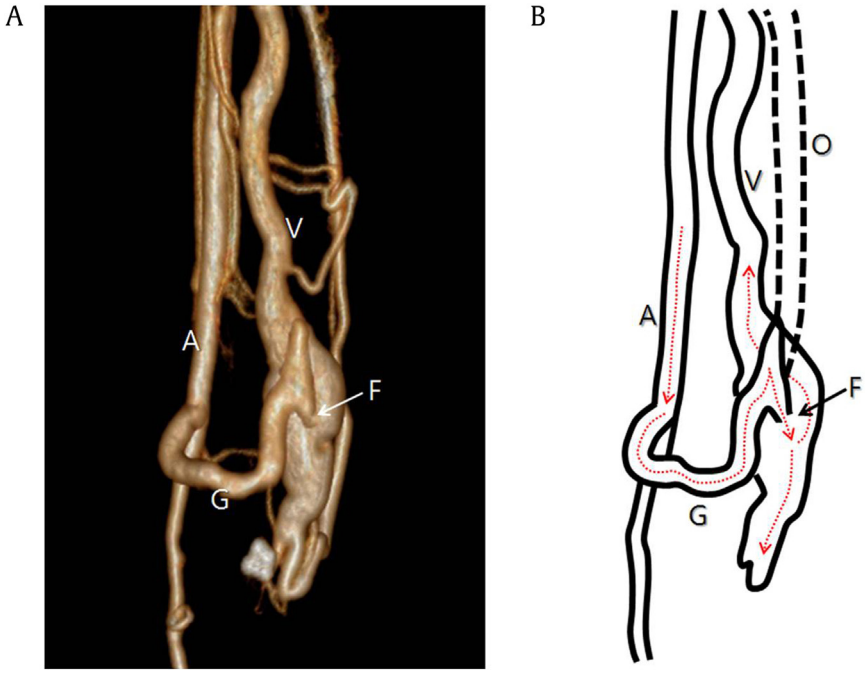

Figure 2. CT angiographic finding. CT angiography (A) and a schematic image (B) clearly show the structural condition of the fistula between the AVG and the cephalic vein. Dotted line indicates the direction of blood flow.
A, brachial artery; AVG, arteriovenous graft; CT, computed tomography; F, fistula; G, AVG; O, occluded part of the AVG not visible on CT angiography; V, cephalic vein.

Discussion

The graft to vein fistula (GVF) means a fistulous connection between the AVG and the adjacent vein. GVF formation is an uncommon complication of AVG that can lead to the graft thrombosis, and its incidence varies between 0.027% and 9% in different reports [2,3].

There have been several cases regarding this topic, which reported that fistula formation was frequently associated with pseudoaneurysm and venous outflow stenosis [2,4–6]. However, in this case, the fistula occurred directly between the graft and the natural vein without a pseudoaneurysm. The venous outflow stenosis was not evaluated, but we believe that the venous outflow stenosis might have been existed.

We cannot determine how this process was developed, but trauma from repeated AVG cannulation during HD might cause development of GVF in the condition of pre-existing venous outflow stenosis. When the GVF occurred by cannulation trauma, increased intragraft pressure due to the pre-existing venous outflow stenosis might persist the GVF. If there was no venous outflow stenosis, we believe that the GVF might disappear naturally. In this situation, blood flow from brachial artery was divided into 2 pathways, the AVG decreased in flow with growing the cephalic vein connected to GVF. Then infection was developed accidentally, it would disturb the intragraft blood flow and decrease the intragraft pressure. Finally, decreased intragraft pressure caused AVG thrombosis, and all blood flow ran through the GVF.

In this case, the patient presented with graft occlusion, infection, and sepsis, but clinical symptoms and signs of GVF are various in different reports. It might be asymptomatic and only detected by physical examination. However, side effects such as increased pressure in access during HD, graft site swelling because of the venous outflow stenosis, poor flow due to decreasing intragraft pressure, graft thrombosis and occlusion, and prolonged bleeding at the puncture site may be experienced [2,4–7].

In almost the whole previously reported cases, the GVF was confirmed by arteriovenous fistulography [2–7]. Although fistulagraphy is an invasive procedure, it is the gold standard method to precisely evaluate a fistula and to develop a treatment plan for existing problems. However, in case of graft infection, fistulography is not recommended because it has a significant risk of diffusion of the infection along the graft [8]. We were able to evaluate structural conditions using a common CT angiography protocol. In addition, we were able to evaluate hemodynamics using Doppler US.

Treatment of the GVF was based on the clinical importance of hemodynamic effects. In case of asymptomatic GVF or that has little effect on hemodynamics, we can wait and see until it will disappear naturally. A GVF associated with AVG thrombosis can be treated by surgical ligation or selective catheterization and an embolization of the fistula tract, followed by mechanical thrombectomy [2–7]. In the present case, the GVF has need to treat because it dilated the connected natural cephalic vein, which received large amount of blood flow from the graft, and the postfistula graft was occluded with thrombus. If not accompanied by graft infection, treatments of fistula ligation and thrombectomy can be considered. However, we had no choice but to remove the graft because of methicillin-resistant *Staphylococcus aureus* graft infection. Removal of the AVG and the fistula through surgery was not problematic. However, the important issue was maintaining a route of access for continuous HD. After careful consideration, we removed the infected graft and created a secondary autogenous AVF with the inadvertently dilated cephalic vein.

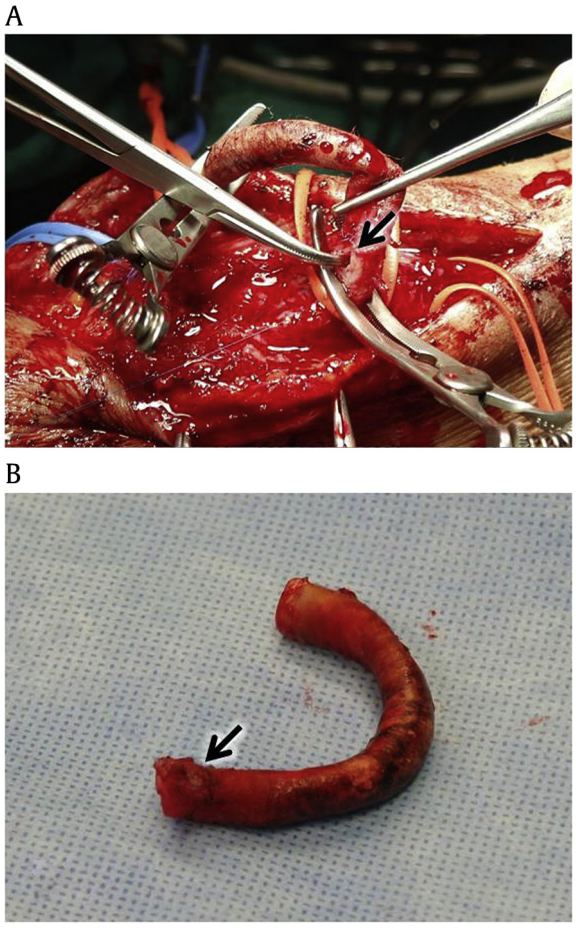

Figure 3. Surgical findings. (A) On surgical exploration, we identified a fistula between the posterior wall of the graft and the underlying cephalic vein. A forceps is inserted into the hole of the separated fistula (arrow). (B) The partial resected graft has an approximately 2-mm-sized round hole (arrow) on the posterior wall.

Based on the report that a partial graft excision has a higher recurrence rate of local infection than a total graft excision, we planned a total graft excision [9]. However, severe adhesion between the vessel and the soft tissue had occurred because of the infection, making proper dissection difficult. In addition, the dilated cephalic vein was close to the graft, producing a high risk of vein injury during dissection. Therefore, partial graft resection was performed. The operation was successful, the AVG infection and the fistula formation were treated, and the secondary autogenous AVF, which is expected to be function within a short amount of time, was created. It will be important to carefully follow-up the recurrence of infection in the remained graft.

Because the GVF developed from repeated and concomitant cannulation of the graft and adjacent vein, proper cannulation techniques are very important to prevent this complication [7]. Avoiding cannulation with adjacent vein to penetrate the graft, rotated cannulation to allow adequate healing of the previous cannulation site, and proper compression of cannulation site at the end of HD to prevent persistent connection between the graft and the vein are helpful in preventing this complication. In addition, it is important to monitor the development of the venous outflow stenosis.

We report this unusual experience of AVG thrombosis related to the GVF, leading to creation of a secondary AVF with the inadvertently dilated cephalic vein. We believe that Doppler US and CT angiography are suitable noninvasive modalities to diagnose the GVF. The dialysis unit staff should keep this uncommon complication in mind and try to prevent this complication. In addition, as making a decision to treatment of this condition, another vascular route for lifeline should be considered.

Conflicts of interest

All authors have no conflicts of interest to declare.

References

[1] Taal MW: Brenner & Rector's the kidney. In: Jane YY, Daniel BO, Thomas AD, eds. Hemodialysis. Philadelphia, PA: Elsevier/Saunders, 2299–2300, 2012
[2] Kanterman RY, Vesely TM: Graft-to-vein fistulas associated with polytetrafluoroethylene dialysis grafts: diagnosis and clinical significance. *J Vasc Interv Radiol* 6:267–271, 1995
[3] Standage BA, Schuman ES, Quinn SF, Ragsdale JW, Sheley RC: Single limb patency of polytetrafluoroethylene dialysis loop grafts maintained by traumatic fistulization. *Ann Vasc Surg* 12:364–369, 1998
[4] Margoles HR, Shlansky-Goldberg RD, Soulen MC, Trerotola SO: A proposed management algorithm for fistulae between hemodialysis access circuits and adjacent veins. *J Vasc Access* 13:374–380, 2012
[5] Min SK, Park YH, Lee HH, Lee JS, Chung WK, Lee JH, Koh YH, Seo TS: Iatrogenic fistula between prosthetic haemodialysis access graft and autogenous vein: unusual cause of graft thrombosis. *Nephrol Dial Transplant* 19:2647–2649, 2004
[6] Haddad NJ, Vachharajani TJ, Van Cleef S, Agarwal AK: Iatrogenic graft to vein fistula (GVF) formation associated with synthetic arteriovenous grafts. *Semin Dial* 23:643–647, 2010
[7] Hwang JK, Moon IS, Kim JI: Vascular access graft thrombosis by iatrogenic fistula. *Dial Transplant* 39:214–215, 2010
[8] Legout L, D'Elia PV, Sarraz-Bournet B, Haulon S, Meybeck A, Senneville E, Leroy O: Diagnosis and management of prosthetic vascular graft infections. *Med Mal Infect* 42:102–109, 2012
[9] Schutte WP, Helmer SD, Salazar L, Smith JL: Surgical treatment of infected prosthetic dialysis arteriovenous grafts: total versus partial graft excision. *Am J Surg* 193:385–388; discussion 388, 2007