Interventional Treatment for Complete Occlusion of Arteriovenous Shunt: Our Experience in 39 cases

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Complete occlusion of arteriovenous shunt is a feared complication of hemodialysis due to limited vessels suitable for reconstruction of arteriovenous shunt. For prolonged use of the arteriovenous shunt, there are many methods for restoring the function of the occluded arteriovenous shunts. So far the standard treatment for complete occlusion of arteriovenous shunt is surgery. Interventional procedure serves as an alternative method for restoring the function of the arteriovenous shunt.

All of the patients in our study had underlying stenosis of blood vessels. The interventional treatment we performed could restore the normal blood flow in the occluded arteriovenous shunt and provide dilatation of the underlying stenosis by performing percutaneous transluminal angioplasty (PTA) at the same time.

Key words: Arteriovenous shunt, Hemodialysis, Percutaneous transluminal angioplasty

The vascular access for hemodialysis can be artificial (polytetrafluoroethylene graft) or native (Brescia-Cimino arteriovenous fistula). Partial or complete occlusion of the arteriovenous shunt is the most common and serious complication of hemodialysis. Surgical thrombectomy and revision is the main way for treatment of complete occlusion. However, the successful rate varies from 28% to 73%. As compared with the surgery, the successful rate for percutaneous restoration of arteriovenous shunt was reported ranging from 46 to 68% [2]. With the improvement of the technique, the restoration rate of complete occluded arteriovenous shunt was increasing. Using both of the mechanical PTA and medical thrombolytic agent, the initial restoration rate was 87% in our institute.

MATERIAL & METHODS

From January 2000 to January 2001, 39 patients (17 men and 22 women, age range 27 to 82 years, mean age 72) who had total occlusion of arteriovenous shunt in our hospital were sent to our department for restoration of the arteriovenous shunt. The occlusion time ranged from 3 hours to 10 days. Of the 39 patients, 29 patients had polytetrafluoroethylene arteriovenous fistula and 10 patients had native arteriovenous shunts.

The diagnosis of complete occlusion was based on signs of absence of bruit or thrill with palpation. Besides, minimal amount of contrast medium would be injected under fluoroscopy in any equivocal cases.

Local anesthesia at the puncture site with lidocaine hydrochloride (Xylocaine, Abbott Laboratories, North Chicago, Ill) was performed first. For polytetrafluoroethylene arteriovenous fistula, vascular access was obtained via puncturing with 18-gauge intravenous canula needle (IC needle) (Vasocan, B. Braun Melsungen AG) directly into the polytetrafluoroethylene graft and he outer sheath was pushed into the vascular lumen till the tip of the IC needle within the lumen. In case of questionable condition, injection
of minimal amount of contrast medium may be useful to confirm the position of the tip of the IC needle (Fig 1a). For both polytetrafluoroethylene and native Brescia-Cimino fistula, the venous route (Fig 1b) was preferred, but puncturing at the brachial artery would be performed in case of failure in localization of the venous route. 1cc (2000U) heparin was injected before the procedure to prevent formation of blood clot during the procedure. Subsequent urokinase of 240,000 to 600,000 U was injected within the thrombotic segment for thrombolysis. Then, we waited the thrombolytic agent to act for 15-30 minutes. Meanwhile, massaging at the arterial anastomotic region was also performed which might cause dislodgment of any potential residual thrombi. If thrombolysis was not completed, mechanical crush or dislodgment of the residual thrombi with the balloon catheter would be performed.

Angioplasty with balloon catheter (Diamond; Meditech/Boston Scientific, Watertwon, Mass) (burst pressure, 15 atm) was achieved when thombolysis was completed and the underlying stenotic segments became visible in fistulogram. The adequate size of the balloon was selected so that the diameter of the balloon would be similar to the normal diameter of the vessel adjacent to the stenotic segment. Dilatation was done until the pressure gauge reached 16 atm or the stenotic segment seen as waist under fluoroscopy became completely disappeared (Fig 2a to 2d). If complete dilatation was not successful, dilatation would be repeated for three times, during each time the balloon was kept dilatation for 1 minute. Fistulogram after the procedure was performed to evaluate the response to treatment.

Primary patency is defined as the interval between the thrombolytic procedure and the subsequent graft failure. Secondary patency is defined as the interval between the first thrombolytic procedure for a thrombosed graft and any surgical procedure required to restore the vascular access (revision or replacement), allowing for intercurrent percutaneous procedures (PTA or repeated thrombolysis) [7]. Although thrombolysis procedure can be repeated many times, eventually the vascular access still needs surgical treatment or being abandoned.

RESULTS

Of all 39 patients, the blood flow in the arteriovenous shunt was successfully restored in 34 patients, with the successful rate being 87% (34/39). Technical failure of the procedure occurred in 5 patients, 4 of them had native arteriovenous shunt (4/10), and only one of them had polytetrafluoroethylene arteriovenous shunt (1/29). Underlying stenosis are seen in all cases, so PTA was needed to restore the blood flow in all cases. Primary patency at 3 month, 6 month and 1 year are 68% (23/34), 53% (18/34), and 46% (16/34) respectively. With repeated procedures, the secondary patency at 3 month, 6 months and 1 year are 82% (28/34), 76% (26/34) and 56% (19/34) respectively (Table 1).

There was complication of venous rupture in 2 cases, which is the cause of technical failure in one case. Time of procedure ranged from 45 minutes to 5 hours. For the native arteriovenous shunt, the time of procedure was especially prolonged, which was frequently more than 2 hours.
DISCUSSION

Although surgical intervention serves as the main treatment method for completely occluded arteriovenous shunt, surgical approach requires hospitalization of the patients and there is time lag between surgical procedures and re-use of the arteriovenous shunt. Other route of dialysis such as insertion of double lumen catheter in the jugular vein is usually necessary during the course, which increases the suffering of the patients.

On the contrary, interventional procedure can be performed in OPD patients. After successful treatment, the patients can undergo dialysis immediately. As underlying stenosis is always present, percutaneous transluminal angioplasty of the stenotic segments can be performed simultaneously during the procedure (Fig 3a to 3c).

However, the use of interventional approach is not a simple task. Simple urokinase injection to restore arteriovenous flow is often useless, as underlying stenosis also exists as our cases. To restore arteriove-
Concomitant angioplasty must be performed. The stenotic segment can be predicted most often as located in the downstream of the thrombotic segment [4].

The reason for high failure rate for native arteriovenous shunt was that variable collateral blood vessels are noted and multiple accessory veins might be exist [3]. When the original outflow tract was previously occluded but the venous return was maintained by these collaterals, manipulation might be difficult, especially when the collateral flow was in the reverse direction (Fig 4). The other problem was collapse of the occluded vessel of which puncture was often a difficult process. Even puncturing in the arterial route, the collapsed vessel was not always found. Venous rupture during the procedure was another problem. Although venous rupture could be treated with prolonged balloon inflation [6] during PTA, venous rupture in complete occluded arteriovenous shunt resulted in loss of the original tract and technical failure in one of our case.

That repeated thrombolysis with urokinase was required for long segments of thrombolysis which prolongs the procedure time to a certain extent.

**CONCLUSION**

Restoration of the failed arteriovenous shunt with interventional procedure can serve as an alternative option of treatment which obviates the need for hospitalization and renders the immediate reuse of the failing shunt. Besides, the use of PTA during

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**Figure 3.** a. Multiple filling defects (arrows) within the shunt indicated deposition of thrombi which resulted in complete occlusion of the arteriovenous shunt. b. After successful thrombolysis with urokinase, residual thrombi (thin arrows) and stenosis (thick arrow) in the peri-anastomotic region of the venous route was seen. Subsequent PTA with 6-mm balloon dilator was performed to clear the residual thrombus and dilatation of the stenotic segment. c. Fistulogram after the procedure showed successful dilatation of the stenotic segment (arrow).

**Figure 4.** A 57-years-old female. After thrombolysis of the native AV shunt, the flow was found to be maintained by collateral vessel in the reverse direction of flow (thin arrow). The original venous route was a blind end tract (thick arrow), the patient had long history of elevated pressure during hemodialysis.
procedure can provide treatment of underlying stenosis. However, the procedure time is long, frequently more than one hour even in experienced hands.

High failure rate was noted for the native arteriovenous shunt, which may be due to more difficult technical approach to the vessels with variable collateral vessels in numbers and directions. Sometimes, repeated PTA may be necessary to keep patency of the arteriovenous shunt [5]. The secondary patency rate after one year is 54% as shown in our study. Since the result is comparative to surgical procedure, interventional procedure can serve as an alternative option of treatment for restoration of the completely occluded arteriovenous fistula.

REFERENCE


對完全阻塞的動靜脈分流之介入性療法：
39個病例之經驗

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動靜脈分流的完全阻塞是血液透析中令人擔心的併發症，因為能做為洗腎用途動靜脈分流的血管數量有限。為了延長動靜脈分流的使用時間，有很多方法被發展出來。雖然目前還是以外科手術治療為主，但是介入性療法其實也可以提供另一解決動靜脈分流的完全阻塞的治療方法。

在我們所做的病例中，所有的病患都合併有血管狹窄。介入性療法除了可以解決完全阻塞的問題外，也可以經皮血管成型術一併解決其血管狹窄之問題。

關鍵詞：動靜脈分流，血液透析，經皮血管成型術