

Surgical repair of aneurysm of arteriovenous fistula in patients with chronic renal failure

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Abstract

The aim of the study was to show the efficacy and results of aneurysm reconstruction that was developed for relieving the patients from pain and mass effects and to give an early hemodialysis option.

Material and methods: Medical records were retrospectively screened over a period of 17 years to identify patients diagnosed with and surgically treated for aneurysm of an AV fistula. Twenty-eight patients were included in this study. The mean average age was 44 ± 3 years (31-60). Seventeen (60.7%) patients were female. Twenty-two (78.5%) patients had hypertension and 9 (32.1%) patients had diabetes mellitus. Aneurysm was examined by using ultrasonography to reveal the flow dynamics. The aneurysm was resected and an appropriate sized graft was interposed under local anesthesia. The same vein was dissected and anastomosed over the graft in an end-to-side fashion.

Results: Mean aneurysm diameter was 40 ± 12 mm. All aneurysm tissues and thrombotic materials were removed from the surgical field. Mean graft length was 37 ± 11 mm. Three (10.7%) patients need surgical revision because of postoperative bleeding. Dermal necrosis occurred in 1 (3.5%) patient. Infection was noted in 1 (3.5%) patient. Vascular access was started from the reconstructed venous area 2 or 4 days later in all patients. The patency rate was 100% in three years.

Conclusions: Surgical reconstruction of the arteriovenous fistula aneurysm can be safely performed in hemodialysis patients with low complication rates. It gives early vascular access with high patency rates. All patients are relieved from pain and distended mass effect.

Key words: arteriovenous fistula, aneurysm, surgery.

Streszczenie

Celem pracy było wykazanie skuteczności i efektów rekonstrukcji tętniaka przetoki tętniczo-żylniej przeprowadzonej celem wyeliminowania bólu, ograniczenia efektów masowych i umożliwienia wczesnej hemodializy.

Materiał i metody: Przeanalizowano dokumentację medyczną obejmującą 17 lat, aby zidentyfikować pacjentów operowanych z powodu tętniaka przetoki tętniczo-żylniej. Do badania zakwalifikowano 28 pacjentów, w tym 17 kobiet (60,7%). Średnia wieku wynosiła 44 ± 3 lata (31–60 lat). Dwudziestu dwóch pacjentów (78,5%) miało nadciśnienie tętnicze, a 9 pacjentów (32,1%) cukrzycę. Tętniaki badano z wykorzystaniem ultrasonografii, aby ocenić dynamikę przepływu. Następnie tętniaki usunięto i w znieczuleniu miejscowym wstawiono odpowiednio dobrane przeszczepy. Tę samą żyłę ponad wszczepem poddano dysekcji i zespoleniu w sposób koniec do boku.

Wyniki: Przeciętna średnica tętniaka wynosiła 40 ± 12 mm. Wszystkie tkanki tętniaka i materiały zakrzepowe usunięto z pola operacyjnego. Średnia długość przeszczepu wynosiła 37 ± 11 mm. Trzech pacjentów (10,7%) wymagało ponownej interwencji chirurgicznej z powodu krwawienia pooperacyjnego. Martwica skóry wystąpiła u 1 pacjenta (3,5%). Infekcję stwierdzono u 1 pacjenta (3,5%). U wszystkich badanych 2–4 dni później rozpoczęto dostęp naczyniowy ze zrekonstruowanego obszaru żylnego. Współczynnik drożności w ciągu 3 lat wynosił 100%.

Wnioski: Chirurgiczną rekonstrukcję tętniaka przetoki tętniczo-żylniej można wykonywać u pacjentów poddanych hemodializie w sposób bezpieczny, przy niskim ryzyku powikłań. Umożliwia ona wczesny dostęp naczyniowy o wysokim współczynniku drożności. U wszystkich pacjentów wyeliminowano ból i powiększające się efekty masowe.

Słowa kluczowe: przetoka tętniczo-żylna, tętniak.

Introduction

Arteriovenous fistula (AVF) became a procedure for long-term hemodialysis in patients with end-stage renal

failure and this has not changed until this day [1-3]. Arteriovenous fistula should give a comfortable repetitive vascular access line for long-term hemodialysis with low morbidity rates. Aneurysm formation may occur because

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Tab. I. Demographics of patients

Features	Noun
Male	11 (39.2%)
Female	17 (60.7%)
Mean age	47.8 ± 11.6 years
Hypertension	22 (78.5%)
Diabetes mellitus	9 (32.1%)
COPD	7 (25%)
PAD	2 (7.1%)
Duration of AVF	4.2 ± 2.1 years

COPD – chronic obstructive pulmonary disease, PAD – peripheral artery disease

of repeating punctures that can weaken the vein wall in some patients. Sometimes, proximal stenosis accelerates the process by raising the pressure into the AVF. The incidence of aneurysm formation is approximately 5% to 6% [4]. These patients may have a large, painful aneurysm sac that may lead to necrosis on dermal tissue. It may be infected due to vascular access or traumatic events. The aneurysm sac can rupture, resulting in possible fatal hemorrhage. This complication can be dealt with by several techniques such as surgical ligation and resection, stent and perivascular metal meshes [5-9]. A few relevant surgical procedures have been described to preserve the function of the existing fistula [6, 8, 9]. There seems to be no idea on the best procedure to reduce the risk of rupture while leaving the patient with a functioning fistula. The aim of this study was to show the efficacy and results of aneurysm reconstruction that was developed for relieving the patients from pain and mass effects and to give an early hemodialysis option.

Material and methods

Between September 1995 and December 2012, our institutional hemodialysis database was screened for patients with aneurysms reconstructed with synthetic graft



Fig. 1. View of the aneurysm

material. Most of the patients were referred to our department from another center. Twenty-eight patients with AVF aneurysm reconstruction by using appropriate size grafts were included in this study. Detailed written informed consent was obtained from all patients after giving information about all of the procedure and the study.

Patients' features are listed in Table I. There were 17 women (60.7%) and 11 men (39.2%) with a mean age of 47.8 ± 11.6 years. Reconstruction of the aneurysm with graft was performed in all 28 patients. All AVF were of an upper extremity. Aneurysmatic veins were localized to the distal forearm in 3 (10.7%) patients, to the distal arm in 7 (19.6%) patients, and the remaining 18 (50.4%) patients had an aneurysmatic sac on the antebraclial fossa. Indications for surgery were generally pain, ischemia and eroded skin, rather than aneurysm size. Patients were scheduled for surgery with local anesthesia.

Operative technique

All procedures were performed under local anesthesia. The related extremity was prepped and draped for a sterile surgical procedure. The skin incision was made approximately 5 cm. The aneurysm sac was isolated from surrounding tissue to reach to the root of the aneurysm and then to the afferent and efferent arteries (Fig. 1). 50 mg of heparin was given for anticoagulation. Both arteries were secured with vascular clamps. Aneurysmal sacs were opened, and venous ends were preserved (Fig. 2). After resecting the sacs, in case of arterial embolus, gentle embolectomy was performed then appropriate size synthetic graft materials were interposed in the related artery and the previously dissected veins were anastomosed over the graft in an end-to-side fashion (Fig. 3). Necrotic and eroded skin was cut and necrotic tissues were removed. Following control of bleeding, when we were sure of the thrill, the incision was closed appropriately after placing an elastic drain.

Results

There was no hospital mortality. No thrombosis was noted in the early postoperative period. There were no ische-



Fig. 2. Appearance of the opened aneurysm sac



Fig. 3. Appearance of the completed anastomosis

mic changes related to the extremity. The mean follow-up time was 37.3 ± 2.8 months. The follow-up was complete in all patients. Mean aneurysm diameter was 40 ± 12 mm. All aneurysm tissues and thrombotic materials were removed from the surgical field. Three (10.7%) patients needed surgical revision because of postoperative bleeding. Two (7.1%) patients needed temporary catheterization for hemodialysis. Two (7.1%) patients had a small amount in the surgical field. Dermal necrosis occurred in 1 (3.5%) patient and infection was noted in 1 (3.5%) patient. These patients were discharged successfully with dressings used regularly without surgical procedures. Vascular access was started using the reconstructed AVF area 2 or 4 days after surgery. Postoperative complications are listed in Table II. Most patients were discharged after 1 or 2 days. All patients were followed at our center at least once at three-month intervals for a detailed physical examination combined with Doppler ultrasonographic assessment. The patency rate was 100% in three years.

Discussion

Arteriovenous fistula are often created to provide vascular access for hemodialysis in chronic renal failure patients. In patient with end stage renal disease, hemodialysis has to be performed until the renal transplantation is performed [1]. Therefore, the vascular surgeons have to find a way to perform AVF creation by using synthetic or autogenous grafts in appropriate cases. To create the AVF, the most convenient region is the upper extremity; especially it should be the snuffbox or forearm region. Brescia-Cimino is the most frequent type of AVF which is used at present [2, 3]. Arteriovenous fistula can be created in the antecubital fossa or arm area.

Arteriovenous fistulae are prone to developing their own complications which include the formation of an aneurysm. Aneurysm formation may occur because of repeated punctures that can weaken the vein wall in some patients. The incidence of aneurysm formation is approximately 5% to 6% [4]. These aneurysms are generally a mixture of true and pseudoaneurysms. Four false and 24 true aneurysms were noted in our series. Sometimes, proximal stenosis ac-

Tab. II. Postoperative complications

Complication	Number
Bleeding	3 (10.7%)
Hematoma	2 (7.1%)
Infection	1 (3.5%)
Dermal necrosis	1 (3.5%)
Nervous injury	1 (3.5%)
Temporary catheterization for dialysis	1 (3.5%)

celerates the process by raising the pressure into the AVF [8]. In our series three patients (10.7%) had aneurysm formation on the forearm after constructing Brescia-Cimino AVF; 25 other (89.2%) patients had an aneurysm on the distal arm or in the antecubital fossa region. This is valuable information for understanding the necessity of creation of AVF on the distal part of the extremity.

This complication can be dealt with by several techniques such as surgical ligation and resection, stent and perivascular metal meshes [5-9]. A few relevant surgical procedures have been described to preserve the function of the existing fistula [6, 8, 9]. There seems to be no consensus on the best procedure to reduce the risk of rupture while leaving the patient with a functioning fistula. Excision of the aneurysm and the communicating veins with restoration of continuity of the artery has been described [6]. In 2003, Lo described plicating the excess wall of the aneurysmal sac, again preserving the fistula [8]. In 2010, Valentine reported a surgical technique that involved creating a new AVF after removing the aneurysm sac of the AVF [9]. However, these techniques leave the patient without a functional AVF for some time. These studies resulted in a delay in the time interval until the fistula could be used ranging from 10 to 30 days. In our study almost all patients were taken for hemodialysis from 2 to 4 days after surgery. Only one patient needed temporary central vein catheterization because of infection in our series.

Although complications such as thrombosis and local infection are more frequent in patients who underwent AVF reconstruction with prosthetic material than with an autogenous graft [10-13], prosthetic graft materials were not used to create a new AVF but to reconstruct the existing one. With this aspect, our approach is different from centers using prosthetic material routinely. An autogenous vein graft was not used in all procedures. Proximal sides of arteries were large and an appropriate size graft was chosen. A Dacron graft was generally chosen in all cases. There was no specific reason to choose it. All surgical procedures were performed under local anesthesia without complications in our institute as well.

In our study mean graft length was 37 ± 11 mm; the use of short grafts may result in increased long-term patency rates. This concept is one of the advantageous aspects of our approaches. The patency rate of our cases is 100% in three years of follow-up.

Conclusions

The advantages of our approach include first of all the fact that we do not use another site to create the AVF but use the existing one, and second, with the appropriate size graft the patients can be taken for a dialysis procedure 2-4 days after surgery. Finally, AVF aneurysms can be effectively treated by excision of the aneurysmal sac and repair of the artery with a synthetic graft and creation of a new AVF at the same sitting via the same incision. All patients will be relieved from pain and the cosmetically distended mass effect.

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