

Hemodialysis Vascular Access and Care

Hemodiyaliz Damar Erişim Yolları ve Bakımı

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Geliş tarihi (Submitted): 2023-03-22

Kabul tarihi (Accepted): 2023-07-13

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Özet

Hemodiyaliz böbrek yetmezliğinin tedavisinde en yaygın kullanılan tek yöntem olmaya devam etmektedir. Hemodiyalizdeki yaşam süresi ve kalitesi, diyalizin kalitesiyle doğru orantılıdır ve bu kalite de hastanın damar erişim yolunun güvenilirliğine ve bütünlüğüne bağlıdır. En ideal damar erişim yolu, diyalizi uygulamak için güvenilir, komplikasyonsuz erişim sağlayan ve aynı zamanda hastanın ihtiyaçlarına uygun olmalıdır. Son altmış yıldır hemodiyaliz vasküler erişim seçenekleri büyük ölçüde değişmemiştir ve arteriovenöz fistül (AVF) tercih edilen erişim olmaya devam etmektedir.

AVF, hemodiyaliz için klinik uygulama kılavuzlarında önerilen ve tercih edilen vasküler bir girişim olmasına rağmen tromboz, hematoma, ödem, periferik iskemi, kanama ve enfeksiyon gibi ciddi komplikasyonlarda gelişebilmektedir. Bu komplikasyonların önüne geçilmesinde hastalara AVF bakımına ilişkin eğitim verilmesi son derece önemlidir. Bu derleme hemodiyaliz hastalarına bakım veren sağlık çalışanlarına rehber olması için hazırlanmıştır.

Anahtar Kelimeler: Damar yolu, hemodiyaliz, arteriovenöz greft, santral venöz kateter, arteriovenöz fistül, bakım, eğitim

Abstract

Hemodialysis remains the most widely used method for treating renal failure. Life expectancy and quality in hemodialysis are directly proportional to the quality of dialysis, and this quality depends on the reliability and integrity of the patient's vascular access route. The ideal vascular access route provides reliable, uncomplicated access to dialysis and is also suitable for the patient's needs. Hemodialysis vascular access options have not changed substantially over the past six decades, and arteriovenous fistula (AVF) remains the access of choice.

Although AVF is a vascular intervention recommended and preferred in clinical practice guidelines for hemodialysis, it can develop into serious complications such as thrombosis, hematoma, edema, peripheral ischemia, bleeding, and infection. To prevent these complications, it is extremely important to educate patients about AVF care. This review has been prepared as a guide for healthcare professionals who care for hemodialysis patients.

Keywords: Vascular access, hemodialysis, arteriovenous graft, central venous catheter, arteriovenous fistula, care, education

INTRODUCTION

Chronic renal failure (CRF) is a progressive and irreversible kidney damage characterized by a decrease in glomerular filtration rate (GFR), the inability to adjust the fluid-electrolyte balance of the kidneys, the inability to fulfill their endocrine functions, and deterioration in metabolic activities. The prevalence of CRF continues to increase in our country and all over the world (1-3).

Renal replacement therapy (RRT) methods are used in the treatment of CRF; hemodialysis (HD), peritoneal dialysis (PD), and kidney transplantation (KT)(1-3). According to the 2021 data from the Turkish Society of Nephrology (TNS), 70% of CRF patients were treated with central HD, 1.3% with home hemodialysis (HHD), 4% with PD, 24% with KT treatment. As can be seen from the usage rates, HD treatment is the most frequently used one among RRT (4).

An intravenous line, dialyzer containing dialysis membrane, dialysate fluid, and dialyzer are, required for HD treatment. The systems that allow the blood to be drawn into the machine for HD treatment are called vascular access. For HD application, a vascular intervention is required for temporary or permanent use. To emphasize the importance of vascular access for hemodialysis patients, analogies are made as “life path”, “the indispensable part of hemodialysis” and “Achilles tendon” (1-3).

1. Temporary vascular access

Temporary catheters are preferred in patients who need urgent HD and short-term dialysis treatment. It is usually inserted under local anesthesia and accompanied by ultrasound, and the patient can be dialyzed immediately after the procedure. Catheters used for temporary use for hemodialysis can be single or double-lumen.

Frequently preferred sites for inserting a venous catheter percutaneously are the subclavian, femoral, and internal jugular veins. Catheter placement in the internal jugular vein is gaining popularity and is preferred especially in children. The femoral vein

is a good choice for very short-term hemodialysis, hemoperfusion, and plasmapheresis treatment (3,5,6).

1.1. Single lumen catheters

Blood taken from the patient is returned to the patient through a second catheter after passing through the dialyzer, or the blood drawn in the first phase is returned to the patient in the same way in the second phase with the Y adapter connected to this single lumen catheter (3,5,6).

1.2. Double-lumen catheters

Double lumen hemodialysis catheter contains two separate cannulas in a single body, the arterial end is at the more proximal and side wall of the catheter. After the blood taken from this end and passed through the dialyzer with the pump of the hemodialysis machine is cleaned, it is returned to the body with the venous part at the distal end of the catheter (3,5,6).

Use and care of the catheter

The absence of catheter infections in hemodialysis units is one of the important indicators of quality patient care. Catheter dressing is one of the main factors in the prevention of catheter infections. An ideal catheter dressing; should be sterile, protected against contamination, keep the catheter site dry, not allow colonization, be non-irritating, be aesthetic and comfortable, be easy to insert and remove, allow the access area to be evaluated, be secure, easy to fix and be economical. Catheter care should pay attention to the following points (3,5,6).

- Ultrasonography support should be used as much as possible to reduce the complications that may develop while inserting the catheter and to increase the chance of success.
- The catheter exit site should be checked for infection at the end of each dialysis, the dressing should be done, and if the suture is dislodged, stitches should be placed again. If possible, fixation should be made with transparent and airtight dressings.
- The skin entry dressing should be changed by

- wiping every 2-5 days.
- After each use, both lumens of the catheter should be flushed with heparinized SF (100U/ml).
- When not in use, they should be washed every other day or at least every other day.
- Excessive use of heparin may lead to the risk of bleeding. Before each dialysis, both lumens should be aspirated to remove any soft clots that may form and remove residual heparin.
- The patient should take a bath without wetting the catheter. If the skin entry dressing gets wet during bathing, it should be changed immediately.

2. Permanent vascular access

Permanent vascular access is preferred in longer-term HD procedures. The most preferred vascular access route in patients undergoing chronic hemodialysis treatment is the AVF (1,2,3). According to the report of the TNR, the preferred vascular access routes in 2021 are; 72.44% were arteriovenous fistula (AVFs), 0.96% were arteriovenous graft (AVGs), 23.63% were indwelling (tunneled) catheters, and 2.97% were temporary (un tunneled) catheters (4).

2.1. Arteriovenous Graft

It is a method used in patients who do not have the appropriate vascular anatomy for AVF opening. Mostly synthetic grafts made of polytetrafluoroethylene are used. It is placed subcutaneously between an artery and a vein (1-3).

2.2. Arteriovenous Fistula (AVF)

AVF is the creation of an anastomosis with a surgical operation between a suitable artery and a most suitable vein. The most commonly used and most preferred site for AVF is between the radial artery and the cephalic vein at the wrist level. Alternative arteriovenous fistula sites are the ulnar artery and the basilic vein, the brachial artery and the cephalic or brachial vein, and the femoral artery and the saphenous vein. When opening the AVF, the patient is started from the most distal, if the attempt is unsuccessful, it is climbed higher. AVF is usually

created in the non-dominant arm. Thus, there is no restriction on the functional arm (1,2,3,5).

2.2.1. Creation of AVF

It is possible to provide approximately 200-300 ml/min blood flow through the fistula by using peripheral veins. Following local anesthesia, a skin incision is made. The artery is carefully released under the fascia and suspended with thick 2nd silk. The vein is located under the skin, it is released and suspended. 1 mg/kg of heparin is given systemically through the liberated vein or from another vein. After the artery and vein are closed with atraumatic vessel clamps, the artery, and vein are opened vertically so that the vein rests on the artery. In the created anastomosis, a fistula is formed by coming to the side of the artery and vein or by coming over the artery to the end of the vein. The passage of current through the fistula is visually noticeable and a thrill (vibration) is felt over it with the finger. The turbulence of the high flow on the vessel wall creates a thrill. The absence of a thrill indicates that the vein is not filling and that there may be a technical error that needs to be sought (1,2,3,5).

2.2.2. Postoperative care of AVF

The hand is held up so that it remains above the level of the heart. The fistula is thrilled and a murmur is looked for using a stethoscope. If there is no murmur, the fistula is closed. If there is a murmur and no thrill can be heard, it is expected that the blood flow through the fistula will increase over time and the fistula will mature (1,2,3,5).

2.2.3. Using the AVF

After the fistula is created, a period of approximately 1-2 months is waited for the fistula to mature. It is generally unsuitable for use before this time, but it is often used earlier in practical practice. If the patient requires urgent dialysis during this waiting period, a temporary vascular access route may be provided.

Two needles are used in the AVF entrance. The blood that will go to the machine is taken from the inlet close to the anastomosis area, and the blood

returning from the machine is given to the venous circulation from the far line. The arterial line is placed 3 cm away from the fistula and the vein line is placed 5 cm away from the arterial line. Thus, recirculation is minimized. For patients with pain sensitivity, it is recommended to apply local anesthetic creams locally before HD.

During HD, patients should be evaluated and monitored for AVF complications (bleeding, thrombosis, venous stenosis, venous hypertension, infection, insufficient flow, high-flow fistula, hand ischemia, etc.). Patient education is extremely important in the management of AVF complications. Training on AVF care should be given to patients regularly and systematically (1,2,3,5).

2.2.4. Complications of AVF

Although AVF is a vascular intervention recommended and preferred in clinical practice guidelines for hemodialysis, it can develop into serious complications such as thrombosis, hematoma, edema, peripheral ischemia, bleeding, and infection. AVF complications constitute a rate of 16-23% among causes of death and hospitalization in HD patients. To prevent these complications, educating patients about AVF care is extremely important. In addition, the AVF opening should not be left until the last months. The fistula must be opened early to allow time for the fistula to mature and to learn to live with the AVF a few months before undergoing HD. In the follow-up of AVFs, a multidisciplinary team consisting of a nephrologist, surgeon, education and hemodialysis nurse should work together (5-11).

Insufficient flow: Insufficient blood flow for dialysis results in increased recirculation percentage and ineffective dialysis. The most common cause of insufficient flow is a partial obstruction in the venous tract due to fibrosis caused by frequent needles inserted. Lesions that can be corrected are repaired surgically or by balloon angioplasty. In addition, patients should be routinely examined every month, AVF blood flow should be checked during the

examination, and training should be repeated for AVF care and protection (5,6).

Thrombosis: The cause of thrombosis seen in the early period is often technical error and requires surgery. During HD, thinning of the wall as a result of using the same site at the entrance of the AVF causes aneurysm formation and can lead to embolism and thrombosis if not treated. Clot formation seen in the late period is often the result of weak flow. Removal of the clot can be done surgically or medically with thrombolytic drugs (9-11).

Venous Hypertension: Exposure of the venous system to high pressure and high flow after fistula operation causes mild venous stasis findings. The flow load from the artery side to the vein side in the distal fistula causes an increase in venous pressure in the distal fistula. If venous hypertension does not resolve spontaneously, the vein distal to the anastomosis should be ligated or rotated to the end position on the anastomosis vein side (1,4,6).

Neuropathy and Ischemia in the hand: In patients who develop arterial insufficiency or steal syndrome, pain, coldness, numbness, and sometimes motor dysfunction in the hands and fingers occurs in the distal extremity. In patients with diabetes or atherosclerosis, whose circulation was not good before, pain, coldness, the feeling of coldness, and non-healing ulcers in the hand should suggest ischemia. If ischemia develops due to the steal phenomenon, it is transformed from the edge position to the end anastomosis in the arterial par and palmar circulation is provided with the ulnar artery. Carpal tunnel syndrome due to peripheral nerve lesion develops in a small number of patients with fistulas at the wrist level. The treatment is the surgical release of the nerve (2,5,12,14).

Infection: Infection can be transmitted by not paying attention to sterility while performing fistula surgery, keeping non-sterile materials in the operating environment, and also from areas where needles are

inserted. Local and systemic blood culture samples should be taken and antibiotics effective against staphylococci should be used in the treatment. For HD, the body's barriers to infection are crossed during each cannulation. Therefore, it is extremely important to comply with aseptic techniques (1,4,5).

Congestive heart failure: HD is a procedure performed directly on the circulatory system, and with it, the cardiac output is loaded approximately 200-500 ml/min during dialysis. Although there is no serious deterioration in heart functions with long-term follow-ups, the increase in cardiac output may cause congestive heart failure in elderly people and people with heart disease. Treatment is surgical narrowing or taping to reduce fistula flow. In HD patients, heart failure may develop due to reasons such as anemia, HT, and fluid overload. Sometimes it is difficult to determine whether the heart failure is due to the fistula or other causes (10-12).

2.2.5. Patient Education for AVF Care

The adequacy of an AVF is directly proportional to its openness to allow long-term hemodialysis, the low number of complications, and its easy applicability. It is extremely important that the patients are constantly supported by the HD team and that their training needs are met so that they can adapt to the opening of the AVF, its readiness for use, and the adaptation to the continuous use process (15-19).

In studies examining the fistula care knowledge level of HD patients in the literature, it has been determined that the knowledge level of patients about fistula care is not at the desired level in general and that training should be given to provide patients with self-care knowledge and behaviors (23-25).

Alizade et al. (20) and Sousa et al. (21) provided education to patients to improve the fistula care behaviors of hemodialysis patients, and it was found that education improved the fistula health behaviors of hemodialysis patients. Köse et al. (22) determined that fistula self-care behavior is effective in the development of complications and recommended

that patients be supported with education programs about fistula complications. These results reveal the importance of patient education. The following topics should be included in the education to be given to the patients.

- The new fistula should be kept in elevation (arm above the heart level).
- The arm exercises that should be done for a newly opened fistula are exercises such as plastic ball squeezing exercises.
- Fistula exercises recommended by health personnel should be performed regularly for the fistula to continue to function healthily.
- The thrill, that is, the vibration should be felt at the site of the fistula surgery, and the murmur, the sound from the fistula, should be heard. The fistula should be checked for vibration at least twice a day. In cases where vibration is not felt or heard, the doctor should be informed.
- To prevent infection before coming to the dialysis session, it is necessary to wash the fistula arm with soap and warm water and dry it with a clean towel (if possible, use disposable paper towels). The fistula should be monitored for signs of infection (redness, itching, swelling, increase or decrease in temperature, etc.). If there is a sign of infection, you should go to the health institution immediately.
- Behaviors that will pressurize the fistula should be avoided. Some of these behaviors are; These are behaviors such as lying on the fistula arm while sleeping, wearing clothes that will tighten the arm, and wearing bracelets, wristwatches, or jewelry. These behaviors damage the fistula by obstructing blood flow.
- Check if your hand changes in temperature and color on the arm on the side of the fistula every day.
- It is necessary not to perform an invasive procedure from the fistula arm, not to take blood, and not to measure blood pressure, even for therapeutic purposes.
- Heavy work should not be done with the fistula arm, and weight should not be lifted above 1 kg.
- Care should be taken in the work done with cutting

and piercing tools, if possible, such work should not be done and the fistula arm should be protected against all kinds of impacts it may be exposed to.

- Apply pressure on the bleeding area against serious bleeding that may occur as a result of the impact, and go to the nearest health institution.
- All kinds of situations that may cause low blood pressure should be avoided to prevent the deterioration of blood flow to the fistula.
- Excessive fluid intake between two dialysis can cause cramps, headache, and chest pain. Therefore, a fluid restriction must be observed.

CONCLUSION

Vascular access routes are an important parameter that affects the quality of life and duration of patients receiving hemodialysis treatment. For this reason, the hemodialysis team should meticulously implement and develop new strategies for the follow-up, care, and patient education processes of vascular access routes.

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