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Physical Examination in Patients with Steal Syndrome

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Abstract
In Indonesia, the number of haemodialysis (HD) patients is increasing every year. In 2014, there were 17,193 new patients. This number has increased in 2015 as many as 21,050 patients and in 2016 as many as 25,446 patients. HD is a process that involves diffusion and ultrafiltration with the aim of removing certain elements from the blood by taking advantage of the difference in the rate of diffusion of blood as it passes through a semipermeable membrane. HD access is established in the arm by connecting the arm vein with the radial or ulnar artery. Arteriovenous fistula (AVF) is the most ideal HD access, because it can be used for the long term, lower morbidity, and mortality, but complications often occur, one of which is steal syndrome. This syndrome can present with different signs and symptoms depending on the severity and duration of post-access access for renal failure patients undergoing HD therapy
Keyword: Steal Syndrome; AVF; Haemodialysis;

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Introduction

In Indonesia, the number of hemodialysis (HD) patients is increasing every year. In 2014, 17,193 new patients were recorded. This number has increased in 2015 by 21,050 patients and in 2016 by 25,446 patients. Based on age and gender distribution, most HD patients have an age range of 35 – 64 years with a percentage of 74.12% of all HD active patients and most of these patients are dominated by men

HD is a process involving diffusion and ultrafiltration with the aim of removing certain elements from the blood by utilizing the difference in blood diffusion rates when passing through a semipermeable membrane. HD is done by pumping the patient's blood and flowing it to a blood compartment bounded by an artificial semipermiable membrane with a dialysate compartment

In general, access is established in the arm by connecting the arm vein with the radial or ulnar artery. This will cause a *shunt* of blood flow from the arteries to the veins so that the veins will enlarge and experience epithelialization

Arteriovenous fistula (AVF) is the most ideal HD access, because it can be used for the long term, lower morbidity and mortality rates. However, almost 50% of AVFs fail, and if they can be used, 25% will fail after 2 years (Because, Rustam, & Rivaldy, 2020). In 2013, AVF failure rates by 35.9% and on average occurred 135 days after the first use of AVF. About 30 – 61% of AVFs will fail on haemodialysis, either due to maturation failure or thrombosis

Some of the complications of AVF are stenosis, thrombosis, aneurysm, infection, *steal syndrome*, venous hypertension, and heart failure (Ismail et al., 2022). Several risk factors such as old age, female sex, cardiovascular disease, diabetes mellitus, location of radiocephalica fistula, small vascular lumen diameter size, previous intravenous catheter insertion, and surgical technique are reported to influence the failure of an AVF (Sari, 2019)

Failure of AVF leads to higher treatment costs and increases patient mortality and morbidity. AVF is the most ideal dialysis access today, but its complications and failure are still problems that need to be solved (Sari, 2019)

This case was reported because patients with HD needs need long-term access but patients experience complications that cause *steal syndrome*.

Case Illustration

A 55-year-old male patient, Balinese tribe came to Prof. IGNG Ngoerah Hospital with complaints of stiff and painful hands during HD since November 2020, complaints when he came to Sanglah Hospital accompanied by blackish hands. After being received by the attending physician, the patient held an anamnesis, the patient replied that the patient had experienced it since the installation of AV Shunt access. The installation of the AV shunt itself has been carried out since October 2020 and in early November 2020 where the patient felt stiffness in the right index finger which then spread to the middle finger and other fingers, currently the patient's hand feels stiff and unable to grasp.

The patient himself has a history of HD related to stage V chronic kidney disease due to type 2 diabetes mellitus (DMT2) suffered by the patient. The patient himself was diagnosed with T2DM since 2006.

Patients undergo routine regular HD in Private Hospitals 2 times a week, namely Wednesday and Saturday, the standard procedure of the HD process requires patients to install AV Shunt access to make it easier for patients to undergo HD therapy at the hospital.

Figure 1. Photo View of the palm and back of the patient's hand.

From the physical examination obtained the general impression of moderate pain, good consciousness, blood pressure 150/90 mmHg, pulse 86 times/minute regular, breathing frequency 22 times/minute, body temperature 36.5°C. Eye examination obtained anemic eyes, chest examination obtained normal chest shape, symmetrical both static and sweetened, no signs of heart enlargement, normal heart sound, no murmur sound in auscultation. Physical examination of the lungs, vesicular breathing sounds, no increase in vocal fremitus, no *ronchi* or *whezing sounds*. Examination of the abdomen obtained distention, no tenderness, no enlargement of organs. On the fourth examination of the extremities, edema was not obtained. The localist status of the right hand was obtained to appear blackish on the palm and back of the right hand, cold palpable, radial artery pulsation not palpable, ulnar artery pulsation palpable, active, and passive joint movement limited, right hand oxygen saturation 92%/92%/95%/92%/93%.

Laboratory examination of leukocytes 5,53x10^3/µL, neutrophil 48,70%, limonite 33,10%, hemoglobin 8,30 g/dL, hematokrit 26,90%, trombosit 256,00x10^3/µL, SGOT 50,20 U/L, SGPT 50,04 U/L, BUN 72,31 mg/dL, SC 9,20 mg/dL, e-LFG 5,77, PPT 10,70, INR 0,93, APTT 31,40, serum iron 30,79 ug/dl, ferritin 1056,44 ng/mL, anti HCV non reaktif, HBsAg non reaktif, kolesterol total 83 mg/dL, kolesterol LDL 41 mg/dL, kolesterol HDL 31 mg/dL, trigliserida 87,20 mg/dL, BS puasa 117 mg/dL

Patients diagnosed with stage V *CKD et-causa* PGD *on* HD regularly twice per week (Wednesday-Saturday in private hospitals), controlled hypertension, ischemic *steal syndrome*, DMT2 patients are treated by vascular surgery with arteriography plan. Arteriography has been performed with the conclusion of total stenosis in the radial artery and total occlusion in the ulnar artery

Follow up during treatment, the main complaint that caused the patient to first enter the hospital began to improve, the patient's hands were still black but stiff which was felt to have decreased. The patient is treated for 3 days, during treatment complaints improve. Currently the patient has no other complaints and is allowed to go home with the last therapy, valsartan 160 mg every 24 hours orally, carvedilol 3,125 mg every 24 hours orally, amlodipine 10 mg every 24 hours orally, folic acid 2 mg every 12 hours orally, CaCO3 500 mg every 8 hours orally, insulin aspart 4 units every 8 hours (subcutaneously 15 minutes before meals), insulin glargine 10 units every 24 hours (subcutaneously when going to bed at night).

Discussion

Patients with chronic kidney disease of any aetiology require replacement therapy. Replacement therapy needed by patients with chronic kidney disease must be able to replace the excretory function and endocrine function of the kidneys. This is because in chronic kidney disease, both of these functions deteriorate. Replacement therapy can be divided into two, namely kidney transplantation and dialysis. A successful kidney transplant will replace all damaged kidney function, while dialysis replaces some excretory function. Dialysis can be classified into peritoneal dialysis and HD (Black & Hawks, 2014)

HD is a process involving diffusion and ultrafiltration with the aim of removing certain elements from the blood by utilizing the difference in blood diffusion rates when passing through a semipermeable membrane. HD is done by pumping the patient's blood and flowing it to a blood compartment bounded by an artificial semipermeable membrane with a dialysate compartment. Therefore, special access is needed for HD especially for routine HD. In general, this access is established in the arm by connecting the arm veins with the radial or ulnar artery. This will give rise to *Shunt* blood flow from arteries to veins so that veins will dilate and undergo epithelialization (Sebayang &; Hidayat, 2020)

AVF is the most ideal HD access, and AVF is the preferred vascular access for HD. Based on the guidelines of the National Kidney Foundation - Kidney Disease Outcome Quality Initiative (NKF-K/DOQI), AVF surgical sites in HD are: forearm (distal radiocephalica or AVF), elbow (brachiocephalica or proximal AVF), and arm (brachial artery-to-transposed basilic vein fistula) (Black & Hawks, 2014), (Schmidli et al., 2018), (Lok et al., 2020). In the 2019 NKF-K/DOQI guidelines, AVF radiocephalica is recommended as the first choice for fistula manufacturing. This recommendation is based on the availability of next, more central access in the future, and lowers risk *steal syndrome* on the installation of fistulas in the upper arm area (Quencer & Arici, 2015)

Vascular ultrasound (Doppler ultrasound) is the gold standard in determining the type and location of vascular access. This examination assesses the diameter of arteries and veins; Vein diameter > 2 mm and arterial diameter > 1.6 mm are considered adequately. This is a predictive factor in determining AVF maturation (Lok et al., 2020). Blood flow, diameter, and depth of an AVF can predict the clinical maturation of an AVF. Before starting to use AVF, it takes time to obtain structural modifications of venous walls or arterialization as a result of flow turbulence. According to the 2019 NKF-K/DOQI guidelines, access can be defined as mature when the flow > 600 ml/min, the minimum venous diameter is 0.6 cm and the depth does not exceed 0.6 cm. The time required is ranging from 1 to 2 months from making the AVF. To evaluate the aforementioned parameters, careful clinical and instrumental monitoring is required (Lok et al., 2020), (Quencer & Arici, 2015)

According to Lok CE *et al* (2006) in *Risk equation determining unsuccessful cannulation events and failure to maturation in arteriovenous fistulas* (REDUCE FTM I). The primary failure rate of AVF reaches 20% and has been reported to increase to 60%. High failure rates increase patient morbidity, increase the time it takes for AVF to become functional and consequently prolong the likelihood of starting patient hemodialysis, as well as increase the cost of hospital care. To date, primary AVF failure rates have not been considered when considering differences in haemodialysis vascular access outcomes

Numerous studies have assessed the causes of AVF failure to mature (*failure to maturation* (FTM)). Some factors that have been associated with FTM of an AVF are age ≥ 65 years, female sex, uremia, diabetes mellitus, peripheral blood vessel disorders and non-white race. Conte, MSet, in 2011 in San Francisco, published a study of 31 patients who underwent AVF surgery as part of a vascular health trial. They found that diabetes mellitus patients had a significantly negative impact on AVF maturation (Salmela, Hartman, Peltonen, Alb ck, & Lassila, 2013), (Conte, Nugent, Gaccione, Roy-Chaudhury, & Lawson, 2011)

Diabetics with stage V chronic renal failure in HD are referred to as "difficult patients" because of problems related to making their vascular access. Diabetes mellitus has been shown to be associated with AVF failure in some studies, but not in all studies. Poor blood sugar control may be an important factor in AVF failure among diabetic subjects (Go biowski et al., 2015), (Afsar & Elsurer, 2012)

Allon et al found that age and diabetes mellitus (DM) were not associated with AVF maturation rates, although both were significantly associated with improved medication. Dialysis patients with DM has more complications and shorter survival duration than non-DM dialysis patients, so it requires more attention and more difficult management (Sedlacek, Teodorescu, Falk, Vassalotti, & Uribarri, 2001), (Allon et al., 2011), (Jin et al., 2018). In patients with this case report are patients with DM who require HD therapy due to kidney failure experienced by this patient.

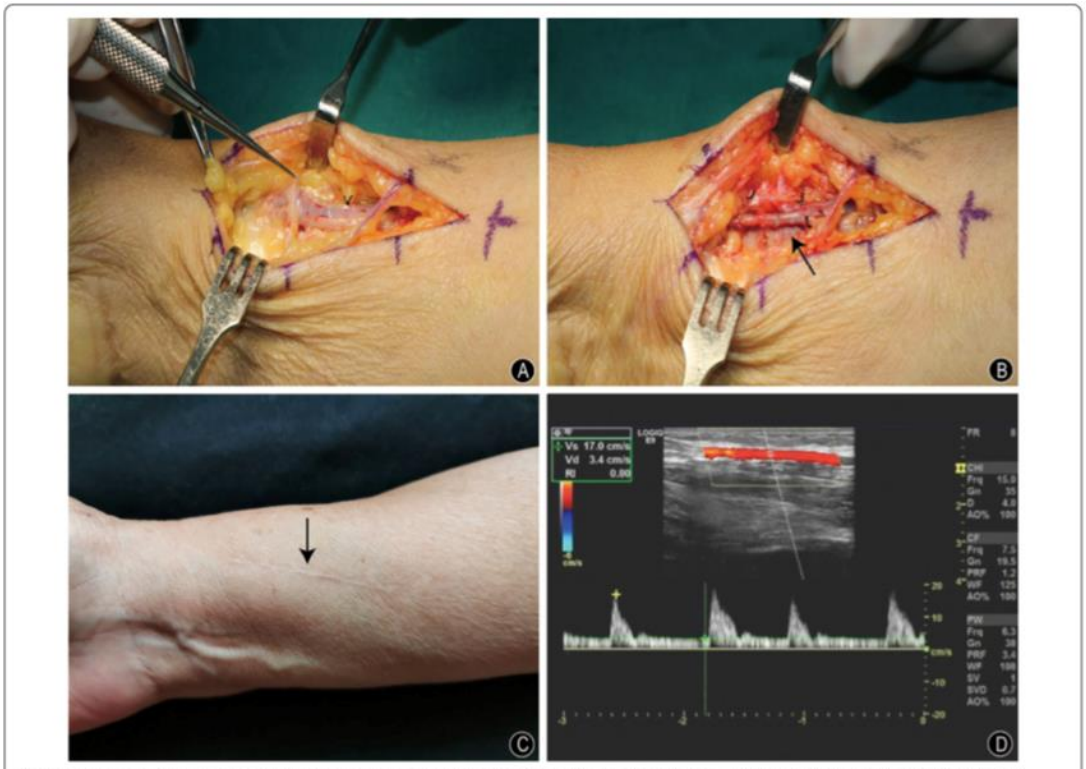

Fig. 2 Intraoperative and postoperative pictures. **A** The artery and the vein within the fistula were mixed up. **B** After resecting and ligating the fistula, the identified radial artery was anastomosed (arrow). **C** The photo showed that the incision was well healed, with no swelling and thrill (arrow). **D** Doppler ultrasound showed the radial artery remained intact, with antegrade flow preserved

Some complications of AVF include:

1. Stenosis,
2. Thrombosis
3. Aneurism
4. Infection
5. *Steal syndrome*,
6. Venous hypertension, and
7. Heart failure.

Several risk factors such as old age, female sex, cardiovascular disease, DM, location of dicephalic fistula, small vascular lumen diameter size, previous intravenous catheter insertion, and surgical technique are reported to influence a failure AVF (Al-Jaishi, 2013)

As obtained in this case report patient, where there was a case of *steal syndrome* in the patient. *Steal syndrome* is a condition that threatens the limbs which can cause permanent damage if left untreated. This syndrome can present with different signs and symptoms depending on the severity and duration. These signs and symptoms include a reduced or absent pulse in the distal of the AVF, reduction of symptoms in the AV access compression, chills, pallor, pain, tingling, and numb. In addition, the presence of bruit and thrill AVF may vary depending on the severity and duration but must be assessed.

If this condition is left untreated, chronic symptoms can include nail bed changes, ulcers, gangrene, and atrophy muscle/tissue (Sen & Tripathi, 2016). *Steal syndrome* be serious complications that can occur after the creation of upper limb AVFs for long-term HD access. Patients report hand and finger pain resulting from hypoperfusion and distal ischemia of the AVF (Asif et al., 2006)

Pathophysiological mechanisms *steal* is a high flow resulting in a distal directional backflow of the AVF. Retrograde flow occurs in distal 80% to 90% of fistulas; However, only 4% of cases develop ischemic symptoms that require intervention (Asif et al., 2006)

Typical symptoms and signs of arterial *steal syndrome* are hand pain, stiffness, cold and paraesthesia's. Symptoms can appear continuously or only during HD, as HD decreases fistula outflow and collateral flow that aggravates ischemia. Arterial signs *steal syndrome* is a pale, reduced radial pulse or no sensory or motor neuropathy. In advanced cases, ulceration or gangrene of the finger may occur in patients who receive HD, the onset of symptoms usually occurs 6 to 10 months from the creation of the fistula. The delay in the onset of symptoms is caused by the phenomenon *steal* which increases gradually as flow through the mature fistula increases (Asif et al., 2006)

In this patient, the patient felt stiffness in the right index finger which then radiated to the middle finger and other fingers, at this time the patient's hand felt stiff and unable to grasp. Failure of AVF leads to higher treatment costs and increases patient mortality and morbidity. AVF is the most ideal dialysis access today, but its complications and failure are still issues to look for Solution to determine the risk factors for failure *AVF* (Kazemzadeh et al., 2012). In these patients arteriography therapy is carried out on *steal syndrome* he experienced.

Conclusion

Patients with chronic kidney disease of any aetiology require replacement therapy. Replacement therapy needed by patients with chronic kidney disease must be able to replace the excretory function and endocrine function of the kidneys. HD is a process involving diffusion and ultrafiltration with the aim of removing certain elements from the blood by utilizing the difference in blood diffusion rates when passing through an artificial semipermeable membrane with a dialysate compartment. Most access used is vascular access. Although with this method the results are very good, but in this type of access very often there are incidents of "*steal syndrome*", especially if the arteriotomy is very long.

Steal syndrome threatens the limbs and can cause permanent damage if left untreated. This syndrome can present with different signs and symptoms depending on the severity and duration of post-installation access for kidney failure patients undergoing HD therapy. A long with the development of technology and science in the field of internal medicine, further research is needed to get good treatment practices for patients undergoing HD therapy due to kidney failure to reduce the risk of steal syndrome after HD therapy in the future.

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