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Case Report

The Meaning of Determining Blood Flow Through Arteriovenous Anastomosis in Achieving The Best Possible Clearance in A Hemodialyzed Patient With High Recirculation

Konstantinos Stavros Mavromatidis [1*], Prodromos Stylianos Bampageorgakas [2], Alexandros Mochament Atalla [3], Sinem Irfan Chousein [4] and Stylianos Athanasios Panagoutsos [5]

[1]*Nephrologist, Director of Renal Unit "Dimokrition", Antoniou Rossidi 11, 69132, Komotini, Thrace, Greece.*
[2]*Cardiology Director, Cardiology Department, General Hospital of Komotini, Kosti Moskof 13, 69132, Komotini, Thrace, Greece.*
[3]*Nephrologist, Consultant, Renal Unit "Therapeftiki", Mousson 4, Pefka, Thessaloniki, Greece.*
[4]*Cardiologist, Private Doctor, Kosti Moskof 13, 69132 Komotini, Thrace, Greece.*
[5]*Nephrologist, Professor of Nephrology, "Democritus" University of Thrace, Director of Nephrology Clinic, Odysseus st, 68100 Alexandroupolis, Thrace, Greece.*
[*]*Corresponding author: mavromatidisk@gmail.com*

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Abstract

The existence and use of internal arteriovenous anastomosis is associated with complications. One of these is the reduced provided clearance (despite satisfactory blood supply from the blood pump), due to increased recirculation. We presented a hemodialyzed patient with a pronounced aneurysmal appearance of the vein of the arteriovenous anastomosis, who despite had have a good blood supply from the pump (>400 ml/min), he had a reduced provided clearance, which was found to be due to stenosis of the anastomosis.

1. Introduction

Internal arteriovenous anastomosis is the best vascular access for hemodialysis. However, it is not without problems. Among other, many patients experience stenosis (mainly of the anastomosis, but also elsewhere), which is responsible for the creation of aneurysms (poststenotic) [1, 2] and possibly for reduced provided clearance (especially when aneurysms are punctured for dialysis needs), but also problems of prolonged bleeding from the puncture sites (when there is increased venous pressure in the return of blood to the patient's heart) [3]. In the case of our patient, who presented aneurysm-like dilatations in the route of the vein of the arteriovenous anastomosis and reduced provided clearance, a check was made for recirculation, which was found to be particularly increased.

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2. Case Presentation

This is a 54-year-old man who had been on dialysis for 146 months with radio-cephalic arteriovenous anastomosis in his left arm. Despite his low body weight (55 kg), he showed elevated creatinine values at the monthly check-up (reaching up to 12.6 mg/dl, with 4.5 hours of dialysis/session). Because he had four large aneurysms in the fistula vein (recirculation was determined and found in repeated measurements of 10-15% (February 2025), while a second stenosis was found shortly after the arteriovenous anastomosis and another stenosis in the venous of the fistula. In the mapping of the fistula vessels, stenosis of the anastomosis was found, with a blood flow of 420 ml/ml. In April of 2025, a new right radio-cephalic anastomosis was performed. Nine months later (January of 2026), when the puncture of the new arteriovenous anastomosis had already begun, recirculation of 19-22% was found (with a blood pump of 400 ml/min). The blood flow in the new fistula was again assessed and found to be 430 ml/min, at which time the blood pump was reduced to 350 ml/min, however the recirculation deteriorated and even reached 35% (February of 2026).

On March of 2026, the blood flow in the new arteriovenous anastomosis was rechecked and found to be 620 ml/min, which increased to 680 ml/min when the old fistula was ligated and occluded (the patient was examined in a sitting position with the vascular access end supported). Flow velocities were measured 3 times in the brachial artery, and the average value was used. The fistula blood flow was calculated in ml/min, using the formula: $Qa = \pi r^2$ x Average Velocity (where Qa = blood flow, $\pi = 3.14$, r = anastomosis radius) [4]. The same day, the patient was referred to vascular surgeon, who ligated the old fistula (left arm). The determined recirculation (March of 2026) in the new fistula with a blood flow of 680 ml/min was 0% (with serum creatinine 11.4 mg/dl, cystatin-C 18.0 mg/dl with 4.5 hours of dialysis/session again).

It is known that arteriovenous anastomosis burdens the cardiac work, especially when they are of high flow [5]. Although the two fistulas together did not exceed 1000 ml/min in flow, a heart ultrasound was performed in September of 2025, where an ejection fraction of 65% was found with minor mitral valve insufficiency and a normal left atrium. On February of 2026, a new heart ultrasound was performed, which again showed a normal left atrium, a left ventricle of normal dimensions, with mild concentric wall hypertrophy, without segmental mobility disorders and an ejection fraction of 64% (GRADE I diastolic dysfunction). A normal aortic valve was also found, but the mitral and tricuspid valves were slightly regurgitant. The right atrium was normal, and the right ventricle was not dilated. In the repeat ultrasound examination performed in April of 2026, approximately two months after the ligation of the left fistula, a blood flow in the fistula of 591 ml/min was found.

The patient was on a dialysis program with predilution online HDF (48 L/session), using 15 G needles, with a polyethersulfone filter, surface area 2.1 m^2 (Elisio 21H, Polynephron, Nipro), with a blood pump of 400 ml/min and a dialysate flow of 500 ml/min, with a Nikkiso DBB EXA machine. The patient never had increased venous pressure during dialysis sessions (usually 150-200 ml/min) and usual negative pressure between -150 and -200 ml/min, the aneurysms emptied when the left arm with the fistula was raised (a fact that indicates that there was no obstacle to the return of blood to the heart), however, due to the large area occupied by the aneurysms, several times the needles (fistula) were located at the borders of the aneurysms or even within them.

3. Discussion

Among vascular access options, native arteriovenous anastomosis is the safest and most durable, with the lowest mortality and morbidity rates [6]. Vascular anastomoses for hemodialysis are divided into distal (e.g., radio-cephalic) and proximal (e.g., brachiocephalic, Brachial-basilic). The blood flow rate from vein of the anastomosis (blood supply from the fistula) plays an important role in ensuring effective hemodialysis. Thus, while low blood pump flow may indicate problems with vascular access, very high flow of anastomosis increases cardiac work, potentially leading to high-output heart failure [5]. The latter, which occurs due to blood bypassing through the anastomosis, is serious and underdiagnosed. This untreated heart failure has an increased mortality rate. In fact, in a series of 120 patients from the Mayo Clinic who had high-output heart failure, the 3-year mortality rate was 38% [7].

It seems that our patient had a fistula with a low blood flow (420 ml/ml), which was not sufficient for the requested amount of blood of pump supply of 400 ml/min. The relative delay in diagnosing the cause of the provided clearance was due to the fact that by puncturing at relatively indicated points between the aneurysms, but also sometimes at their borders, he had a very good blood supply to the filter (>400 ml/min) and did not have increased venous pressure. In particular, the venous pressure of the extracorporeal circuit was always <200 ml/min (meaning that there was no recirculation due to difficulty in returning blood to the heart), while the negative pressure was also always higher than -200 ml/min (meaning that the pump found the requested blood, regardless of whether it came from the fistula and from what was returned from the filter to the vein). The same and more increased recirculation was observed when the new fistula was punctured (with a blood flow of 430 ml/min and a recirculation of 35%) where the last was zeroed when the fistula flow reached >600 ml/min (i.e. when the maturation of the fistula was improved). The fact that a flow of 620 ml/min was observed in the new fistula, which increased to 680 ml/min when the old fistula was ligated and occluded, may mean that the ligation of the old fistula played a role in accelerating the maturation of the new one and increasing its flow. Nowadays, the fistula flow is 591 ml/min, the patient has 0% recirculation and is in good health, with excellent provided clearance.

4. Conclusion

It is concluded that in cases of increased recirculation, blood flow in the anastomosis should be investigated (despite satisfactory blood supply to the filter) and when it is reduced, an attempt should be made to correct it, when possible, or a new arteriovenous anastomosis should be performed at another site.

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