



Effects of Loop Diuretics Continuation on AV Fistula Maturation and Clinical Outcomes in Hemodialysis Patients

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Background: Arteriovenous fistula (AVF) is the preferred vascular access for hemodialysis due to its superior long-term patency and lower complication rates. However, AVF maturation may be influenced by various factors, including the use of loop diuretics. This retrospective study examines the association between continued loop diuretic use and the maturation of brachiocephalic AVF, along with related clinical outcomes

Materials and Methods: A retrospective cohort study was conducted at Ayatollah Rouhani Hospital, Babol, involving 400 patients who had undergone brachiocephalic AVF creation for hemodialysis access. Medical records were reviewed to categorize patients based on their loop diuretic use at the time of AVF creation: high-dose, low-dose, and no diuretic use. The primary outcome was AVF maturation within 60 days, defined as successful two-needle cannulation with adequate flow rates for hemodialysis. Secondary outcomes included AVF failure, infection, the need for additional interventions, and patient survival

Results: Of the 400 patients included, 150 had been on high-dose loop diuretics, 130 on low-dose, and 120 had not received diuretics. AVF maturation at 60 days was observed in 80% of the low-dose group, compared to 65% in the high-dose group and 68% in the non-diuretic group ($p < 0.05$). The high-dose group had a higher incidence of AVF non-maturation (35%) and required more secondary interventions such as balloon angioplasty and surgical revision. Infection rates did not differ significantly between groups. Patient survival at six months was also similar across groups.

Conclusion: The retrospective analysis suggests that high-dose loop diuretics may have a negative impact on AVF maturation, while low-dose diuretic use is associated with improved maturation outcomes. These findings highlight the need for further investigation to optimize diuretic management in hemodialysis patients.

Keywords: Arteriovenous Fistula, Hemodialysis, Loop Diuretics, Vascular Access Maturation

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Introduction

Arteriovenous fistula (AVF) is the preferred vascular access for hemodialysis due to its long-term patency and lower risk of infection compared to central venous catheters and grafts (1). Successful AVF maturation is critical for achieving adequate dialysis efficiency and reducing morbidity associated with vascular access failure. However, AVF maturation is a complex process influenced by patient-specific factors, surgical techniques, and pharmacological interventions (2). Diuretics are commonly prescribed for hypertension and volume management in patients with non-dialysis dependent chronic kidney disease (CKD) (3).

In many clinical settings, these medications are often discontinued when a patient initiates dialysis, despite the absence of strong evidence supporting this practice (4, 5). On the other hand, loop diuretics remain a common part of dialysis patients' treatment regimens (6). To date, there is limited data on the implications of this decision, particularly concerning AVF maturation and overall vascular outcomes. Loop diuretics promote urine output and may provide several advantages for patients undergoing hemodialysis who retain some residual renal function. These benefits include more consistent volume control, enhanced sodium and potassium excretion, and protection against complications associated with fluid overload (7).

Additionally, improved potassium excretion might allow for greater dietary freedom, potentially supporting better nutritional balance, adequate protein intake, and the prevention of protein-energy wasting, all of which contribute to an improved quality of life (8-10). Among patients with end-stage kidney disease (ESKD), loop diuretics are the most commonly used and potentially the most effective class of diuretics (11). Although loop diuretics play a crucial role in volume management (12), their effects on vascular remodeling, endothelial function, and circulatory dynamics raise questions about their potential impact on AVF maturation.

Some researchers propose that loop diuretics could reduce venous dispensability and impair vascular adaptation, thereby hindering AVF maturation (13). In contrast, others suggest that controlled fluid management with diuretics might promote hemodynamic stability, improving vascular outcomes and access patency (8, 14). Given the ongoing debate surrounding the use of loop diuretics in dialysis patients, this study aims to evaluate whether continuing these medications affects AVF maturation success, failure rates, and the need for secondary interventions. The findings could potentially influence clinical

decision-making regarding the use of loop diuretics and their role in vascular access outcomes for hemodialysis patients.

Materials and methods

This retrospective cohort study was conducted at Ayatollah Rouhani Hospital, Babol, and included patients undergoing hemodialysis who underwent brachiocephalic AVF creation between 2020 and 2023. Medical records were reviewed to collect demographic data, comorbidities, medication use, and AVF-related outcomes.

Patients were categorized into three groups based on their loop diuretic regimen: high-dose, low-dose, and no diuretic use. The study population included adult patients (≥ 18 years) with end-stage kidney disease (ESKD) who required hemodialysis and underwent brachiocephalic AVF creation. To be included, patients had to have at least three months of follow-up after AVF creation. Patients with severe peripheral artery disease, prior AVF failure, incomplete follow-up records, or those on medications affecting vascular remodeling (such as corticosteroids or immunosuppressant) were excluded. Additionally, patients with severe heart failure (NYHA class IV) were also excluded due to potential hemodynamic instability.

Loop diuretic dosages were classified as follows: high-dose (≥ 80 mg/day of furosemide or equivalent), low-dose (< 80 mg/day of furosemide or equivalent), and no diuretic use. This classification allowed for a comparative analysis of the impact of different diuretic doses on AVF maturation. Data extraction included demographic characteristics such as age, sex, body mass index (BMI), and smoking status. Clinical parameters including the primary cause of eskd, presence of diabetes, hypertension, cardiovascular disease, and baseline kidney function before dialysis initiation were recorded. Medication use was documented, specifically focusing on loop diuretics, antihypertensive medications (calcium channel blockers, beta-blockers, ace inhibitors, arbs), anticoagulants, and statins. Laboratory data, including hemoglobin, serum albumin, serum potassium, serum sodium, and inflammatory markers (C - reactive protein), were collected.

The AVF outcomes assessed included maturation status at 60 days, need for additional interventions such as angioplasty or surgical revision, infection rates, and long-term patency. To ensure comparability across study groups, a propensity score matching (PSM) approach was employed to match patients based on antihypertensive medication use, diabetes status, and

other comorbidities. A 1:1 nearest-neighbor matching without replacement was performed to minimize bias. Additionally, a multivariate logistic regression model was used to adjust for potential confounders, ensuring that the effect of loop diuretics on AVF maturation was analyzed independently of other variables, particularly antihypertensive medication use. AVF maturation was defined as the ability to support hemodialysis with two-needle cannulation and an adequate blood flow rate (>600 mL/min) within 60 days (15). Maturation was evaluated through clinical examination for the presence of a palpable thrill and continuous bruit, with Doppler ultrasound performed when necessary to assess vessel diameter, flow volume, and the presence of stenosis. Secondary outcomes included AVF failure, need for further interventions, incidence of AVF infection, and patient survival at six months.

The Institutional Review Board (IRB) of Babol University of Medical Sciences granted approval for this study (IR.MUBABOL.REC.1399.459). Patient confidentiality was maintained, and data were anonymized before analysis. Given the retrospective nature of the study, the requirement for informed consent was waived in accordance with institutional guidelines.

Results

A total of 400 patients were included in the study, with 150 in the high-dose diuretic group, 130 in the

low-dose group, and 120 in the no diuretic group. Baseline characteristics were similar among the groups in terms of age, sex distribution, body mass index (BMI), prevalence of diabetes, hypertension, cardiovascular disease, and laboratory values (Table 1). AVF maturation at 60 days was observed in 80% of patients in the low-dose diuretic group, which was significantly higher than the high-dose diuretic group (65%) and the no diuretic group (68%) ($p < 0.05$). The high-dose diuretic group had a higher incidence of AVF non-maturation (35%) and required more secondary interventions, including balloon angioplasty and surgical revision.

Further analysis showed that patients in the high-dose diuretic group exhibited a higher incidence of AVF stenosis (22%) compared to the low-dose (12%) and no diuretic (14%) groups. The need for surgical revision was also notably higher in the high-dose group (18%) compared to the low-dose (8%) and no diuretic (10%) groups. There were no statistically significant differences in infection rates across the three groups. Patient survival at six months was similar among the groups, indicating that loop diuretic use did not significantly affect short-term mortality.

A combined graphical representation of AVF maturation rates and the need for secondary interventions by diuretic use is shown in Figure 1. This figure illustrates the significantly higher maturation rate in the low-dose group compared to the other groups, while also highlighting the increased necessity for corrective procedures in the high-dose diuretic group.

Table 1. Baseline characteristics of studied groups.

Variable	High-Dose Diuretics	Low-Dose Diuretics	No Diuretics
Age (years) (Mean \pm SD)	65.2 \pm 7.5	64.8 \pm 7.2	66.0 \pm 7.8
Male (%)	60	58	55
BMI (kg/m ²) (Mean \pm SD)	27.4 \pm 3.2	26.9 \pm 3.1	27.1 \pm 3.3
Diabetes (%)	45	42	40
Hypertension (%)	80	78	76
Cardiovascular Disease (%)	50	48	46
Ejection Fraction (EF%) (Mean \pm SD)	45 \pm 6	50 \pm 5	52 \pm 5
Systolic BP (mmHg) (Mean \pm SD)	140 \pm 12	138 \pm 10	135 \pm 11
Diastolic BP (mmHg) (Mean \pm SD)	85 \pm 8	83 \pm 7	80 \pm 6
Serum Albumin (g/dL) (Mean \pm SD)	3.5 \pm 0.4	3.6 \pm 0.3	3.4 \pm 0.4
Serum Potassium (mEq/L) (Mean \pm SD)	4.7 \pm 0.5	4.5 \pm 0.4	4.6 \pm 0.4
Serum Sodium (mEq/L) (Mean \pm SD)	136 \pm 3	137 \pm 3	138 \pm 3

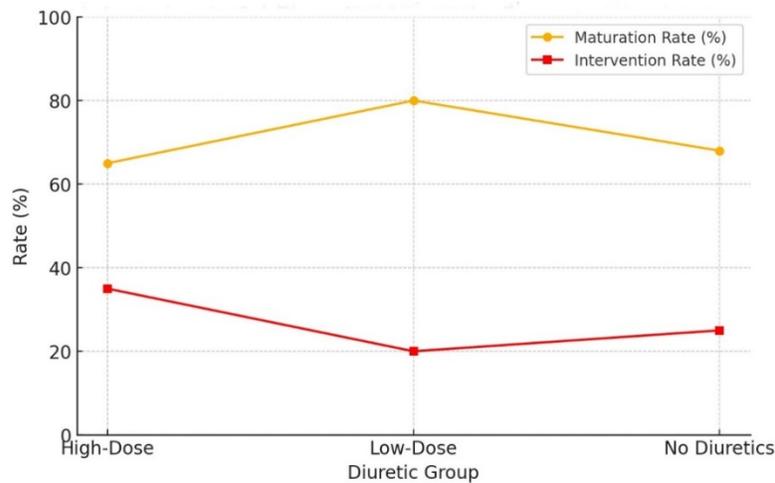


Fig. 1. AVF Maturation and Intervention Rates by Diuretic Use.

Discussion

This study demonstrates that the continuation of loop diuretics, particularly at high doses, may negatively impact AVF maturation, increasing the need for secondary interventions. In contrast, low-dose diuretics appear to support vascular remodeling and improve AVF outcomes by maintaining optimal intravascular volume and venous compliance.

These findings align with previous research highlighting the role of diuretics in volume management and hemodynamic stability in dialysis patients. Prior studies, including those by Trinh & Bargman and the Dialysis Outcomes and Practice Patterns Study (DOPPS), have emphasized the benefits of diuretics in reducing intradialytic weight gain, minimizing ultrafiltration demands, and mitigating intradialytic hypotension (4, 5). Additionally, Sibbel et al.'s study finding demonstrated that the continuation of loop diuretics at the initiation of hemodialysis was associated with lower rates of hospitalization and intradialytic hypotension, as well as reduced intradialytic weight gain (16). However, despite these advantages, their impact on AVF maturation has remained unclear.

Our findings provide further insight into this relationship, demonstrating that excessive diuresis with high-dose loop diuretics that may lead to hypovolemia, reduced venous return, and impaired vascular remodeling, ultimately compromising AVF maturation. The physiological basis for this observation likely stems from the effects of controlled volume management on endothelial function and shear stress. Low-dose diuretics may prevent excessive volume depletion while maintaining venous dispensability, facilitating arterialization of the AVF. Conversely,

high-dose diuretics may induce excessive fluid loss, triggering sympathetic activation, vasoconstriction, and impaired nitric oxide-mediated vasodilation, all of which negatively affect vascular adaptation (17, 18). From a clinical standpoint, optimizing loop diuretic dosing in hemodialysis patients may enhance AVF maturation, reduce reliance on temporary vascular access, and lower the risk of catheter-related complications. While previous research has primarily focused on systemic outcomes such as blood pressure regulation and ultrafiltration efficiency, our study underscores the importance of individualized diuretic management in vascular access planning. Further research is warranted to establish optimal dosing strategies that balance fluid control with vascular health, ultimately improving hemodialysis outcomes and patient stability.

Conclusion

The findings of this study have significant clinical implications for vascular access management in hemodialysis patients. While high-dose loop diuretics may impair AVF maturation and increase the need for secondary interventions, low-dose loop diuretics appear to enhance vascular remodeling and improve AVF outcomes. These results suggest that careful and individualized diuretic prescribing should be considered as part of vascular access optimization strategies.

Declaration

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Conflicts of interest

The authors have nothing to disclose.

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Conception and design: PT, FM, AAM, IJ
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 Writing the article: PT, FM, AAM, IJ, AB
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