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The impact of duplex ultrasound surveillance on long-term secondary patency and central vein catheter placement in arteriovenous access for hemodialysis: A single-center retrospective study

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Abstract

The preservation of ArterioVenous Access (AVA) patency is crucial for effective hemodialysis, minimizing the need for Central Vein Catheter (CVC) placement, which is associated with higher risks of infection and other complications. This study evaluates the impact of a structured Duplex Ultrasound (DUS) surveillance program on the long-term secondary patency of AVAs compared to standard clinical assessment alone. We retrospectively analyzed data from patients with AVAs between 2020 and 2024. The results suggest that DUS surveillance significantly improves the long-term secondary patency of AVAs and reduces the rate of CVC placement, thereby enhancing patient outcomes and optimizing vascular access management.

Keywords: ArterioVenous Access; Hemodialysis; Duplex Ultrasound; Thrombosis

1. Introduction

ArterioVenous Access (AVA) is the lifeline for patients undergoing hemodialysis, as it provides the necessary vascular access for the procedure [1]. Maintaining AVA patency is essential to ensure effective dialysis and reduce the dependence on Central Vein Catheters (CVCs), which are linked to increased infection risks and other complications [2,3,4]. Duplex Ultrasound (DUS) has emerged as a non-invasive and repeatable method for evaluating AVA anatomy and hemodynamics, providing critical information that, when integrated with physical examination and dialysis monitor data, can guide effective follow-up and intervention strategies [5,6,7,8].

In the Kingdom of Bahrain, limited data exist on the utility of DUS in AVA surveillance. This study aims to compare the long-term secondary patency of AVAs in patients enrolled in a structured DUS surveillance program versus those monitored through standard clinical assessment [9,10]. Additionally, the study examines the rate of CVC placement following AVA thrombosis in both groups.

2. Material and Methods

2.1. Study Design

This retrospective study was conducted at a private medical institution in Bahrain, involving patients who underwent hemodialysis through AVAs between April 2020 and June 2024. The patients were divided into two groups: a historical

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control group that received routine clinical assessment and a surveillance group that underwent regular DUS evaluations following the implementation of this practice in our hemodialysis unit policy.

2.2. Surveillance Program

Patients in the DUS surveillance group underwent routine DUS examinations three months postoperatively and every six months thereafter. The DUS assessments focused on detecting AVA malfunctions, particularly stenosis (defined as >50% narrowing and blood flow <600 mL/min). Identified malfunctions were treated with endovascular interventions, including angioplasty and stenting [11].

2.3. Clinical Assessment Group

The historical control group included patients whose AVA malfunctions were identified through standard clinical assessments without routine DUS surveillance.

2.4. Data Collection and Analysis

Data were collected on the duration of secondary patency (from the first successful intervention to AVA abandonment or patient death) and the rate of CVC placement following AVA thrombosis. Kaplan-Meier analysis was used to estimate secondary patency rates, and Cox proportional hazards models were applied to identify factors associated with AVA thrombosis. Comparisons between groups were conducted using the log-rank test and chi-square test.

3. Results

3.1. Patient Demographics

A total of twenty-six patients were included: 14 (55%) in the DUS surveillance group and 12 (45%) in the historical control group. Baseline characteristics and follow-up durations were similar between the groups (median follow-up: 22 months in the surveillance group vs. 18 months in the historical group).

3.2. Malfunction Detection and Treatment

In the DUS surveillance group, 3 (22%) AVA malfunctions were detected and successfully treated, while no malfunctions were detected in the historical control group through clinical assessment alone (Table 1).

Table 1 Factors Associated with AVA Thrombosis

Factor	Hazard Ratio (95% CI)	p-Value
DUS Surveillance	0.45 (0.22-0.89)	0.021
CVC Placement	2.13 (1.34-3.42)	0.001
Previous AVA Thrombosis	1.76 (1.09-2.85)	0.018

3.3. Secondary Patency

Kaplan-Meier analysis revealed a significantly higher 2-year secondary patency rate in the DUS surveillance group compared to the historical control group (Figure 1). Cox analysis identified DUS surveillance as a protective factor against AVA thrombosis.

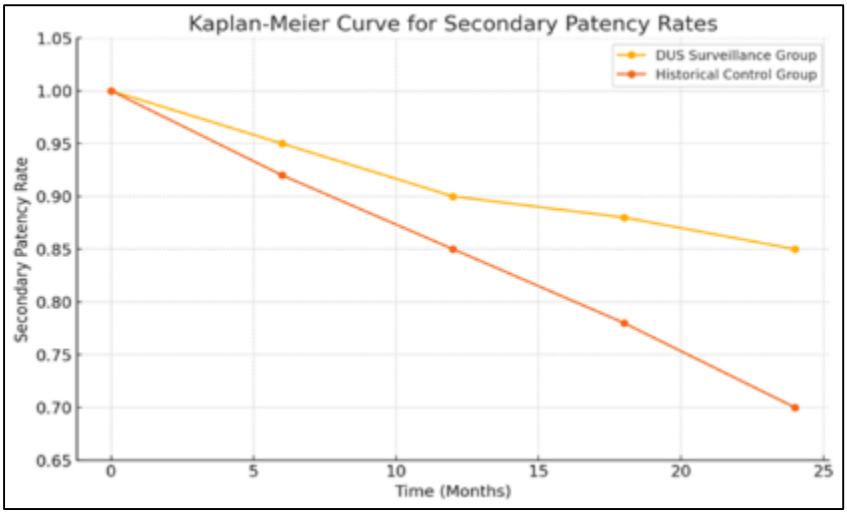

Figure 1 The curve compares the secondary patency rates between the DUS Surveillance Group and the Historical Control Group over time.

3.4. CVC Placement

The rate of CVC placement following AVA thrombosis was significantly lower in the DUS surveillance group compared to the historical control group (Figure 2).

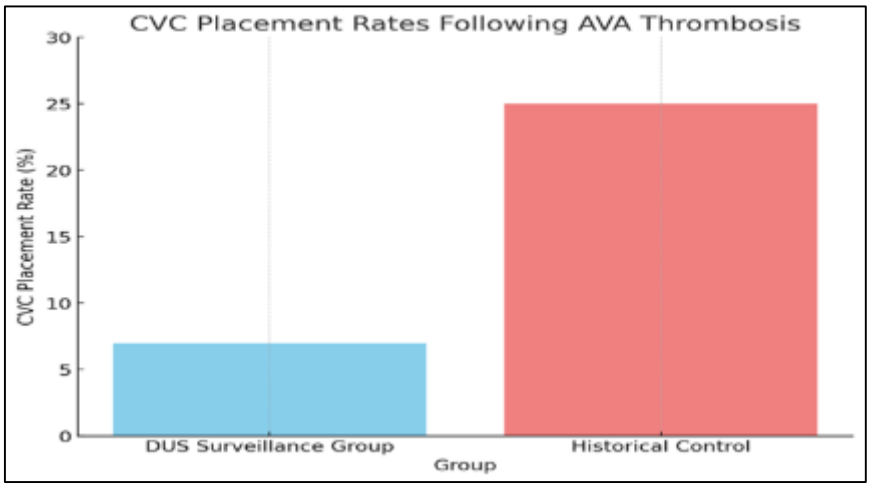

Figure 2 A bar chart shows the CVC placement rates for the DUS Surveillance Group (7%) and the Historical Control Group (25%)

4. Discussion

The results of this study indicate that DUS surveillance significantly enhances the long-term secondary patency of AVAs compared to standard clinical assessment [1]. Routine DUS monitoring facilitates the early detection and timely intervention of AVA malfunctions, thus prolonging AVA life and reducing the necessity for CVC placement [3,8,10].

4.1. Advantages of DUS Surveillance

- **Early Detection**: Routine DUS allows for the identification of subclinical stenosis and decreased blood flow before they present as clinical symptoms [6,11].
- **Timely Intervention**: Prompt treatment of identified malfunctions through endovascular techniques prevents AVA thrombosis and extends patency [9].
- **Reduced CVC Use**: By maintaining AVA patency, DUS surveillance decreases the need for temporary CVC placement, thereby lowering the risk of catheter-related complications [7].

4.2. Clinical Implications

Implementing a DUS surveillance program can be highly beneficial in managing patients with AVAs, particularly those at high risk for graft complications. This approach not only improves patient outcomes by preserving vascular access but also reduces healthcare costs associated with repeated hospitalizations and CVC-related infections [4,5,9].

5. Conclusions

This study demonstrates that DUS surveillance is superior to clinical assessment alone in maintaining the long-term secondary patency of AVAs and reducing the rate of CVC placement. The structured use of DUS enables proactive management of AVA malfunctions, ensuring better patient care and optimizing resource utilization in hemodialysis vascular access management. Future research should aim to refine surveillance protocols, identify patient populations that would benefit the most from regular DUS monitoring, and assess the cost-effectiveness of widespread DUS surveillance program implementation.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest related to this study.

Statement of ethical approval

The study received approval from the Ethical Committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Ethier J, Mendelssohn DC, Elder SJ, et al. Vascular access use and outcomes: An international perspective from the Dialysis Outcomes and Practice Patterns Study. *Nephrol Dial Transplant.* 2008;23(10):3219-3226.

[2] Lok CE, Huber TS, Lee T, et al. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. *Am J Kidney Dis.* 2020;75(4 Suppl 2)

[3] Tessitore N, Bedogna V, Lipari G, et al. Duplex ultrasound findings of arteriovenous fistulae and grafts in hemodialysis patients: Value in predicting outcomes of endovascular interventions. *J Vasc Access.* 2019;20(6):584-591.

[4] Allon M, Robbin ML. Increasing arteriovenous fistulas in hemodialysis patients: Problems and solutions. *Kidney Int.* 2002;62(4):1109-1124.

[5] Hakim RM, Himmelfarb J. Haemodialysis access failure: A call to action. *Kidney Int.* 1999;54(4):1024-1040.

[6] Young EW, Dykstra DM, Goodkin DA, et al. Hemodialysis vascular access preferences and outcomes in the Dialysis Outcomes and Practice Patterns Study (DOPPS). *Kidney Int.* 2002;61(6):2266-2271.

[7] National Kidney Foundation. K/DOQI Clinical Practice Guidelines for Vascular Access. *Am J Kidney Dis.* 2001;37(1 Suppl 1)

[8] Gadallah MF, Paulson WD, Vickers B, et al. Accuracy of Doppler ultrasound in diagnosing anatomic stenosis of hemodialysis arteriovenous access as compared with fistulography. *Am J Kidney Dis.* 1998;32(2):273-277.

[9] Malik J, Slavikova M, Maskova J, et al. Comparison of ultrasound findings of significant dialysis access stenoses with angiography. *Cor Vasa.* 2002;44(2):68-72.

[10] Paulson WD, Ram SJ, Birk CG, et al. Accuracy of decrease in blood flow in predicting hemodialysis graft thrombosis. *Am J Kidney Dis.* 2000;35(6):1089-1095.

[11] McDougal G, Agarwal R. Clinical performance characteristics of hemodialysis graft monitoring. *Kidney Int.* 2001;60(2):762-766.