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Education-Based Nursing Management of Vascular Access Complications in End-Stage Renal Disease: A Case Study

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ABSTRACT

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Background: End-stage renal disease (ESRD) requires lifelong haemodialysis (HD) therapy. Functional vascular access is a key determinant of the success and adequacy of HD therapy and patient safety. Despite advance in vascular access management, catheter-related complications, such as luminal obstruction, continue to present significant challenges in clinical practice. This study aims to describe the education-based nursing management in addressing vascular access complications, particularly catheter obstruction in ESRD patient undergoing HD.

Case Presentation: Mrs. AN, a 58-year-old woman with ESRD experienced complete obstruction of both lumens of her right subclavian catheter during HD therapy. The procedure was interrupted for 2 hours and 25 minutes despite a 45-minute heparin flush without success. Previously, a similar incident occurred, which was a month earlier.

Conclusion: Nursing management of ESRD patients with catheter obstruction requires an integrated approach combining nursing education for patients and nurses with appropriate clinical interventions. This education encompasses vascular access care, early detection of obstruction, hygiene practices, and adherence to haemodialysis schedules. This case study highlights that effective nursing education has the potential to improve patients' knowledge, skills, and adherence, thereby contributing to the prevention of recurrent complications, enhanced patient safety, and long-term therapeutic success.

Keywords: Nursing management; Haemodialysis; Catheter obstruction; End-stage renal disease; Case report

INTRODUCTION

End-Stage Renal Disease (ESRD) is a progressive condition in which kidney function is no longer sufficient to sustain life without renal replacement therapy. Haemodialysis (HD) is the most common renal replacement therapy for patients with ESRD, alongside kidney transplantation and peritoneal dialysis (1). Optimal vascular access is key to successful HD. However, in clinical practice, a central venous catheter is frequently used as the initial access when an arteriovenous fistula or graft is not yet available or requires maturation (2).

Central venous catheters are highly susceptible to complications, particularly mechanical obstruction, which may impair blood flow adequacy and compromise patient safety. Other complications associated with central venous catheters include bloodstream infections, venous thrombosis, malposition, pneumothorax, and catheter rupture or dislodgement, all of which can prolong hospitalisation. Among these, infectious complications were the most prevalent, accounting for 69.5% (3). Therefore, HD vascular access care requires close monitoring and proactive preventive strategies, as complications such as thrombosis, stenosis, and infection are associated with increased morbidity, mortality, and reduced quality of life among patients undergoing HD (4).

This case report describes recurrent HD catheter obstruction within a short time frame in a patient with ESRD and comorbid diabetes mellitus, highlighting the challenges of maintaining functional vascular access for HD. The report aims to describe nursing management in addressing vascular access complications, particularly catheter obstruction, and to emphasise the critical role of nurses in assessment, intervention, and prevention of catheter-related complications through an education-based approach focusing on patient and family education. Education-based nursing management supports patients and families in self-managing their condition by improving understanding of the disease, self-care therapies, and warning signs, thereby enhancing readiness for discharge, reducing rehospitalisation, and lowering the burden of healthcare costs.

CASE PRESENTATION

Mrs. AN, a 58-year-old patient with ESRD, was admitted due to HD catheter dysfunction. She experienced recurrent obstruction of a right subclavian HD catheter, resulting in impaired delivery of effective HD therapy. Previously, she had an episode of catheter obstruction approximately four months earlier, for which she received treatment at her district hospital and underwent temporary HD via a right Peripheral Venous Catheter (PVC). Approximately one month later, the patient developed a recurrent complete obstruction of the right subclavian vein catheter about 2 hours and 25 minutes after the initiation of HD, despite heparin flushing.

Medical and Surgical History

The patient was diagnosed with ESRD for 5 years. She had a history of hypertension for seven years and diabetes mellitus for eight years. Her diabetes was managed with routine pharmacological therapy, including subcutaneous insulin aspart at a dose of 4–6 units administered before meals and her hypertension was managed with antihypertensive therapy consisted of amlodipine 5mg once daily. She also was prescribed with atorvastatin 20 mg once daily for lipid management, calcium carbonate 500 mg taken three times daily with meals as a phosphate binder, and oral ferrous sulphate 325 mg once daily. She had previously undergone a cholecystectomy in 2023, without no reported postoperative complications.

Nursing Assessment

On admission, the patient was in a stable general condition, exhibited signs of anxiety related to recurrent catheter obstruction, while family members were actively involved and supportive in the patient's care. Vital signs taken and found her blood pressure was 160/66 mmHg, heart rate of 90 beats per minute, respiratory rate of 20 breaths per minute, body temperature of 36.6°C, and oxygen saturation of 97% on room air. Physical examination revealed that the HD catheter remained in situ but was nonfunctional. A peripheral intravenous line using a 22-gauge cannula in the right hand was patent and well maintained, with no clinical signs of phlebitis. Laboratory investigations revealed elevated serum urea (27.2 mmol/L) and creatinine (766 µmol/L), accompanied by hypoalbuminemia (34 g/L),

hypocalcaemia (2.11 mmol/L), and markedly elevated phosphate levels (27.2 mmol/L).

Further assessment revealed a significant knowledge gap in vascular access care, including measures taken to prevent catheter blockage, adherence to the HD schedule, and diabetes self-management. The nursing diagnosis identified for this case was knowledge deficit, related to the patient's and family's limited understanding of the disease, treatment, and required home care skills, as evidenced by their inability to adequately explain the therapy regimen and the expressed need for additional information to ensure safety and independence after discharge.

Nursing Management

Vascular access care, hemodynamic monitoring, interprofessional teamwork, and patient-centred support, integrated with nursing-based education management were the main nursing interventions for this patient. To prevent catheter-related infections and recurrent complications, nurses educated Mrs. AN and her family on diabetes management, early recognition of catheter obstruction, adherence to the haemodialysis schedule, and appropriate hygiene practices. The catheter care, activity limitations, and the need to report early signs of catheter dysfunction were also included.

Catheter patency was routinely assessed before each haemodialysis session, and strict aseptic technique was applied during catheter handling to minimise the risk of infection and blockage. Teach-back methods and demonstrations were used to show the patient and family proper arm and catheter positioning, with instructions repeated to confirm understanding. Vital signs were monitored before, during, and after dialysis sessions, and fluid balance was documented regularly. When catheter obstruction could not be resolved through flushing, the nursing team promptly collaborated with the nephrology team for further management.

During hospitalisation, nurses reinforced adherence to prescribed pharmacological therapies, including insulin, antihypertensive agents, statins, phosphate binders, and nutritional supplements. The nursing team monitored for adverse effects and ensured medications were administered according to the treatment plan. The patient and family

were educated regarding the purpose of each therapy. Family members were actively involved in structured teaching to support catheter care and home monitoring, while psychosocial support was provided to address anxiety related to haemodialysis and catheter complications.

Overall, the integration of education-based nursing management with vascular access care, close hemodynamic monitoring, interprofessional pharmacological collaboration, and patient-centred support resulted in improved adherence and patient confidence during haemodialysis. Vital signs remained stable throughout dialysis sessions, and no further severe catheter occlusion was observed during hospitalisation. The patient and family demonstrated improved understanding of catheter management and early complication recognition, supporting safer continuation of haemodialysis therapy.

DISCUSSION

Haemodialysis catheters are particularly prone to mechanical complications, including obstruction, with reported incidence rates ranging from 17% to 33% depending on catheter type and patient population (7). One of the most common mechanisms is fibrin sheath formation, which occurs when plasma proteins and thrombotic material accumulate along the catheter surface, progressively impairing blood flow and leading to catheter dysfunction (8). However, recurrent episodes of catheter obstruction within a short interval such as in this case study, suggested persistent catheter dysfunction rather than a temporary mechanical blockage, posing a significant challenge in maintaining reliable vascular access for haemodialysis (6). The presence of long-standing diabetes mellitus and hypertension in this patient contributed further to an increased risk of vascular complications (5). In patients with uncontrolled diabetes mellitus, the risk of recurrent catheter obstruction is further increased due to a prothrombotic state (9). Chronic hyperglycaemia promotes endothelial dysfunction, platelet hyperreactivity, increased coagulation factor activity, and impaired fibrinolysis (10). As a result, thrombus and fibrin sheath structures tend to be denser and more resistant to dissolution, which may explain the rapid recurrence of obstruction in both catheter lumens despite prior intervention (11).

Nursing interventions that can be performed such as in this case is mainly on routine monitoring and care, including maintaining cleanliness of the insertion site, using aseptic technique, and changing the dressing regularly. In nursing practice, chlorhexidine–alcohol-based antiseptics remain the standard, especially for surgical hand preparation, and periodically evaluating catheter function (17). While for nursing education intervention, it should be specifically address preventive measures, including adequate post-HD catheter flushing, the use of pulsatile (push–pause) flushing techniques, and the application of positive-pressure locking to prevent blood reflux into the catheter lumen (18). In HD practice, nurses should be educated to flush each catheter lumen with an adequate volume of 0.9% sodium chloride using a pulsatile technique after every dialysis session, followed by locking with solutions recommended by institutional protocols, such as heparin at an appropriate dose or alternative agents. Although heparin is commonly used to maintain catheter patency, emerging evidence suggests that 0.9% sodium chloride may provide comparable effectiveness. Therefore, the choice and dosage of locking solutions should be guided by a risk–benefit assessment and local clinical guidelines (19).

Education-based nursing management plays a crucial role in preventing vascular access complications (12). Previous studies have shown that structured patient and family education improves knowledge, self-care behaviours, adherence to dialysis schedules, and early recognition of access dysfunction, while significantly reducing rates of infection, thrombosis, and access-related complications (6). Nurses are uniquely positioned to deliver ongoing education due to their repeated and direct contact with HD patients (13). Education-based nursing management has been shown to contribute to improved patient satisfaction, early detection of complications, and enhanced shared decision-making in care. In addition, ongoing multimodal approaches, such as practical demonstrations, written modules, and follow-up reinforcement, are necessary, as the effectiveness of education may decline in the absence of continuous supervision and support (13). However, implementation remains challenging due to limited nursing time, high workload, low patient health literacy, and variable compliance with dialysis and self-care recommendations (11). Therefore, sustainable

and standardised education programmes integrated with clinical practice guidelines are needed to optimise patient adherence, reduce catheter-related complications, and improve long-term outcomes in ESRD management (6).

In addition to patient education, strengthening nurses' competency through evidence-based training programs is essential (14). Educational interventions for dialysis nurses have been shown to enhance knowledge and technical skills in catheter maintenance, complication prevention, and adherence to vascular access care bundles (12). Nursing education to nurses should also emphasize appropriateness of catheter selection and placement, minimising unnecessary catheter manipulation, the use of closed access systems, and strict adherence to catheter care bundles. Such structured, evidence-based educational approaches among nurses are expected to reduce recurrent catheter obstruction and improve vascular access outcomes in HD patients (20). Standardised vascular access education programmes and regular in-service training are needed to ensure nurses maintain competency in access assessment, catheter care, and early complication detection (15).

LIMITATION

This case report has several limitations that should be noted. First, the diagnosis of recurrent catheter obstruction, including the presence of a fibrin sheath or intraluminal thrombus, was not confirmed by imaging techniques or further diagnostic testing, thus limiting the ability to definitively determine the underlying cause. Second, the relatively short follow-up period limited the evaluation of the long-term effectiveness of educational nursing interventions in preventing catheter complications. Third, as a single case study, these findings cannot be generalized to the entire population of patients with end-stage renal disease undergoing HD.

IMPLICATION FOR NURSING PRACTICE

Implementing education-based nursing management on ESRD patients is crucial for improving the safety and success of therapy, particularly regarding the prevention and management of vascular access complications. In dialysis practice, nurses play a role not only in technical procedures but also as educators who systematically provide structured education to patients and their

families/caregivers about fistula, graft, or catheter care; early signs of complications; and when to seek help. Therefore, a standardised, evidence-based vascular access education program is needed, with uniform materials, media, and evaluation so that mutual education is not dependent on individual nurses. The broader implications for education and education policy include the need to integrate specific curricula for vascular access management and ESRD patient education into basic education and continuing training, as well as the development of standard operating procedures and policy institutions that require documentation, audits, and quality improvement of continuing education programs [21]. Such policies can support consistent practice across dialysis units, improve quality of care, and reduce catheter-related morbidity in long-term HD patients [16].

CONCLUSION

Overall, this case study demonstrates that nurses play a vital role in the comprehensive management of patients with ESRD who experience HD catheter obstruction, extending beyond technical interventions to include patient- and family-centred nursing education. Through systematic assessment, targeted clinical interventions, and continuous educational support, nurses address existing catheter obstruction while actively preventing recurrence by improving patient's knowledge, skills, and adherence to vascular access care. A structured, education-based nursing approach strengthens preventive strategies, empowers patients as active partners in HD therapy, and contributes to improved patient safety and quality of life. Effective management of vascular access complications requires multidisciplinary collaboration, sustained educational efforts for patients and healthcare providers, and institutional commitment. Sustainable, structured, and patient-centred nursing education programmes are therefore essential to minimising recurrent catheter obstruction and optimising long-term clinical outcomes for patients undergoing HD.

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest in this study.

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AUTHOR CONTRIBUTIONS

ZNH: Conceptualization, study design, data collection, data analysis, manuscript drafting. PAW: Supervision, critical revision of the manuscript, final approval.

REFERENCES

1. Braun M, Khayat M. Kidney disease: end-stage renal disease. *FP Essent.* 2021;509:26–32. Available from: <https://consensus.app/papers/kidney-disease-endstage-renal-disease-khayat-braun/ab65109b21205115af44a7b7798d1dff/>
2. Besarab A, Frinak S, Margassery S, Wish J. Hemodialysis vascular access: a historical perspective on access promotion, barriers, and lessons for the future. *Kidney Med.* 2024;6:100871. Available from: <https://consensus.app/papers/hemodialysis-vascular-access-a-historical-perspective-on-margassery-besarab/3621ace964da553a987d75ad49e99ebb/>
3. Bağcı MS, Erdem AY, Ozbek NY, Yaralı N. Port-catheter complications in children with malignancy. *Turk Arch Pediatr.* 2025;60:99–104.
4. Franchin M, Tadiello M, Guzzetti L, Gattuso A, Mauri F, Cervarolo M, et al. Acute problems of hemodialysis access: thrombosis, aneurysms, symptomatic high-flow fistulas, and complications related to central lines. *Semin Vasc Surg.* 2023;36(2):300–6. Available from: <https://consensus.app/papers/acute-problems-of-hemodialysis-access-thrombosis-franchin-tadiello/75e49129471d557cbbc4abb34666b39d/>
5. Lazarus B, Kotwal S, Gallagher M, Gray N, Coggan S, Rogers K, et al. Effect of a

- multifaceted intervention on the incidence of hemodialysis catheter dysfunction in a national stepped-wedge cluster randomized trial. *Kidney Int Rep.* 2023;8:1941–50. Available from: <https://consensus.app/papers/effect-of-a-multifaceted-intervention-on-the-incidence-of-gray-kotwal/ae002adbd1c45246baf61437d14f99fc/>
6. Sun J, Fan H, Cui T. Management of tunneled-cuffed catheters in hemodialysis patients with hypotension and recurrent central venous thrombosis: a single-center retrospective cohort study. *Sci Prog.* 2025;108. Available from: <https://consensus.app/papers/management-of-tunneledcuffed-catheters-in-hemodialysis-sun-fan/c954628f30b35ffab704b9bb6a49ef4d/>
 7. Fathy R, Monem A, Abdullah WH, Atallah HR. Effect of nursing intervention on controlling interdialytic weight and vascular access complications among patients undergoing hemodialysis. 2022;351–66.
 8. Wembenyui C, Marsh N, Larsen E. Educational or behavioural interventions to improve long-term haemodialysis vascular access self-management: a systematic review. *J Ren Care.* 2024.
 9. Wilson S, Mone P, Kansakar U, Jankauskas SS, Donkor K, Adebayo A, et al. Diabetes and restenosis. *Cardiovasc Diabetol.* 2022;21:1–14. doi:10.1186/s12933-022-01460-5
 10. Li X, Weber NC, Cohn DM, Hollmann MW, Devries JH, Hermanides J, et al. Effects of hyperglycemia and diabetes mellitus on coagulation and hemostasis. *Thromb Haemost.* 2021;121:153–64.
 11. Jalili J, Vaseghi S, Asvadi T, Baastani M. Evaluating tissue plasminogen activator (tPA) in dialysis catheter dysfunction: a focus on fibrin sheath and risk factors. *Am Heart J Plus.* 2025;58.
 12. Hernán V, Muñoz GM, Monroy AM, Cabana AF, Rivas EO, García IZ, et al. Influence of care on the prevention of bacteremia in hemodialysis: systematic review. *Nephrol Nurs J.* 2023;50(4):333–44. Available from: <https://consensus.app/papers/influence-of-care-on-the-prevention-of-bacteremia-in-hernán-cabana/9dc339ed7bdf55229bb5abd5c48499b4/>
 13. Almeida ACN, Pires MH, Santana IS, Salgado PO. Effectiveness of an educational intervention for the prevention of catheter-related infections in hemodialysis patients. 2022.
 14. Ribeiro GDSR, Campos JF, Silva RC. What do we know about flushing for intravenous catheter maintenance in hospitalized adults? *Rev Esc Enferm USP.* 2022;75(5):1–11.
 15. Smith K, Ayars C. Improving vascular access knowledge and assessment skill of hemodialysis staff. *J Osteopath Med.* 2025;125(6):321–7. doi:10.1515/jom-2023-0262
 16. Villanueva AD. A systematic review of patient education strategies for arteriovenous fistula care in hemodialysis patients. 2024;2–5.
 17. Pilard M, Ollivier EL, Gourdou-Latyszenok V, Couturaud F, Lemarié CA. Endothelial cell phenotype, a major determinant of venous remodeling. *Front Cardiovasc Med.* 2022;9:1–18.
 18. Lourdes C, Evalarozza T, Bernadette S, Baleña L. Guarding the line: a systematic review of nurse-led infection prevention protocols for reducing catheter-related bloodstream infections in hemodialysis settings. 2025;7(4):1–34.
 19. Mahmoud HM, Ahmed DA, Rady SE. Nurses' knowledge and practices regarding permanent vascular access care among patients on hemodialysis. 2024;15(2):1470–89.
 20. Khalid H, Sarwar H, Azam S. Effect of standardized educational intervention on nurses' knowledge and practices regarding management of hemodialysis. 2025;3(7).
 21. Wang J. Comprehensive nursing care for vascular access in hemodialysis patients with end-stage renal disease. *Int J Public Health Med Res.* 2024. Available from: <https://consensus.app/papers/comprehensiv-e-nursing-care-for-vascular-access-in-wang/3c1cee8a0f0759ff939a1db849eaa704/>