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Predialysis education program and early vascular access: a single center experience

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ABSTRACT

Aims: The main objective of this study is to investigate the impact of a pre-dialysis education program on the selection of vascular access during the initiation of maintenance hemodialysis therapy and the short-term impact of this education on patient outcomes.

Methods: The data were collected from two different times in the past from patients under maintenance hemodialysis: the first group consisted of a group of patients who received a predialysis education program (intervention group) from a dedicated nephrologist, and the second group included those who did not undergo a control program (control group). Predialysis education program involved six modules addressing understanding kidney disease, diet, and nutrition, treatment options for end-stage kidney disease, dialysis procedures, medication management, and self-care/independence. Patients aged ≥18 years were enrolled in the study. The patients were compared according to their clinical status during the onset of maintenance hemodialysis, including vascular access type, serum potassium level, previous hospitalization, and urgent hemodialysis need. Additionally, the hospitalization and infection rates within 6 months following the onset of maintenance hemodialysis were compared. P<0.05 was assigned as significant.

Results: A total of 203 hemodialysis patients, 129 patients in the intervention group and 74 patients in the control group, were assessed. The mean age was 65.06±13.14 for the intervention versus 65.66±9.13 for the control group (p=0.729). 51.9% (n=67) in the intervention group versus 55.4% (n=41) were females (p=0.371). The control group had more hospitalization (p<0.001), intervention need of vascular access problems (p<0.001), vascular access infection (<0.001), exposure to an intermittent catheter (<0.001), 127 of 129 patients in the intervention group started hemodialysis with an arteriovenous fistula. The control group started hemodialysis with a catheter Potassium, phosphorus, and bicarbonate levels were higher in the control group during the first hemodialysis session (5.25±1.12 vs 4.59±0.79, p<0.001, 6.60±1.18 vs 4.25±1.04, p<0.001, and 21.77±3.96 vs 14.18±2.83, p<0.001, respectively).

Conclusion: This study demonstrated that a well-organized education program can lower the burden of morbidity in end-stage kidney disease and support the patient and healthcare providers with a favorable transmission from a non-hemodialysis period to a hemodialysis period.

Keywords: End-stage kidney disease, pre-dialysis education, maintenance hemodialysis, morbidity, vascular access

INTRODUCTION

End-stage kidney disease (ESKD) poses a significant global health challenge, imposing a substantial burden on both patients and healthcare systems.[1,2] Maintenance hemodialysis (MHD) therapy is a critical intervention for patients with ESKD as it sustains life. The choice of vascular access during the initiation of HD plays a crucial role in ensuring successful treatment outcomes and enhancing patients' overall quality of life.[3,4]

In recent years, pre-dialysis education programs have gained recognition as an essential component in the care of patients with ESKD.[5-8] These programs aim to provide patients with comprehensive information about kidney disease, treatment options, and self-management strategies to optimize their health and decision-making during the transition to maintenance HD as well as other choices.[9-11] By empowering patients with knowledge and awareness, pre-dialysis education programs have the potential to improve patients' active involvement in their care and enable them to make informed choices, particularly regarding vascular access options. However, clinical evidence is lacking regarding the question, "What are the most effective educational methods?" It is also unclear how to provide the staff's competencies to develop such an education.[7,12]

The current study aims to investigate the effects of a pre-dialysis education program on the choice of vascular access during the initiation of maintenance HD therapy and the impact of this program on the 6-month outcomes of the patients.

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METHODS

The study was carried out with the permission of the Sakarya University Faculty Non-invasive Researches Ethics Committee (Date: 02.05.2023, Decision No: 107). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Participant

This study is a retrospective case-control study that was conducted at our State Hospital between January 1, 2020, and December 31, 2022. Because of being retrospective, informed consent was not obtained. The participants were divided into two groups: the intervention group, consisting of ESKD patients who received a pre-dialysis education program (intervention group), and ESKD patients who received urgent dialysis without contributing to a pre-dialysis education program (control group), comprising patients who did not undergo any specific education program. 64 out of 74 ptaients in the control group were chosen from another centre.

Inclusion Criteria

Age ≥18 years, surviving within 6 months following initiating maintenance HD, CKD stage 3-5.

Exclusion Criteria

Deaths, incomplete data, switching peritoneal dialysis or transplantation, malignancy, hospitalization due to decompensated heart failure, and infections unrelated to vascular access.

Data Collection

The data for this study was collected retrospectively from patient records maintained during the study duration. Information related to the clinical status of patients during the onset of maintenance HD was gathered, and 6-month outcomes were compared between the two groups, including the type of vascular access chosen (arteriovenous fistula or catheter), serum potassium, phosphorus, bicarbonate levels, hospitalization and infection rates, the need for urgent HD, and mortality rates following the onset of maintenance HD. Additionally, hepatitis B virus surface antigen (HbsAg), antibody of HbsAg (AntiHBs), antibody of hepatitis C virus, and antibody of human immunodeficiency virus (Anti-HIV) tests were performed.

Pre-Dialysis Education Program

The pre-dialysis education program involved six modules delivered to the intervention group face-to-face by a dedicated nephrologist. The modules covered crucial topics related to kidney disease, including understanding the disease process, dietary and nutritional considerations, available treatment options for end-stage kidney disease, dialysis procedures, effective medication management, and promotion of self-care and independence (**Table 1**).

Table 1. Modules of pre-dialysis education program

	Content of the modules
Module-1	Understanding Kidney Disease: Focus on educating patients about the anatomy and function of the kidneys, as well as the causes and progression of kidney disease.
Module-2	Diet and Nutrition: Provide patients with guidance on maintaining a healthy diet and nutrition plan, including guidelines for fluid and salt intake.
Module-3	Treatment Options: Provide an overview of the different types of dialysis and other treatment options available for ESKD, including peritoneal dialysis, hemodialysis, and transplantation.
Module-4	Dialysis Procedures: Focus on educating patients about the procedures involved in dialysis, including preparation for dialysis, catheter care, infection control, and monitoring for potential complications.
Module-5	Medication Management: Focus on the medications commonly used to treat kidney disease and the importance of adherence to medication regimens.
Module-6	Self-Care and Independence: Focus on empowering patients to take an active role in their own care, including self-monitoring, self-care techniques, and communication with healthcare providers.

RESULTS

A total of 203 participants with a mean age of 65.28±11.82 years were enrolled in the study. The two groups were similar in terms of age (p=0.729). 51.9% (n=67) in the intervention group versus 55.4% (n=41) were females (p=0.371). In the intervention group, the mean duration from AVF creation to initiating HD was 147.23±7.22 days. The clinical and laboratory features of the participants are given in **Table 2**. All 74 patients in the control group needing dialysis underwent their first dialysis through a temporary non-tunneled catheter (25 of 74 were exposed to a femoral intervention). Among the control group, 50 out of 74 patients still had a catheter at the end of month 6 after the initiation of dialysis.

Biochemical Comparison

The intervention group showed significantly lower phosphorus (p<0.001) and potassium (p<0.001) levels and significantly higher bicarbonate (p<0.001) levels during their first HD session compared to the control group (**Table 3**).

Clinical Outcomes

The data demonstrated that the intervention group, which had AVF as the primary vascular access, experienced fewer hospitalizations (<0.001), shorter hospitalization durations (<0.001), and fewer vascular access-related complications (<0.001) compared to the control group, which relied solely on catheter access (**Table 4**). Only two patients in the intervention groups required a temporary catheter within 6 months of follow-up after starting HD.

Table 2. The clinical and laboratory features of the participants at the entry into the study

Characteristics, n=203			**Serology, yes/no, %**
Age (years)		65.28±11.82	HBsAg positive; 4/193 Anti Hbs positive; 70/133 Anti-HCV positive; 2/201 Anti-HIV positive; 0/2023
Gender, Female, no, %		108/95(53.2/46.8)	
BMI (kg/m²)		27.02±6.93	
eGFR at the entry of the intervention group		16.42±6.57	
eGFR at the first dialysis in the intervention group		11.76±4.54	
Active smoker		19(11.3)	
Comorbidity During Dialysis; yes/no, n, %			**Drugs, yes/no, n***
DM HT CAD	80/123 (39.4/60.6) 132/65 (62/35) 52/151 (25.6/74.4)	ACEi ARB Loop diuretics Spironolactone Aspirin Apixaban Warfarin	34/95 28/101 110/19 10/119 82/121 5/124 6/147 *Note: there are missing data

Abbreviations: ACEi: Angiotensin-converting enzyme inhibitor, ARB: Aldosterone antagonist, BMI: Body mass index, CAD: Coronary artery disease DM: Diabetes mellitus, HT: Hypertension, eGFR: Estimated glomerular filtration rate, HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus.

Table 3. The comparison of the two groups for the stage, phosphorus, potassium, and bicarbonate at the beginning of the study

		Intervention group n=129	**Control group n=74**	**P value**
Age, year		65.06±13.14	65.66±9.13	0.729
BMI, kg/m²		27.18±6.97	26.46±6.82	0.575
Gender, male/female, n		62/67	33/41	0.371
CKD stage * n (%) Stage 3 Stage 4 Stage 5		 8 (6.2) 60 (46.6) 61 (47.2)	 0 0 74 (100)	 NA
First HD	Phosphorus, mg/dl	4.59±0.79	5.32±0.93	<0.001
	Potassium, mEq/L	5.05±0.97	5.67±0.67	<0.001
	Bicarbonate, mmol/L	21.77±3.96	14.18±2.83	<0.001

Abbreviations: BMI: Body mass index, *eGFR wrere calculated according to CKD-EPI 2021

Table 4. The comparison of the two groups regarding vascular access and hospitalization

After initiating maintenance HD, yes/no, n (within 6 months)	**Intervention group n=129**	**Control group n=74**	**P value**
Hospitalization	32/97	53/20	<0.001
Total Hospitalization number	0.5±0.41	1.21±0.55	<0.001
Vascular access, AVF/catheter	127/2	0/74	<0.001
Vascular access-related hospitalization	7/122	56/18	<0.001
Vascular access-related infection (catheter infection, thrombophlebitis, cellulitis, etc.)	1/128	1/73	<0.001
Need for temporary catheter insertion	0/129	2/72	<0.001
Hospitalization duration at the HD initiation, days	2.48±2.02	4.68±2.03	<0.001

Abbreviations: HD: Hemodialysis

Pre-dialysis education program improved the serology of HBV. Pre-education, 77 of 129 participants were negative for HbsAb; however, following the education program, the count of negative individuals reduced to 42 during the first HD session. In the control group, only 16 patients were positive for HbsAb.

DISCUSSION

This study aimed to investigate the impact of a pre-dialysis education program on the choice of vascular access and its subsequent effects on the 6-month outcomes of ESKD patients undergoing maintenance HD. The results revealed that the intervention group, which received a specialized pre-dialysis education program, experienced significant improvements in various clinical parameters (better potassium, phosphorus, and bicarbonate levels, lower hospitalization rates and duration, better vaccination rates, and lower intermittent catheterization rate) compared to the control group, which did not undergo any specific education program. In a study of 302 patients with stage 3-5 CKD, a comprehensive 8-module multidimensional pre-dialysis training program demonstrated a potential delay in CKD progression. Inspired by these findings, we developed a modified multidimensional program in a similar manner, creating specific training topics and modules.[13]

Maintenance hemodialysis (MHD) therapy is crucial for sustaining the lives of ESKD patients. One essential aspect of ensuring high quality of life for patients in the management of ESKD patients is the choice of vascular access during the initiation of HD. Moreover, pre-dialysis education programs have emerged as an essential component in the care of ESKD patients, aiming to provide comprehensive information about kidney disease, treatment options, and self-management strategies.[7] Predialysis education provides closer clinical and laboratory monitoring, which leads to a mild transmission from a non-hemodialysis period to a maintenance HD period. This approach gives the opportunity to regulate fluid and electrolyte imbalances, create desirable vascular access, prevent urgent dialysis sessions, and select an individualized treatment modality.[8] Moreover, Previous studies demonstrated a

direct association between the number and consistency of care provided by a nephrologist in 3 months or more of the 6 months before dialysis and a superior prognosis.5 In our study, a specialized pre-dialysis education program provided clear benefits such as better serum potassium, phosphorus, and bicarbonate levels at the time of first HD sessions and a low catheter incidence as vascular access. This education program significantly increased the likelihood of initiating maintenance HD therapy with an AVF, reaching almost 99%.

A pre-dialysis education can improve the contribution of the patients to self-care and increase adherence to medicines and lifestyle change, a lower hospitalization rate can be expected as they become more aware of expected scenarios.[16,17] These education programs offer substantial benefits to patients, both during the initiation of dialysis and throughout their treatment course, fostering improved treatment compliance and empowering patients to find incorporate with healthcare providers regarding hemodialysis-related problems.[18,19] This study found a significant reduction in hospitalizations and hospitalization duration in the intervention group following a face-to-face pre-dialysis education program. Programmed initiation is better compared to emergent, unplanned dialysis.[20] Patients with AVF as their primary vascular access had fewer hospitalizations related to vascular access complications, such as catheter infection, thrombophlebitis, and cellulitis. The reduced need for temporary catheter insertion in the intervention group further highlights the positive impact of AVF as the preferred vascular access. Furthermore, In our study, we managed many of our patients as outpatients taking discrete sessions of dialysis without admission to the ward. Our patients were mostly supported and prevented from unnecessary emergency department applications. even admitted patients needed less follow-up duration. Our vascular access gave an option to maximize the diuretic and antihypertensive therapy as needed with more confidence with less fear from adverse effects like deterioration in renal function and electrolyte imbalance.

Moreover, the pre-dialysis education program led to improvements in serological markers related to HBV. The program significantly increased the number of participants testing negative for HBV surface antibody during their first HD session. This result is encouraging, as it indicates that education and awareness efforts can positively influence serology and potentially reduce the risk of infectious complications among ESKD patients.

Limitations of the Study

Retrospective study design: The study's retrospective nature could introduce inherent biases and limit our ability to establish causality. The lack of randomization might lead to potential confounding factors affecting the observed outcomes.

Single-center setting: The study was conducted at a single center, which may limit the generalizability of the findings to other healthcare settings with different patient populations and care practices.

Missing data: Incomplete data for some participants may have affected certain analyses, potentially introducing bias or limiting the accuracy of the results.

Selection bias: The inclusion and exclusion criteria might have introduced selection bias, as patients with specific characteristics or conditions could have been excluded, potentially influencing the study outcomes.

Short-term follow-up: The study's 6-month follow-up period may not capture long-term outcomes, and the effects of the pre-dialysis education program beyond this duration remain unknown.

Pre-dialysis education variability: The study did not account for potential variations in the delivery or depth of pre-dialysis education among participants, which might impact the outcomes.

Non-randomized allocation to AVF: The higher proportion of AVF use in the intervention group might also be influenced by other unmeasured patient characteristics such as education, high sociocultural status, and incomes or preferences that were not controlled for in the analysis.

Calculation of costs: Emergent unplanned was shown to have a negative effect on costs and hospitalization, but we did not calculate the costs in our study.

CONCLUSION

The positive outcomes of this pre-dialysis education program underscore its value as an essential component of ESKD patient care. Integrating such programs into routine clinical practice can empower patients, optimize their treatment journey, and improve their long-term quality of life. By emphasizing AVF as the primary vascular access and promoting informed decision-making, pre-dialysis education holds promise for enhancing patient outcomes and reducing healthcare burdens.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the Sakarya University Faculty of Medicine Non-invasive Researches Ethics Committee (Date: 02.05.2023, Decision No: 107).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

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