

Predictors of survival and functioning of arteriovenous fistula in patients on hemodialysis during a one-year follow-up

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Abstract

Introduction: The mortality rate of hemodialysis patients is extremely high and it is significantly affected by vascular access dysfunction. Our research aimed to determine predictive parameters of arteriovenous fistula functioning and survival in a one-year follow-up period.

Methods: The research was organized as a prospective, one-year study, which included 120 dialysis patients who were followed for one year. We recorded the demographic and gender structure, clinical parameters, and laboratory findings significant for the survival and functioning of arteriovenous fistulas. Laboratory findings are presented as the mean values of the analysis at the beginning and the end of the one-year control period.

Results: Univariable regression analysis confirmed the predictive significance of anastomosis positioning, type of vascular access, length of hemodialysis treatment, hemoglobin, Kt/V index values, and creatinine concentration for one-year survival, but multivariable regression analysis confirmed predictive significance only for length of treatment. Univariable regression analysis revealed significant predictors of vascular access function for the length of hemodialysis treatment, diastolic blood pressure, leukocytes, platelets, hemoglobin, creation of an arteriovenous fistula by a nephrologist, starting hemodialysis with a fistula and not with a central venous catheter, multivariable regression analysis confirmed predictive significance for the length of dialysis treatment and creation of an arteriovenous fistula by a nephrologist.

Conclusion: A prognostically important parameter for the one-year survival of a patient on hemodialysis is the length of dialysis treatment. In contrast, predictive parameters for the functioning of an arteriovenous fistula are the length of dialysis and the creation of a fistula by a nephrologist.

Keywords: Predictive factors, arteriovenous fistula, functioning, survival, mortality rate, hemodialysis.

What is new? What is important?

Functional parameters of arteriovenous fistula and mortality of hemodialysis patients have a two-way interaction. A common prognostic parameter for one-year survival and arteriovenous fistula functioning is the length of dialysis, that is, the length of dialysis is positively associated with one-year survival and negatively with arteriovenous fistula functioning.

INTRODUCTION

The World Health Organization has identified chronic kidney disease as a global health problem, with an estimated incidence of approximately 850 million people worldwide (>10% of the world's population) with a prevalence rate of 11%. About 4.5 million patients die annually as a result of complications of chronic kidney failure [1],

According to the Spanish Registry for Dialysis and Transplantation, the annual mortality was about 15.2% [2]. Risk factors are numerous and causally related and are often assessed separately, and to control them, they need to be assessed simultaneously [3].

Mortality in patients with chronic renal failure is 10 to 30 times higher than in the general population with an annual mortality of 14.6%

in Europe and 15.6% in the United States [4]. Adjusted all-cause mortality rates are 6.3–8.2 times higher for dialysis patients than for the general population. The DOPPS Phase 1 study found a 1-year mortality rate of 17.5% [5].

Functional vascular access for hemodialysis is vital for dialysis patients because vascular access dysfunction is associated with a higher risk of mortality and morbidity, and on the other hand, all risk factors that affect fistula functioning are frequent causes of mortality in hemodialysis patients. The loss of function of the arteriovenous fistula is independently associated with a higher risk of mortality, and the basis of everything is the vascular pathological changes that occur after the creation of the anastomosis. These changes are multifactorial, predominating immune disorders, chronic inflammation, and endotoxemia [6].

Over the past decades, several studies have investigated the influence of the type of vascular access on the mortality rate of hemodialysis patients. Data derived from national registries showed increased survival in patients with arteriovenous fistulas [7].

Previous studies have reported a wide range of arteriovenous fistula survival rates: 68% to 92% for 1-year survival. Many clinical characteristics have been reported as prognostic indicators for long-term arteriovenous fistula patency, such as medical conditions, medications, prior placement of a central venous catheter, and interventions to achieve arteriovenous fistula maturation [8].

Common independent predictors of survival in hemodialysis patients are: age, race, albumin and hemoglobin levels, etiology of renal failure, and the presence of certain comorbidities, and their interaction occurs when the effect of one risk factor is dependent on the presence of another risk [9].

In a one-year follow-up period, the research aimed to determine predictors of arteriovenous fistula functioning and survival of dialysis patients treated with chronic hemodialysis.

MATERIAL AND METHODS

The research was organized at the Nephrology and Dialysis Clinic of the University Clinical Center Kragujevac, Serbia, as a prospective, one-year cohort study.

All patients treated in our Hemodialysis Center, with functional vascular access, were the subject of our study. The functionality of the arteriovenous fistula was performed on a subgroup of 101 subjects.

Exclusion factors are patients under 18 years with dysfunction of vascular accesses, fatal outcomes

as a result of proven malignant disease, patients who were transplanted during the controlled period, change of renal replacement modality (peritoneal dialysis), or loss to follow-up (data censoring).

Based on the goal of the research, the patients were divided into two groups. The group of respondents who completed the one-year study included 101 (84.2%) patients, while the second group consisted of respondents who died during the study period, and it included 19 (15.8%) patients.

In all subjects, we recorded demographic and gender structure, type of vascular access (arteriovenous fistula/arteriovenous graft/Hickman catheter), positioning of the arteriovenous fistula (distal/proximal), duration of dialysis (in months), type of hemodialysis (bicarbonate/hemodiafiltration), blood pressure (systolic/diastolic), body mass index, whether dialysis was started with a dialysis catheter, information about who created the vascular access (nephrologist/vascular surgeon), and the quality of dialysis was calculated using the mathematical formula Kt/V .

Of the laboratory findings, routine biochemical analyses were performed, according to the annual control protocol, as well as certain non-standard parameters (prealbumin, C-reactive protein, β microglobulin, interleukin 6).

All laboratory findings and certain clinical parameters were recorded at the beginning and the end of the one-year study. The results are shown as the mean values of the analysis at the beginning and the end of the one-year control period.

The main endpoints of the study were defined by the need to determine prognostic factors for the survival of dialysis patients and for the functioning of vascular accesses for chronic hemodialysis, in a period of one year.

The study was approved by the Ethics Committee of the Clinical Center Kragujevac, in accordance with the Helsinki Declaration for Medical Research.

STATISTICAL METHODS

Using SPSS for Windows, version 22, data were examined, and the level of statistical significance was set at $p \leq 0.05$. Relative numbers, central tendency, and measures of variability were used to describe the sample of hemodialysis patients. Mann-Whitney and Chi-square tests were used to evaluate the differences in the investigated parameters. We performed logistic and linear univariable and multivariable regression analyses to examine predictors of arteriovenous fistula survival and functionality in hemodialysis patients followed up for one year.

RESULTS

SURVIVAL OF THE PATIENT ON THE HEMODIALYSIS

Of a total of 120 patients included in the study, 101 (84.2%) survived and 19 (15.8%) died during the follow-up period. The average age of the subjects was 64.17 ± 10.78 years (survivors 64.01 ± 10.51 vs. deceased 65.00 ± 12.39), 70 (58.3%) patients were men, while 50 (41.7%) of respondents were female. Patients on hemodialysis who survived the 1-year follow-up had statistically significantly more arteriovenous fistula as vascular access than Hickman catheter or arteriovenous graft ($p = 0.001$). Distal positioning of the arteriovenous fistula was statistically significantly more frequent than the proximal-located one ($p = 0.038$). Patients who completed the study during the follow-up period spent significantly more months on hemodialysis (74.50 ± 64.12 vs. 27.49 ± 27.14 ; $p = 0.001$), they had statistically substantially higher hemoglobin concentration (104.75 ± 11.85 vs. 96.68 ± 17.60 ; $p = 0.008$), and had higher Kt/V index values (1.10 ± 0.23 vs. 0.97 ± 0.37 ; $p = 0.010$) (Table 1).

Univariable logistic regression analysis showed that the predictors of one-year survival in hemodialysis patients are the positioning of arteriovenous fistula, type of vascular access, length of hemodialysis treatment, higher hemoglobin values, index Kt/V values, and creatinine concentration. In multivariable

logistic regression analysis (Method Enter, Model Summary: $\chi^2 = 71.467$; Cox & Snell $R^2 = 0.243$; Nagelkerke $R^2 = 0.417$; Hosmer-Lemeshow goodness-of-fit $\chi^2 = 11.728$, $p = 0.164$), only the length of hemodialysis treatment was shown to be a significant predictor of survival, meaning that the shorter the time on hemodialysis, the higher the fatality rate (Table 2).

SURVIVAL OF THE ARTERIOVENOUS FISTULA

In hemodialysis patients who survived the one-year follow-up ($N = 101$), the average length of functioning arteriovenous fistula was 63.04 ± 51.16 months. In the group of subjects with arteriovenous fistulas who survived there were 89 (91.8%) patients, while 8 (8.2%) patients with arteriovenous fistulas did not complete the follow-up period. In the univariable linear regression analysis, significant predictors of longer vascular access functioning were more months on hemodialysis, lower diastolic blood pressure, lower leukocytes and platelets, higher hemoglobin, creation of an arteriovenous fistula by a nephrologist and the start of hemodialysis treatment with central venous catheter. On the other hand, multivariable linear regression analysis (Method Enter, R Square Change 0.487, F Change 8.408, $p = 0.001$) confirmed that only a greater number of months on hemodialysis and the creation of an arteriovenous fistula by a nephrologist were significant predictors of longer-functioning vascular access (Table 3).

Table 1

Differences in sociodemographic and clinical characteristics of patients

Variables		All patients (N=120)	Survive (N=101)	Exitus (N=19)	p-value
Age		66.0 (59.0-71.8)	66.0 (59.0-71.0)	68.0 (51.0-70.0)	0.863
Gender N (%)	male	70(58)	57 (56.4)	13 (68.4)	0.448
	female	50(42)	44 (43.6)	6 (31.6)	
AVF positioning N (%)	distal	46(38)	43 (42.6)	3 (15.8)	0.038*
	proximal	74(62)	58 (57.4)	16 (84.2)	
	AVF	97(81)	89 (88.2)	8 (42.1)	
Type of VA N (%)	AVG	1(1)	1 (0.9)	0 (0)	0.001*
	Hickman catheter	22(18)	11 (10.9)	11 (57.9)	
Length of HD (months)		51.0 (29.0-82.8)	56.0 (32.5-85.0)	14.0 (6.0-43.0)	0.001*
Type HD N (%)	bicarbonate	101(84)	85 (84.2)	16 (84.2)	1.000
	hemodiafiltration	19(16)	16 (15.8)	3 (15.8)	
SBP (mmHg)		130.0 (120.0-140.0)	130.0 (120.0-140.0)	120.0 (120.0-140.0)	0.701
DBP (mmHg)		80.0 (70.0-80.0)	80.0 (70.0-80.0)	80.00 (70.0-80.0)	0.409
BMI (kg/m ²)		24.8 (22.0-27.5)	24.3 (21.9-27.5)	25.3 (23.5-27.4)	0.361
WBC		6.4 (5.4-8.0)	6.2 (5.4-7.9)	7.2 (5.4-8.5)	0.411
HGB		104.0 (96.3-110.8)	105.0 (97.5-112.5)	97.0 (84.0-104.0)	0.008*
PLT		194.5 (154.3-244.0)	191.0 (153.0-237.0)	225.0 (158.0-280.0)	0.146
Urea		19.7 (17.6-22.8)	19.6 (17.7-22.8)	19.7 (17.5-23.0)	0.776

Table 1 (continued)

Variables	All patients		Survive	Exitus	p-value
	(N=120)		(N=101)	(N=19)	
Creatinine	799.5 (683.3-914.0)		822.0 (687.5-940.5)	704.0 (637.0-811.0)	0.042*
Kt/V	1.1 (0.9-1.2)		1.1 (1.0-1.2)	0.9 (0.7-1.2)	0.010*
Albumin	40.0 (38.0-42.0)		40.0 (38.0-42.0)	39.0 (34.0-42.0)	0.366
Prealbumin	0.3 (0.3-0.4)		0.3 (0.3-0.4)	0.3 (0.3-0.4)	0.729
Na	139.0 (137.0-140.3)		139.0 (138.5-140.5)	137.0 (136.0-141.0)	0.404
K	5.3 (4.7-5.7)		5.3 (4.8-5.7)	4.9 (4.4-5.6)	0.142
Ca	2.3 (2.2-2.4)		2.3 (2.2-2.4)	2.2 (2.1-2.4)	0.212
P	1.5 (1.2-1.8)		1.5 (1.2-1.8)	1.6 (1.2-2.0)	0.527
CRP	4.1 (1.9-7.6)		4.2 (1.9-7.6)	2.9 (2.2-14.1)	0.404
β microglobulin	22.9 (19.2-28.3)		22.9 (19.4-27.6)	23.1 (12.6-33.5)	0.746
IL-6	7.7 (4.6-18.3)		7.3 (4.6-17.1)	13.7 (6.9-33.7)	0.163
Who created AVF	nephrologist	29(24)	25 (24.8)	4 (21.1)	1.000
	vascular surgeon	91(76)	76 (75.2)	15 (78.9)	

SBP-Systolic blood pressure; DBP-Diastolic blood pressure; BMI-body mass index; VA-Vascular access; AVF-arteriovenous fistula; AVG-arteriovenous graft; WBC-White Blood Cell Count; HGB-Hemoglobin; PLT-Platelet Coun; K-Potassium; Na-Sodium; Ca-Calcium; PO₄-Phosphate; CRP-C reactive protein; IL-6-interleukin; Kt/V-HD adequacy index; HD-hemodialysis; CVC-central venous catheter; *statistically significant value

Table 2

Results of univariable and multivariable regression of predictors of survival

Variables	B	Exp(B)	95% C.I.for EXP(B)		p-value	B	Exp(B)	95% C.I.for EXP(B)		p-value
			Lower	Upper				Lower	Upper	
Age	0.009	1.009	0.963	1.057	0.712					
Gender	0.514	1.673	0.589	4.752	0.334					
AVF positioning	1.375	3.954	1.083	14.431	0.037*	-0.283	0.754	0.133	4.269	0.749
Type of VA	1.202	3.327	1.911	5.791	0.001*	0.511	1.667	0.776	3.578	0.190
Length of HD (months)	-0.041	0.960	0.936	0.984	0.001*	-0.035	0.966	0.936	0.996	0.028*
Type HD	-0.004	0.996	0.260	3.819	0.995					
SBP (mmHg)	-0.005	0.995	0.966	1.025	0.744					
DBP (mmHg)	-0.020	0.980	0.918	1.047	0.552					
BMI (kg/m ²)	0.048	1.050	0.940	1.171	0.389					
WBC	0.073	1.076	0.890	1.301	0.450					
HGB	-0.050	0.951	0.913	0.991	0.016*	-0.026	0.975	0.912	1.095	0.312
PLT	0.004	1.006	0.999	1.013	0.115					
Urea	-0.027	0.973	0.863	1.098	0.661					
Creatinine	-0.003	0.997	0.994	1.000	0.030*	-1.342	0.261	0.927	1.024	0.540
Kt/V	-2.209	0.110	0.012	0.997	0.050*	-0.950	0.387	0.035	4.278	0.438
Albumin	-0.078	0.925	0.803	1.066	0.280					
Prealbumin	-1.802	0.165	0.001	478.284	0.658					
Na	-0.210	0.811	0.517	1.271	0.360					
K	-0.702	0.495	0.203	1.207	0.122					
Ca	-1.497	0.224	0.007	7.018	0.394					
P	0.200	1.221	0.339	4.392	0.760					
CRP	0.016	1.016	0.993	1.039	0.169					
β microglobulin	-0.004	0.996	0.970	1.023	0.777					

Table 2 (continued)

Variables	B	Exp(B)	95% C.I. for EXP(B)		p-value	B	Exp(B)	95% C.I. for EXP(B)		p-value
			Lower	Upper				Lower	Upper	
IL-6	-0.001	0.999	0.994	1.005	0.790					
Who created AVF	0.210	1.234	0.375	4.063	0.730					
Did you start HD with CVC	-0.360	0.697	0.254	1.917	0.484					

VA-Vascular access; SBP-Systolic blood pressure; DBP-Dyastolic blood pressure; BMI-body mass index; AVF-arteriovenous fistula; AVG-arteriovenous graft; WBC-White Blood Cell Count; HGB-Hemoglobin; PLT-Platelet Coun; K-Potassium; Na-Sodium; Ca-Calcium; PO₄-Phosphate; CRP-C reactive protein; IL-6-interleukin; Kt/V-HD adequacy index; HD-hemodialysis; CVC-central venous catheter; *statistically significant value

Table 3

Results of univariable and multivariable regression of predictors of length of functional vascular access in hemodialysis patients who survived during one-year follow-up

Variables	Univariable analysis		Multivariable analysis	
	B (95% C.I. for B)	p-value	B (95% C.I. for B)	p-value
Age	0.07 (-0.90;1.04)	0.888		
Gender	-1.76 (-22.23;18.71)	0.865		
AVF positioning	-11.95 (-32.35;8.43)	0.247		
Type of vascular access	-13.27 (-29.24;2.68)	0.102		
Length of HD (months)	-0.58 (0.47;0.69)	0.001*	-0.29 (0.14;0.44)	0.001*
Type HD	23.94 (-3.458;51.33)	0.086		
SBP (mmHg)	-0.34 (-0.95;0.27)	0.269		
DBP mmHg)	-1.48 (-2.80;-0.13)	0.032*	0.30 (-1.08;1.68)	0.662
BMI (kg/m ²)	-1.34 (-3.66;0.98)	0.254		
WBC	-4.96 (-8.77;-1.15)	0.011*	-0.62 (-4.19;2.94)	0.727
HGB	1.06 (0.23;1.90)	0.013*	-0.17 (-0.93;0.59)	0.654
PLT	-0.22 (-0.37;-0.07)	0.005*	-0.09 (-0.23;0.05)	0.197
Urea	-1.30 (-3.25;0.64)	0.186		
Creatinine	0.02 (-0.03;0.07)	0.357		
Kt/V	20.92 (-23.70;65.54)	0.355		
Albumin	-1.45 (-4.53;1.63)	0.352		
Prealbumin	-51.93 (-180.21;76.34)	0.421		
Na	-3.31 (-14.95;8.34)	0.554		
K	-2.99 (-17.10;11.12)	0.674		
Ca	40.87 (-18.27;100.02)	0.172		
P	0.16 (-22.94;22.98)	0.999		
CRP	-0.31 (-0.90;0.29)	0.304		
β microglobulin	0.10 (-0.19;0.39)	0.505		
IL-6	0.02 (-0.04; 0.08)	0.514		
Who created AVF	-26.24 (-49.03;-3.45)	0.024*	-23.16 (-42.72;-3.60)	0.021*
Did you start HD with CVK	25.42 (5.85;44.98)	0.011*	7.72 (-9.97;25.72)	0.381

VA-Vascular access; SBP-Systolic blood pressure; DBP-Dyastolic blood pressure; BMI-body mass index; AVF-arteriovenous fistula; AVG-arteriovenous graft; WBC-White Blood Cell Count; HGB-Hemoglobin; PLT-Platelet Coun; K-Potassium; Na-Sodium; Ca-Calcium; PO₄-Phosphate; CRP-C reactive protein; IL-6-interleukin; Kt/V-HD adequacy index; HD-hemodialysis; CVC-central venous catheter; *statistically significant value

DISCUSSION

Vascular access functioning and mortality in hemodialysis patients depend on numerous parameters that are complex and closely related and are in the domain of traditional and non-traditional risk factors. Within such complex interactions, there are dilemmas as to how and whether it is possible to establish an effective model for predicting the outcome of treatment. Given the great complexity and inconsistency in their impact on mortality and functioning of vascular access, we were aware of the complexity and numerous interrelationships when establishing the hypothesis for this study.

SURVIVAL OF THE PATIENT ON THE HEMODIALYSIS

Despite the visible progress of modern medicine, the mortality rate of hemodialysis patients remains alarmingly high, and after one year of treatment is between 10 and 25% [1, 10]. Such a wide range of mortality is probably due to the influence of risk factors that can be conditionally classified into short-term predictors that are varied and often contradictory [11]. The mortality rate of our subjects, in the projected period of one year of follow-up, was 15.8%, which is in accordance with the stated mortality.

Indicators of nutritional status, projected in body mass index, are powerful predictors of morbidity and mortality, which has long been considered the main factor in survival, is at least confusing and can be inaccurate, because it does not take into account body composition, so the effects of lean and fat mass mixed, which reduces its potential predictive value [4, 12]. Moreau-Gaudry *et al.* have determined through their research that a single measurement of serum creatinine (predialysis) is a strong determinant of patient survival, even after only one year of follow-up, which gives this parameter the power to predict survival, far more than other, perhaps overemphasized accepted parameters [13]. The results of our research confirmed that the group of patients, whose one-year follow-up ended fatally, had statistically significantly lower values of creatinine concentration, in correlation with the subjects who survived the controlled period. The value of serum creatinine, according to univariable statistical analysis, has a statistically significant negative relationship with the survival of dialysis patients. However, multivariable statistical analysis did not confirm its predictive significance for patient mortality in our study.

Hemoglobin has a negative correlation with the survival rate of hemodialysis patients, that is, a low hemoglobin concentration can increase the risk of death in hemodialysis patients [14]. And the results of our study confirmed these findings, hemoglobin was significantly higher among the subjects who survived. According to univariable statistical analysis, hemoglobin was negatively associated with the survival rate of hemodialysis patients in a one-year follow-up study. However, multivariable statistical processing did not confirm its predictive capacity.

The Kt/V index is useful as a reference for controlling and improving the amount and efficiency of dialysis and significantly affects the survival of hemodialysis patients [15, 16], which we found in our study, but without confirming its predictive significance as a mortality risk factor.

SURVIVAL OF THE ARTERIOVENOUS FISTULA FOR HEMODIALYSIS

Of all the types of vascular access, arteriovenous fistula is, according to general recommendations, the vascular approach of choice for hemodialysis because it has the lowest complication rate and is superior in terms of survival. Patients who start hemodialysis with a catheter have a 70 to 77% higher mortality rate than those who start hemodialysis with an arteriovenous fistula [17, 18], so it is no surprise that vascular access is one of the factors that determine the outcome of treatment [19]. This suggestion is true only when patients with mature arteriovenous fistulae are included for outcome determination [8]. The group of our subjects who survived the one-year control period had, as vascular access, a statistically significantly higher number of arteriovenous fistulas and they were positively associated with survival. However, arteriovenous fistulas did not confirm their predictive capacity by multivariable statistical method.

Guidelines for vascular access, whenever feasible, recommend creating an arteriovenous fistula in the distal part of the upper extremity as the first choice [20]. Our previous research is in accordance with the recommendations on the distal position, as the primary location of arteriovenous anastomosis, where we confirmed the predictive significance of the distal fistula on the survival of patients on hemodialysis [21]. Starting from the fact that every part of the vascular system represents an extremely important potential for patients who need an arteriovenous fistula, our position was that, wherever

possible, an initial attempt should be made to create an anastomosis in the distal part of the forearm. Therefore, the results of our research confirmed, by univariable statistical analysis, the importance of the distal position of the arteriovenous fistula on the survival of our subjects, but without confirmed predictive influence.

Platelets play a role in the development of vascular access stenosis, and the key event in the development of stenosis is intimal hyperplasia. It is apostrophized that higher platelet aggregability is found in patients with vascular access dysfunction and that for the risk of thrombosis, platelet activity is more important than platelet count [22]. Through our research, we confirmed the negative association of the number of platelets with the function of the arteriovenous fistula through univariable statistical analysis, but the predictive significance of platelets was not confirmed.

Leukocytes are an important link in a complex multi-step process that, by activating cytokines and chemokines, inflammatory damages endothelial cells leading to intimal hyperplasia. It is a very complex mechanism that creates the conditions for stenosis and thrombosis of the arteriovenous fistula [23]. In our research, the significant influence of leukocytes on the functioning of the arteriovenous fistula was confirmed a negative association between leukocytes and fistula function was determined, without predictive significance.

Some studies have found a reduced rate of functional fistulas in patients with elevated blood pressure, most likely due to impaired endothelial cell functions and the consequent development and progression of atherosclerosis [24, 25]. In our subjects who survived the one-year follow-up period, a negative association was found between functionality and the diastolic component of blood pressure, but its value was not confirmed by multivariable statistical analysis.

KDOKI guidelines recommend the use of a central venous catheter for periods not exceeding seven days, due to possible stenosis and occlusion of the central vein resulting in significant long-term effects, such as venous hypertension, which affects the reduction of flow through the arteriovenous fistula and its inadequate function [26]. In our study, 55.8% of subjects started hemodialysis with central venous catheters. The policy of our Clinic is, whenever there is a possibility to create an arteriovenous fistula in time, before the start of hemodialysis treatment, that is, for patients to start hemodialysis with matured fistulas and to avoid the placement of central venous catheters. We

believe that this attitude had a decisive influence on the functioning of the arteriovenous fistula, which was confirmed by univariable statistical analysis, but without predictive significance.

It is currently believed that countries where nephrologists have a significant role in professional coordination, including participation in the organization of treatment and creation of vascular access, achieve good results [27]. The results of our previous research showed that arteriovenous fistulas created by vascular surgeons had a 38% higher chance of failure compared to fistulas created by nephrologists. One of the conclusions was the use of radiological diagnostics and a detailed preoperative clinical examination of blood vessels by a nephrologist [28]. The results of our current study confirmed the negative association of arteriovenous fistula functioning concerning the information about who created the fistula but without predictive significance.

The risk of mortality increased concerning the length of dialysis treatment [4]. The uremic syndrome causes a complex mixture of organ dysfunction [29] hurts multiple organ systems and metabolic pathways and directly affects the increase in the mortality rate of dialysis patients—[30]. The relationship between uremia, altered immune response, and impaired vascular biology is well recognized, which is why it can be argued that uremia can affect the outcome of arteriovenous fistula [31]. Survival of dialysis patients decreases with age and length of treatment, due to a large number of uremic complications and more frequent comorbidities [32]. Our result of the multivariable regression shows that the shorter the time on hemodialysis, the higher the mortality, that is, those who died during the 1-year follow-up had lower length on hemodialysis treatment, compared with those who survived, perhaps due to shorter follow-up time, etiological reason for end-stage renal failure, or higher number of comorbidities.

The study had several limitations. First, the study was organized as an observational one, so the results may indicate an association and not a cause, which suggests that the results must be interpreted with caution to determine the possible association between the mortality rate and the functionality of the arteriovenous fistula, and how the outcome of the treatment and the functioning of the fistula can be improved after adjustment with independent risk factors. Likewise, we did not analyze other important factors that may affect the functionality of the arteriovenous fistula, nor did we define the cause of mortality in our subjects,

which could have an impact on the results of our research, such as the presence of various comorbidities and the etiology of renal failure.

CONCLUSION

In both scientific and clinical practice, the priority is to accurately predict the risk of the outcome, using a model of multiple predictors, a model whose prediction is usually based on statistically significant, although not necessarily cause-and-effect relationships of the examined parameters. Some variables that were investigated

as parameters of arteriovenous fistula functionality and mortality of patients on hemodialysis in both groups of subjects in our research achieved two-way interactions. Prognostically important parameters for the one-year survival of hemodialysis patients and the functioning of the arteriovenous fistula is the length of dialysis. Logistic multivariable regression analysis performed on the baseline data of two groups of patients showed that the length of dialysis affects patients' survival rate and the arteriovenous fistula's function. The length of dialysis is positively associated with one-year survival and negatively with arteriovenous fistula functioning.

Introducere: Rata mortalității la pacienții hemodializați este extrem de ridicată și este afectată semnificativ de disfuncția accesului vascular. Cercetarea noastră și-a propus să determine parametrii predictivi ai funcționării și supraviețuirii fistulei arteriovenoase într-o perioadă de urmărire de un an.

Metodologie: Cercetarea a fost organizată ca un studiu prospectiv, de un an, care a inclus 120 de pacienți dializați care au fost urmăriți timp de un an. Am înregistrat structura demografică, parametrii clinici și analizele de laborator semnificative pentru supraviețuirea și funcționarea fistulelor arteriovenoase. Analizele de laborator sunt prezentate ca valori medii ale analizei la începutul și la sfârșitul perioadei de control de un an.

Rezultate: Analiza de regresie univariabilă a confirmat semnificația predictivă a poziționării anastomozelor, tipul de acces vascular, durata tratamentului cu hemodializă, hemoglobina, valorile indicelui Kt/V și concentrația creatininei pentru supraviețuirea la un an, dar analiza de regresie multivariabilă a confirmat semnificația predictivă numai pentru durata tratamentului. Analiza de regresie univariabilă a evidențiat predictorii semnificativi ai funcției de acces vascular pentru durata tratamentului cu hemodializă, tensiunea arterială diastolică, leucocite, trombocite, hemoglobină, crearea unei fistule arteriovenoase de către un nefrolog, începerea hemodializei cu o fistulă și nu cu un cateter venos central. Analiza multivariabilă a confirmat semnificația predictivă pentru durata tratamentului de dializă și crearea unei fistule arteriovenoase de către un medic nefrolog.

Concluzie: Un parametru important din punct de vedere prognostic pentru supraviețuirea la un an a unui pacient în hemodializă este durata tratamentului de dializă. Parametrii predictivi pentru funcționarea unei fistule arteriovenoase sunt durata dializei și crearea unei fistule de către un nefrolog.

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