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Original Article

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ABSTRACT

Objective: Creation of vascular access in the elderly represent a challenge for surgeons. We aimed to determine the potential parameters of arteriovenous fistula functioning in the elderly patients.

Design: Retrospective cross-sectional study

Setting: Tertiary university hospital

Subjects: Three hundred seventy fourold people who underwent operative interventions in order to create and resolve fistula complications.

Intervention: In the period of 15 years, with information about the length of the fistula function. All parameters which could have an effect on functioning of the arteriovenous fistula were analyzed.

Main outcome measures: To determine the predictive parameters of functioning arteriovenous fistula for hemodialysis in the elderly.

Results: Survival predictors of arteriovenous fistula, using Univariant Cox regression models, they are hemoglobin (B -0.00; SE 0.00; p = 0.014), sodium (B -0.01; SE 0.00; p = 0.003), creatinine (B 0.00; SE 0.00; P = 0.053), triglyceride (B -0.25; SE 0.13; p = 0.045), presence of catheter (B 0.324; SE0.11; p = 0.002), the use of Doppler ultrasound(B -0.26; SE 0.11; p = 0.012), and diameter of the artery that was used for anastomosis (B -0.25; SE 0.11; p =0.024). Survival predictors of arteriovenous fistula, using Cox regression multivariate analysis, are preoperative mapping of blood vessels (B -1.18; SE 0.33; p = 0.000).

Conclusion: Preoperative ultrasound mapping of blood vessels is an equally important predictive parameter of functioning of arteriovenous fistulas, older age, both male and female.

KEY WORDS: aged, renal dialysis, vascular fistula

INTRODUCTION

The 2012 Annual Report of the European Renal Association–European Dialysis and Transplant Association (ERA–EDTA) registry shows that patients aged 65–74 years and >75 years represent, respectively, 22 and 20% of the total prevalent renal replacement therapy population[1].

When Cimino and Brescia originally described the arteriovenous fistula in 1966, the dialysis population was a select group of young patients that excluded those with diabetes[2]. Today, studies show that older patients, women, and patients with vascular disease or vascular disease risk factors are at greatest risk of having an arteriovenous fistula fail to mature[3]. Arteriovenous fistulas are recommended by many national clinical guidelines as the vascular access, but, there is concern about whether general guidelines also apply to the elderly population[4]. In fact, vascular access planning in the elderly is different from that in younger patients, and the Fistula First Initiative may not be the preferred approach for older patients because of their reduced life expectancy and conflicting results after surgery[5].

Epidemiological data show that one in nine Americans has chronic renal insufficiency and over half a million are dialysed, of which 55% are men and 45% are women. Although arteriovenous fistulae have been proven to be preferred for hemodialysis, it is less likely that women begin hemodialysis with an already formed arteriovenous fistula[6,7].

Guidelines for vascular approach agree that arteriovenous fistula is the best option for patients on hemodialysis, but there is no consensus on the optimal time for its creation. Only 18% of American patients begin hemodialysis by a newly established vascular approach, and this rate in Europe does not exceed 30-45%[8].

There is a significant discrepancy in literature about impact of the gender differentiation on functioning of arteriovenous fistula[9]. Numerous studies report a lower prevalence of arteriovenous fistula use in women than men, but the reasons are inconsistent and not adequately clarified[10,11].

Vernaglione *et al*[12] found that arteriovenous fistulae have a lower rate of functioning in women, with a failure rate of 50%. Miller *et al*[10] showed that of functional is 30 percentes fistula lower in women than men. They also recorded an inferior outcome in fistula in forearm region and in the upper arm area. Fewer studies, such as the research of Erkut *et al*[13] showed that there is no difference in the initiation of functional fistula, which at least gives hope that women could have the same level of functionality, as men at the same time. By analyzing risk factors for arteriovenous fistula failure, Marcus *et al*[14] pointed to some clinical strategies that could improve the function of arteriovenous fistula,primarly pointing to the importance of perspective ultrasound mapping of blood vessels.

Astor *et al*[15] found that neither the race nor gender were important predictors of the function of permanent vascular access, but that early referral to nephrologists could be useful for initiating the hemodialysis process by creating the so-called " preventive fistulae".

The aim of our research was to determine the potential parameters of arteriovenous fistula functioning in the elderly.

SUBJECTS AND METHODS

The survey was conducted at the Center for Nephrology and Dialysis, Urology and Nephrology, Clinical Center Kragujevac, Serbia, as a retrospective, descriptive-analytic study that included all surgical interventions carried out for the purpose of creating and resolving complications of arteriovenous fistula, in the period fifteen years, in patients in whom there information about the length of the fistula function. The total number of surgical interventions in this period was 1115, according to gender differentiation 718 (64.4%) men and 397 (35.6%) women. The basic requirement for patient selection was the length of the fistula function, in the patients who were older than 65 years. Length of the fistula function defined by the time interval from its creation to thrombosis. On the basis of this criterion, 374 old peoplewere registered.

In the study, we analyzed all relevant clinical and laboratory parameters, which could have an effect on functioning of the arteriovenous fistula. We have evaluated the predictive effect of the positioning of the fistula (distal/proximal), length of the fistula function, type of arteriovenous anastomoses (termino-terminal/termino-lateral), the use of central-venous catheters for hemodialysis, pre-operative ultrasound mapping of the blood vessels, preventive creation of a fistula, the diameters of arteries and veins used for anastomosis and the values of systolic and diastolic arterial blood pressure. Likewise, the study also included biochemical parameters that were part of routine laboratory analyzes.

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

Statistical analysis

All statistical analyses were performed in SPSS 24.0 (SPSS Inc., Chicago, IL). Results were presented as frequency, percent, mean – standard deviation (SD) and median (where appropriate). In further analyses, both univariate and multivariate Cox regression models were applied with duration of AVF as a dependent variable. Kaplan Meier method was used to compare duration of duration of arteriovenous fistulae related to binary variables types of arteriovenous anastomosis, Doppler and dichotomised diameter of the vein variable.

RESULTS

On average, our respondents were 71.4 ± 5.2 years old. According to gender structure, there were 255 (68.2%) men and 119 (31.8%) women. Distally positioned fistulas in our study had 123 (32.9%) old people, while, proximal positioned fistula had 251 (67.1%) respondent. According to the type of arteriovenous anastomosis, 289 (77.3%) elderly had a termino-lateral type, while 85 (22.7%) elderly had a termino-terminal type of anastomosis. Preventively created fistulas were recorded in 134 (35.8%) old people. Preoperative ultrasound mapping of the blood vessels used for anastomosis was performed in 192 (51.3%) elderly, and 209 (55.9%) old people had a central-venous catheter for hemodialysis. On average, lumen veins used for anastomosis are 2.4 ± 0.5 mm while arteries 2.5 ± 0.5 mm. The mean systolic blood pressure, registered during the operative intervention was 147.2 ± 27.3 mmHg, while it's diastolic 78.5 ± 13.8 mmHg, Table 1.

We also analyzed biochemical parameters as part of routine laboratory analyzes. The results are presented in Table 2, as mean value.

Univariant Cox regression model, as statistically significant predictors of arteriovenous fistula survival detected hemoglobin (B -0.00; SE 0.00; p = 0.014); creatinine (B -0.00; SE 0.00; p = 0.053); sodium (B -0.01; SE 0.00; p = 0.003); triglyceride (B -0.25; SE 0.13; p = 0.045); placment of central venous catheter (B 0.324; SE 0.11; p = 0.002); preventive mapping of blood vessels (B -0,26; SE 0.11; p = 0.012) and artery diameter which was used for anastomosis (B -0.25; SE 0.11; p = 0.024), Table 3.

Logistic regression analysis test (multivariate Cox regression analysis), showed that predictive parameters of fistula function in the elderly are preoperative mapping of blood vessels used for arteriovenous anastomosis (B -1.18; SE 0.33; p = 0.000), Table 4.

DISCUSSION

They still exist there are limited data on the outcomes of arteriovenous fistulas placement in the older patients, with conflicting results in the literature[16]. A recent decision analysis on the vascular access choice in incident hemodialysis patients provided evidence that the arteriovenous fistula attempt strategy significantly diminish among older patients[17]. Despite significant success in the process of creating a functional arteriovenous fistula, there remains a challenge of precisely determining the predictive parameters of fistula maturation in the elderly, which in many studies, only for themselves, is described as a natural discriminator for the functioning of the fistula[18]. For this reason, our idea was to determine the factors that could predict the fistula functioning, in people older than 65 years, in relation to gender

differentiation. One of the significant results of our study is negative correlation of the creatinine and length of functioning of arteriovenous fistula in the elderly, using univariant regression model, as well as the concentration of hemoglobin, sodium, triglycerides and using of central venous catheters. Almost no research on the predictive parameters of arteriovenous fistulae for hemodialysis in the elderly, in order to compare with such our results, which leads us to think that adequate hemodialysis depuration is an important factor in the function of the fistula, but the predictive significance for these parameters we did not confirm.

There are authors who claim that old people are less suitable to dialysing via the arteriovenous fistula[10] because of the small caliber of blood vessels used for anastomosis. Inferior outcomes of fistula in elderly are perceived by the some authors as a consequence decreased blood flow, primarily because of the smaller lumen of the artery[19,20]. Our findings confirmed that the lumen of the artery, in the univariate model, was a significant parameter of functioning of the old people fistula, but we did not confirm its predictive significance.

A study Hod et al. has shown that placing an arteriovenous fistula >6–9 months predialysis in the elderly is not associated with a better success rate[21]. Delaying arteriovenous fistula placement may in fact be better, in that some authors suggest that elderly patients with chronic kidney disease should be referred later to reduce the risk of creating an arteriovenous fistule that will never be used[22]. There is currently no general consensus as to the best dialysis vascular access for elderly patients with end stage renal disease, and debate continues[23], which means that vascular access may be optimized by considering individual patient characteristics, and a patient-based approach is recommended[24]. The results of our research have shown that 35.8% of elderly have a preventively created fistula, but this is not a predictive parameter of arteriovenous fistula function, which supports the need to investigate local and associated predictors of fistula function in order to make an appropriate decision about the time of creation of a vascular access.

Marcus *et al*[14] found that the average rate of functioning arteriovenous fistula, after preoperative ultrasound mapping of blood vessels, was 487 days. There is no data on the functioning of arteriovenous fistula in old people. Caplin *et al*[25] do not find a significant difference in lumen vein size in preoperative mapping of blood vessels compared to gender[19]. The results of our study showed that more than half of the elderly had a preoperative mapping of blood vessels used for arteriovenous anastomosis and that this was one of the predictive parameters of arteriovenous fistula functionality. However, Doppler screening, in our respondents, is almost equally represented in both sexes, so it can be concluded that ultrasound mapping of blood vessels is an equally significant predictive parameter in both older men and older women.

In fact, good blood vessel identification for arteriovenous anastomosis significantly affects the length of the functioning of the fistula, wherefore this method declares as an important component of survival of the arteriovenous fistula.

Limitations of the study

The retrospective methodology of our study introduces inherent weaknesses to its design, because of the possibility of confounding and bias.

We presented our own experiences that are based on experience of a single operator (first author) so, perhaps, the results of our research can not be generalizable to other centers.

CONCLUSION

Analyzing the results of our study, we found that preoperative ultrasound mapping of blood vessels is an equally important predictive parameter of functioning of arteriovenous fistulas, older age, both male and female.

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Author Contribution:

RS: He designed the topic, processed the database, wrote a manuscript;

VP: Has done statistical data processing

SM: Help updating the database, read and approve the manuscript

GR: Help updating the database, read and approve the manuscript

SL: Help updating the database, read and approve the manuscript

DM: Help updating the database, read and approve the manuscript

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Table 1: Basic demographic and clinical characteristics of study patients

Variable	**Values**
Patients, n	374
Age (years), mean ± sd	71.4 ± 5,2
Gender, n(%)	
Male	255 (68.2%)
Female	119 (31.2%)
Positioning of arteriovenous fistula, n(%)	
Distal position	123 (32.9%)
Proximal position	251 (67.1%)
Length functioning arteriovenous fistula (months), median (range)	20(1-112)
Type of arteriovenous anastomosis, n (%)	
Termino-lateral	289 (77.3%)
Termino-terminal	85 (22.7%)
Insertion central venous catheter, n (%)	209 (55.9%)
Preoperative mapping blood vessels (Doppler), n (%)	192 (51.3%)
Type of fistula in relation to the time of creating, n (%)	134 (35.8%)
Vein diameter (mm), mean ± sd	2.4 ± 0.5
Artery diameter (mm), mean ± sd	2.5 ± 0.5
Systolic blood pressure, (mmHg), mean ± sd	147.2±27.3
Diastolic blood pressure, (mmHg), mean ± sd	78.5±13.8

Table 2: Basic biochemical characteristics of study patients

Variable	**Values**
Patients, n	374
Leukocytes (10^9/L), mean ± sd	8,6±5,3
Erythrocites(10^{12}/L), mean ± sd	3.3±1.8
Hemoglobin (g/L), mean ± sd	94.4±15.6
Platelets (10^9), mean ± sd	211.9±77.2
Glycemia (mmol/L), mean ± sd	5.6±1.9
Sodium (mmol/L), mean ± sd	137.1±15.4
Potassium (mmol/L), mean ± sd	4.9± 0.9
Total calcium (mmol/L), mean ± sd	1.8±0.5
Inorganic phosphorus (mmol/L), mean ± sd	2.0 ±0.4
Albumin (g/L), mean ± sd	34.4±6.1
Creatinine (μmol/L), mean ± sd	650.4±257.1
Urea (mmol/L), mean ± sd	25.7±9.6
Cholesterol (mmol/L), mean ± sd	4.3±1.2
Triglycerides (mmol/L), mean ± sd	1.5±0.8
Fibrinogen (g/L), mean ± sd	5.0±1.9

Table 3: Univariate Cox regression models with arteriovenous fistula failure, as dependent variable

Variable	**B**	**SE**	**P**
Age (years)	0.01	0.01	0.284
Gender	-0.031	0.11	0.790
Positioning of arteriovenous fistula	0.17	0.10	0.119
Leukocytes	-0.01	0.01	0.273
Erythrocites	-0.05	0.03	0.170
Hemoglobin	-0.00	0.00	0.014*
Platelets	0.00	0.00	0.800
Glycemia	-0.04	0.03	0.189
Sodium	-0.01	0.00	0.003*
Potassium	-0.07	’0.06	0.204
Total calcium	-0.06	0.11	0.586
Inorganic phosphorus	-0.02	’0.12	0.844
Albumin	0.00	0.00	0.378
Creatinine	-0.00	0.00	0.053*
Urea	0.00	0.00	0.124
Cholesterol	0.02	0.05	0.592
Triglyceride	-025	0.13	0.045*
Fibrinogen	0.02	0.04	0.623
Type of arteriovenous anastomosis	0.15	0.12	0.217
Insertion central venous catheter	0.324	0.11	0.002*
Preoperative mapping blood vessels (Doppler)	-0.26	0.11	0.012*
Type of fistula in relation to the time of creating	0.17	0.10	0.119
Vein diameter	-0.15	0.12	0.224
Artery diameter	-0.25	0.11	0.024*
Systolic blood pressure	-0.00	0.00	0.470
Diastolic blood pressure	0.00	0.00	0.914

*statistically significant parameters

Table 4: Multivariate Cox regression models with arteriovenous fistula failure, as dependent variable

Variable	**B**	**SE**	**P**
Hemoglobin	-0.00	0.00	0.348
Sodium	-0.03	0.03	0.463
Creatinine	0.00	0.00	0.832
Triglyceride	0.06	0.24	0.809
Preoperative mapping blood vessels (Doppler)	-1.18	0.33	0.000*
Diameter of the vein	-0.51	0.33	0.126

*statistically significant parameters