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Impact of surgeon factor on radiocephalic fistula patency rates

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HIGHLIGHTS

- Overall secondary patency rate was found in 144 (77.4%) patients.
- No statistical difference was observed according to secondary patency rates.
- Postoperative complication rate was 9.6%.
- Operating surgeon is not a major factor on radiocephalic fistula patency rates.

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ABSTRACT

Introduction: Hemodialysis with arteriovenous fistula (AVF) has been widely accepted treatment modality for patients with chronic renal failure (CRF). Radiocephalic fistulas are considered to be the most desirable for the initial vascular access. The aim of this study is to investigate the surgeon factor on radiocephalic fistula patency rates.

Methods: A total of 186 patients with diagnosis of CRF underwent Radiocephalic fistula for hemodialysis access were included. Patients were divided into 2 groups according to operating surgeon. Patients were evaluated according to demographic characteristics, secondary patency rates, second AVF creation and complications.

Results: Mean age was 57.7 ± 14.8 years. The most common etiology of CRF was idiopathic (66.6%). 40 (75.5%) patients in group 1 and 122 (91.7%) patients in group 2 were pre-dialysis patients ($p < 0.05$). Overall secondary patency rate was 77.4%. Patients in group 1 and group 2 have secondary patency rates of 83% and 75.2%, respectively ($p = 0.458$). Second AVF creation was done in 2 (3.8%) patients in group 1 and 23 (17.3%) patients in group 2 ($p < 0.05$). Postoperative complication rate was 9.6%.

Conclusion: Operating surgeon is not a major factor of secondary patency in radiocephalic arteriovenous fistulas.

1. Introduction

Renal replacement therapy (RRT) is the only treatment modality except renal transplantation for chronic renal failure (CRF) that can be achieved with either hemodialysis or peritoneal dialysis. AVFs are preferred due to longer patency, decreased thrombosis, infection, and mortality rates compared to arteriovenous grafts (AVG) and central venous catheters [1]. Proximal or distal AVFs have different patency rates however distal AVFs on non-dominant site are commonly recommended and initially preferred site. The radiocephalic fistula, described in 1966, is the distal AVF considered to be the most desirable for the initial vascular access [2]. This fistula is accepted as to be the gold standard for vascular access in CRF patients [3]. Primary failure rates has been reported to be 15–30% [4,5]. As the diameter of artery and vein increases from distal to proximal arm, patency rates also increase. Patency rates can also be influenced by operating surgeon factor especially for distal AVFs that need high technical skill and experience. The aim of the current study is to investigate the surgeon factor on distal AVF, radiocephalic fistula, patency rates.

2. Methods

A total of 408 consecutive patients with diagnosis of CRF

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underwent arteriovenous fistula for hemodialysis access between October 2011 and February 2015 in Baskent University Adana Teaching and Research Center. Of these patients 186 underwent radiocephalic fistula creation were included in our study. Snuff-box and proximal radiocephalic fistulas were excluded. Data were collected retrospectively and randomization was not done. Patients were divided into 2 groups according to performing surgeon; group 1 consists of one general surgeon experienced on vascular access surgery (approximately performing 160–200 vascular access operations per year) and group 2 consists of other eight surgeons which are residents performing all general surgery operations (averagely performing 30–50 vascular access operations per year). All patients were operated under local anesthesia. All patients were evaluated for age, sex, comorbidity, etiology, duration of CRF, number of previous AVFs, arterial, venous, and anastomosis diameter, AVF site, anastomosis technique, preoperative mapping with venography, postoperative intravenous heparin infusion, postoperative secondary intervention (for bleeding, thrombus etc.), presence of early-term complications such as hematoma, bleeding, infection and thrombosis affecting patency, presence of angiographic or surgical intervention for complications, catheterization during operation, operation time, secondary patency rates, functionality of vascular excess (presence of thrill or murmur), preoperative presence of central catheter and second AVF creation. Preoperative venous mapping with venography was carried out when there is a history of multiple AVF operations or there was a problem related to venous structures on physical examination. Patients with insufficient thrill after anastomosis were administered IV heparin infusion at 100 U/kg for 12 h. Enteric-coated aspirin 100 mg was prescribed on discharge next day after surgery to all patients. The patients were checked at the end of the first and third weeks. Patients with functioning AVFs underwent hemodialysis at the end of 4th week.

The distal part of the non-dominant extremity was selected as the vessel and anatomical site whenever possible. Physical examination was done for all patients. The criteria of operability without ancillary tests were i) confirming adequate circulation according to Allen test; ii) the power of arterial pulsation being of 2 out of 4 in semi quantitative assessment; iii) vein diameter being at least 1 mm in tourniquet-free evaluation and 2 mm in tourniquet evaluation, and returning to its original diameter when tourniquet is removed; and iv) the suitable vein being observed for at least 5 cm and easily compressible. Secondary patency was defined as four consecutive hemodialysis procedure without problem together with the presence of thrill and/or murmur 1 month after the operation.

3. Statistical analysis

Statistical analysis was performed using the statistical package SPSS (Version 17.0, SPSS Inc., Chicago, IL, USA). For each continuous variable, normality was checked by Kolmogorov Smirnov and Shapiro–Wilk tests and by histograms. Comparisons between groups were applied using Mann Whitney U test were used for the data not normally distributed. The categorical variables between the groups was analyzed by using the Chi square test or Fisher Exact test. A multiple logistic regression analysis was used to know associations between group and other measurements, with group as dependent variable. Values of $p < 0.05$ were considered statistically.

4. Results

Among 186 patients 53 (29%) were in group 1 whereas 133 (71%) were in group 2. Characteristics of patients were given in Table 1. 117 (62.9%) patients were male and 69 (37.1%) female. Mean age of patients in group 1 and 2 was 61 ± 16 and 56.4 ± 14.2 years, respectively that is statistically different ($p = 0.027$). The most common etiology of CRF was idiopathic (66.6%), followed by diabetes (19.4%), hypertension (4.8%), glomerulonephritis (3.8%), stone disease (2.7%), polycystic kidney disease (2.2%) and Alport syndrome (0.5%). Hypertension (31.7%) was the most common comorbidity followed by coronary artery disease together with hypertension and diabetes (20.4%), hypertension and diabetes together (17.2%), diabetes (8.6%), congestive heart failure (2.7%). The mean CRF duration was 19 ± 36.9 months for group 1 and 16 ± 27.8 months for group 2 ($p = 0.927$). Average body mass index (BMI) for group 1 was 24.4 ± 4.1 for group 1 and 24.5 ± 2.8 kg/cm^2 ($p = 0.507$). Most of the patients were predialysis therefore 40 (75.5%) patients in group 1 and 122 (91.7%) patients in group 2 did not have prior AVF surgery. 12 (6.5%) patients have 2 prior AVF operations, 9 (4.8%) patients have 1 AVF operation and 3 (1.6%) patients have 3 AVF operations. The most common site of AVF was left (79.6%) being the non-dominant site whereas right site was preferred in 38 (20.4%) patients. There was no statistical difference between groups according to site ($p > 0.05$). Preoperative vascular mapping with digital subtraction venography was performed in only 33 (17.7%) patients. Surgeon of group 1 performed only end to side anastomosis whereas surgeons in group 2 performed side-to-side anastomosis in 84 (63.2%) and end-to-side anastomosis in 49 (36.8%) patients. Mean operation time of patients for group 1 and 2 was 30.6 ± 12.4 and 58.2 ± 23 min respectively ($p = 0.000$). Average artery, vein and anastomosis diameters for group 1 were 2.45 ± 0.59 and 2.35 ± 0.64 and 3.04 ± 0.79 mm respectively whereas group 2 measurements were 3.32 ± 0.56 and 3.21 ± 0.61 and 5 ± 1.86 mm respectively (Table 2). Significant statistical difference between groups was observed according to artery, vein and anastomosis diameters ($p = 0.000$). Intraoperative catheter administration was done in 1 (1.9%) patient of group 1 and 21 (15.8%) patients of group 2 that is statistically significant ($p = 0.005$). 15 (28.3%) patients in group 1 and 44 (33.1%) patients in group 2 received postoperative heparin infusion for 24 h ($p > 0.05$). Of 123 patients have central venous catheter, 37 (69.8%) were in group 1 and 86 (64.7%) were in group 2 ($p = 0.607$). Overall secondary patency rate was 77.4%. Patients in group 1 and group 2 have primary patency rates of 83% and 75.2%, respectively ($p = 0.458$). Early postoperative complications such as venous thrombosis, bleeding and seroma were observed in 6 (11.3%) patients of group 1 and 12 (9%) patients of group 2 ($p = 0.252$). Second AVF creation was done in 2 (3.8%) patients in group 1 and 23 (17.3%) patients in group 2 that is statistically significant ($p = 0.016$). No postoperative mortality was observed but overall mortality was seen in 15 patients (8.1%).

Table 1
Characteristics of the patients in both groups.

	EVAS (n = 53)	OS (n = 133)	P value
Male/Female	42/11	75/58	**0.004**
Age (years)[a]	61 ± 16	56.4 ± 14.2	**0.027**
CRF duration (Months)[a]	19 ± 36.9	16 ± 27.8	0.927
BMI (kg/cm^2)[a]	24.4 ± 4.1	24.5 ± 2.8	0.507
Preemptive renal disease (%)	75.5	91.7	**0.005**
AVF site (%)			1.000
Right	20.8	20.3	
Left	79.2	79.7	
Anastomosis type (%)			**0.000**
Side-to-side	0	63.2	
End-to-side	100	36.8	
Operation time (Minutes)[a]	30.6 ± 12.4	58.2 ± 23	**0.000**

Abbreviations: AVF: Arteriovenous fistula, BMI: Body mass index, CRF: Chronic renal failure, EVAS: Experienced vascular access surgeon, OS: Other surgeons.
[a] Values are means ± standard deviation.

Table 2
Intraoperative data and patency rates of both groups.

	EVAS (n = 53)	OS (n = 133)	P value
Artery diameter (mm)[a]	2.45 ± 0.59	3.32 ± 0.56	**0.000**
Vein diameter (mm)[a]	2.35 ± 0.64	3.21 ± 0.61	**0.000**
Anastomosis diameter (mm)[a]	3.04 ± 0.79	5 ± 1.86	**0.000**
ICA (%)	1.9	15.8	**0.005**
Presence of central catheter (%)	69.8	64.7	0.607
Secondary patency (%)	83	75.2	0.458
Second AVF creation (%)	3.8	17.3	**0.016**

Abbreviations: AVF: Arteriovenous fistula, EVS: Experienced vascular access surgeon, ICA: Intraoperative catheter administration, OS: Other surgeons.
[a] Values are means ± standard deviation.

Table 3 shows the association of variables with secondary patency rates in multiple logistic regression analysis clustered at experienced vascular surgeon and other surgeons. The odds ratio of secondary patency rate of experienced vascular surgeon as the artery diameter decreases was six times more than other surgeons [odds ratio (OR) 6.498, 95% confidence interval (95% CI) 1.820 to 23.198, P = 0.004]. The odds ratio of secondary patency rate of experienced vascular surgeon as the vein diameter decreases was three times more than other surgeons [odds ratio (OR) 3.643, 95% confidence interval (95% CI) 1.163 to 11.410, P = 0.026]. These findings suggest that experienced vascular surgeon has better secondary patency rates compared to other surgeons as the artery or vein diameter decreases. No statistically significant difference was observed in other parameters.

5. Discussion

National Kidney Foundation Department Outcomes Quality Initiative guidelines state that AVF is the optimum method for dialysis access [6]. AVF site should be selected as the non-dominant site for achieving comfort of the patient. Primary vascular access should be started from the distal arm such as radiocephalic fistula. However the primary AVF failure rates were higher (28% for distal, 20% for proximal arm, P = 0.001) in more distal compared with proximal arm [7]. Although risk factors for AVF failure such as older age, female gender, presence of diabetes and distal AVFs have been identified [8], another factor, operating surgeon factor should have to be investigated. Several studies investigated surgeon factor and stated that vascular access for hemodialysis should be performed by either an experienced vascular surgeon or under his supervision [9,10]. However some studies did not find statistical difference regarding surgeon factor, they encourage surgical trainees to be specialized in this field without causing impairment in patient care [11,12]. This factor was first evaluated in literature by the study of Prischl et al. and found its prognostic relevance in short and long-term AVF patency rates [13]. In this current study although we can not find significant difference between groups, we also advocate AVF operations have to be performed by experienced vascular surgeons.

Table 3
Logistic regression model for odds of surgeon factor.

	Odds ratio (95% CI)	P value
Age	0.970 (0.934–1.007)	0.108
Sex	2.257 (0.736–6.923)	0.154
Artery diameter	6.498 (1.820–23.198)	**0.004**
Vein diameter	3.643 (1.163–11.410)	**0.026**
Anastomosis diameter	0.759 (0.275–2.094)	0.595
ICA	0.485 (0.000–798.428)	0.848
Second AVF creation	4.667 (0.676–32.201)	0.118

Abbreviations: ICA: Intraoperative catheter administration.

Distal AVFs are recommended for initial hemodialysis access [14]. The most common of distal AVFs, Brescia-Cimino fistula, was first described as side-to-side anastomosis however in a recent review end-to-side anastomosis technique is recommended in distal AVFs [15]. In our study experienced vascular access surgeon preferred end-to-side anastomosis in all operations although other surgeons performed this type of anastomosis in only 36.8% of patients. This makes one of the limitations of our study as the secondary patency rates may have been disturbed by difference in anastomosis technique. As end-to-side anastomosis needs more skill and experience to be accurately performed, application of this technique by surgeons have lower experience in vascular access may also influence patency rates. Retrospective design of this study is another limitation.

Artery, vein and anastomosis diameter can also affect patency rates. Since vessel diameter ≤2 mm in distal arm is not recommended [16,17], average artery and vein diameters for experienced surgeon group are 2.45 ± 0.59 and 2.35 ± 0.64 mm in the current study that is significantly different with other surgeons. This may be due to experienced surgeon preformed AVF creation in patients with non-visible vein on physical examination whereas others preferred preoperative imaging or patients with visible vein on physical examination. As other surgeons preferred usually side-to-side anastomosis, higher anastomosis diameters are observed.

Patients with CRF have higher cardiovascular disease complications, including atherosclerosis [18]. The generation of advanced glycation end products is increased in patients with CRF, which contributes to vascular injury [19]. As the duration of CRF increases, vascular injury also increases. Patients with preemptive disease have less vascular injury than the patinets that have long duration of CRF. In the current study, 91.7% of patients in other surgeons group were predialysis whereas only 75.5% of patients in experienced vascular access surgeon group were predialysis, which may contribute to patency rates not being statistically different.

Primary patency rates for distal AVFs is reported to be as high as 96.8% unfortunately secondary patency rates are decreased to 75.6% [20]. Fassiadis et al. [10] found primary and secondary patency rates as 80% vs. 93% in consultant surgeon group and 74% vs. 81% in junior surgeons group ($p < 0.025$). Overall secondary patency rates were 77.4% and secondary patency rates of experienced surgeon group (83%) and other surgeons group (75.2%) in the current study is similar with the literature findings however not significantly different ($p > 0.05$). However statistical difference between groups was observed for second AVF creation and experienced vascular access surgeon performed second AVF surgery in only 3.8% patients ($p < 0.05$).

6. Conclusion

Formation of distal AVFs is a challenging issue with difficult technical skills. Although experienced vascular access surgeon has better secondary patency rates, statistical difference with other surgeons is not observed. Thus in order to understand accurate effect of surgeon factor, prospective randomized studies should be performed.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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