

Radiocephalic Arteriovenous Fistula as A Possible Efficient Hemodialysis Access in Elderly Patients Above 60 Years

Hamdy AbdelAzeem AboElNeel*, AbdulRahman Mohamed Salem,
Mohamed Emam Fakhr, Karim Shalaby Mohamed Elawady

Department Vascular Surgery, Faculty of Medicine, Ain Shams University, Egypt

*Corresponding author: Hamdy AbdelAzeem AboElNeel, Mobile: (+20) 01111230823, E-Mail: dr_hamdy2009@hotmail.com

ABSTRACT

Background: Although there is debate about the best initial vascular access for elderly patients, Kidney Disease Outcomes Quality Initiative guidelines do not take age into account when deciding the location of autogenous arteriovenous hemodialysis access.

Objective: The purpose of this study was to study the outcome of the radiocephalic arteriovenous fistulae in elderly patients, above 60 years of age, as regard primary failure, maturation and non-maturation.

Patients and Methods: A single-center prospective cohort study of elderly patients above age of 60 years who were planned for permanent hemodialysis set for primary radiocephalic arteriovenous fistula after fulfilling the inclusion and exclusion criteria during the period from March 1, 2021, to February 28, 2022.

Results: During the study period, 83 patients (42 males and 41 females) were included who presented with chronic renal failure (CRF) and were planned for permanent vascular access for the first time. Functional maturation at 6 months was achieved in 66 patients (81.48%). They were significantly younger than those without functional maturation, and the diameter of their radial artery and cephalic veins was, 2.10 mm and 2.50 mm respectively. Also, patients with functional maturity in relation to gender and comorbidities, were not significantly different from those without functional maturity. In the patients, primary, assisted primary and secondary patencies at 6 months were 75.3%, 88.9% and 92.6% respectively.

Conclusions: Age has a substantial impact on the functional maturation of radiocephalic fistula in elderly patients, according to this study. This impact should be taken into account when arranging a vascular access in incident elderly patients if they are supported by additional prospective research.

Keywords: Radiocephalic arteriovenous fistula, Possible efficient hemodialysis, Elderly patients, Arteriovenous.

INTRODUCTION

The autogenous arteriovenous fistula (AVF) has been indicated as the ideal vascular access for chronic hemodialysis patients by current treatment guidelines ⁽¹⁾. According to recent guidelines, radiocephalic arteriovenous fistula (RCAVF) is specifically advised as the first in the order of choice for patients who begin hemodialysis ⁽²⁾.

The RCAVF at the wrist is typically the initial option for vascular access; however, a recent meta-analysis has found a high primary failure rate and moderate patency rates at 1 year. Despite having a high primary failure rate due to early thrombosis or inability to mature, RCAVFs have excellent long-term patency and a low complication rate after they are established ⁽³⁾. Compared to catheters and arteriovenous grafts (AVG), which have higher rates of morbidity and death, it has greater patency rates, fewer problems, and reduced health care expenditures ⁽⁴⁻⁸⁾.

For natural autologous arteriovenous (AV) fistulas, the annual failure and thrombotic event rate is 0.2 per patient, compared to 0.8 per patient for synthetic AV grafts ⁽⁹⁾.

On the other hand, 19% of patients have AVFs that have not fully matured, which is characterised as an inability to achieve a sufficient flow for optimal hemodialysis after a 6-week maturation period ⁽¹⁰⁾.

The "fistula first at all costs" method may not

be the best economical option for all patient groupings, notwithstanding recent challenges to this popular technique. On the other hand, the challenging elder population with a higher late referral rate makes it impossible to always implement the "all autogenous" approach ⁽¹¹⁾.

There aren't many statistics about access outcomes in elderly patients, and those that exist have mixed findings despite the fact that more than half of all patients commencing hemodialysis are over 60 years ⁽¹²⁾.

In a recent report, 12% of elderly patients achieved RCAVF adequacy, which was defined as the ability to use the fistula for hemodialysis with two needles and a flow of 350 mL/min on at least 6 sessions per month ⁽¹³⁾. This was despite the optimal results of access salvage of RCAVF using percutaneous transluminal angioplasty ⁽¹⁴⁾. A distal AV fistula is more likely to fail due to inadequate vasculature in elderly patients due to their severe comorbidities, such as uremic or ischemic cardiomyopathy, peripheral vascular disease, and diabetes mellitus ⁽¹⁵⁾. Growing older is a big element that negatively affects their result for these reasons ⁽¹⁶⁾.

In spite these factors, neither the American nor the European guidelines for older people with end-stage renal disease contain any particular recommendations ^(17,18). If these recommendations are followed, choosing

a distal AV fistula in elderly patients will be linked to a higher likelihood of primary failure that calls for a second access operation. The late referrals who have already begun dialysis will be most negatively impacted by this since a prolonged period with temporary catheters and their associated complications would be necessary⁽¹⁹⁾.

But, in the event of failure, RCAVFs enable the development of a more proximal access. For a patient with end-stage renal illness who has a short life expectancy, however, such a benefit is of negligible significance. According to some statistics, the average life expectancy for octogenarians is 28 to 31 months, and 50% of patients pass away within the first two years of starting dialysis^(20,21).

According to a meta-analysis, elderly patients have a statistically significant 50% higher chance of RCAVF failure at 12 months compared to non-elderly adults. With elderly patients having 12-month secondary patency rates of 67.8% and 12-month primary patency rates of 54%, these numbers support successful access salvage attempts⁽²²⁾.

Life expectancy, patient preferences, costs, the number of revisions necessary to maintain access patency, the length of time temporary catheters are required, and the amount of time until access is adequate for cannulation are additional factors that should be taken into account when treating elderly patients. Additionally, there is an increased risk of steal following proximal access reconstruction, particularly in elderly individuals⁽²³⁾.

The purpose of this study was to study the outcome of the radiocephalic arteriovenous fistulae in elderly patients, above 60 years of age, as regard primary failure, maturation and non-maturation.

PATIENTS AND METHODS

Research Question: Is radiocephalic arteriovenous fistula an efficient access for elderly hemodialysis patients above age of 60 years?

Study Population: Elderly patients above age of 60 years for permanent hemodialysis set for primary radiocephalic arteriovenous fistula after fulfilling the following inclusion and exclusion criteria.

Inclusion criteria:

- First permanent vascular access
- Patent radial artery and cephalic vein.
- Arterial and venous diameters at wrist ≥ 2 mm (By Duplex study).
- RCAVF with immediate (day 0) technical success.

Exclusion criteria:

- Currently or previous history of selected upper limb DVT.
- Currently or previous history of selected upper limb superficial phlebitis.
- RCAVF that had immediate (day 0) failure.

Study design: Prospective cohort study.

Sample size: All patients recruited from medical multicenter (Ain Shams University Hospitals).

Duration of study: each patient was followed up after primary radiocephalic arteriovenous fistula creation for 6 months.

Primary endpoints: access failure, maturation* and non-maturation**.

Failure to mature: An AV access that, six months after it is created, cannot be successfully used for dialysis, despite radiologic or surgical intervention (also known as endovascular or open procedural care).

Primary patency:

The period of time used to measure intra-access patency that runs from the date a vascular access was created (AV access) or inserted (central venous catheter) to the date of the earliest of the following events: thrombosis or any treatment intended to help maintain or restore patency (e.g., angioplasty).

*Access maturation is defined as ability to be successfully cannulated with 2 needles over period of at least 6 hemodialysis sessions during 30-day period and achieved blood flow for adequate hemodialysis with following criteria:

1. Clinically:
 - Adequate venous diameter.
 - Soft easily compressible vein.
 - Continuous systolic and diastolic low-pitched Bruit.
 - Palpable thrill near anastomosis for varying adequate length along the vein.
 - Superficial enough to be punctured with 2 needles.
2. Duplex Ultrasound (at least 6 mm for diameter, less than 6 mm depth from skin and flow volume at least 600 ml/min).

**Access non-maturation: inability of access to achieve previously mentioned criteria of maturation for at least 6 weeks after creation.

Secondary endpoints: any other complications and death.

All patients were assessed:

Preoperatively:

1. Clinically (age, gender and comorbidity as diabetes mellitus (DM), systemic hypertension, body mass index and coronary heart disease).
2. Anatomically (radial artery and cephalic vein diameters and patency)

Postoperatively: (at day of creation, 1, 3 and 6 months)

3. Clinically:
 - Adequate venous diameter.

- Soft easily compressible vein.
 - Continuous systolic and diastolic low-pitched bruit.
 - Palpable thrill near anastomosis for varying adequate length along the vein.
 - Superficial enough to be punctured with 2 needles.
4. Duplex ultrasound (for diameter, depth and flow volume in ml/min).

Ethical consent:

The Academic and Ethical Committee at Ain Shams University approved the study. Each patient signed a written informed consent form to agree to participate in the study. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, guided the conduct of this work.

Statistical analysis

Statistical Package for the Social Sciences (SPSS 25) was used to review, code, tabulate, and introduce the acquired data to a computer. Mean ± standard deviation (SD) was used to present numerical data. Proportion and frequency were used to present non-numerical information.

The statistical significance of the difference between the means of the two study groups was evaluated using a student t-test. To investigate the connection between two qualitative variables, the Chi-Square test was performed. The association between two qualitative variables was examined using the Fisher's exact test when the predicted count was less than 5 in more than 20% of the cells. A descriptive method for analysing the distribution of time-to-event variables is Kaplan-Meier Survival Analysis. P value less than 0.05 was regarded as significant.

RESULTS

This is a prospective cohort study including 83 patients (42 males and 41 females) who presented with CRF and were planned for permanent vascular access for the first time. We recruited patients who fulfilled the inclusion criteria during the period from March 1, 2021,

to February 28, 2022. Age of patients ranged from 60 to 73 years (mean= 65.18 ± 3.28 years). Radial artery diameter ranged from 2 to 2.2 mm (Mean= 2.1 ± 0.08), while cephalic vein diameter ranged from 2 to 3 mm (Mean= 2.47 ± 0.33). Demographic data are presented in Table 1.

Table (1): Demographic data within whole group

	N	%
Gender	Male	42 (50.6%)
	Female	41 (49.4%)
Diabetes Mellitus	46	55.4%
Systemic Hypertension	58	69.9%
Obesity	15	18.1%
Coronary Heart Disease	50	60.2%

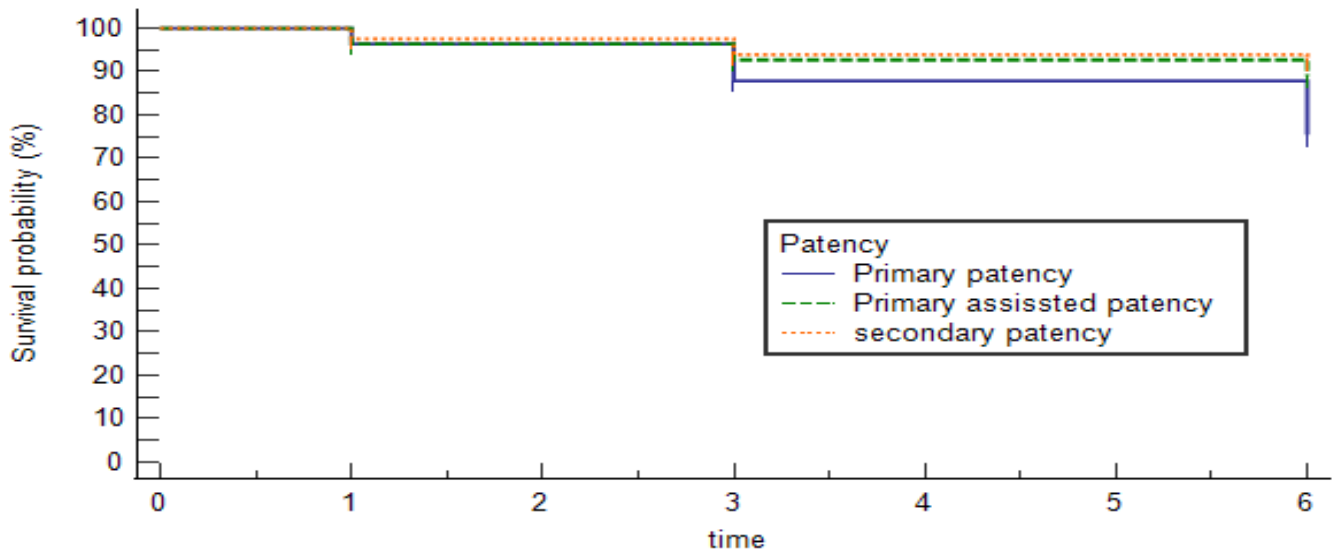
Primary, assisted primary and secondary patencies are demonstrated in table (2) and figure (1).

One patient presented on 23rd day postoperative with thrombosed fistula after an episode of hypotension. Surgical thrombectomy was done with regained patency. 3 patients had successful balloon-assisted maturation (BAM) during the 2nd month.

During the 4th and 5th months, 6 patients had successful BAM, 2 patients had failed trials of BAM and their access was abandoned. One functionally mature fistula thrombosed during the 5th month. Surgical thrombectomy and completion venoplasty was done with regained patency and efficient dialysis till the end of the follow up period.

Table (2): Primary, assisted primary and secondary patency

	Day 1	Month 1	Month 3	Month 6
1 ^{ry}	83 (100%)	80 (96.4%)	72 (87.8%)	61 (75.3%)
1 ^{ry} assisted	83 (100%)	80 (96.4%)	75 (91.5%)	72 (88.9%)
2 ^{ry}	83 (100%)	81 (97.6%)	77 (93.9%)	75 (92.6%)
Total (n)	83 (100%)	83 (100%)	82 (100%) 1 patient lost follow-up	81 (100%) 1 patient lost follow up



Number at risk		0	1	2	3	4	5	6
Group: Primary patency	83	79	79	71	71	71	61	
Group: Primary assisted patency	83	79	79	75	75	75	72	
Group: secondary patency	83	80	80	76	76	76	75	

Figure (1): K-M curve for patency.

There was postoperative minor bleeding in 4 patients and it was managed conservatively. There was no procedure related mortality.

Functional maturation at 6 months was achieved in 66 patients (81.48%). There was significant difference between patients with functional maturation and patients without as regard age (Table 3). However, the difference between both was insignificant as regard gender and comorbidities (Table 4).

Table (3): Effect of age and initial diameter of radial artery and cephalic vein on functional maturity at 6 months

	No Functional Maturation		Functional Maturation (M6)		t test		
	Mean	SD	Mean	SD	t	p value	Significance
Age (years)	67.53	4.27	64.64	2.77	2.51	0.023	S
Radial artery diameter (mm)	2.09	0.09	2.10	0.08	-0.64	0.527	NS
Cephalic vein diameter (mm)	2.39	0.22	2.50	0.35	-1.51	0.140	NS

SD: Standard deviation, S: Significant, NS: Non-significant

Table (4): Relation between gender and comorbidities and functional maturity

		No Functional Maturation		Functional Maturation (M6)		Test of sig.		
		N	%	N	%	test value	p value	Significance
Gender	male	9	22.0%	32	78.0%	$\chi^2 = 0.65$	0.421	NS
	female	6	15.0%	34	85.0%			
Diabetes Mellitus	no	7	20.0%	28	80.0%	$\chi^2 = 0.09$	0.765	NS
	yes	8	17.4%	38	82.6%			
Systemic Hypertension	no	4	16.7%	20	83.3%	Fisher exact test	1.000	NS
	yes	11	19.3%	46	80.7%			
Obesity	no	12	17.9%	55	82.1%	Fisher exact test	0.716	NS
	yes	3	21.4%	11	78.6%			
Coronary Heart Disease	no	9	28.1%	23	71.9%	$\chi^2 = 3.24$	0.072	NS
	yes	6	12.2%	43	87.8%			

χ^2 : Chi square test, NS: Non-significant

DISCUSSION

Eighty-three patients were included in this study; all of them had chronic renal failure (CRF) and were planned for permanent vascular access creation. Patients underwent radiocephalic arteriovenous fistula (RCAVF) with follow-up of 6 months.

In our study, Six-month primary, assisted primary, and secondary patency was 75.3%, 88.9%, and 92.6%, respectively. While a meta-analysis of dialysis outcomes in elderly patients done by **Lazarides et al.** (22,23) found a statistically significant higher rate of autogenous radiocephalic direct AV access primary (OR 1.8), 1-year (OR 1.5), and 2-year (OR 1.4) failure in elderly patients compared with the nonelderly. According to **Burt et al.** (24), the access maturation rate at 2 years was 0.92 (95% CI, 0.80-1.06) for radiocephalic fistula patients under 60 years old and 0.74 (95% CI, 0.58-0.95) for those over 60 years old. **Almasri et al.** (25) showed in one study that primary patency in individuals >65 years old with diabetes was considerably lower than in non-diabetic patients (hazard ratio [HR], 0.50; 95% CI, 0.26-0.96). **Segal et al.** (26) and **Ferring et al.** (27) in two studies compared primary patency in relation to gender and found that it was significantly lower in women than in men (HR, 0.607; 95% CI, 0.421-0.876).

Based on an analysis of the available data, patency was lowest in AVFs, then AVGs, and finally catheters. It was lower among women, elderly, and patients with diabetes (25).

In our study, there was statistically significant effect of age on functional maturation at 6 months, while there were no statistically significant effect of radial artery diameter or cephalic vein diameter on functional maturation at 6 months. Age was utilised as a categorical variable by **Wan et al.** (28) and after multivariate adjustment, every 20 years of age rise was significantly linked with a greater OR (OR>1.543) for the occurrence of immaturity. **Goh et al.** (29) state that functional maturity achieved in 64% of patients older than 70 years who had radiocephalic AVF.

The rule of "6" was applied by **Misskey et al.** (30) to assess maturation. At 12 months, RCAVF maturation failure was 25%± 3% in those under 65, 32%± 3% in those between 65 and 79, and 40%± 7% in those over 80 (P value = 0.016 for 65 years vs. >80 years). These results indicate that an age cutoff >65 years old is likely to be the most appropriate in differentiating age-related outcomes in the development of autogenous AV access among elderly cohorts. Patients >80 years old performed similarly to those in the cohort 65 to 79 years old.

In our study, as regard the relation between gender, diabetes, hypertension, obesity and coronary heart disease and their effect on functional maturation at 6 months, there were no statistically significant effect.

CONCLUSION

Age has a substantial impact on the functional maturation of radiocephalic fistula in elderly patients, according to this study. This impact should be taken into account when arranging a vascular access in incident elderly patients if they are supported by additional prospective research.

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Conflict of interest: Nil.

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