Functional Outcome of Arteriovenous Fistula For Maintenance Hemodialysis In End Stage Renal Disease

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ABSTRACT

Objective — *To find out functional outcome of arteriovenous (AV) fistula for hemodialysis in end stage kidney disease.*

Study design — *Cross sectional study.*

Place & Duration of study — *Department of Surgery Combined Military Hospital Malir Cantt Karachi, from January 2017 to July 2018.*

Methodology — *A total of 116 patients were included in this study. Radio-cephalic and brachio-cephalic fistulae (end to side) were created. Doppler studies were done before and after every procedure for the estimation of velocity volume of blood flow, depth from the skin, diameter of vessels and the maturation time of AV fistula. Patients were followed up to the first dialysis via AV fistula to assess the functional outcomes and complications.*

Results — *Out of 116 patients, 88 were male and 28 female. Age of the patients ranged from 35 year to 65 year. Brachio-cephalic AV fistula matured earlier than radio-cephalic fistula with mean maturation time of 40 days for brachio-cephalic and 45 days for radio-cephalic technique which was statistically significant (p= 0.000). Complication rate with radio-cephalic fistula was 65% as compared to 35% of brachio-cephalic fistula (p = 0.67 NS).*

Conclusions — *Brachio-cephalic AV fistula maturation time was less than that of radio-cephalic AV fistula. Complication rate of brachio-cephalic fistula was also low with better functional outcome.*

Key words — *Brachio-cephalic AV fistula, Radio-cephalic fistula, Chronic renal failure, Hemodialysis.*

INTRODUCTION:

End stage renal disease (ESRD) / chronic kidney disease (CKD) is the presence of kidney damage or decrease in kidney function that persists for at least three months, associated with progressive and irreversible loss of large number of functioning nephrons.[1] Diabetes mellitus, hypertension and glomerulonephritis are the main causes of CKD.[2] These patients need hemodialysis as a part of treatment.

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There are three types of hemodialysis access namely autogenous AV fistula, prosthetic bridging graft (BG) and indwelling central venous catheter. Ideal access delivers a flow rate sufficient for effective dialysis, that can be easily cannulated, has long life and low complication rate.[3] AV fistulae are preferred to prosthetic grafts and central venous line because of their higher primary patency rates, lower frequency of stenosis, thrombosis and infection.[3,4] Total number of intervention during the life of access for AV fistula is lower as compared to other hemodialysis accesses.[4] Three types of AVF are radio-cephalic at wrist, brachio-cephalic at elbow and brachio-basilic after transposition of basilic vein.[5] The aim of this study was to determine functional outcome of type of AV fistulae required for maintenance hemodialysis in CKD.

METHODOLOGY:

This study was carried out from January 2017 to July 2018 in the Department of Surgery, CMH Malir

Cantt Karachi. A total of 116 patients were included. Patients who were diabetic and hypertensive and those in need of kidney transplant, requiring maintenance hemodialysis with preserved left upper limb, were included. Patients with previously failed AV fistula and those who had previous history of multiple IV cannulation of veins of left upper limb were excluded.

Radio-cephalic and brachio-cephalic (side to end) AV fistulae were created. Doppler studies before and after every procedure were done to check velocity, volume of blood flow, depth from the skin, diameter of vessels, ease of access and the maturation time of AV fistula.

Patients were followed up to first dialysis through AV fistula after maturation and overall functional outcome and complications were recorded. NKF-KDOQI guild lines for vascular access were followed (criteria for fistula formation) as rule of 6's 600ml per minute blood flow, 6mm diameter, less than 6mm depth from the skin. Data was analyzed using descriptive and inferential statistics. Mean and percentage were used to present numerical data. Complications were compared with application of Chi square test and p value < 0.05 was considered significant.

RESULTS:

Out of 116 patients, 88 were male and 28 female. Age of the patients ranged from 35 year to 65 year (table I). Brachio-cephalic AV fistulae were made in 78 patients of whom 59 were male and 19 female with mean Q Max of brachial artery 120 ± 36.95 ml /minute and cephalic vein 31 ± 20 ml /minute at elbow which were greater than at wrist. Depth of brachial artery from skin was 3 ± 0.5 mm and cephalic vein at elbow was 1.25 ± 0.25 mm. These measurements were well under the required values. Complications in vessel walls at elbow in brachial artery were 5 in number, and cephalic vein 4 in number.

Radio-cephalic fistulae were made in 38 patients of whom 29 were males and 9 females. Mean Q Max of radial artery at wrist was 20 ±14 ml per minute and cephalic vein 13±6 ml per minute, depth from the skin of radial artery was 2±0.5 mm and cephalic vein 2.5±0.43 mm from skin.

Postoperative Doppler studies of brachio-cephalic AV fistula showed earlier maturation time (as compared to radio-cephalic AV fistula. Doppler studies showed more flow rate in brachio-cephalic AV fistula (table II). Procedure related complications are shown in table III.

DISCUSSION:

Issues related to construction and maintenance of AV fistula is still debated in literature. Many studies have been conducted to determine the efficiency of type of AV fistula for maintenance hemodialysis in CKD.[6,7] Creating and maintaining long-term access for hemodialysis remains a clinical challenge. Arteriovenous fistulae are the preferred access type for chronic hemodialysis patients.[8] Nonetheless, AV fistulae are not without their own complications, including thrombosis, infection, aneurysm, seroma, steal syndrome, heart failure, and bleeding.[9,10] In a study by Akram et al, cumulative one year patency of Crimino AV fistula, elbow AV fistula and graft AV fistula were 66%, 70% and 37% respectively. This showed that brachio-cephalic AV fistula was better in terms of patency.[11] Although access failure rates have varied slightly from study to study and across patient populations, radiocephalic fistulae in particular are well documented in all studies as failing to mature at rates greater than that of brachiocephalic fistulae. Same was observed in index study.

Table I: Demographic Data of Patients

Gender	Brachio-cephalic fistula (n)	Radio-cephalic fistula (n)	Total (n)
Men	59	29	88
Women	19	9	28
Total (n)	78	38	116

Table II: Postoperative Doppler Study for Blood Flow and Maturation TIme

Variable	Brachio-cephalic AV fistula	Radio-cephalic AV fistula
Q max (ml/minute)	800 + 190.36	680 mlmin+_180
Mean maturation time (Days)	40	45

Table III: Complications in AV Fistula		
Variable	**Brachio-cephalic Fistula (n=78)**	**Radio-cephalic Fistula (n=38)**
Pseudo-aneurysm	3 (3.8 %)	2 (5.26%)
Ecchymosis at operation site	2 (2.56%)	6 (15.79%)
Edema of wound	2 (2.56%)	6 (15.79%)
Wound Infection / bleeding	3 (3.8%)	2 (5.26%)
Total (n -%)	10 (12.8%)	16 (42%)

Chi square test: p=0.67* Not significant

In a study of 204 patients by Dixon et al, it was noted that primary and cumulative patency of upper arm native access were significantly longer than that of forearm access.[12] In their study 1, 3, and 5 year cumulative secondary patency rate of upper arm AVF were 69%, 53%, and 53%, respectively, compared to 52%, 43%, and 34% for lower arm access. Primary patency of upper arm access was also superior to that of forearm access. In a larger, systematic review of 34 studies, Huber et al also reported a significantly greater primary patency of upper arm native access compared to that of forearm access (60% vs. 49% at 18 months).[13] As such, our results are consistent with number of studies in the literature.

In our study complication of vessel wall as calcification in brachial artery was seen in 5, cephalic vein 4 at elbow and radial artery at wrist 8, and cephalic vein at wrist, were two. Study conducted by Khadatkar et al revealed complication of vessel wall as calcification / atherosclerosis in brachial artery were 3, cephalic vein at elbow 2. Radial artery zero and cephalic vein zero at wrist.[14] Maturation time of AVF and flow rate values in our study are comparable with that reported in litearyure.[14,15,16] This showed superiority of brachio-cephalic fistula.

Different complications were found in brachio-cephalic fistula (n=10) and radio-cephalic fistula (n=18). In Mahakalkar et al study more complications were found at wrist postoperatively as observed in our study such as edema of hand and redness at operative side. Complication rate in cases of radio-cephalic fistula were more than that of brachio-cephalic fistula in a reported series.[17]

CONCLUSIONS:

Flow rate, maturation time, complication rate of brachio-cephalic fistula at elbow were quite comparable with that of radio-cephalic fistula. Pre and post procedural Doppler studies are mandatory for assessment of functional outcome of AV fistulae.

REFERENCES:

1. Hall JE. Guyton and Hall textbook of medical physiology e-Book. Elsevier Health Sciences; 2015.
2. John R, Webb M, Young A, Stevens PE. Un referred chronic kidney disease: a longitudinal study. Am J Kidney Dis. 2004;43:825-35.
3. Feldman HI, Kobrin S, Wasserstein A. Hemodialysis vascular access morbidity. J Am Soc Nephrol. 1996;7:523-35.
4. Allon M, Robbin ML. Increasing arteriovenous fistulas in hemodialysis patients: problems and solutions. Kidney Int. 2002;621109-24.
5. Beathard GA, Peden EK, Eidt JF, Mills JL, Collins KA. Creating an arteriovenous fistula for hemodialysis.[Internet] Available from URL https://www.uptodate.com/contents/arteriovenous-fistula-creation-for-hemodialysis-and-its-complications. Accessed on 2018.
6. Añel RL, Yevzlin AS, Ivanovich AP. Vascular access and patient outcomes in hemodialysis: questions answered in recent literature. Artif Organs. 2003;27:237-41.
7. Dhingra RK, Young EW, Hulbert-Shearon TE, Leavey SF, Port FK. Type of vascular access and mortality in US hemodialysis patients. Kidney Int. 2001;60:1443-51.
8. Perera GB, Mueller MP, Kubaska SM, Wilson SE, Lawrence PF, Fujitani RM. Superiority of autogenous arteriovenous hemodialysis access: maintenance of function with fewer secondary interventions. Ann Vasc Surg. 2004;18:66-73.

9. Patel A, Dalal A, Munshi A. Study of 110 cases of arteriovenous fistula created for hemodialysis. Indian J App Basic Med Sci. 2006;8(1).

10. Ahsan ZU, Waheed A, Zaeem FA, Nazir F. Arteriovenous fistulas constructed using side-to-side anastomosis with ligation and division of distal venous arm; a tertiary care hospital experience. J Vasc Access. 2010;11:26-30.

11. Akram M, Bashir EA. Vascular Access for Hemodialysis. Pak Armed Forces Med J. 2007;57(4):253-7.

12. Dixon BS, Novak L, Fangman J. Hemodialysis vascular access survival: upper-arm native arteriovenous fistula. Am J Kidney Dis. 2002;39:92-101.

13. Huber TS, Carter JW, Carter RL, Seeger JM. Patency of autogenous and polytetrafluoroethylene upper extremity arteriovenous hemodialysis accesses: a systematic review. J Vasc Surg. 2003;38:1005-11.

14. Khadatkar A, Mahakalkar C, Pradhan T, Bora A. Comparative analysis of radiocephalic versus brachiocephalic native arteriovenous fistula for hemodialysis in end stage renal disease. Int J Res Med Sci. 2016;5:171-6.

15. Robbin ML, Chamberlain NE, Lockhart ME, Gallichio MH, Young CJ, Deierhoi MH, et al. Hemodialysis arteriovenous fistula maturity: US evaluation. Radiology. 2002;225:59-64.

16. Petrovic D. Clinical importance of color Doppler ultrasonography in preoperative assessment of hemodialysis vascular access creation. Sanamed. 2012;7:113-8.

17. Mahakalkar CC, Kolte SP, Yeola ME, Patwardhan MA, Jain NN, Kaple MN. Site selection for vascular access creation in hemodialysis in end stage renal disease. Int J Res Med Sci. 2017;2:681-5.

Received for publication: 19-09-2018

Accepted after revision: 15-11-2018

Author's Contributions:
Khalid Ibrahim: Manuscript writing
Sarah Fatima: Data Collection
Bushra Aman: Data Collection, Literature review

Conflict of Interest:
The authors declare that they have no conflict of interest.

Source of Funding:
None

How to cite this article:
Ibrahim K, Fatima S, Aman B. Functional outcome of arteriovenous fistula for maintenance hemodialysis in end stage renal disease. J Surg Pakistan. 2018;23(3):99-102. Doi:10.21699/jsp.23.3.5.