Research Paper MEDICAL SCIENCE

Factors Affecting Outcome of Arterio Venous Fistula - Our Experience At A Tertiary Care Hospital In India

Dr Goutham Gopinath	ASSOCIATE PROFESSOR, DEPARTMENT OF UROLOGY, PARIYARAM MEDICAL COLLEGE.
DR REMYA	MEDICAL OFFICER, DEPARTMENT OF UROLOGY, PARIYARAM
DR BESTIN	SENIOR RESIDENT, PARIYARAM MEDICAL COLLEGE, PARIYARAM

ABSTRACT

Background: Vascular access may be "the life line" for patients suffering from chronic kidney disease on hemodialysis. The autogenous arteriovenous fistula provides the best access for hemodialysis because of low complication rate, long-term use, repeatability and lower cost, compared to arteriovenous graft and central venous catheter. The primary objective of this study was to investigate the factors affecting the outcome of arteriovenous fistula in our institute.

Methodology: This prospective case series study was conducted at Department of Urology, Pariyaram medical college, Kannur, Kerala from period 2011 january to 2013 december. . Patients were chosen for arteriovenous fistula at wrist and patients undergoing other types of vascular access or secondary fistula formation were excluded.

Results: Two hundred and two patients underwent arteriovenous fistula formation. The mean ± SD age was 64 ± 12 years and there were 114 (56%) males and 88 (44%) females. 12.6% fistulae failed within first month without dialysis. The primary patency rate was 70% at three months and 59% at six months.

Failing arteriovenous fistula was managed by new arteriovenous fistula in our series. 26% patients had redo arteriovenous fistula. This study demonstrated a poor outcome for fistulas in diabetic patients. Fifteen out of 23 (65.2%) who failed primarily were diabetics and out of these diabetics 13 (86.7%) failed in first three months. Infection and burst fistulae were found in nine (4.9%), pseudo aneurysm in 3.2%, fever 4.9%, peri-operative failure 0.55% and burst fistulae 3.2%.

Conclusions: One-third of radiocephalic fistulas fail within two years. The outcome is worse for women and diabetic patients. This information may be useful in assessing and counseling patients with end-stage renal failure. Arteriovenous fistula is the better and ideal choice for haemodialysis. A radiocephalic fistula in forearm seems to have better results as comparison to cubital fossa arteriovenous fistula. End to side anastomosis results are better than side to side anastomosis.

KEYWORDS

INTRODUCTION

Arteriovenous fistula is the treatment of choice for hemodialysis in chronic renal failure patients. Back in early 20th century the arteriovenous shunting was started for hemodialysis. [1] In 1950's, Quinton -Scribner silastic Teflon shunts were standard procedure. Shunt infection and thrombosis were the main complications of arteriovenous shunts. Spontaneous dislocation was also a major issue.[1] To overcome this problem Brescia, Cimino, and Hurlwith made surgically created fistulae between cephalic vein and radial artery at the wrist, first described in the 1966.[2] Prevalence of arteriovenous fistulae increased from 33% in 2003 to 41% in 2005 while the incidence increased from 26.3% in 1999 to 36.3% in 2003. [3] Chronic renal failure patients had enormous benefits from these fistulae, as these have better safety profile and long-term patency.[4,5] Chronic renal failure patient may have unsuitable veins for native arteriovenous fistula.[6] Severe arteriosclerosis, edema of the arm, vascular calcification, multiple vein puncture are usual problem.[7] To overcome these difficulties other fistula sites in different parts of body have been recommended such as, antecubital area of non-dominant arm where Radial or Brachial artery could be anastomosed with Cephalic or Basalic vein.[5,8,9] However selection of brachial artery could pose risk of significant cardiovascular complication and due to high brachial artery bifurcation (HiBAB). Moreover this site provides limited space for venipuncture for hemodialysis purpose.[10,11]

METHODOLOGY

This prospectively designed case series study was conducted at Department of Urology, Pariyarm medical college hospital, Kannur, Kerala from period 2012 january to 2014 december. Patients were chosen for arteriovenous fistula at wrist after the evaluation of normal radial pulse and distensible veins at the wrist of nondominant arm. Patients undergoing other types of vascular access or secondary fistula formation were excluded. Pre-operative evaluation included detailed evaluation of vessels clinically, quality of artery and vein, arterial assessment by Ellens test. Status of the arm whether dominant or non-dominant (some patients could be having left dominant arm), functional or paralyzed arm, previous vein puncture or edema or trauma were assessed. Ipsilateral presence of subclavian double lumen catheter or its scar marks which might pose a risk of engorged superficial shoulder vein further confirmed the diagnosis. All the fistula formation ware performed under local anesthesia. Vertical incision was made at forearm for Radial artery and Cephalic vein. Anastomosis was created in an end to side or side to side fashion depending upon mobility of target vein. The distal vein was ligated in case of radio-cephalic anastomosis. Heparin was not administered routinely during or after fistula formation. Prolene 6/0 suture was always used. Haemostasis was checked and secured. Skin was closed with Nylon 3/0. Noncircular dressing was applied and postoperative hand exercises were advised. All operations were performed by the researcher and supervised by the senior consultant. AVF maturation time proposed was one month. Patients were followed for 3 to 6 months. Primary failure occurred if the fistula never matured adequately, dialysis was no longer possible via this access site or intervention was required to maintain fistula function.

RESULTS

Two hundred and two patients underwent arteriovenous fistula formation. The mean ± SD age. of patients was 63 ± 13 years and there were 114 (56%) males and 88 (44%) females. 191 (95%) had left non-dominant arm and 11 (5%) right

non-dominant arm. Radiocephalic arteriovenous fistulae were 129, 10 had Radial artery with Median antebrachial vein, 03 had Radial artery with venacomitant and 60 were Antecubital arteriovenous fistula made by anastomosis between Brachiocephalic, Basalic, Median cubital.

Medical history included diabetes in 96 (48%), hypertension in 76 (38%) patients and 20 (10%) had both history of hypertension and diabetes mellitus. Other associated diseases were found in 34 (17%). These were chronic glomerulonephritis 9 (4.4%), polycystic disease 04 (1.6%), renal atrophy 02 (0.55%), Minimal change glomerulonephritis 02 (0.55%), secondary primary postpartum haemorrhage 02 (1.1%), rapidly progressive glomerulonephritis 4 (1.1%), obstructive nephropathy 12 (3.8%) and chronic interstitial nephritis 04 (1.6%). Twenty four (12.6%) fistulae failed within the first month without dialysis. The primary patency rate was 141 (70%) at 3 months and 119 (59%) at 6 months. Failing arteriovenous fistulae were managed by new arteriovenous fistula in our series, 52 (26%) patients had redo arteriovenous fistula made.

The study also demonstrated a poor outcome for fistulas in diabetic patients; as 16 out of 24 (65.2%) who failed primarily were diabetics and out of these 13 (86.7%) failed in first 3 months. Analysis of complications, infection and burst fistulae was found in 9 (4.91%), pseudo aneurysm in 06 (3.27%), fever 09 (4.91%), peri-operative failure 01 (0.55%) and burst fistulae 06 (3.27%)

DISCUSSION

Kolff et al. [12] performed the first clinical hemodialysis in 1943, the sacrifice of peripheral vessels was almost unavoidable in hemodialysis patients. Quinton et al. [13] introduced the first external AVF construction using rigid Teflon tubing in 1960. However, this hemodialysis technique could not be applied long-term because of complications including thrombus, infection, and bleeding. Subsequently, Brescia et al. [14] first described internal AVF construction in 1966 and enabled repeatable long-term hemodialysis with a low risk of infection. Brescia et al. [14] introduced internal AVF between the radial artery and the cephalic vein, also called the Brescia-Cimino procedure, which has been recognized as the most common surgical technique for internal AVF construction. Cascardo et al. [15] described the side-to-side brachiocephalic fistula in 1970 and Gracz et al. [16] introduced perforating vein AVF in 1977. Mehigan and McAlexander [17] suggested procedures for the creation of AVF at the snuffbox for proximal vascular preservation in 1982. The ideal AVF provides adequate blood flow without any complications in the long term. However, repeated vessel punctures during prolonged hemodialysis lead to the development of vessel injuries, which in turn lead to thrombosis or obstruction. Therefore, additional AVF construction is essential. The duration of use of the AVF is profoundly correlated to the lifespan of patients with CRF. Taking reoperation into account, the distal part needs to be considered the primary surgical site. The surgical procedure of radiocephalic AVF (side-to-side anastomosis with distal vein ligation and division) is performed in the distal part with easier procedures than other surgical techniques and has fewer complications with similar effects as those of vein end-to-side arterial anastomosis. Early failure is the condition of being unable to perform hemodialysis because of an obstructed anastomotic site and insufficient blood flow within one month after the AVF. The possible causes of early failure include the use of inappropriate vessels, and lack of dilatation due to perivascular fibrosis, intraoperative vessel intimal injury, low blood pressure, or thick subcutaneous fat tissue [14]. Approximately 4% of the cases exhibited early failure. The risk factors affecting the early obstruction of AVF are reported to be age, gender, diabetes mellitus, and association of complications including hypertension and cardiovascular disease [19,20]. Unlike early obstruction, thrombus formation and vessel stenosis could occur because of repeatedly punctured vessels. To prevent these, vessel injury needs to be minimized by changing the puncture site. A large number of studies have identified the risk factors affecting the patency rate of AVF and commonly suggested the size and the condition of the vein and insufficient venous blood flow as the crucial factors influencing the early success rate [17-19]. Therefore, the evaluation of the preoperative vein status is thought to be beneficial in anticipating postoperative fistula maturation. Preoperative vein status could be examined through ultrasonography, venography, physical examination, or other methods. However, the most favorable screening methods remain unclear. In 2009, Lauvao et al. [20] reported that no differences were found in the outcome of maturation between the group that underwent a venogram and the group that underwent a physical exam. Since physical exams were thought to be sufficient for predicting preoperative vein status, ultrasonography, venography, and other tests were not performed in our patients.

In this study 202 patients underwent CBRC arteriovenous fistula at wrist and were followed up for two years. Results showed that first month failure rate in these fistulae were 12.6% even without dialysis while primary patency rate was 70% at three months and 59% at six months.

Kakkos SK, et al;[21] documented patency rates of 70% at 12 months and 58% at 18 months and compared these with transposed brachial-basilic fistulas in which patency rates were 82% at 12 months and 78% at 18 months.

Patency of arteriovenous fistula may be influenced by patient factors, techniqueand core of the fistula following operation. Kumar A, et al;[22] demonstrated highly variable out comes for radio cephalic fistulas compared to brachiocephalic fistulae, the incidence of vascular steal syndrome was extremely rare (0%) in radiocephalic as compared to much higher (20%) in brachiocephalic fistulae. The patency rate at 24 months varied between 13 and 62 percent for different operators.

Wong V, et al; described that there was poor outcome of fistulas in women, which may be partly explained by their smaller vessels.[23]

In this study diabetic patients of either sex had a poor outcome for these fistulae as from 77 (42%) diabetics in the study, 65.2% failed primarily and 86.7% failed in first three months. Leapmen and Colleagues[24] also demonstrated the poor out come for diabetic patients and reported even lower patency rates of 42% at 12 months and 18% at 60 months. Similarly, Monroy-Cuadros M and colleague [25] found diabetes to be a significant risk factor for failure of fistulas within the 1st year.

REFERENCES

1. Quinton W, Dillard D, Scribner BH. Cannulation of blood vessels for prolonged hemodialysis. Trans Am Soc Artif Intern Organs. 1960;6:104-113.
2. Brescia MJ, Cimino JE, Appel K, Hurwich BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. N Engl J Med. 1966;275(20):1089-1092.
3. Pflederer TA, Kwok S, Ketel BL, Pilgram T. A comparison of transposed brachiobasilic fistulae with non-transposed fistulae and grafts in the Fistula First era. Semin Dial. 2008;21(4):357–363.
4. Goodkin DA, Pisoni RL, Locatelli F, Port FK, Saran R Hemodialysis vascular access training and practices are key to improved access outcomes. Am J Kidney Dis.2010;56(6):1032-42.
5. Ahmed GM, Mansour MO, Elfatih M, Khalid KE,Mohammed Ahmed ME. Outcomes of arteriovenous fistula for hemodialysis in Sudanese patients: Single-center experience. Saudi J Kidney Dis Transpl. 2012;23(1):152-157.
6. Saran R, Elder SJ, Goodkin DA, Akiba T, Ethier J, Rayner HC, et al. Enhanced training in vascular access creation predicts arteriovenous fistula placement and patency in hemodialysis patients: Results from the Dialysis Outcomes \and Practice Patterns Study. Ann Surg. 2008;247(5):885–891.
7. Keith DS, Nichols GA, Gullion CM. Longitudinal followup and outcomes among a population with chronic kidney disease in a large managed care organization. Arch Int Med. 2004;164(6):659–663.
8. Vachharajani TJ, Moossavi S, Jordan JR, Vachharajani V, Freedman BI, Burkart JM. Re-evaluating the Fistula First Initiative in Octogenarians on Hemodialysis. Clin J Am Soc Nephrol. 2011;6:1663–1667.
9. Kim YO, Yang CW, Yoon SA. Access blood flow as a predictor of early failure of native arteriovenous fistula in hemodialysis patients. Am J Nephrol.

2001;21(3):221-225.
10. Kirksey L. Unrecognized high brachial artery bifurcation is associated with higher rate of dialysis access failure. Semin Dial. 2011;24(6):698-702.
11. Kian K, Shapiro JA, Salman L, Khan RA, Merrill D, Garcia L, et al. High brachial artery bifurcation: clinical considerations and practical implications for an arteriovenous access. Semin Dial. 2012;25(2):244-247.
12. Kolff WJ, Berk HT, Welle NM, van der Ley AJ, van Dijk EC, van Noordwijk J. The artificial kidney: a dialyser with a great area. Acta Med Scand 1944;117:121-34.
13. Quinton W, Dillard D, Scribner BH. Cannulation of blood vessels for prolonged hemodialysis. Trans Am Soc Artif Intern Organs 1960;6:104-13.
14. Brescia MJ, Cimino JE, Appel K, Hurwich BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. N Engl J Med 1966;275:1089-92.
15. Cascaro S, Acchiardo S, Beven EG, Popowniak KL, Nakamoto S. Proximal arteriovenous fistulae for haemodialysis when radial arteries are unavailabe. Proc Europ Dial Transplant Assoc 1970;7:42-6.
16. Gracz KC, Ing TS, Soung LS, Armbruster KF, Seim SK, Merkel FK. Proximal forearm fistula for maintenance hemodialysis. Kidney Int 1977;11:71-5.
17. Mehigan JT, McAlexander RA. Snuffbox arteriovenous fistula for hemodialysis. Am J Surg 1982;143:252-3.
18. Marx AB, Landmann J, Harder FH. Surgery for vascular access. Curr Probl Surg 1990;27:1-48.
19. Wong V, Ward R, Taylor J, Selvakumar S, How TV, Bakran A. Factors associated with early failure of arteriovenous fistulae for haemodialysis access. Eur J Vasc Endovasc Surg 1996;12:207-13.
20. Tonelli M, Hirsch DJ, Chan CT, et al. Factors associated with access blood flow in native vessel arteriovenous fistulae. Nephrol Dial Transplant 2004;19:2559-63.
21 . Kakkos SK, Andrzejewski T, Haddad JA, Haddad GK, Reddy DJ, Nypaver TJ, et al. Equivalent secondary patency rates of upper extremity Vectra Vascular Access Grafts and transposed brachial-basilic fistulas with aggressive access surveillance and endovascular treatment. J Vasc Surg. 2008;47(2):407-414.
22. Kumar A, Jha MS, Singla M, Gupta N, Raina P, Dubey D, et al. Radio-median cubital / radiocephalic arteriovenous fistula at elbow to prevent vascular steal syndrome associated with brachiocephalic fistula: Review of 320 cases. Indian J Urol. 2007;23(3):261-264.
23. Wong V, Ward R, Taylor J, Selvakumar S, How TV, Bakran A. Factors associated with early failure of arteriovenous fistulae for hemodialysis access. Eur J Vasc Endovasc Surg. 1996;12(2):207-213.
24. Leapman SB, Boyle M, Pescovitz MD, Milgrom ML, Jindal RM, Filo RS. The arteriovenous fistula for hemodialysis access: gold standard or archaic relic? Am Surg. 1996;62(8):652-657.
25. Monroy-Cuadros M, Yilmaz S, Salazar-Bañuelos A, Doig C. Independent prediction factors for primary patency loss in arteriovenous grafts within six months. J Vasc Access. 2012;13(1):29-