OUTCOME OF ARTERIO-VENOUS FISTULA RECONSTRUCTION IN CHRONIC KIDNEY DISEASE PATIENTS PRESENTING IN A TERTIARY CARE HOSPITAL IN EASTERN NEPAL

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ABSTRACT

Introduction

Renal Replacement Therapy is the treatment modality for the chronic kidney disease (CKD) which ranges from hemodialysis, peritoneal dialysis to the renal transplantation, the latter being the best form of treatment. But, renal transplantation is available at limited centers only so hemodialysis is the most commonly used treatment modality of chronic kidney disease which requires a vascular access. But there are limited vascular surgeons in the region so most of the arterio-venous (AV) fistulas are reconstructed by Urologist/Surgeons exposed to vascular surgery during their residency/training period.

Objectives

To know the factors influencing the site selection, to assess the success rate and to document the complications of AV fistula reconstruction.

Methodology

This is a hospital based prospective observational study conducted in the Birat Medical College – Teaching Hospital, Morang, Nepal from June 2021 to May 2022. We included the CKD patients requiring vascular access for hemodialysis with Color Doppler available for vascular mapping. Patients with brachial sites previously used and without Color Doppler were excluded from the study. AVF was reconstructed under local anesthesia and outcomes were recorded.

Result

Thirty one patients of CKD underwent AVF reconstruction over the study period. Male and female ratio was 1.33 (57% and 43%). The mean age was 42.14 ± 11.34 years (Range 26-65 years). The mean diameter of radial artery (RA) and cephalic vein (CV) at wrist were 1.92 ± 0.56mm and 1.91 ± 0.20 mm respectively. Similarly, the mean diameter of brachial artery (BA) and CV at elbow were 3.66 ± 0.87mm and 3.57 ± 0.55 mm respectively. The fistula reconstructed were Lt RC (radio-cephalic) – 50% (14), Lt BC (brachio-cephalic) -35.71% (10) and Lt BB (brachio-basalic)- 14.29% (4) respectively. Complications occurred in 4 cases (14.28%).

Conclusion

Selection of type of AVF creation is influenced by the vessel diameter as well as previous fistula surgery status and AVF access for hemodialysis has adequate patency with acceptable complications.

KEYWORDS

Arterio-venous fistula; Chronic kidney disease; Outcome

INTRODUCTION

Non-communicable diseases (NCDs) contribute to 70% of all deaths globally and three-quarters of these deaths occurs in the low and middle income countries.[1] Globally, cardiovascular diseases (CVDs), chronic respiratory diseases, diabetes mellitus and cancers are the four major NCDs, and this is not different from the statistics in the South East Asia.[2] The burden of chronic kidney disease (CKD) is increasing rapidly coinciding with increases in the burden of diabetes and cardiovascular disease globally.[3-6] There is no definite scientific data on the prevalence of CKD in Nepal. However; a study from eastern part of Nepal reported the prevalence of CKD to be 10.6%.[7]

Renal Replacement Therapy (RRT) is the treatment modality for the CKD patients which ranges from hemodialysis, peritoneal dialysis to the renal transplantation, the latter being the best form of RRT. But, renal transplantation services are available at limited centers only and it is not accessible and affordable to all CKD patients. So, hemodialysis is the most commonly used treatment modality for the CKD patients. For hemodialysis, a vascular access is required and it has to be created surgically. There are three types of vascular access which can be used for hemodialysis. They are central venous catheter (CVC), arteriovenous fistula (AVF) and arteriovenous graft (AVG). Each type of vascular access has its own merits and demerits. The vascular access choice influences and contributes to the overall morbidity and mortality of the patient. The best access to place with least complications is the AVF. The problem is that many of these fistulas fail for unknown reasons. One-year patency rates range from 60 to 65%,[8,9] with 60% of fistulas being not suitable for dialysis between 4 and 5 months after surgery.[10] Previously; most of the people in this region used to visit the capital city of the country or neighboring country for hemodialysis and/or AV fistula reconstruction. But, with the availability and expansion of the services in the region; the scenario has been changed. There are many centers in the region which are providing hemodialysis facilities to the CKD patients and our center is one of them with regular, dedicated and well equipped hemodialysis unit. But there are limited vascular surgeons in the region and busy in providing sophisticated vascular surgical facilities; so most of the AV fistulas are reconstructed by Urologist/Surgeons exposed to vascular surgery during their residency/training period with variable outcomes. This study aims to know the factors influencing the site selection, to assess the success rate and to document the complications of AV fistula reconstruction by a Urologist in patients attending Birat Medical College- Teaching Hospital, Morang, Nepal.

METHODOLOGY

This is a hospital based prospective observational study conducted in the Birat Medical College – Teaching Hospital, Morang, Nepal over a period of one year (June 2021 to May 2022). The study was approved by the Institutional Review Committee (Ref : IRC-PA-137/2077-78).

We included the CKD patients requiring vascular access for hemodialysis who had Color Doppler available for vascular mapping. We excluded the patients with acute on chronic CKD and patients with brachial site used previously in any form of surgery.

Patient demography and relevant clinical history was recorded on preformed proforma. Patients were evaluated preoperatively as per the institutional protocol. All patients had color doppler of the upper limb done by a single radiologist with arterial and venous diameter at wrist and elbow and proximal and distal patency taking under consideration. These findings were documented on the proforma. All AVF reconstruction were done under local anesthesia using 2% Lignocaine and 0.025% Bupivacaine (2:1) diluted in equal volume of normal saline and infiltrated subcutaneously using a 5cc syringe along the proposed line of incision. Skin was incised with surgical blade number 15. Further subcutaneous dissection was carried using mosquito forceps. Bipolar diathermy was used for the hemostasis in addition to pressure and packing. At the wrist, the radial artery and cephalic vein were isolated and taken on vascular loops. Similarly at the elbow, brachial artery and cephalic vein or brachial artery and basilic vein were isolated and taken on vascular loops. The vein was divided and ligated distally and the artery was incised longitudinally at either location for end to side anastomosis. The left sided radio-cephalic (distal end of the cephalic vein anastomosed to the side of the radial artery- end to side) was preferred AVF reconstruction site followed by brachio-cephalic (end to side) and brachio-basilic (end to side) respectively. Right sided reconstruction was the least preferred site. The preferred suture material for vascular reconstruction were 7 0 polypropylene double arm (round body) and 3 0 polypropylene (cutting body) for the skin closure. The wound was closed only after successful demonstration of thrill at the reconstruction site, otherwise the procedure was revised in the same setting. After AVF reconstruction, the operated limb was elevated in a sling and the patient was permitted limb exercise from the next morning. Patients received tablet Cefixime 200mg twice daily till suture was removed (7-10 days) along with tablet Paracetamol 15mg/Kg as analgesics on demand basis. All the patients and their relatives were instructed to contact immediately if no thrill was palpated or any complications occurred (bleeding, swelling, numbness or fever). Patients were followed at the time of suture removal, at 6 weeks postoperatively and after 3 months. Fistula patency status and any complication/s after the procedure was documented.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS Statistics version 27 (IBM, Armonk, NY). Continuous and ordinal variables were expressed as mean ± standard deviation. The nominal variables were expressed as frequency and percentage.

RESULTS

Thirty-one patients of CKD underwent AVF reconstruction over the study period. Three patients were excluded because they lost to follow up. Male and female ratio was 1.33 (accounting 57% and 43% respectively). The mean age

was 42.14 ± 11.34 years (Range 26-65 years). The mean diameter of RA and CV at wrist were 1.92 ± 0.56mm and 1.91 ± 0.20 mm respectively. Similarly, the mean diameter of BA and CV at elbow were 3.66 ± 0.87mm and 3.57 ± 0.55 mm respectively. The fistula reconstructed were Lt RC – 50% (14), Lt BC-35.71% (10) and Lt BB- 14.29% (4) respectively.

Complications occurred in 4 cases (14.28%). Surgical site infection and bleeding from the anastomotic site occurred in one case requiring exploration, debridement and revision of anastomosis who had undergone BC-AVF previously. Two cases of RC-AVF got stenosed before starting cannulation for the dialysis. In both cases, fistula was revised. In one case, CV was anastomosed on the RA more proximally while the other case was converted into BC-AVF. One case developed pseudoaneurysm at the canulation site which was referred to a vascular surgeon for further management. Initiation of hemodialysis via AVF attempted 6 weeks after the creation of AVF in uncomplicated cases. After three months post-surgery, 24 cases (85.71%) were receiving hemodialysis via their AVF. Fistula was not mature in the cases with complications and requiring revision at the 3 month follow up.

DISCUSSION

The burden of chronic kidney disease (CKD) is increasing rapidly coinciding with increases in the burden of diabetes and cardiovascular diseases globally.[3-6] Renal replacement therapy is necessary once a patient has progressed to CKD. Kidney transplants are the ideal choice for renal replacement; however, they are not widely available and accessible due to various reasons. Consequently, hemodialysis (HD) is often the modality of choice for the CKD patients and a widely used mode of RRT. For hemodialysis, a vascular access is required and it has to be created surgically. There are three types of vascular access which can be used for hemodialysis. They are central venous catheter (CVC), arteriovenous fistula (AVF) and arteriovenous graft (AVG). The ideal vascular access should provide adequate flow rates to sustain dialysis, be easy to access/cannulate, be cost-effective, and have excellent long-term patency and minimal complications.

The mean age of patients in our study was 42.14 years and among them 57% were males and 43% were females. This is comparable with the study of Gupta and colleagues where mean age was 43.9 years and 65.74%were males and 34.26% were females.[11]

Among the patients in this study, 13 (46.43%) were diabetic and 2 (7.14%) of them developed complications indicating presence of diabetic is not the risk factor for AVF complications here. Similarly, the complications were equal in males and females concluding gender is not a risk factor for fistula outcome. We had a single case of a 65 year patient in this study so we cannot comment on the influence of age on fistula outcome at present. Other studies show proportion of diabetes in the range of 16.6%-50% and concludes its presence and patient age do not affect the fistula outcome but shows better outcome in male gender.[11-13] This is similar to the outcome of the our study but the gender related outcome variation can be due to small sample size in the current study.

Hypertension was present in all patients in this study but whether it was cause or effect of CKD cannot be differentiated from this study and hence we are unable to comment on the effect of hypertension on AVF outcome. Hypertension was seen in 92% of cases and did not influence AVF outcome in the study of Venkat Ramanan and collegues.[13]

The selection of AVF reconstruction site was based on vascular diameter on color doppler and whether the patient had undergone any AVF reconstruction in the past or not. Patients in whom brachial site was used already were not eligible for RC-AVF because of loss of patency proximal to the fistula. Studies suggest that vascular diameter of <2mm are associated with high failure rate of AVF.[11,14] In this study, AVF reconstruction was considered only when vascular diameter was 2mm or more in doppler study. The mean diameter of RA and CV at wrist were 1.92 ± 0.56mm and 1.91 ± 0.20 mm respectively. Similarly, the mean diameter of BA and CV at elbow were 3.66 ± 0.87mm and 3.57 ± 0.55 mm respectively in this study. The mean artery and vein diameter was 2.4± 0.6mm each in the study of Gupta et al.[11] While mean artery and vein diameter was 3.3± 1.1mm each in the study of Oprea and colleagues. This difference can be due to differences in patient race.[15]

In this study, the fistulae reconstructed were RC-AVF- 50%, BC-AVF- 35.71% and BB-AVF-14.29% and all were end to side. This is comparable with the study of Oprea and colleagues where each type was 50.5%, 39.8% and 9.7% respectively.[15] Depending on the vessel size RC-AVF was preferred followed by the others which is in accordance with KDOQI (Kidney Disease Outcomes Quality Initiative) and Society of Vascular Surgery Guidelines.[16] After 3 months post procedure, 24 patients were receiving hemodialysis through their AVF indicating primary patency rate of 85.71%. The four cases (14.29%) who were complicated were unable to receive hemodialysis through their AVF at this time. In a systemic review, Kucey et al. found the primary patency rate of 60-70%.[17] While others report it about 83%.[11] This variation can be due to difference in the duration of follow up, the patency rate decreases with duration. In both studies, it was assessed at 1 year.

The complication rate in AVF creation varies from 21% to 33% depending on various factors.[11,17,18] In the current study, complication occurred in 14.29% of cases which is lesser than other studies. This can be due to less number of patients here and short duration of follow up.

CONCLUSION

Selection of type of AVF creation is influenced by the vessel diameter as well as previous fistula surgery status. The AVF access for hemodialysis has adequate patency with acceptable complications.

RECOMMENDATION

We recommend multicentric studies with a larger number of patients and longer duration of follow up to know the long term consequences and actual outcome of AVF reconstruction.

LIMITATION OF THE STUDY

This study is limited by being a single center with a lesser number of patients, procedures performed by a single Urologist and shorter duration of follow up.

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CONFLICT OF INTEREST

None, declared.

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REFERENCES

1. WHO. Non communicable diseases. [Internet] 2019 [cited 2019 March 11]; Factsheet]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
2. WHO. Noncommunicable diseases in the South-East Asia Region, situation and response, 2011: [cited 2019 April 12]; available from http://www.searo.who.int/nepal/mediacentre/ 2011_non_communicable_diseases_in_the_south_east_asia_region.pdf
3. Jha V, Wang AY-M, Wang H. The impact of CKD identification in large countries: the burden of illness. Nephrology Dialysis Transplantation. 2012;27(suppl 3):iii32-8. DOI: 10.1093/ndt/gfs113.
4. Nakamura K, Okamura T, Hayakawa T, Kadowaki T, Kita Y, Ohnishi H, et al. Chronic kidney disease is a risk factor for cardiovascular death in a community-based population in Japan. Circulation Journal. 2006;70(8):954-9. DOI: 10.1253/circj.70.954.
5. Ninomiya T, Kiyohara Y, Kubo M, Tanizaki Y, Doi Y, Okubo K, et al. Chronic kidney disease and cardiovascular disease in a general Japanese population: the Hisayama Study. Kidney international. 2005;68(1):228-36. DOI: 10.1111/j.1523-1755.2005.00397.x
6. Zhang QL, Rothenbacher D. Prevalence of chronic kidney disease in population-based studies: systematic review. BMC public health. 2008 Apr 11;8:117.DOI: https://doi.org/10.1186/1471-2458-8-117
7. Sharma SK, Dhakal S, Thapa L, Ghimire A, Tamrakar R, Chaudhary S, et al. Community-based screening for chronic kidney disease, hypertension and diabetes in Dharan. Journal of Nepal Medical Association. 2013;52(189):205-12. PMID: 23591297
8. J. H. M. Tordoir, P. Rooyens, R. Dammers, F. M. van der Sande, M. de Haan, and T. I. Yo, "Prospective evaluation of failure modes in auto genousradiocephalic wrist access for haemodialysis," Nephrology Dialysis Transplantation, vol. 18, no. 2, pp. 378–383, 2003. DOI: https:// doi.org/10.1093/ndt/18.2.378
9. P. Roy-Chaudhury, L. M. Spergel, A. Besarab, A. Asif, and P. Ravani, "Biology of arteriovenous fistula failure," Journal of Nephrology, vol. 20, no. 2, pp. 150–163, 2007. PMID: 17514619
10. M. K. Lazarides, G. S. Georgiadis, G. A. Antoniou, and D. N. Staramos, "A meta-analysis of dialysis access outcome in elderly patients," Journal of Vascular Surgery, vol. 45, no. 2, pp. 420–426, 2007. DOI: 10.1016/j.jvs.2006.10.035
11. Gupta A, Kumar V, Peswani A R, et al. (January 04, 2022) Outcomes of Arteriovenous Fistula Creation in Patients Undergoing Hemodialysis: An Indian Experience. Cureus 14(1): e20921. DOI:10.7759/cureus.20921
12. Allon M, Litovsky S, Young CJ, et al.: Medial fibrosis, vascular calcification, intimal hyperplasia, and arteriovenous fistula maturation. Am J Kidney Dis. 2011, 58:437-43. DOI: 10.1053/j.ajkd.2011.04.018
13. Venkat Ramanan, S., Prabhu, R.A., Rao, I.R. et al. Outcomes and predictors of failure of arteriovenous fistulae for hemodialysis. IntUrolNephrol 54, 185–192 (2022). https://doi.org/ 10.1007/s11255-021-02908-5
14. Allon M: Current management of vascular access. Clin J Am Soc Nephrol. 2007, 2:786-800. DOI:10.2215/CJN.00860207
15. Oprea A, Molnar A, Vlăduțiu D, Scridon T, Trifan C, Săcui D, Săsărman V, Mircea PA. Correlation between preoperative vein and artery diameters and arteriovenous fistula outcome in patients with end-stage renal disease. Clujul Med. 2018 Oct;91(4):399-407. DOI: 10.15386/cjmed-1080.
16. Sidawy AN, Spergel LM, Besarab A, Allon M, Jennings WC, Padberg FT, Jr, et al. The Society for Vascular Surgery: clinical practice guidelines for the surgical placement and maintenance of arteriovenous hemodialysis access. J Vasc Surg. 2008;48(5 Suppl):2S–25S. DOI: 10.1016/j.jvs.2008.08.042
17. Kucey AS, Engineer A, Albers SS. Outcomes of Patients Referred for Arteriovenous Fistula Construction: A Systematic Review. Int J Med Students. 2019 Sep-Dec;7(3):73-81.DOI 10.519
18. Salahi H, Fazelzadeh A, Mehdizadeh A, Razmkon A, Malek-Hosseini SA. Complications of arteriovenous fistula in dialysis patients. Transplant Proc. 2006;38:1261–1264. DOI: 10.1016/j.transproceed.2006.02.066