

Early Failure of Arteriovenous Fistula: Association with Mortality in Patients on Hemodialysis-A Retrospective Study at A Single Centre

Aandrei J Jha¹, Tushar Kumar², Sheil Avaneesh³, Ruchi Singh⁴, Madhav Kumar⁵, Abhishek Kumar⁶

¹Assistant Professor, Department of Cardiothoracic and Vascular Surgery
Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India.

²Assistant Professor, Department of Cardiothoracic and Vascular Surgery
Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India.

³Additional Professor and Head, Department of Cardiothoracic and Vascular Surgery,
Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India.

⁴Senior Resident, Department of Cardiothoracic and Vascular Surgery
Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India.

⁵Assistant Professor, Department of Cardiothoracic and Vascular Surgery, Indira
Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India.

⁶Senior Resident, Department of Microbiology, Anugrah Narayan Magadh Medical
College and Hospital, Gaya, Bihar, India, India

Received: 20-04-2021 / Revised: 11-05-2021 / Accepted: 29-06-2021

Corresponding author: Dr. Tushar Kumar

Conflict of interest: Nil

Abstract

Background: Arteriovenous fistula (AVF) has many post-operative complications. One of it is failure to mature, prone to early dysfunction which relates to poor outcome. Though it is not sure that whether early AVF failure is linked with death in CKD patients on hemodialysis.

Material and methods: A retrospective cohort study was performed using data of patients who underwent initial AVF surgery at our institution at IGIMS PATNA from April 2018-March 2020. Demographic, clinical, biochemical and AVF parameters were noted from the logbook records, and the association between these variables and mortality was analysed. The Inclusion criteria were 1. Patient aged between 20-60 years who underwent avf creation within given time period. 2. Only native avf creation patient was selected 3. Patient with brachiocephalic avf were selected. Exclusion criteria were Patient in whom av graft was done 2. Patient who was seriously ill 3. Patient with Radiocephalic avf. A total of 620 patients on hemodialysis (68% male) were included, and the median observation period was 2 years. Out of them 68 patients had failure of AVF. Out of which 48 had early failure within 8 weeks of avf creation. Out of 48, 42 died within a year of AVF creation but none had mortality linked or associated with AVF creation. The cause of mortality in most of them were linked to cardiovascular causes as evident from their death records. **Conclusion:** Mortality in CKD patient is an independent variable and does not relate with early failure of arterio-venous fistula, though it definitely raises the morbidity.

Keywords: A-V fistula, hemodialysis, A-V graft.

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Studies have suggested that arteriovenous fistula is the most suitable type of vascular access for hemodialysis[1-3]. Due to native tissue, fistulas have longer patency and lower rates of complications compared with arteriovenous grafts and catheters[4,5] but with the increasing proportion of elderly patients on hemodialysis, the rate of failure to mature has increased with a decrease in patency rates[6]. So, the choice and use of vascular access should be selected on the basis of each patient's and risks and benefits should be thoroughly analysed before the procedure. Moreover, complications related to vascular access should be considered carefully prior to the choice of vascular access type, informing the patient prior regarding type, risk, prognosis and fistula care to be taken postoperatively (creation, monitoring, and use). Fistula complications are associated with high morbidity and mortality, which adds to a high economic burden[7-10]. The predictors of overall mortality in CKD patients include older age, peripheral artery disease (PAD), cardiomegaly, higher white blood cell (WBC) count and calcium level, and lower total cholesterol level, while predictors of cardiovascular mortality included older age, coronary artery disease (CAD), PAD and lower hemoglobin level. Several earlier studies have concluded that patients with early AVF failure were associated with increased risk of overall mortality. Delivery of effective dialysis is of utmost importance for hemodialysis patients since vascular access dysfunction is associated with higher risk of mortality and morbidity[11,12] Clinical practice guidelines have recommended that native arteriovenous fistula (AVF) as the first-choice access to support hemodialysis owing to good long-term patency and a low incidence of complications[13,14].

However, the AVF has several disadvantages of higher early failure rate, which is usually caused by immaturity and thrombosis[14] and also several late complications. Several clinical factors have been identified as being associated with higher rate of early failure, eg. Presence of diabetes, advanced age, cardiovascular disease, high creatinine, coagulopathy [15-17]. These comorbidities and related risk factors are also common underlying causes of mortality in hemodialysis patients[18] in several studies and also our study showed this. Arterio-venous access (AVA) includes both AVF and arteriovenous graft (AVG). The main aim of this study was to investigate the association between the early failure of AVF and mortality in hemodialysis patients.

Materials and methods: The study was conducted in department of CTVS IGIMS PATNA Retrospective cohort data of patient operated from April 2018-March 2020 were analysed from logbook records and data tabulated. Demographic, clinical, biochemical and AVF parameters were noted from the logbook records, and the association between these variables and mortality was analysed. A total of 620 patients on hemodialysis (68% male) were included, and the median observation period was 2 years (April 2018- March 2020).

Inclusion criteria

1. Patient aged between 20-60 years of age who underwent AVF creation within given time period.
2. Only native AVF creation patient was selected.
3. Patient with brachiocephalic AVF were selected

Exclusion criteria

1. Patient in whom AV Graft was done.

2. Patient who was seriously ill.
3. Patient with RC AVF

Methods: Data were analysed, and observation were put with respect to vascular access, before vascular access placement, preoperative sonographic vascular mapping was performed in a large portion of our patients for the purpose to identify vessels suitable for access creation. Only patient who underwent BC -AVF were selected. Early AVF failure was defined as an AVF that never developed to the point that it could be used or failed within the first 8 weeks of usage after operation irrespective of the cause of failure. Data on mortality was collected from their death certificates and cause was noted whether due to cardiovascular, or other reasons. Death due to cardiovascular causes and AVF complication or due to renal failure were noted.

A total of 620 patients on hemodialysis (68% male) were included, and the median observation period was 2 years. Out of them 68 patients had failure of AVF (68 out of 620). Out of which 48 had early failure within 8 weeks of AVF creation. Out of 48, 42 died within a year of AVF creation but none had mortality linked or associated with AVF creation. The cause of mortality in most of them were linked to cardiovascular causes as evident from their death records (30 out of 42). Advanced age, Female sex, poor nutritional status, anemia, hypoproteinemia, high creatinine, low albumin presence of associated comorbidities had more failure rates. Most of causes of mortality were due to cardiovascular dysfunction 30 out of 42. In remaining 12 patient the death was due to unidentifiable causes as the patient were from very remote areas where death records could not be actually verified due to deficiency of document.

Results:

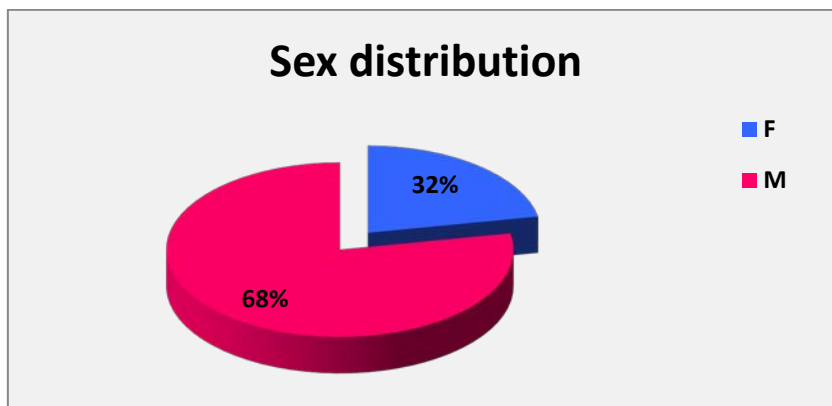


Figure 1: Sex distribution

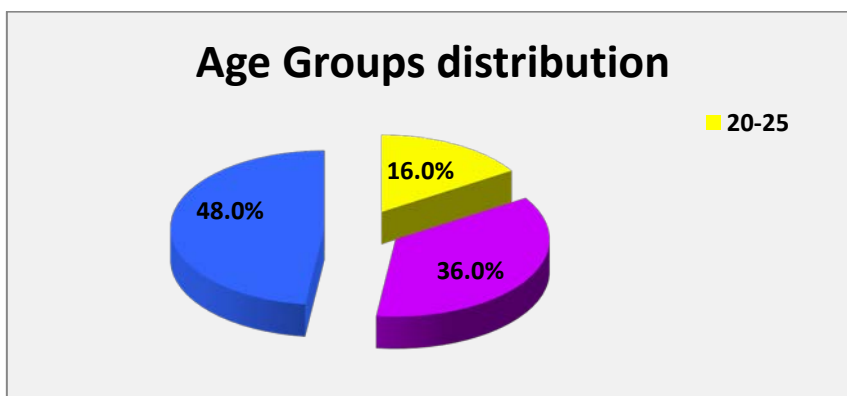


Figure 2: Age groups distribution

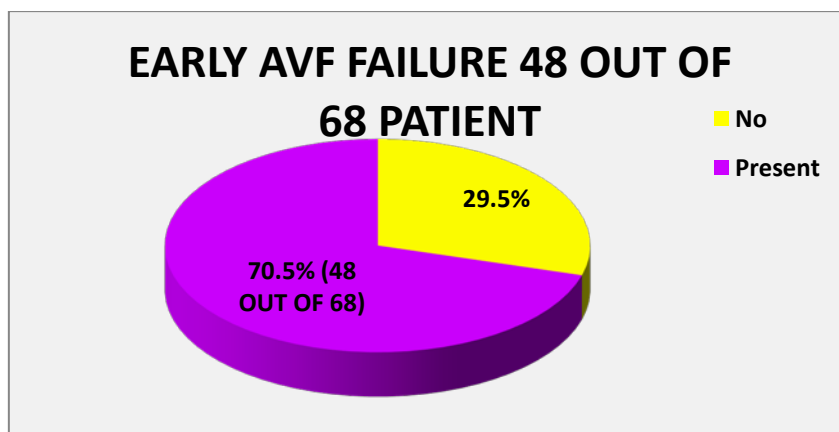


Figure 3: Early AVF failure 48 out of 68 patients

Table 1: Death due to cardiovascular cause (30 out of 42)

DEATH DUE TO CARDIOVASCULAR CAUSE	%
30 OUT OF 42	71.4%

Discussion:

Patients with early AVF failure were associated with a significantly higher risk of overall morbidity but not mortality. Although several studies have discussed the relationship between vascular access dysfunction and mortality, the present study suggested that the early fistula failure was not linked directly with mortality. This study indicated that older and female patients were prevalent in the group of early AVF failure, and this finding is consistent with a previous study, which established that elder age had an impact on early AVF failure probably owing to higher vascular stiffness. It is also postulated that smaller vessel diameters in female gender are responsible for the higher early AVF failure rate. Hormonal factors could also be recognized as another risk factor of early AVF failure based on prior investigation. Additionally, early AVF failure patients also showed higher prevalence of cardiovascular risk factors. Similar findings are also seen in prior studies, in which these risk factors directly influence AVF patency. Finally, a low serum albumin level was not only a marker of malnutrition but an inflammatory indicator as well and might also be related to vascular access stenosis.

Kuo et al. established that dialysis vascular

access dysfunction was significantly associated with an increased risk of major adverse cardiovascular events (MACE), and a significant exposure–response trend between the frequency of vascular access dysfunction and MACE was noted. Though the parameters in the study were based on diagnostic codes and several important variables such as vascular access type, laboratory data and medications were not included in analysis since these might affect access dysfunction and cardiovascular events[19].

Study by Wu et al. showed that early AVF failure was independently associated with a higher risk of mortality, and they showed that patients with intervention-free intervals of <3, 3–6, and 6–12 months had similar trends of lower survival. Similarly, the studied variables were dependent on diagnostic codes and the cause of death was not illustrated[20]. There are several possible explanations for the links between early AVF failure and overall mortality in hemodialysis patients. Firstly, various risk factors including cardiovascular disease, presence of diabetes, malnutrition, and inflammatory state have been reported to be both main causes of the AVF dysfunction and mortality in hemodialysis patients as well. These risk factors are commonly

observed in dialysis patients. Moreover, vascular disease in both arm and cardiac areas share common pathogenic mechanisms like atherosclerosis, arteriosclerosis and calcification. Based on previous findings, maturation failure of AVF might be related to combined impacts of neointimal hyperplasia and unfavorable remodeling majorly owing to preexisting calcified vessels. In fact, these vascular pathologic changes increase both AVF failure rate and mortality rate in hemodialysis patients. It was proposed that the pathophysiology underlying the development of AVF dysfunction is complicated and multifactorial. Patients on maintenance hemodialysis, the immune disorders, chronic inflammation and endotoxemia are prevalent, and these inflammatory and endotoxin factors not only exhibit bad effect on vascular endothelial cells through causing atherogenesis but could also lead to infection status; therefore, patients with AVF dysfunction and cardiovascular disease are also susceptible to infectious disease and other comorbidities, and these contribute to their mortality.

Earlier studies have showed that patients with older age, history of CAD, Peripheral arterial disease and cardiomegaly were associated with an increased risk of overall and/or cardiovascular mortality. Finally, anemia, hypoalbuminemia, high WBC count and corrected calcium level, which could lead to inflammation status, atherosclerotic vascular disease and infection-related complications, might also increase risk of death among hemodialysis populations.

In contrast to previous studies, our results indicated that early AVF failure was not a significant risk factor, as most of mortality in patient occurred due to cardiovascular dysfunction which could not be solely attributed to AVF dysfunction. There were several limitations of our study, it was a single centre study, the data was retrospective, and limited, a small no. of early dysfunction patients, most of patient were from rural background were the cause

of death remained unidentified due to death at home, moreover the CKD patient had several associated comorbidities and cardiovascular risk factors present. Moreover, majority of patient were from a very poor economic background where financial constraint had impingement on their treatment protocol directly.

Conclusion:

Mortality in CKD patient is an independent variable and does not relate with early failure of arterio-venous fistula. Though the dialysis of patient gets hampered, it does not solely contribute to mortality in CKD patients. These patients had several associated cardiovascular risk factors at time of presentation which affected both the patency of AVF adversely and also impacted the morbidity.

References:

1. Jindal K, Chan CT, Deziel C, Hirsch D, Soroka SD, Tonelli M et al. Canadian Society of Nephrology Committee for Clinical Practice Guidelines. 2006;17[Suppl 1]: S1–S27.
2. Vascular Access 2006 Work Group: Clinical practice guidelines for vascular access. Am J Kidney Dis.2006. [Suppl 1]: S176–S247.
3. Tordoir J, Canaud B, Haage P, Konner K, Basci A, Fouque D et al. EBPG on vascular access. Nephrol Dial Transplant .22[Suppl 2]: ii88–ii117.
4. Lok CE, Sontrop JM, Tomlinson G, Rajan D, Catral M, Oreopoulos G, et al. Cumulative patency of contemporary fistulas versus grafts. Clin J Am Soc Nephrol 8.2003: 810–818.
5. Huijbregts HJTT, Bots ML, Wittens CHAA, Schrama YC, Moll FL, et al. CIMINO study group: Hemodialysis arteriovenous fistula patency revisited Results of a prospective, multicenter initiative. Clin J Am Soc Nephrol.2008; 3: 714–719.
6. Al-Jaishi AA, Oliver MJ, Thomas SM, Lok CE, Zhang JC, Garg AX, Kosa

- SD, Quinn RR, Moist LM: Patency rates of the arteriovenous fistula for hemodialysis: A systematic review and meta-analysis. 2014. *Am J Kidney Dis* 63: 464–478.
7. Tonelli M, Klarenbach S, Jindal K, Manns B; Alberta Kidney Disease Network: Economic implications of screening strategies in arteriovenous fistulae. *Kidney Int.* 2006; 69: 2219–2226.
 8. Lee H, Manns B, Taub K, Ghali WA, Dean S, Johnson D, Donaldson C: Cost analysis of ongoing care of patients with end-stage renal disease: The impact of dialysis modality and dialysis access. *Am J Kidney Dis.* 2002; 40:611–622.
 9. Manns B, Tonelli M, Yilmaz S, Lee H, Laupland K, Klarenbach S, Radkevich V, Murphy B: Establishment and maintenance of vascular access in incident hemodialysis patients: A prospective cost analysis. 2005. *J Am Soc Nephrol* ;16: 201–209.
 10. Ravani P, Palmer SC, Oliver MJ, Quinn RR, MacRae JM, Tai DJ, Pannu NI, Thomas C, Hemmelgarn BR, Craig JC, Manns B, Tonelli M, Strippoli GFM, James MT: Associations between hemodialysis access type and clinical outcomes: A systematic review. *J Am Soc Nephrol.* 2013;24: 465–473.
 11. Feldman, H. I., Kobrin, S. & Wasserstein, A. Hemodialysis vascular access morbidity. *J. Am. Soc. Nephrol.* 1996;7(4), 523–535.
 12. Polkinghorne, K. R., McDonald, S. P., Atkins, R. C. & Kerr, P. G. Vascular access and all-cause mortality: A propensity score analysis. *J. Am. Soc. Nephrol.* 2004;15(2), 477–486.
 13. Vascular Access 2006 Work Group. Clinical practice guidelines for vascular access. *Am J Kidney Dis.* 2006; 48(Suppl 1): S176-247.
 14. Tordoir, J. et al. EBPG on vascular access. *Nephrol. Dial. Transpl.* 2007; 22(Suppl 2), ii88-117.
 15. Abreu, R. et al. Predictors of early failure and secondary patency in native arteriovenous fistulas for hemodialysis. *Int. Angiol.* 2018;37(4):310–314.
 16. Smith, G. E., Gohil, R. & Chetter, I. C. Factors affecting the patency of arteriovenous fistulas for dialysis access. *J. Vasc. Surg.* 2012; 55(3): 849–855.
 17. Hernandez, T. et al. Risk factors for early failure of native arteriovenous fistulas. *Nephron. Clin. Pract.* 2005;101(1): c39-44.
 18. Ma, L. & Zhao, S. Risk factors for mortality in patients undergoing hemodialysis: A systematic review and meta-analysis. *Int. J. Cardiol.* 2017;238:151–158.
 19. Wu, C. K. et al. Association of early loss of primary functional patency of arteriovenous access with mortality in incident hemodialysis patients. A nationwide population-based observational study. *Medicine (Baltimore).* 2018; 97: e11630.