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PATENCY RATE OF ARTERIO-VENOUS FISTULA AT WRIST AMONG DIABETIC AND NON-DIABETIC PATIENTS OF CKD-5

Arvind Mehra*, Saurabh Bawa, Sanjeev Gupta, Pamposh Raina and Pawan Kaundal

Department of Surgery, Department of Medicine, Department of Urology, Indira Gandhi Medical College, Shimla, Himachal Pradesh.

***Corresponding Author: Arvind Mehra**

Department of Surgery, Department of Medicine, Department of Urology, Indira Gandhi Medical College, Shimla, Himachal Pradesh.

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ABSTRACT

Background: Over the past three decades, diabetes mellitus is found to be most quickly spreading cause of chronic kidney disease (CKD) globally. Vessel diameter is an important predictor of patency of arterio-venous fistula (AVF) which found to alter in diabetes. **Objectives:** Considering the increasing role of diabetes mellitus as a cause of CKD and the challenges involved in constructing AVFs in certain groups of patients, the present study was to evaluated the patency rate of AVF among diabetic and non-diabetic patients of CKD-5. **Methodology:** Total 131 patients of CKD-5 who required AV-fistula formation were included in this study with 73 (55.7%) non-diabetic and 58 (44.3%) diabetic cases. Sociodemographic and clinical parameters were analyzed using a pre-designed semi-structured proforma. Patency rate of AVF was assessed at 3 and 6 months follow up. **Results:** The mean age of the patients was 51.69 ± 14.27 years in case of non-diabetic patients and was 54.53 ± 10.24 years in case of diabetic patients with majority of males in both groups. Among total 111 survived cases at 3 month follow up, AV fistula was patent in 97 (87.4%) cases among which 60 (61.9%) were non-diabetic and 37 (38.1%) was diabetic. Among total 97 survived cases at 6 months follow up, AV fistula was patent in 75 (77.3%) cases among which 49 (65.3%) were non-diabetic and 26 (34.7%) was diabetic. **Conclusion:** Present study revealed that AVF was more viable in non-diabetic patients compared to the diabetes. Diabetes thus found to be contributing factor in failure of AVF among patients with CKD-5.

KEYWORDS: Diabetes, CKD, AVF, Surgery, Patency.

INTRODUCTION

James Cimino and colleagues published the first surgical arteriovenous fistulas (AVF) for hemodialysis in 1966, and they are still the most common kind of vascular access for hemodialysis today.[1] In comparison to arteriovenous grafts and catheters, fistulas have longer patency and reduced rates of complications after they are established.[2,3] For individuals with chronic renal failure who will likely require hemodialysis, fistulas are employed. A vascular access type known as an autogenous arteriovenous fistula (AVF) involves a direct connection between an artery and a vein. Usually, this surgical treatment is done as an outpatient. It permits the vein's vein to carry arterial blood. This results in venous engorgement and expansion, providing sufficient blood flow for hemodialysis at a rate of 400–600 mL/min.[2]

There are numerous various ways to create an AVF, however we have mostly created fistulas in the hand and forearm regions without the use of an interposition or graft. Vascular surgery is for dialysis is required in patients with chronic renal disease.[4] An arteriovenous fistula frequently requires 2-3 months to develop or mature5 therefore it should be placed 6 months prior to anticipated dialysis. A silastic Teflon shunt was used for dialysis access with one end secured into radial artery and the other end into the cephalic vein at wrist and Teflon shunt remaining outside the skin for vascular access for dialysis, the problem with this procedure was infection and thrombosis. This problem was solved by surgically creating arteriovenous fistula between radial artery and cephalic vein at wrist by Brescia et al. In subsequent years various dialysis techniques were developed with the aim to remove toxic products from blood stream of various molecular size by more bio compatible membranes.[1]

The type of material used to create the vascular access (autologous or prosthetic), the location (distal, radiocephalic, or proximal, brachiocephalic and brachiobasilic), the age of the patient, smoking history, the use of a central venous catheter during the construction of the AVF, and the presence of comorbidities like metabolic syndrome and diabetes mellitus are some of the factors linked to AVF failures.[5] Diabetes and systemic arterial hypertension are the two chronic conditions that affect people with end stage kidney disease (ESKD) the most often worldwide. It

should be noted, nevertheless, that diabetes linked to ESKD has been rising in frequency within the Indian epidemiological profile, and if the trend keeps up, it will reach global prevalence rates in the next years.[6,7]

Over the past three decades, patient characteristics have altered, and diabetes mellitus is now the most quickly spreading cause of ESKD globally. The prevalence of diabetes has been rising across Asia as a result of recent Westernization of eating patterns. According to a recent comprehensive analysis, the sole predictor of a well-functioning AVF is vessel diameter since, when they are measured preoperatively, comorbidities like diabetes have already had an influence on the vessels. Although it is commonly known that diabetes is a chronic condition that worsens with time, there is debate about whether diabetes can predict the survival of atherosclerotic small and medium-sized arteries.[8]

Considering the increasing role of diabetes mellitus as a cause of ESKD in our country, and the challenges involved in constructing AVFs in certain groups of patients, the present study was designed. We evaluated the patency rate at 3 and 6 months among diabetic and non-diabetic patients with fistula formation at wrist.

METHODOLOGY

Study design: Present study was a prospective, observational, single centric, descriptive and hospital-based study conducted at the department of surgery at a tertiary care center of north India. Total 131 patients of CKD-5 who required AV-fistula formation were included in this study with 73 (55.7%) non-diabetic and 58 (44.3%) diabetic cases.

Data collection: A pre-designed semi-structured proforma was used for collecting information for the study. Sociodemographic and clinical parameters were analyzed using a pre-designed semi-structured proforma. Patients who were admitted in the surgery department were, followed up for determining the duration of hospital stay, complications and outcome. Patency rate of AVF was assessed at 3 and 6 months follow up.

Statistical analysis: The statistical analysis was carried out using SPSS 27.0. For quantitative variables, mean and standard deviation was used as measures of central tendency and variability respectively. For qualitative variable, fraction of total and percentages was calculated. Chi-square was used to compare two quantitative variables. A p value <0.05 was considered as statistically significant.

RESULTS

The mean age of the patients was 51.69 ± 14.27 years in case of non-diabetic patients and was 54.53 ± 10.24 years in case of diabetic patients. The mean age of the patients in diabetic group is significantly high compared to the non-diabetic group. Among all 131 patients, there were 42 (32.1%) were females and 89 (67.9%) were males. In the 73 non-diabetic patients, there were 26 (32.6%) were females and 47 (64.4%) were males. In the 58 diabetic patients, there were 16 (27.6%) were females and 42 (72.4%) were males. The mean duration of illness was 18.05 ± 18.11 months in cases of non-diabetic patients and was 24.46 ± 33.12 in cases of diabetic patients. Among all 131 patients, hypertension was present in 104 (79.4%) patients. Among 73 non-diabetic patients, the hypertension was present in 54 (74%) patients; and among 58 diabetic patients, hypertension was present in 50 (86.2%) patients. Among all 151 patients, smoking was present in 21 (16%) patients. Among 73 non-diabetic patients, the smoking was present in 10 (13.7%) patients; and among 58 diabetic patents, smoking was present in 11 (19%) patients (Table 1).

Table 1: Sociodemographic determinants of the patients.

Variable	Subgroup	Non-diabetic	Diabetic	p value
Age		51.69 ± 14.27 yrs	54.53 ± 10.24 yrs	0.003*
Gender	Female	26 (35.6%)	16 (27.6%)	0.328
	Male	47 (64.4%)	42 (72.4%)	
Duration of illness		18.05 18.11	24.46 33.12	0.123
Hypertension		54 (74.0%)	50 (86.2%)	0.086
Smoking		10 (13.7%)	11 (19.0%)	0.414

Among total 131 patients, mortality at 3 months was observed in 20 (15.3%) patients whereas rest of 111 (84.7%) patients were alive. In 20 mortality cases, 5 (25%) were non-diabetic and rest of 15 (75%) were diabetic. Among total 111 patients alive after 3 months follow up, mortality at 6 months was observed in 14 (12.6%) patients whereas rest of 97 (87.4%) patients were alive. In 14 mortality cases, 5 (35.7%) were non-diabetic and rest of 9 (64.3%) were diabetic (Table 2). The overall mortality at 3 months was observed in 20 cases among which 5 (25%) patients were non-diabetic and 15 (75%) patients were diabetic. At 6 months follow up, mortality was observed in 14 cases among which 5 (35.7%) were non-diabetic and 9 (64.3%) were diabetic. Over mortality was in 34 cases among which 10 (29.4%) were non-diabetic and 24 (70.6%) were diabetic.

Table 2: Mortality rate at 3 months and 6 months follow up.

Variable	Non-diabetic	Diabetic	Total	p value
3 Months	5 (25.0%)	15 (75.0%)	20 (58.8%)	0.499
6 Months	5 (35.7%)	9 (64.3%)	14 (41.18%)	0.036*
Total	10 (29.4%)	24 (70.6%)	34 (100%)	

Out of 131 patients 111 patients survived 3 months following AV fistula creation. Among total 111 survived cases, AV fistula was patent in 97 (87.4%) cases among which 60 (61.9%) were non-diabetic and 37 (38.1%) was diabetic. Out of 131 patients 97 patients survived 6 months following AV fistula creation. Among total 97 survived cases, AV fistula was patent in 75 (77.3%) cases among which 49 (65.3%) were non-diabetic and 26 (34.7%) was diabetic (Table 3).

Table 3: AVF patency rate at 3 months and 6 months follow up.

Variable	Non-diabetic	Diabetic	Total	p value
3 Months	60 (88.2%)	37 (86.0%)	97 (87.4%)	0.735
6 Months	49 (77.8%)	26 (76.5%)	75 (77.3%)	

DISCUSSION

The major reason for AVF failure, despite the fact that diabetes mellitus is typically considered to be a risk factor, is not the diabetic condition per se, but rather the poor quality of the vessels that are more frequently found in diabetic nephropathy. Preprocedural vascular assessment can significantly impact the success of AVF formation. The quality of the accessible veins and hemodynamic parameters, such as vein size, feeding artery size, feeding artery quality, and blood flow, are the most crucial determinants in the success of an AVF.[9]

Comparison of epidemiological data between groups with and without diabetes revealed that the mean of age of the diabetic patients was significantly higher in our study. Our findings were similar to the study conducted by Cruz et al. who reported the mean of 59.97 years for the diabetic patients and 52.54 years for non-diabetic patients.[5] In the study by Mortaz et al., mean age of the patients was 58.08 years.[10] In the Jeong et al., study, patients in the diabetic group were older than those in the non-diabetic group.[11] Other studies in the literature have shown similar results, identifying diabetes as the most common comorbidity among older patients receiving hemodialysis on AVFs.[12-14]

In our study, the patency at 3 months and 6 months was lower in case of diabetic patients compared to the non-diabetic patients. Similar observations have been reported by the Cruz et al. which revealed that patency at 24 months shows that there was a significant reduction in patency among the patients in the diabetic group, due greater number of vascular access occlusions observed from 12 to 24 months after creation of the AVFs in this group.[5] The fistula patency was maintained l00%, 92.64%, 89.48%, 84.38%, and 83.6l% from year 1 to 5, respectively in the study by Mortaz et al.[10] Jeong et al. reported that AVF patency rates were significantly lower in the diabetic group compared with the non-diabetic group.[11]

Sesso et al. studied 295 patients undergoing hemodialysis, of whom 7l patients were diabetic, who had less duration of fistula patency. After one year, they reported survival rate of 67% for diabetic patients.[15] Of the 106 patients studied by Tuka, 48 were diabetic. Higher wall shear rate in the feeding artery was reported with diabetes mellitus and distal vascular access creation. This could be of relevance in the pathogenesis of access complications and thus, lower patency rates in diabetic patients.[16] Resic et al. conducted a study on 40 patients undergoing hemodialysis, of whom 30%o were diabetic. Predictors of AVF malfunction in their study were age, diabetes, and being overweight, while other clinical and demographical factors did not influence AVF adequacy.[17]

Lin et al. and Murphy and Nicholson did not observe a significant difference in duration of vascular patency among diabetic and non-diabetic patients.[18,19] Diabetic patients exhibited poorer primary fistula patency than non-diabetics, according to a research by Arhuidese et al., although there was no discernible difference between primary aided and secondary patency.[20] Miller et al. discovered that the presence of diabetes did not affect the main or secondary graft patency in a single-center research involving 256 patients who received prosthetic grafts.[21] Fitzgerald et al. demonstrated that diabetic individuals' maturation durations for fistulas were longer than those of non-diabetics.[22] Dunn et al. also demonstrated that diabetics had considerably longer maturation durations for fistulas, although a multivariate analysis eliminated this link.[23]

Diabetes may have a deleterious impact on endothelial remodelling after the formation of an AVF, which might explain why there is less patency in diabetic cases. Juxta-anastomotic development is hampered, and early failure is more likely. Lower patency may be caused by intimal hyperplasia, atherosclerosis, and vascular calcifications.[20] In our study, significantly high mortality (24 cases or 18.32%) was observed in case of diabetic patients compared to the non-diabetic patients (10 cases or 7.63%). Similarly in the previous study by Jeong et al. patients in the diabetic group had a higher mortality rate as well as worse primary and secondary

AVF patency rates compared with patients in the non-diabetic group.[11]

This study had certain limitations, namely the limited sample size, which prevented generalised conclusions from being drawn. Another potential limiting element is the absence of institutionalised surgical therapy for the creation of AVFs, which results from the fact that these procedures were carried out by various professional teams throughout the years. Some of the variations in results compared to previous research may have been due to a number of important characteristics that were absent from our data sources, such as vessel diameter and vessel quality. Because a sizeable fraction of patients who got AVF placement at our tertiary medical facility also received hemodialysis by AVF within a specific time frame, other crucial criteria are also unavailable. They then got hemodialysis and were followed up at various hospitals when stability had been achieved. As a result, the data analysis strategy for this study did not cover infection-related and other outcomes.

CONCLUSION

After 3 months follow up mortality was observed in 20 cases and after six months follow up, mortality was observed in another 14 patients. Mortality observed at a high rate in case of diabetes patients. In cases who survived, the patency at 3 months and 6 months was found to be lower in case of diabetic patients compared to the non-diabetic patients. The overall AV fistula patency at 3 months was 87.4% at 6 months was 77.3%. Present study revealed that AVF was more viable in non-diabetic patients compared to the diabetes. Diabetes thus found to be contributing factor in failure of AVF among patients with CKD-5.

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