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CORRELATION OF SARCOPENIA WITH DIABETES IN CKD V PRE DIALYSIS

Dr. Hafiz Faisal Munir Qamar[1], Dr. Muhammad Mohsin Riaz[2]*, Dr. Mubashir Dilawar[3], Dr. Aqeel Ahmed[4], Dr. Nabiha Rizvi[5], Dr. Muhammad Asif[6], Dr. Hafiz Nauman Munir Saqib[7]

[1]Registrar Nephrology, Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan, Email: docfaisal73@gmail.com
[2]*Assistant Professor of Nephrology, Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan, Email: dr.m.mohsin@gmail.com
[3]Registrar Nephrology, Fatima Memorial Hospital, Lahore, Pakistan, Email: mubashirdilawar@hotmail.com
[4]Senior Registrar Nephrology, Gujranwala Medical College Teaching Hospital, Gujranwala, Pakistan, Email: aqeelahmad.2006@gmail.com
[5]Assistant Professor of Nephrology, Lahore Medical and Dental College Lahore, Pakistan, Email: rizvinabiha@gmail.com
[6]Senior Registrar Nephrology, DG Khan Medical College Dera Ghazi Khan, Pakistan, Email: dr.azee06@gmail.com
[7]Medical Officer of Nephrology, Evercare Hospital, Lahore, Pakistan, Email: numanh363@gmail.com

***Corresponding Author:** Dr. Muhammad Mohsin Riaz
*Email: dr.m.mohsin@gmail.com

Abstract

Introduction: Sarcopenia, which refers to the loss of both muscle mass and strength, is present among CKD stage V pre-dialysis patients, especially those with diabetes, and results in worse prognoses.

Objective: The purpose of the present study was also to determine the prevalence of sarcopenia and its relation to diabetes in CKD stage V pre-dialysis patients and the effect on muscular strength.

Materials and Method: This quasi-experimental study was conducted at Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan, from October, 2023 to March, 2024, and included 90 patients with CKD stage V with eGFR<15 ml/min/1.73m². The dynamometer assessed handgrip strength at baseline and before 3 months of the creation of arteriovenous fistula (AVF). Diabetes mellitus was diagnosed with the help of medical records.

Results: Mean handgrip strength also reduced from 21.00 ± 7.35 kg to 19.22 ± 7.92 kg post-AVF (p<0.001). Handgrip strength was significantly lower in diabetic patients than in non-diabetic patients, 18. 45 ± 7.61 kg for people with diabetes, while for non-diabetics, it was 20.07 ± 8.23 kg (p=0.042). Diabetic patients who exhibited handgrip strength of less than 20 kg was 68.1% while that of non-diabetic patients was 51.2% (p=0.039).

Conclusion: Diabetes was found to harm sarcopenia in pre-dialysis CKD stage V patients, and there is a need to develop interventions.

Keywords: Sarcopenia, Diabetes, CKD Stage V, Handgrip Strength, Arteriovenous Fistula.

INTRODUCTION

Sarcopenia is defined as the progressive loss of skeletal muscle mass and strength. It is observed in patients with CKD and is most prominent in pre-dialysis CKD stage V patients. This is compounded by the presence of metabolic acidosis, inflammation, and various other comorbidities, especially diabetes mellitus, which is common among patients with CKD. The interaction between sarcopenia and diabetes in CKD V pre-dialysis patients is significant because both are associated with poor clinical outcomes, which are characterized by a high morbidity level, mortality, and a diminished quality of life. Knowledge of this relationship can be critical in designing effective prevention and treatment strategies to address muscle wasting and improve the poor prognosis of such patients (1).

One of the pronounced effects of CKD, especially at later stages, is skeletal muscle injury. A prime factor is uremic conditions, such as acidosis, inflammation, and oxidative stress, which contribute to the rate of muscle proteins being broken down and delay muscular tissue repair. In CKD stage V pre-dialysis patients, the (eGFR) is less than 15 mL/min/1.73m², the kidney function is severely compromised and enhances these catabolic processes. In this context, sarcopenia is not only an outcome of kidney disease but also an indicator of poor prognosis and survival. Two, prior research revealed that 20–50% of CKD patients have sarcopenia, and this depends on the age and the presence of extra-renal complications such as diabetes(2). Employing the material of the Screening for Chronic Kidney Disease among Older People across Europe (SCOPE), it is crucial to emphasize that diabetes is considered to be one of the factors that contribute to sarcopenia in elderly CKD patients, prompting the demand for additional investigations of this relationship in pre-dialysis settings (1).

Diabetes mellitus, which is a notable cause of CKD, also affects muscle health through influences like insulin resistance, high blood sugar levels, and chronic inflammation, among others. These factors impair muscle formation by inhibiting protein synthesis and enhancing the breaking down of muscle tissues. A recent study has revealed that in CKD V patients on predialysis, diabetes is related to higher levels of sarcopenia, particularly in males and the older population (3). This shows that diabetes and CKD have synergistic interactions that make metabolic dysfunction worse due to muscle loss, with a resultant poor prognosis. For example, sarcopenic obesity, characterized by low muscle mass and high adiposity, has been established to be contributing to mortality and disease progression among Pre-dialysis CKD patients, especially those with Diabetes (4).

The increased risk of sarcopenia is evident in the non-dialysis CKD population due to many factors, such as age, nutritional status, and lack of exercise. According to previous research, up to 37% of pre-dialysis CKD patients suffer from sarcopenia, and this risk is further heightened by diabetes (5). Cachexia is common in CKD, especially in diabetic patients with changes in the extracellular to intracellular water ratio, which contributed to muscle dysfunction and sarcopenia in those patients nearest to maintaining dialysis (6). Additionally, meta-analyses have identified muscle wasting as being associated with poor prognosis in patients with CKD, including more frequent hospitalizations and reduced survival, further emphasizing the need for early identification and intervention (7).

Protein intake is one of the most crucial factors that should be taken into consideration in the context of sarcopenia in predialysis CKD patients with diabetes. Even though integrated protein consumption translates to minimizing the progression of CKD, protein restriction brings about muscle wasting, mainly in sarcopenic patients. Several studies indicate that it is possible to slow down the development of sarcopenia by having a well-proportioned protein diet, which should be adjusted according to the patient's need, but it should not harm the kidney's health, especially for patients with diabetes (8). These percentages are even higher in dialysis patients, and a study conducted in Australia revealed a 40-50% prevalence of sarcopenia in maintenance dialysis patients, whereby diabetes is a contributing factor. Despite these results being from dialysis cohorts, they can offer the prediction of a decline in muscle health in the data derived only from predialysis CKD V patients with diabetes.

As an essential marker of muscle performance, handgrip strength is decreased in CKD and is directly related to sarcopenia. The low handgrip is related to metabolic abnormalities in CKD V pre-dialysis patients, such as hyponatremia, which is more prevalent in people with diabetes due to impaired sodium metabolism (10). Skeletal muscle depletion in the elderly dialysis patient correlates well with mortality rates and is therefore likely applicable to pre-dialysis staging, particularly of diabetics (11).

Moreover, phase angle, a bioimpedance assessment of muscle mass quality, is decreased in sarcopenic CKD patients, and diabetes affects this parameter (12).

The diagnosis and mortality risk of sarcopenia in dialysis patients have been primarily described, and systematic reviews reported that the risk of death for sarcopenic patients is 1.5-2 times higher. This is particularly relevant to pre-dialysis patients with CKD V, as the loss of muscle mass in these patients tends not only to continue but may even increase upon beginning dialysis (13). Diabetes, together with age and dialysis modality, has been found to affect muscle strength and functional capacities in CKD patients, where differential analysis revealed that diabetic hemodialysis patients were more likely to suffer sarcopenia compared to non-diabetic (14). Specifically, late-stage CKD has been independently associated with sarcopenia, and this indicates that the disease burden of renal dysfunction accelerates the development and progression of muscle atrophy, and the condition is worsened by diabetes (15).

Finally, it is known that there is a correlation between sarcopenia and diabetes in CKD V pre-dialysis patients due to metabolic, inflammatory, and nutritional changes. This kind of study in a population with a high risk of sarcopenia due to the presence of diabetes highlights the need for specific and compelling screening and intervention plans. These findings suggest that managing muscle disease in the early stages of predialysis, especially among diabetic patients, may enhance favorable clinical results as well as the patient's quality of life.

Objective: To assess the relation of arteriovenous fistula placement to handgrip strength in patients undergoing CKD, where measurement was taken before and 3 months after the procedure.

MATERIALS AND METHODS

Design: Quasi-experimental study.

Study setting: The study was conducted at Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan.

Duration: The study was conducted from October, 2023 to March, 2024.

Inclusion Criteria:

The patients included both male and female, between the ages of 20 to 60 years with CKD - 5 / CKD-5D, GFR ≤ 15 ml/min/1.73 m², receiving hemodialysis through an AVF.

Exclusion Criteria

Patients with upper extremity malformations, neurological or muscular disorders, ejection fraction <35%, inflammatory arthritis, previous upper extremity surgery, or peripheral vascular disease were excluded.

Methods

This quasi-experimental investigation was done on 90 patients of CKD stage V (eGFR < 15 ml/min/1.73 m²) after taking their consent and their demographical profile. Regarding Ethical considerations, the study maintained the anonymity of the respondents and did not engender any health risk among the samples. Sarcopenia was estimated by handgrip strength using a hand-held dynamometer. Individuals were placed on a chair with the backrest and shoulders pulled toward the sides, elbows at 90 degrees, and forearms horizontal. The output force was measured three times, and the mean was calculated and recorded in kilogram-force (kg-f). Handgrip strength was measured at baseline and three months post-AVF creation, regardless of patients' dialysis status. Diabetes type was ascertained from the patient's medical records. Participant data were collected with the help of a specially constructed proforma by the researcher. Quantitative data were analyzed by IBM SPSS statistics version 26, t-tests for pre-AVF and post-AVF handgrip strength $p \leq 0.05$ was taken as significant.

RESULTS

In this quasi-experimental study, 90 patients of CKD stage V were included to determine the association between sarcopenia and diabetes with handgrip strength as the main index. The characteristics of the patient cohort are summarised in Table 1. The patients' mean age was 45.41 ± 10.93 years, with an age range of 20 to 60 years. About 64.44% (58 males) of the participants were male, while 35.56% (32) were female, thus a 1.8: 1 male-to-female ratio. Diabetes was present in 52.2% of the patients, with 47 patients, while hypertension was observed in 93.3% of the patients, or 84 patients. In the placement of AVF, the left arm was chosen in 95.56% of the cases, while the right arm was only used in 4.44% of the cases. Of them, 81.1% (n=73) had undergone hemodialysis, which has been in progress at a mean of 2.68 ± 2.93 years (0.08-12 years).

Table 1: Demographic Characteristics of Study Participants

Variable	Value
Mean Age (years)	45.41 ± 10.93
Age Range (years)	20–60
Gender (Male/Female)	58 (64.44%) / 32 (35.56%)
Male:Female Ratio	1.8:1
Diabetes Mellitus	47 (52.2%)
Hypertension	84 (93.3%)
AVF Arm (Left/Right)	86 (95.56%) / 4 (4.44%)
Hemodialysis Initiated	73 (81.1%)
Mean Duration of Hemodialysis (years)	2.68 ± 2.93

Results of the handgrip strength tested before and after the creation of AVF are presented in Table 2. The average handgrip strength before avatar creation was recorded at 21.00 ± 7.35 kg in the 10 – 50 kg range, which was reduced to 19.22 ± 7.92 kilograms with a variation between 8-50 kg after receiving avatars. This was roughly significant on the $p<0.001$ level, which proves that muscle strength drops considerably after the creation of AVF.

Table 2: Handgrip Strength Before and After AVF Placement

Measurement Time Point	Mean ± SD (kg)	Range (kg)	p-value
Before AVF Placement	21.00 ± 7.35	10–50	
After AVF Placement	19.22 ± 7.92	8–50	<0.001

Details on the relationship between diabetes and sarcopenia based on handgrip strength are presented in Table 3. The mean score of handgrip strength after AVF creation in diabetic patients was 18.45 ± 7.61 kg, while it was 20.07 ± 8.23 kg in non-diabetic patients. This difference was statistically significant on st ($p= 0.042$), which supports the fact that sarcopenia is worse in the CKD V population of diabetics than in the rest. Furthermore, diabetics had a lower proportion of handgrip strength of less than 20 kg 6 months after AVF creation (68.1% vs 51.2% of non-diabetics/$p>0.039$).

Table 3: Handgrip Strength Post-AVF by Diabetes Status

Variable	Diabetic (n=47)	Non-Diabetic (n=43)	p-value
Mean Handgrip Strength Post-AVF (kg)	18.45 ± 7.61	20.07 ± 8.23	0.042
Patients with Handgrip <20 kg (%)	32 (68.1%)	22 (51.2%)	0.039

These results indicate the decline in handgrip strength after AVF placement, while diabetes plays a vital role in exacerbating muscle wasting in CKD V pre-dialysis participants. Their high prevalence in this cohort thus contributes to muscle dysfunction among elderly clients.

DISCUSSION

The quasi-experimental research study conducted at the Department of Nephrology, Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan, offers significant results about the relationship between sarcopenia and diabetes in CKD stage V pre-dialysis patients where handgrip strength measures muscle function. The decline in mean handgrip strength after the creation of AVF from 21.00 ± 7.35 to 19.22 ± 7.92 kg, p-value < 0.001, suggests that the creation of new AVF affects upper limb muscle strength, which appears to worsen much more in diabetic patients. This finding is consistent with prior evidence suggesting that sarcopenia is a common and progressive complication in patients with CKD, especially those with diabetes, which accelerates the reduction of muscle mass and functional impairment. The SCOPE study pointed out that reduced muscle mass and physical function, which is defined as sarcopenia, are more common in elderly CKD patients with diabetes and also found these manifestations in a younger population (mean age 45.41 ± 10.93 years), further indicating that diabetes-related muscle impairments are not limited to elderly individuals (1).

Sarcopenia in CKD stage V is caused by factors such as uremic toxins, metabolic acidosis, and chronic inflammation that worsen due to diabetes. The urea accelerates the degradation of the muscle proteins while reducing their synthesis, which results in the loss of muscle bulk and power. Diabetes elevates the rate of this process through insulin insensitivity, high blood glucose levels, and increased radical formation, which together enhance the degradation of muscle proteins and slow down the process of muscle repair (2). Diabetic patients tested lower handgrip strength post-AVF at 18.45±7.61kg based on the analysis as opposed to the 20.07 ±8.23 kilograms of a non-diabetic patient. This fact supports the observation that diabetes worsens sarcopenia in the CKD population (3). This is in parallel with the study carried out by Huang et al., where male sex and aging were found to be the independent risk factors of sarcopenia in pre-dialysis CKD patients, with diabetes being the prominent cause. Similarly, diabetics had a higher proportion of significant handgrip strength (<20 kg) than non-diabetics (68.1% vs. 51.2%, p=0.039) Wilcoxon test showing that diabetes together with CKD contributes to muscle dysfunction.

Although an AVF is crucial in preparing for hemodialysis, creating this fistula poses several problems in maintaining muscles. Manipulation of the flow through a fistula may cause steal syndromes, which are characterized by a decrease in blood flow to distal tissues and subsequent pain, numbness, and weakness. These might partly explain the decline in handgrip strength identified in this study (4). Using the sample of diabetic CKD patients, which is also characterized by sarcopenic obesity, Oliveira et al. pointed out that deficiency in muscle strength appeared to affect not only mortality but also several other aspects of patients' condition (4). In the present study, diabetes was found to be as high as 52.2 percent, and hypertension at 93.3 percent may have worsened the vascular and muscular disorders because both complications are associated with endothelial dysfunction and reduced muscle perfusion. Indeed, the fact that 95.56% of patients had left arm AVF may mean they avoided usage of this arm over time, leading to muscle atrophy as reported in other studies (6).

Sarcopenia in patients with CKD is not only associated with poor physical function but also with hospitalization, quality of life, and mortality. A systematic review by Ribeiro et al. found that sarcopenia in CKD patients is associated with a 1.5-2-fold increase in mortality rate and is of interest in our patients with pre-dialysis CKD, where diabetes exacerbates muscle dysfunction(7). Protein intake is one of the essential factors that should be considered while dealing with sarcopenia and nutritional management. Isaka also pointed out that pre-dialysis CKD patients should consume appropriate levels of protein to avoid muscle wasting and a decline in kidney function, which sometimes could be hard in diabetic patients since they have different metabolisms (8). Thus, our study indicates that diabetic CKD patients might need nutrition and exercise interventions to affect sarcopenia, as indicated by several studies performed on dialysis patients, of which diabetes was considered a key cause of muscle loss (9).

The efficacy of handgrip strength as a noun surrogate for sarcopenia is a cheap and viable tool in the clinical setting. The study of Markaki et al. showed that the reduced handgrip strength in CKD stage 5D patients could be caused by metabolic acidosis such as hyponatremia since it is more common in diabetic patients because of aldosterone dysfunction (10). This concurs with our earlier observation that patients with Diabetes had a higher reduction in muscle strength after AVF. Sarcopenia in elderly HD patients is an independent predictor of poor prognosis. Thus, a similar trend might be expected for patients in earlier stages of CKD, especially those with Diabetes (11). As highlighted by Do et al., phase angle might be used alongside handgrip strength to better evaluate muscle quality and severity of sarcopenia in the diabetic CKD population (12).

This was evident from the study conducted by Shu et al., who established that sarcopenia affected more than 70% of dialysis patients and was associated with a 1.5 to 2-fold increase in mortality rate, thus emphasizing the need to address the issue during the pre-dialysis stage. This finding was inappropriate since 81.1% of the patients in the study had already commenced with hemodialysis, which depicted an escalation of muscle wastage from pre-dialysis to the dialysis stage. Diabetes is one of the well-known risk factors for muscle strength loss, in addition to age and dialysis modality, as observed by Silva et al., where diabetic dialysis patients showed worse physical function (14). For instance, An et al. stated that proteinuria and late-stage CKD are independent predictors of sarcopenia, pointing to the fact that dysfunction of the kidneys alone leads to the loss of muscle mass, which is worsened by diabetes(15). Given the statistically significant decrease in handgrip strength after AVF creation in the current study, it may be essential to establish hand exercise programs to enhance AVF maturation and muscular power among CKD patients (6).

Lastly, there is a correlation between sarcopenia and diabetes in CKD stage V pre-dialysis patients, outlined by a marked decline in muscle strength following AVF placement due to diabetes. These results underline the medical necessity for nutritional intervention, exercise routines, and muscle function monitoring in elderly patients at a higher risk of sarcopenia to avert this devastating condition's consequences. Further studies should examine the long-term effects of sarcopenia and the effectiveness of specific interventions for patients with diabetic CKD.

CONCLUSION

This study also shows a correlation between sarcopenia and diabetes amongst CKD stage V pre-dialysis patients with diabetes having a more reduced number of muscle strength following arteriovenous fistula (AVF) placement (18.45 ± 7.61 kg post-AVF placement in people with diabetes compared to 20.07 ± 8.23 in non-diabetics, p=<|human|>This paper also reveals the correlation between sarcopenia and diabetes in CKD stage V pre-dialysis patients that muscle strength is further affected in patients with diabetes by AVF placement, (18.45 ± The reduced muscle power from a mean of 21.00 ± 7.35kg to 19.22± 7.92 kg, p-value < 0.001 indicates that the creation of the AVF affected muscle performances, especially in diabetic patients where patient strength was found to be reduced to a greater extent 68.1% compared to 51.2%, p-value 0.039. These observations underscore the importance of effective identification of the disease and dietary and exercise recommendations for hand patients at risk of developing sarcopenia. Understanding and managing muscle-related complications in diabetic patients with CKD can enhance functional capacity and the quality of life of patients with CKD, underlining the critical role of interdisciplinary management of these patients even before they progress to dialysis.

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