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Predictors of Clinical Outcome after Percutaneous Coronary Intervention in Hemodialysis Patients with Acute Myocardial Ischemia Syndrome

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ABSTRACT

Introduction: Acute myocardial ischemia syndrome (AMIS), encompassing conditions such as unstable angina and acute myocardial infarction, is a major global health concern due to its significant morbidity and mortality rates. **Objective:** The main objective of the study is to find the predictors of clinical outcomes after percutaneous coronary intervention in hemodialysis patients with acute myocardial ischemia syndrome. **Methodology:** This retrospective cohort study was conducted at Army Cardiac Hospital Lahore from June 2023 to June 2024. Data were collected from 178 patients. Data were extracted from electronic health records, capturing comprehensive patient information across multiple domains. **Results:** The study analyzed data from 178 hemodialysis patients with mean age of 58.91 ± 8.02 years, with a gender distribution of 60% males and 40% females. Comorbid conditions were prevalent, with 65% having diabetes mellitus and 85% hypertension. Smoking was reported by 25% of individuals, and 40% had a history of myocardial infarction (MI) or revascularization. Laboratory parameters indicated anemia (mean hemoglobin: 10.2 ± 1.5 g/dL), low albumin levels (3.2 ± 0.5 g/dL), and systemic inflammation, as 70% had elevated CRP levels. **Conclusion:** It is concluded that hemodialysis patients undergoing PCI for acute myocardial ischemia syndrome face significant risks influenced by nutritional status, systemic inflammation, and comorbidities such as diabetes and cardiogenic shock.

INTRODUCTION

Acute myocardial ischemia syndrome (AMIS), encompassing conditions such as unstable angina and acute myocardial infarction, is a major global health concern due to its significant morbidity and mortality rates. PCI has remained a key intervention in managing AMIS because it allows timely revascularization leading to better survival rates. However, its application in patients with ESRD on hemodialysis has some limitations because this group of patients has some specific features from the clinical and pathophysiological points of view [1]. Such patients present enormous cardiovascular challenges owing to inflammation, calcification, and other complications and thus tend to have multifactorial and unpredictable risks. Patients with hemodialysis are at higher risk for

adverse outcomes post PCI, their in-hospital mortality, recurrent ischemic event rate, and long-term cardiovascular event rate exceed that of the general population [2]. This is mainly due to both advanced CKD and its comorbid complication of dialysis which increases the CAD risk and its management risks. For instance, uremic toxins, chronic volume overload, and disturbances in calcium-phosphate metabolism in ESRD result in widespread endothelial dysfunction cochlear to both the technical aspects of the PCI and post-procedure recovery process [3].

Many clinical, procedural, and patient characteristics affect the outcomes of PCI in hemodialysis patients. The study of these predictors is essential to better refine risk assessment, develop appropriate patient management, and ultimately, extend the value of patient-centered outcomes [4]. This is because while PCI interventions have progressed to include even high-risk groups, the use of interventional techniques and adjunctive pharmacotherapies in hemodialysis patients requires a delicate balance between therapeutic gain and risk. The major clinical factors affecting prognosis in patients on HD undergoing PCI for AMIS include nutritional status, sarcopenia, and RRF [5]. They found that factors such as malnutrition, and muscle wasting that are prevalent in dialysis patients increased the risk to the overall scaled acute Kidney Injured (AKI)/chronic Kidney Disease (CKD) population, the risk of worse post-PCI outcomes and poorer recovery are secondary to systemic inflammation, reduced physiological reserve. In the same way, residual renal function is another significant factor – less function defined as worse function is associated with higher rates of AKI, as well as higher mortality rates [6].

Outcomes with regards to this is by several aspects including; the presence of cardiogenic shock, diabetes mellitus, and proxy for access site during percutaneous coronary intervention. Cardiogenic shock is linked with increased procedural complications and a poorer in-hospital prognosis in hemodialysis patients because of hemodynamic instability and profound cardiac disease that undermines PCI [7]. Another common condition in these patients is diabetes mellitus, which independently and synergistically with other antecedents intensifies endothelial damage and progression of CAD with additional adverse consequences [8]. In addition, device-specific options including femoral vs radial access have been proven to influence the complication profile as well as the success profiles in hemodialysis patients, having such choices as an important part of treatment planning [9]. Despite these challenges, PCI should continue to be embraced and sometimes is even necessary for hemodialysis patients with AMIS. Adding pre-procedural risk assessments like risk-scoring systems and biomarkers to the decision-making process might improve patient sampling and procedural results. However, patient care by nephr ologists cardiologists, and interventional procedures must embrace a holistic approach [10].

OBJECTIVE

The main objective of the study is to find the predictors of clinical outcome after percutaneous coronary intervention in hemodialysis patients with acute myocardial ischemia syndrome.

METHODOLOGY

This retrospective cohort study was conducted at Army Cardiac Hospital Lahore from June 2023 to June 2024. Data were collected from 178 patients.

Inclusion Criteria

1. Age >18 years.
2. Diagnosed with AMIS based on clinical presentation, electrocardiographic findings, and cardiac biomarkers.
3. Maintenance hemodialysis for end-stage renal disease.
4. Underwent PCI during hospitalization.

Exclusion Criteria

1. Patients not on hemodialysis.
2. Those with incomplete clinical data.
3. Patients who underwent surgical revascularization instead of PCI.

Data Collection

Data were extracted from electronic health records, capturing comprehensive patient information across multiple domains. Demographic and clinical characteristics, including age, gender, history of diabetes, hypertension, smoking status, and previous cardiovascular events, were recorded to establish baseline profiles. Laboratory findings such as pre-procedural levels of hemoglobin,

serum albumin, cardiac biomarkers (troponin and creatine kinase-MB), and inflammatory markers like C-reactive protein (CRP) were analyzed to assess patients' physiological and inflammatory status. Metadata reflected patient's nutrient and functional status parameters such as BMI, sarcopenia, comorbidity rates, and malnutrition determined from various objective nutritional assessment scores that imply patients' general health and prognosis for recuperation. These data described procedural aspects of the PCI intervention, including vascular access site; type of the stents used, bare-metal or drug-eluting; Acute kidney injury (AKI) during the intervention as well as access complication. Outcome measures in the follow-up period were recorded with vigour, with emphasis on short-term and long-term measures. These were: in-hospital mortality, the 30-day MACE and the longer-term results – ischemic reoccurrence, restenosis, and one-year survival. This kind of detailed data appropriately supported identification of predictor variables for clinical prognosis in diversified patients after acute myocardial ischemia syndrome treated with hemodialysis and percutaneous coronary intervention. The major endpoints were short term mortality and major adverse cardiovascular events (MACE): CG defined as death, myocardial infarction and repeat revascularization. Secondary end points were procedural successful rates, AKI, and 6-months survival.

Statistical Analysis

Data were analyzed using SPSS v26. Descriptive statistics were used to summarize baseline characteristics and procedural data. Continuous variables were expressed as means ± standard deviation (SD) or medians with interquartile ranges (IQR) as appropriate. Categorical variables were presented as frequencies and percentages.

RESULTS

The study analyzed data from 178 hemodialysis patients with mean age of 58.91 ± 8.02 years, with a gender distribution of 60% males and 40% females. Comorbid conditions were prevalent, with 65% having diabetes mellitus and 85% hypertension. Smoking was reported by 25% of individuals, and 40% had a history of myocardial infarction (MI) or revascularization. Laboratory parameters indicated anemia (mean hemoglobin: 10.2 ± 1.5 g/dL), low albumin levels (3.2 ± 0.5 g/dL), and systemic inflammation, as 70% had elevated CRP levels.

Table 1

Demographics and Clinical Characteristics

Characteristics	Values
Age (years)	58.91 ± 8.02
Gender (Male/Female)	60% / 40%
Diabetes Mellitus (%)	65%
Hypertension (%)	85%
Smoking (%)	25%
History of MI or Revascularization (%)	40%
Laboratory Parameters	Values
Hemoglobin (g/dL)	10.2 ± 1.5
Albumin (g/dL)	3.2 ± 0.5
CRP Elevated (%)	70%

The procedural factors revealed that the radial access site was predominantly used in 70% of cases, while the femoral site was employed in 30%. Drug-eluting stents were utilized in 75% of procedures, compared to 25% using bare-metal stents. Acute kidney injury occurred in 20% of the population, highlighting a notable procedural complication.

Table 2

Procedural Data

Procedural Factors	Values
Access Site (Radial/Femoral)	70% / 30%
Drug-Eluting Stents (%)	75%
Bare-Metal Stents (%)	25%
Acute Kidney Injury (%)	20%

The outcomes revealed an in-hospital mortality rate of 15% and a 30-day incidence of major adverse cardiac events (MACE) at 35%. Recurrent myocardial infarction (MI) was observed in 10% of cases, while repeat revascularization occurred in 5%. The 1-year survival rate was 65%, with 25% experiencing recurrent ischemia and 15% developing restenosis, indicating significant long-term challenges post-procedure.

Table 3

Outcomes in patients

Outcomes	Values
In-Hospital Mortality (%)	15%
MACE at 30 Days (%)	35%
Recurrent MI (%)	10%
Repeat Revascularization (%)	5%
1-Year Survival Rate (%)	65%
Recurrent Ischemia (%)	25%
Restenosis (%)	15%

Malnutrition was associated with a 2.5-fold increased risk (OR 2.5, 95% CI 1.5–4.2, p=0.01), while elevated CRP levels showed a 1.8-fold risk

increase (OR 1.8, 95% CI 1.2–2.8, p=0.03). Cardiogenic shock was the strongest predictor, with a 3.2-fold increased risk (OR 3.2, 95% CI 1.8–5.5, p<0.001). Diabetes mellitus (OR 2.1, 95% CI 1.4–3.1, p=0.02) and sarcopenia (OR 2.0, 95% CI 1.2–3.5, p=0.04) were also significant, highlighting the importance of addressing these factors in clinical management.

Table 4

Predictors of Adverse Outcomes

Predictors	Odds Ratios (95% CI)	p-Value
Malnutrition	2.5 (1.5–4.2)	0.01
Elevated CRP Levels	1.8 (1.2–2.8)	0.03
Cardiogenic Shock	3.2 (1.8–5.5)	<0.001
Diabetes Mellitus	2.1 (1.4–3.1)	0.02
Sarcopenia	2.0 (1.2–3.5)	0.04

The follow-up metrics at six months showed a survival rate of 65%, indicating moderate long-term outcomes post-procedure. Recurrent ischemia was reported in 25% of patients, while restenosis occurred in 15%, reflecting ongoing risks of adverse cardiovascular events in a significant portion of the population.

Table 5

Follow-Up Data

Follow-Up Metrics	Values
6-months Survival (%)	65%
Recurrent Ischemia (%)	25%
Restenosis (%)	15%

DISCUSSION

This study highlights key predictors of clinical outcomes in hemodialysis patients undergoing percutaneous coronary intervention (PCI) for acute myocardial ischemia syndrome (AMIS). The results stress the increased risk for this population because of its clinical conditions that include inflammation, malnutrition, and other diseases. The findings offer important information regarding antecedents to procedural success, in-hospital efficacy and survival, and centralised management that is needed to enhance outcomes amongst this high-risk population [11]. The significant independent predictors of the adverse outcomes for each respective, endpoint, included undernutrition, and elevated CRP levels. Such outcomes can be explained by the data proved in prior studies which indicated that systemic inflammation and poor nutritional state were related to the deterioration of cardiovascular outcomes in dialysis patients. Malnutrition and sarcopenia bring preclinical capacities to deal with acute events and develop complications [12]. These findings strengthen the case for routine screening and subsequent nutrition counseling and, dietary optimization and supplementation in pre and post-PCI hemodialysis patients. Of the procedural variables tested, the access site and the type of stent employed during PCI were shown to be significant. Compared to femoral access, radial access was less likely to incite complications such as vascular injuries and acute kidney injury (AKI) [13]. The present study also emphasizes the need to follow the radial access in patients on hemodialysis as much as possible because it has been found to decrease the risk of having complications during the procedure. The prescription of drug-eluting stents to 75% of the patients also tends to the current evidence on the efficiency of DES over bare metal stents, especially in high-risk patients, due to reduced rates of restenosis. After the patient data preprocessing, diabetes mellitus and cardiogenic shock were differentiated as factors greatly influencing the occurrence of major adverse cardiovascular events and in-hospital mortality. These elevated risks stress the importance of strict glycemic control and participant personas and complications management in dialysis patients who received PCI [14]. Likewise, the poor prognosis of cardiogenic shock is also a direct measure of the cardiac function of these patients and hence underlines the need to deal with early and correct hemodynamic derangements. The 65% one-year survival indicates that patients on hemodialysis remain at risk for adverse events following PCI. About one-quarter of patients experienced recurrent ischemia while about one-fifteenth developed restenosis, both of which require careful surveillance and effective secondary preventive methods [15-17]. These are; optimization of medical therapy, antiplatelet regimes, and appropriate lifestyle changes concerning cardiovascular risk. It also stresses the possibility of a second chance of survival through the multi-disciplinary management of such patients with, cardiologists, nephrologists, and dieticians amongst others [18]. The implication of the current study's findings for clinical practice is an important contribution of this study [19]. There are various methods for risk stratification, such as regarding the nutritional status, the markers of inflammation, and

comorbidities will enable the identification of the high-risk patient to direct the optimum treatment [20]. Further, procedural results may be improved by the incorporation of radial access strategies and novel stent platforms. There are critical gaps, that require further investigation with regards to novel reformatory strategies that include utilization of anti-inflammatory agents and enhanced nutritional support in Hemodialysis patients experiencing PCI.

CONCLUSION

It is concluded that hemodialysis patients undergoing PCI for acute myocardial ischemia syndrome face significant risks influenced by nutritional status, systemic inflammation, and comorbidities such as diabetes and cardiogenic shock. Radial access and drug-eluting stents improve procedural outcomes while addressing modifiable risk factors and enhancing multidisciplinary care is essential for improving long-term survival and reducing complications.

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