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OPTIMIZATION OF OUTCOMES OF PERCUTANEOUS CORONARY INTERVENTIONS IN PATIENTS WITH CORONARY ARTERY DISEASE AND CHRONIC KIDNEY DISEASE

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ABSTRACT

Coronary artery disease (CAD) and chronic kidney disease (CKD) frequently coexist, particularly in elderly populations. Their coexistence increases cardiovascular morbidity and mortality due to complex pathophysiological interactions such as accelerated atherosclerosis, endothelial dysfunction, oxidative stress, and disturbances in water-electrolyte balance. This study aims to optimize percutaneous coronary intervention (PCI) outcomes in patients with CAD and CKD by evaluating diagnostic approaches, procedural strategies, and peri-procedural management. We retrospectively analyzed 100 patients with CAD and CKD who underwent PCI between 2022 and 2024 at the Republican Specialized Scientific-Practical Medical Center of Surgery named after acad. V. Vakhidov. Data included demographics, CKD stage distribution, procedural details, and short-term outcomes. The majority of patients (46%) were in CKD stage 3, with a mean age of 64 years. PCI was associated with a high procedural success rate (>95%), while contrast-induced nephropathy (CIN) occurred in 9% of cases, predominantly in advanced CKD stages. Conclusion: Optimizing PCI in CKD patients requires a multidisciplinary approach, minimization of contrast volume, and close monitoring of renal function. Our findings support the integration of nephrology and cardiology expertise to improve outcomes in this high-risk group.

Introduction

Coronary artery disease (CAD) remains the leading cause of death worldwide, while chronic kidney disease (CKD) is increasingly recognized as a major public health concern. Epidemiological studies indicate that approximately 30–40% of patients with CKD also have CAD, and up to 50% of CAD patients exhibit some degree of CKD. This coexistence results in worse clinical outcomes due to shared risk factors such as hypertension, diabetes mellitus, dyslipidemia, and systemic inflammation.

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The pathophysiology of CAD in CKD patients is multifactorial. In addition to traditional atherosclerotic mechanisms, CKD-specific factors such as uremic toxins, altered calcium-phosphate metabolism, and increased vascular calcification contribute to accelerated vascular damage. Patients with CKD also present with altered platelet function and coagulation abnormalities, increasing both thrombotic and bleeding risks.

Percutaneous coronary intervention (PCI) is a cornerstone of CAD management, offering rapid revascularization and symptom relief. However, in CKD patients, PCI poses unique challenges, including the risk of contrast-induced nephropathy (CIN), higher rates of restenosis, and increased peri-procedural complications. Therefore, optimizing PCI strategies in CKD patients requires a careful balance between procedural efficacy and renal protection.

Materials and Methods

This retrospective observational study included a total of 100 patients diagnosed with both coronary artery disease (CAD) and chronic kidney disease (CKD) who underwent percutaneous coronary intervention (PCI) between January 2022 and December 2024 at the Republican Specialized Scientific-Practical Medical Center of Surgery named after acad. V. Vakhidov. The study was approved by the institutional ethics committee, and informed consent was obtained from all participants.

Inclusion criteria were: age greater than 18 years, angiographically confirmed CAD, and CKD stages 2–5 according to Kidney Disease: Improving Global Outcomes (KDIGO) classification. Exclusion criteria included acute kidney injury without chronic kidney disease, active systemic infection, malignancy, recent major surgery (<3 months), and refusal to participate.

Baseline assessment included a detailed clinical history, physical examination, and cardiovascular risk profiling. Diagnostic procedures involved: electrocardiography (ECG), transthoracic echocardiography (TTE) for left ventricular ejection fraction (LVEF) measurement, and treadmill stress testing for ischemia detection. Laboratory investigations included complete blood count (CBC), serum biochemistry (urea, creatinine, electrolytes, liver enzymes), lipid profile, serum cardiac troponin I (cTnI), creatinine clearance via Roberg's test, brain natriuretic peptide (BNP), N-terminal pro-brain natriuretic peptide (NT-proBNP), and coagulation profile.

All PCI procedures were performed by experienced interventional cardiologists using standard techniques. The choice of vascular access (radial or femoral), type of stent (drug-eluting stent [DES] or bare-metal stent [BMS]), and adjunctive pharmacotherapy (antiplatelet agents, anticoagulants) was individualized based on clinical presentation, coronary anatomy, and renal function status. Periprocedural hydration protocols were implemented in all patients, using isotonic saline to reduce the risk of contrast-induced nephropathy (CIN). Contrast volume was minimized according to patient risk, and iso-osmolar contrast media were preferred.

Patients undergoing chronic hemodialysis continued their sessions as per schedule, with timing adjustments made for those undergoing PCI to optimize hemodynamic and metabolic stability. Post-procedure, patients were closely monitored for renal function changes, access site complications, and adverse cardiac events. Follow-up evaluations were scheduled at 1 month, 6 months, and 12 months after PCI, including clinical review, ECG, echocardiography, and relevant laboratory tests.

Results and Discussion

A total of 100 patients were included in the study, with a mean age of 64 years. The cohort consisted of 62 males (62%) and 38 females (38%). The distribution of CKD stages revealed that the majority of patients were in stage 3 (46%), followed by stage 4 (28%), stage 2 (18%), and stage 5 (8%). The high proportion of stage 3 CKD underscores the prevalence of moderate renal impairment among CAD patients undergoing PCI.

The procedural success rate for PCI was 96%, with 4 patients experiencing technical failure due to complex coronary anatomy or severe calcification. The incidence of major adverse cardiovascular and cerebrovascular events (MACCE) during the 12-month follow-up was 12%, including myocardial infarction (5%), stroke (2%), and repeat revascularization (5%). The mortality rate was 4%, primarily among patients with advanced CKD (stage 4–5).

Contrast-induced nephropathy (CIN) occurred in 9 patients (9%), with the highest incidence in CKD stage 4 and 5 groups. Patients who received adequate pre-procedural hydration and lower contrast volumes showed significantly lower rates of CIN. The use of iso-osmolar contrast agents also contributed to a reduced risk of renal injury.

In terms of stent selection, drug-eluting stents (DES) were used in 78% of cases, while bare-metal stents (BMS) were employed in 22% of cases. DES use was associated with a lower rate of in-stent restenosis (4% vs. 10% in BMS), but prolonged dual antiplatelet therapy (DAPT) increased the risk of bleeding in CKD patients. Balancing restenosis prevention with bleeding risk remains a clinical challenge in this population.

Our findings align with previous research indicating that CAD patients with CKD represent a high-risk group requiring individualized treatment strategies. The integration of nephrology consultation during the peri-procedural period proved beneficial in managing renal risk factors, optimizing fluid balance, and adjusting pharmacotherapy to minimize adverse events.

Limitations of this study include its retrospective design, single-center nature, and relatively small sample size. Nonetheless, the study provides valuable insights into optimizing PCI outcomes in CAD patients with CKD, emphasizing the importance of a multidisciplinary approach.

Table 1. Baseline Characteristics of the Study Population

Characteristic	Value
Total patients	100
Mean age	64 years
Male	62
Female	38
CKD Stage 2	18
CKD Stage 3	46
CKD Stage 4	28

CKD Stage 5	8

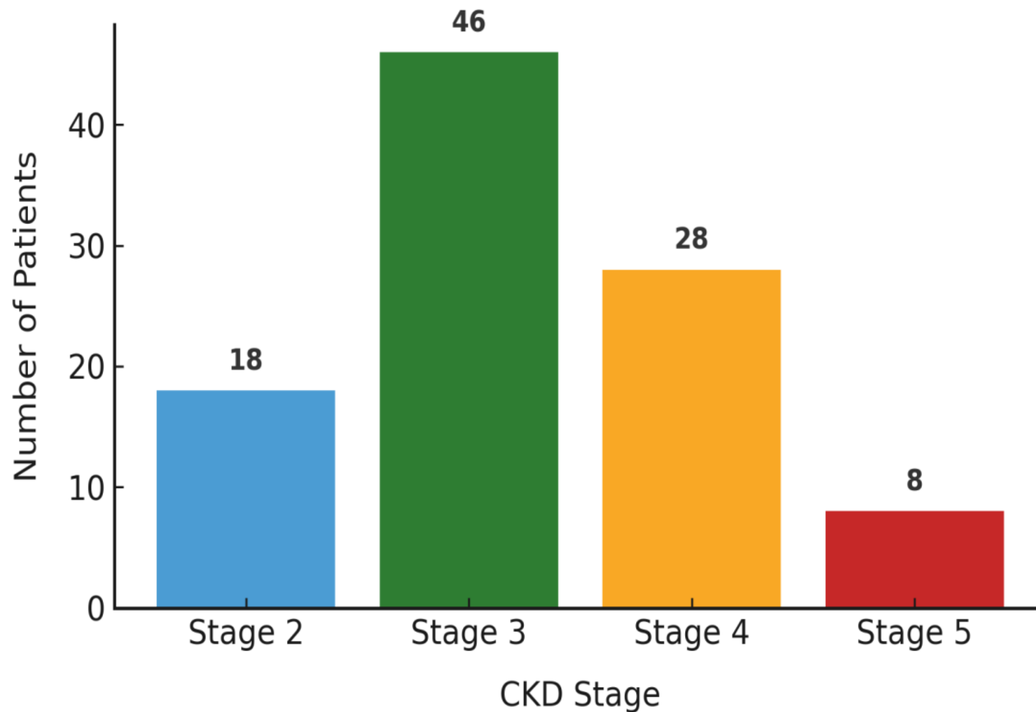

Figure 1. Distribution of CKD Stages

Conclusions

Percutaneous coronary intervention (PCI) in patients with concomitant coronary artery disease (CAD) and chronic kidney disease (CKD) can be performed with high procedural success and acceptable complication rates when guided by an individualized, patient-centered approach. The optimization of outcomes in this high-risk population requires a comprehensive strategy that includes accurate patient selection, minimization of contrast volume, peri-procedural renal protection measures, and meticulous post-procedural monitoring.

Our findings emphasize that the integration of multidisciplinary expertise—particularly between cardiologists and nephrologists—plays a pivotal role in reducing complications, preventing disease progression, and improving both short- and long-term survival rates. Furthermore, the incorporation of contemporary guideline-directed medical therapy and patient education are essential to achieving sustained benefits.

Future research should focus on large-scale, multicenter prospective studies to validate these findings, refine PCI protocols for CKD patients, and explore novel pharmacologic and interventional techniques that may further reduce the burden of adverse outcomes.

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