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Research Article

Clinical Outcomes of Percutaneous Coronary Intervention in Patients with Multivessel Coronary Artery Disease

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Abstract
Introduction: Multivessel coronary artery disease involves significant stenoses in several epicardial vessels. It carries a substantial risk of ischemia and adverse events.
Objective: To evaluate clinical outcomes, procedural success, complications and short-term follow-up events in patients with multivessel coronary artery disease undergoing predominantly DES-based percutaneous coronary intervention (PCI).
Study Design: Prospective observational study.
Place and Duration of Study: Tertiary care hospitals of Khyber Pakhtunkhwa, from July, 2025 to December, 2025.
Methodology: A total of 120 consecutive adult patients with angiographically confirmed multivessel disease undergoing PCI were enrolled. Clinical, angiographic and procedural data were recorded on a structured proforma. In-hospital complications and short-term adverse cardiovascular events were assessed.
Results: The mean age was 59.4 ± 10.2 years, and 68.3% of patients were male. Hypertension (60.0%) and diabetes mellitus (45.0%) were the most common risk factors. Three-vessel disease was present in 36.7% of patients, with a mean of 2.2 ± 0.9 stents per patient. Procedural success was 95.0%. The most frequent in-hospital complications were arrhythmia (4.2%) and peri-procedural myocardial infarction (3.3%). In-hospital mortality was 1.7%. During follow-up, recurrent angina occurred in 11.7%, repeat revascularization in 5.0%, stent thrombosis in 0.8% and mortality in 1.7%.
Conclusion: DES-based PCI achieved high procedural success with low complication and short-term adverse event rates in multivessel coronary artery disease.

Keywords: Multivessel Coronary Artery Disease, Percutaneous Coronary Intervention, Drug-Eluting Stents, Procedural Success, Clinical Outcomes.

INTRODUCTION

Multivessel coronary artery disease (MVD) is a more severe type of atherosclerotic coronary disease characterized by multiple major epicardial coronary artery stenoses. It is known to be linked to myocardial ischemia, angina, myocardial infarction, heart failure, and therefore effective revascularization is crucial. Advances in devices, imaging, lesion preparation, pharmacotherapy, and stent technology have made PCI a viable treatment for selected patients for the treatment of complex disease. The use of drug-eluting stents (DES) is especially relevant in contemporary PCI as these are devices that deliver antiproliferative therapy and help to prevent restenosis. Meaningful PCI outcomes have been shown even in patients who were initially deemed to be at high risk for CABG, but outcomes differ depending on baseline risk (1).

The decision regarding PCI or coronary artery bypass grafting (CABG) in MVD remains complicated due to the procedural differences and long-term event profiles of the two strategies. There is evidence over 5 years that mortality and myocardial infarction can be quite similar in selected populations, and that repeat revascularization and stroke may be different (2). PCI using DES can be performed in one or staged procedures without sternotomy and surgical recovery, while treating multiple lesions. Anatomical features, comorbidities, and patient preferences are

thus important considerations when deciding between treatment and contemporary PCI. PCI technology is still evolving but DES are still the backbone of modern PCI treatment. As an alternative, percutaneous approaches have been investigated including drug coated balloons, which may decrease permanent metallic implantation in the setting of MVD (3). However, DES are still applicable in the scenario of durable scaffolding, drug delivery of antiproliferative drugs and reliable lesion coverage. Patient factors also have an impact on outcomes. Diabetes mellitus is also associated with diffuse atherosclerosis, higher cardiovascular risk and the long-term outcomes of PCI versus CABG in diabetic patients with MVD are important to consider, along with procedural outcomes (4).

The technical success and the clinical outcomes of PCI may be affected by the coronary anatomy. Chronic total occlusion (CTO) lesions are challenging lesions that may require special crossing techniques, longer procedures, higher amount of contrast and complications management. The complexity of this patient population is evident in the PCI literature in patients with prior CABG and underscores the need to select the right lesions and have the right interventionist (5). In addition, comparative evidence using CTO and MVD also shows that anatomical patterns and complete revascularization are significant factors in treatment selection (6). These are especially important for multiple lesions to be treated with DES. Effectiveness of PCI should be assessed over the long term. A systematic review comparing the long-term results of PCI and CABG in patients with multivessel or left main disease showed that the results of the two procedures can diverge over time (7). Therefore, mortality, myocardial infarction, repeat revascularization, stent related complications and survival should be assessed. Prognosis might be altered by baseline characteristics. Patients undergoing coronary intervention may have significant comorbidities and anemia can impair the delivery of oxygen. In MVD patients who underwent PCI, evidence showed anemia to be a clinically relevant factor associated with outcomes and therefore should be taken into consideration during risk assessment (8).

Other factors, such as age and systemic atherosclerotic disease, also affect the outcomes of PCI. MVD patients are often elderly and have multiple comorbidities, complex coronary anatomy and high procedural risk. Long-term comparative studies have, therefore, been undertaken to compare PCI and surgical revascularization in elderly patients with a focus on survival (9). Another measure of overall vascular burden and atherosclerosis is peripheral arterial disease (PAD). Randomized trials of contemporary stents have provided patient-level pooled evidence on the outcome of PCI in patients with concomitant PAD, and systemic vascular disease should be taken into account when interpreting results following coronary stent implantation (10). Mortality or myocardial infarction is not the only measure of clinical success following PCI. Although technically successful revascularization, residual/recurrent angina can impair function and quality of life. In complex coronary disease treated with PCI or CABG, evidence shows that the presence of residual angina at follow-up is important, and that symptom relief is a key treatment outcome (11). Also, the approach of the multidisciplinary heart-team has differed in three-vessel coronary disease, affecting treatment selection and management, and thus individualized assessment (12). Cardiovascular events should therefore be assessed in conjunction with symptoms and revascularization completeness in the evaluation of DES-based PCI.

Advances in anatomical and technological knowledge continue to drive PCI. The technical difficulty of ostial left circumflex lesions is related to the need for exact stent position and protection of the adjacent coronary anatomy, and is a subject of contemporary studies (13). More recently, evidence has focused on outcomes in patients with PAD who receive PCI with contemporary stents, to evaluate newer devices (14). The new generation DES have been compared with CABG in stable patients with MVD, which reflects the transition towards advanced drug eluting technology (15). Advances in PCI for unprotected LMS have been correlated with improved clinical results, reflecting the role of new devices and techniques in complex PCI (16). Long-term outcome assessment after PCI has been stressed from elderly patients with MVD, as well (17). In summary, current data continues to support further investigation of DES-based PCI in MVD, which is dependent on coronary anatomy, procedural complexity, comorbidities, age and technology. Mortality, myocardial infarction, stroke, repeat revascularization, stent thrombosis, bleeding, renal complications, and symptom status can

be used to measure clinical effectiveness comprehensively.

Objective:
To evaluate clinical outcomes, procedural success, complications, and short-term follow-up events among patients with multivessel coronary artery disease undergoing percutaneous coronary intervention predominantly using drug-eluting stents.

MATERIALS AND METHODS

Study Design: Prospective observational study
Study Setting: Tertiary care hospitals of Khyber Pakhtunkhwa.
Study Duration: July, 2025 to December, 2025 (6 months)
Sample Size: 120 patients
Sample Technique: Consecutive sampling
Inclusion criteria: All patients ≥18 years old with multivessel coronary artery disease confirmed by angiography who received PCI during the study period were included. Patients undergoing PCI of two or more major epicardial coronary vessels or significant lesions in multiple coronary territories were eligible. Patients who were treated primarily with DESs and who gave informed consent to participate and follow-up were included.

Exclusion criteria: PCI for single-vessel disease, patients treated with only CABG, patients with previous stent thrombosis who required emergency PCI and patients with incomplete clinical or angiographic data were excluded. Patients who refused consent or who could not be followed-up for short-term follow up were also excluded**.**

METHODS

Patients who met inclusion criteria were recruited in a consecutive manner and assessed prior to PCI regarding demographic data, cardiovascular risk factors, clinical presentation, comorbidities, laboratory parameters and angiographic characteristics. Coronary angiography was done to determine the number, location, severity, and anatomical complexity of the disease. PCI was undertaken in line with current institutional practice, the majority of which were for clinically appropriate lesions, and drug-eluting stents were used extensively. The procedural details such as number of vessels treated, number and type of stents implanted, lesion preparation, contrast volume and procedural duration were recorded. Technical and procedural success was defined as satisfactory coronary flow restoration, without major complications during the procedure, in the hospital. Peri-procedural myocardial infarction, arrhythmia, bleeding, vascular complications, acute kidney injury, stroke, stent thrombosis, and death were monitored. Short-term follow-up included recurrent angina, myocardial infarction, repeat revascularization, cardiac-related hospitalization and death. A structured proforma was used to collect data which were analysed by appropriate descriptive and inferential statistical methods.

RESULTS

There were 120 patients with angiographically confirmed multivessel coronary artery disease who underwent primarily drug-eluting stent (DES)-based percutaneous coronary intervention (PCI). The mean age was 59.4 ± 10.2 years, and more than half of the patients (53.3%) were aged 51–65 years, while 30.0% were older than 65 years. The study population consisted of 68.3% (n = 82) males and 31.7% (n = 38) females, with 16.7% of patients being aged 50 years or less. The two-vessel disease was seen in 63.3% and three-vessel disease in 36.7% of the patients. The baseline, clinical and angiographic characteristics are summarized in Table 1. During the study period, all patients received PCI and were followed up for the short-term.

Table 1. Baseline, Clinical and Angiographic Characteristics of the Study Population (N = 120)

Characteristic	n	%
Age (years), mean ± SD	59.4 ± 10.2	—
Age group		
≤50 years	20	16.7
51–65 years	64	53.3
>65 years	36	30.0
Sex		
Male	82	68.3
Female	38	31.7

Risk factors		
Hypertension	72	60.0
Diabetes mellitus	54	45.0
Dyslipidemia	48	40.0
Smoking	42	35.0
Clinical presentation		
Stable angina	46	38.3
Unstable angina	42	35.0
Acute myocardial infarction	32	26.7
Number of diseased vessels		
Two-vessel disease	76	63.3
Three-vessel disease	44	36.7

Values are presented as n (%) unless otherwise indicated. SD: standard deviation.

The most common cardiovascular risk factors were hypertension (60.0%), diabetes mellitus (45.0%), dyslipidaemia (40.0%) and smoking (35.0%). As for the clinical indications for PCI, the most frequent were stable angina (38.3%), unstable angina (35.0%) and acute myocardial infarction (26.7%), as shown in Figure 1. This meant that almost two-thirds of the patients had an acute coronary syndrome (61.7%) and hence a high clinical risk.

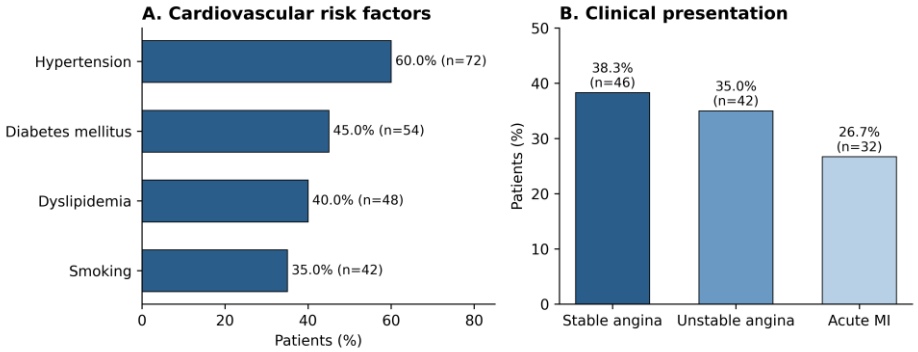


Figure 1. Distribution of (A) Cardiovascular Risk Factors and (B) Clinical Presentation among the Study Population (N = 120). Risk Factor Categories are Not Mutually Exclusive.

The most commonly treated artery was the left anterior descending artery (73.3%), followed by the right coronary artery (58.3%) and the left circumflex artery (48.3%). The mean number of stents implanted was 2.2 ± 0.9 stents per patient, with almost half of the patients receiving two stents (48.3%), 31.7% receiving three or more, and 20.0% receiving a single stent. (Figure 2) The number of stents placed was therefore high, with an average of 4 stents being placed in approximately four-fifths of the patients (80.0%) indicating the level of severity and complexity associated with multivessel involvement.

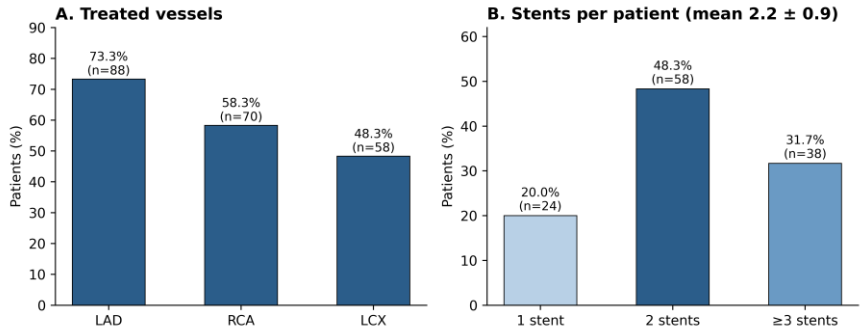


Figure 2. Procedural Characteristics: (A) Distribution of Treated Coronary Vessels and (B) Number of Stents Implanted Per Patient

Note: Percentages in panel A exceed 100% because most patients underwent treatment of more than one vessel. LAD: left anterior descending; RCA: right coronary artery; LCX: left circumflex.

PCI was successful in 114 patients (95.0%) and in six patients (5.0%) it failed due to suboptimal lesion results or procedural complications. The most common in-hospital complications were arrhythmia (4.2%) and peri-procedural myocardial infarction and acute kidney injury (3.3%, each). Bleeding complications occurred in 2.5% of patients, vascular complications in 1.7% and stroke in 0.8% (2 patients); in-hospital mortality was 1.7%. Table 2 shows procedural and follow-up results. The procedural success was considered as satisfactory post-intervention coronary flow without major in-hospital complications and most of the patients had an uncomplicated procedural course and hospital stay.

Table 2. Procedural and Short-Term Clinical Outcomes (N = 120)

Outcome	N	%
Procedural / in-hospital		
Successful PCI	114	95.0
Additional intervention required	6	5.0
Arrhythmia	5	4.2
Peri-procedural MI	4	3.3
Acute kidney injury	4	3.3
Bleeding complication	3	2.5
Vascular complication	2	1.7
Stroke	1	0.8
In-hospital mortality	2	1.7
Short-term follow-up		
Recurrent angina	14	11.7
Repeat revascularization	6	5.0
Follow-up MI	3	2.5
Stent thrombosis	1	0.8
Follow-up mortality	2	1.7

Values are presented as n (%). MI: myocardial infarction; PCI: percutaneous coronary intervention.

In short-term follow-up, recurrent angina occurred most frequently (11.7%) and repeat revascularization was needed in 5.0% of patients. 2.5% of patients had follow-up myocardial infarction, 0.8% had stent thrombosis, and 1.7% died. In-hospital and follow-up events are compared in frequency in Figure 3. The majority of patients were thus clinically stable at discharge with a low rate of major adverse cardiovascular events. Overall, there was a high procedural success rate and low rate of serious short-term adverse events for DES-based PCI in multivessel disease.

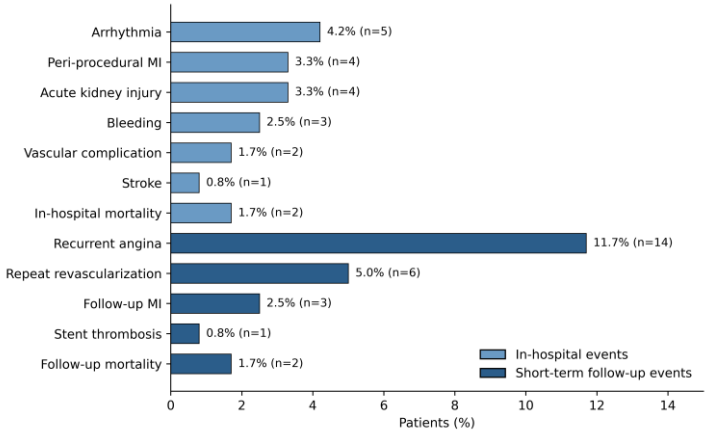


Figure 3. Frequency of In-Hospital Complications and Short-Term Follow-Up Adverse Events after PCI (N = 120). MI: Myocardial Infarction.

DISCUSSION

The present study aimed to assess clinical outcomes of percutaneous coronary intervention (PCI) in 120 patients with multi-vessel coronary artery disease (MVD), mostly with drug-eluting stents (DES). The mean age was 59.4 ± 10.2 years and males were the predominant group. The main cardiovascular risk factors were hypertension, diabetes mellitus, dyslipidemia and smoking. The development of DES technology, lesion preparation, pharmacotherapy and procedural techniques have increased the use of PCI for complex MVD (1). 38.3% of the present cohort had stable angina, 35.0% had unstable angina and 26.7% had acute myocardial infarction (AMI). This distribution illustrates the use of DES-based PCI in various clinical scenarios. Comparative evidence has shown that PCI and coronary artery bypass grafting (CABG) could result in different long-term event patterns in MVD, including the risk of repeat revascularization (2). Thus, clinical presentation is still a significant factor when assessing PCI results.

Forty-five (45.0%) patients had diabetes mellitus. Diabetes is linked to diffuse atherosclerosis, complicated coronary anatomy and elevated cardiovascular risk (3). When comparing PCI with CABG in diabetic patients with MVD, differences in subsequent clinical events and repeat revascularization have been highlighted (4). This high prevalence of diabetes could thus add to the complexity of treatment and follow up. Angiographically, 63.3% of the patients had two-vessel disease, and 36.7% had three-vessel disease. LADA was the most common artery treated, followed by the right coronary artery and left circumflex artery. The mean number of stents implanted was 2.2 ± 0.9, including 48.3% who had two and 31.7% who had three or more. Procedures may be longer, require more contrast and be more difficult due to complex anatomy. Chronic total occlusions can be difficult and require special techniques and operator experience (5).

Procedural success was achieved in 95.0% of patients and 5.0% needed further intervention. This high success rate suggests that modern DES-based PCI may have satisfactory angiographic outcomes in the right patient population with MVD. The same applies to evidence regarding chronic total occlusion PCI, where anatomical complexity, lesion selection, and procedural expertise are also important (6). The small percentage requiring further intervention indicates that few interventions required further revascularization at the time. Complication rates observed were relatively low. Peri-procedural myocardial infarction and acute kidney injury occurred in 3.3% and 2.5% respectively, while bleeding, vascular complications and stroke occurred in 1.7% and 0.8% respectively. In-hospital mortality was 1.7%. These results highlight the need to evaluate the effectiveness of procedures in conjunction with their safety. Long-term comparative data suggest that there may be temporal variation in the difference between PCI and CABG that requires follow-up to assess revascularization strategies (7). Anemia has also been found to be a relevant prognostic factor in MVD patients who underwent PCI, which should be taken into account in a comprehensive risk assessment (8).

Consideration should be given to age and systemic vascular disease. The mean age of 59.4 years was a strong sign of cardiovascular risk associated with age, but outcomes were not specifically analyzed by age subgroups. Studies of elderly patients with MVD have shown the value of comorbidities and clinical risk in assessing revascularization outcomes (9). Other indicators of generalized atherosclerosis include peripheral arterial disease and have been linked to outcomes after coronary stent implantation (10). In short-term follow-up, 11.7% of patients experienced recurrent angina, and 5.0% had repeat revascularization. The incidence of follow-up myocardial infarction, stent thrombosis, and mortality were 2.5%, 0.8%, and 1.7%, respectively. Even though PCI is successful, recurrent angina may still occur which means that all symptoms have not been resolved through the procedure. Residual angina following revascularization for complex coronary disease has been highlighted in the past (11). The low rate of repeat revascularization must be viewed with caution as follow-up was brief, and late restenosis or disease progression may not have been observed (12).

Modern technology still impacts on PCI results. New-generation DES deliver antiproliferative agents and act as mechanical scaffolding, and device and technique advances have enhanced the capacity to treat complex lesions (13). Comparative analysis of newer generation DES and CABG in stable MVD has brought to the forefront the significance of the procedural outcome along with longer-term events (14).

The accurate placement of the stent, the assessment of the lesion, and operator experience in complex PCI are also highlighted by studies of ostial left circumflex lesions and unprotected left-main disease (15). In summary, the present study showed high procedural success rate and low rates of major procedural complications and short-term adverse cardiovascular events in predominantly DES-based PCI in MVD. Recent data confirms PCI as a valid revascularization strategy for the right patient and repeat intervention and symptoms are still relevant endpoints (16). Long-term data in elderly and complex MVD patients highlight anatomical complexity, baseline risk, completeness of revascularization, and follow-up length (17). The generalizability and assessment of late outcomes is limited by the single-center design, the small sample size, and the short follow-up. However, these results offer some short-term evidence about DES-based PCI and highlight the need for ongoing clinical monitoring. Larger studies with longer follow-up are needed to assess restenosis, re-revascularization, stent thrombosis, mortality and quality of life. Follow-up would help to clarify if outcomes are favorable in the short term, and offer greater evidence of long-term effectiveness and patient-centered outcomes in MVD.

CONCLUSION

In the present study, predominantly drug-eluting stent-based PCI in patients with MVD led to good short-term clinical results. The procedural success rate was high (95.0%) and 5.0% of patients needed further intervention. The rates of major peri-procedural complications were low including myocardial infarction, bleeding, acute kidney injury, vascular complications, stroke, and mortality. In the short-term follow-up, the most common clinical event was recurrent angina, while repeat revascularization, myocardial infarction, stent thrombosis and mortality occurred rarely. These results suggest that contemporary DES-based PCI can be an effective revascularisation procedure in a well selected patient population with multivessel disease with acceptable procedural safety. The single center design, small number of patients, and short follow-up period, however, restrict the evaluation of long-term outcomes. Larger prospective studies with longer follow-up are suggested for assessing durability, recurrent ischemia, repeat revascularization, and long-term cardiovascular outcomes.

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