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Original Research Article

Comparison of percutaneous coronary intervention outcomes in diabetic patients with non-ST-elevation myocardial infarction having multivessel disease

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ABSTRACT

Background: Diabetic patients with non-ST-elevation myocardial infarction (NSTEMI) and multivessel coronary artery disease (MVD) present unique challenges in revascularization strategy selection. This study compares the clinical outcomes of multivessel (MVR) versus single-vessel revascularization (SVR) using percutaneous coronary intervention (PCI) in such patients.
Methods: A prospective observational study was conducted at a tertiary center in Bangladesh including 110 diabetic NSTEMI patients with angiographically confirmed MVD. Patients underwent either MVR (n=58) or SVR (n=52). Outcomes assessed over a 6-month follow-up included major adverse cardiovascular and cerebrovascular events (MACCE), left ventricular ejection fraction (LVEF), functional capacity (METS), and survival.
Results: Baseline characteristics were comparable between groups. The MVR group had significantly more stents (2.36±0.49 vs. 1.17±0.38; p<0.01) and longer stent length (58.76±10.22 mm vs. 33.46±10.93 mm; p<0.01). MACCE was significantly lower in the MVR group (6.89% vs. 30.77%; p=0.001), with reduced myocardial infarction and revascularization rates. Both groups showed significant improvement in LVEF and METS post-PCI, with no significant intergroup difference. Kaplan–Meier analysis revealed superior event-free survival in the MVR group.
Conclusions: Multivessel PCI offers superior clinical outcomes and event-free survival in diabetic NSTEMI patients with MVD, without increasing periprocedural risks. Individualized risk-benefit assessment remains essential.

Keywords: Non-STEMI, Multivessel PCI, Diabetes mellitus, MACCE, Revascularization strategy

INTRODUCTION

Cardiovascular disease remains the leading cause of mortality worldwide, with ischemic heart disease accounting for a substantial share of the global health burden (Roth et al). Among the spectrum of acute coronary syndromes (ACS), NSTEMI represents a significant proportion and often occurs in patients with MVD, particularly among those with diabetes mellitus (DM).[1] The diabetic population is known to have more diffuse atherosclerotic involvement, endothelial dysfunction, and prothrombotic tendencies, all of which contribute to adverse clinical outcomes even after timely PCI.[2,3] Consequently, treatment strategies for diabetic patients presenting with NSTEMI and MVD pose a major clinical challenge.

Historically, PCI has predominantly targeted the culprit vessel responsible for ischemia. However, emerging evidence suggests that in cases of MVD, a complete revascularization strategy may yield better long-term outcomes than culprit-only PCI. Several studies, including a large registry analysis and randomized trials, have reported reduced rates of major adverse cardiovascular events (MACE) in NSTEMI patients with MVD when multivessel PCI was pursued as opposed to SVR.[1,4] In particular, a retrospective study demonstrated a significantly lower three-year incidence of composite cardiac death, myocardial infarction, and repeat revascularization in the complete revascularization group.[1] Similarly, out-of-hospital staged multivessel PCI was associated with superior survival and lower MACE compared to culprit-lesion-only PCI in hemodynamically stable NSTEMI patients.[4]

Despite these findings, some studies suggest that multivessel PCI may carry a higher risk of periprocedural complications, including bleeding and renal injury, without consistent improvements in long-term mortality-particularly in high-risk populations like those with diabetes and cardiogenic shock.[5] This has led to ongoing debates about the optimal timing, extent, and selection criteria for revascularization in diabetic patients with NSTEMI and MVD. Furthermore, most prior studies have focused on Western populations, with limited data available from low- and middle-income countries like Bangladesh, where the epidemiology of cardiovascular disease and healthcare infrastructure may influence both patient outcomes and treatment decisions.

In Bangladesh, the prevalence of diabetes is rising rapidly, amplifying the burden of coronary artery disease and complicating treatment strategies in ACS.[6] Given that diabetic patients often exhibit silent ischemia, diffuse lesions, and higher SYNTAX scores, the choice between SVR and MVR becomes particularly critical. However, there is a notable gap in regional literature evaluating the comparative effectiveness of these two approaches in NSTEMI patients with MVD, particularly within resource-constrained settings.

To address this gap, the present study aims to compare the short-term clinical outcomes of SVR versus MVR in diabetic patients presenting with NSTEMI and MVD at a tertiary care center in Bangladesh. The focus is on major adverse cardiac and cerebrovascular events (MACCE), LVEF, and functional capacity following PCI. The results of this study are expected to contribute meaningful insights into revascularization strategies in diabetic patients and support evidence-based decision-making in similar resource-limited healthcare settings.

METHODS

This prospective observational study was conducted in the department of cardiology at Bangabandhu Sheikh Mujib medical university (BSMMU), Dhaka, Bangladesh, over a 12-month period from June 2023 to May 2024. The study population consisted of adult patients (aged ≥18 years) with a known diagnosis of type 2 DM who were admitted with NSTEMI and had angiographically confirmed MVD, defined as ≥50% diameter stenosis in at least two major epicardial coronary arteries. All patients underwent successful PCI using drug-eluting stents. Patients were excluded if they had single-vessel coronary artery disease, STEMI, prior coronary artery bypass grafting (CABG), significant left main disease, cardiogenic shock before PCI, valvular heart disease, cardiomyopathy, atrial fibrillation, systemic illnesses such as malignancy or autoimmune disorders, or if they declined to participate or were lost to follow-up. A purposive sampling technique was employed. Based on prior literature indicating differences in major adverse cardiovascular and cerebrovascular event (MACCE) rates between multivessel and single-vessel PCI strategies, the minimum calculated sample size was 100; to accommodate for potential attrition, 110 patients were enrolled, of whom 52 underwent SVR and 58 underwent MVR. The decision to perform SVR or MVR was made by the attending interventional cardiologist, guided by clinical presentation, anatomical suitability, and current international guidelines. All PCI procedures followed standard practice, with drug-eluting stent deployment, pre- and post-dilation as required, and appropriate use of antiplatelet therapy. Baseline demographic and clinical data-including age, sex, cardiovascular risk profile, serum creatinine, echocardiographic findings, and angiographic characteristics (e. g., number of diseased vessels, SYNTAX score, stent length and number)-were recorded. Follow-up assessments were conducted six months post-PCI and included evaluation of MACCE (composite of all-cause mortality, non-fatal myocardial infarction, stroke, and repeat revascularization), LVEF, functional capacity (in metabolic equivalents or METS), and symptom burden, assessed by Canadian cardiovascular society (CCS) angina class and New York Heart Association (NYHA) dyspnea class. Statistical analyses were performed using SPSS version 25.0. Continuous variables were summarized as mean±standard deviation and compared between groups using independent t tests. Categorical variables were expressed as frequencies and percentages, with group comparisons made using chi-square or Fisher's exact tests. Kaplan-Meier survival curves were generated for MACCE, and log-rank tests were used for group comparisons. Cox proportional hazards models were applied to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (CIs), accounting for age, sex, SYNTAX score, stent length, and baseline LVEF. A p value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the institutional review board (IRB) of BSMMU (Approval No.: BSMMU/IRB/2023/112), and the study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants, and all personal data were de-identified to ensure confidentiality.

RESULTS

There were no statistically significant differences between the MVR and SVR groups in terms of age, sex, or the distribution of cardiovascular risk factors, including hypertension, smoking, dyslipidemia, and family history of coronary artery disease (all p>0.05). Similarly, comorbidities such as peripheral arterial disease, previous myocardial infarction, prior PCI, cerebrovascular events, heart failure, and chronic kidney disease were comparable between the two groups (Table 1).

The MVR group required significantly more stents (2.36±0.49 vs. 1.17±0.38; p<0.01) and longer total stent length (58.76±10.22 mm vs. 33.46±10.93 mm; p<0.01) than the SVR group. There was no significant difference in SYNTAX scores or the proportion of double- and triple-vessel disease. However, periprocedural renal dysfunction occurred more frequently in the MVR group (13.8% vs. 3.85%; p<0.01) (Table 2).

The MVR group had significantly lower rates of myocardial infarction (1.72% vs. 11.54%; p=0.036), non-target vessel revascularization (0% vs. 17.31%; p=0.001), and any revascularization (1.72% vs. 19.23%; p=0.002) compared to the SVR group. The composite outcome of death, MI, or revascularization was significantly lower in the MVR group (6.89% vs. 30.77%; p=0.001). There were no significant differences in death alone, target vessel revascularization, or composite of death or MI (Table 3).

Table 1: Distribution of risk factors and comorbidities.

Variables	MVR (n=58) (%)	SVR (n=52) (%)	P value
Demographic characteristics			
Age (in years)	54.4±5.3	56.3±5.7	[a]0.072[ns]
Male	43 (51.8)	40 (48.2)	[b]0.735[ns]
Female	15 (55.56)	12 (44.44)	
Risk factors and co-morbidities			
HTN	34 (53.97)	29(46.03)	[a]0.299[ns]
Current smoker	26 (52.0)	24 (48.0)	[a]0.338[ns]
Dyslipidemia	14 (43.75)	18 (56.25)	[a]1.025[ns]
Family history of CAD	23 (46.0)	27 (54.0)	[a]0.482[ns]
PAOD	1 (50.0)	1 (50.0)	[a]0.077[ns]
Previous MI	3 (60.0)	2 (40.0)	[a]0.331[ns]
Previous CVA	1 (33.34)	2 (66.67)	[a]0.677[ns]
Prior PCI	2 (50)	2 (50)	[a]0.110[ns]
CHF	10 (52.63)	6 (47.37)	[a]0.543[ns]
CKD	7 (41.18)	10 (58.82)	[a]1.033[ns]

*MVR=Multivessel revascularization; SVR=Single vessel revascularization; CAD: coronary artery disease; PAOD: Peripheral arterial disease; MI: Myocardial infarction; CVA: cerebrovascular accident; CHF: Congestive heart failure; CKD: chronic kidney disease; LVEF: Left ventricular ejection fraction. The level of significance was measured using Chi-square tests and t test, p<0.05-significant and >0.05-not significant. Data presented as n (%) or mean ±SD. 's'=Statistically significant; 'ns' statistically not significant; [a]P value obtained from unpaired 't' test; [b]P value calculated from chi square test. Value within parentheses indicate percentage.

Table 2: Angiographic and PCI related variables.

Variables	MVR group (n=58) (%)	SVR group (n=52) (%)	P value
SYNTAX score	20.05±1.986	20.48±2.262	[a]0.416[ns]
DVD	39 (50.75)	38 (49.25)	[a]0.220[ns]
TVD	19 (51.61)	14 (48.39)	[a]0.509[ns]
Number of stents	2.36±0.485	1.17±0.382	[a]<0.01[s]
Total stent length (mm)	58.76±10.22	33.46±10.93	[a]<0.01[s]
Periprocedural renal dysfunction	8 (13.8)	2 (3.85)	[a]<0.01[s]

*Data are presented as n (%) or mean ±SD. [a] Unpaired t test was done to measure level of significance; Value within parentheses indicate percentage; ns-not significant; s-significant. [b]Level of significance was calculated by chi square test. SYNTAX=Synergy between PCI with Taxus and cardiac surgery; DVD: double vessel disease; TVD: Triple vessel disease; SVR-single vessel revascularization; MVR-multi vessel revascularization.

Table 3: Comparative outcome of SVR and MVR in diabetic patients having MVD in terms of MACCE.

MACCE	MVR group (n-58) (%)	SVR group (n-52) (%)	P value
Death	3 (5.17)	6 (11.54)	0.231[ns]
MI	1 (1.72)	6 (11.54)	0.036[s]

Continued.

MACCE	MVR group, (n-58) (%)	SVR group, (n-52) (%)	P value
TVR	1 (1.72)	1 (1.92)	0.943[ns]
NTVR	0	9 (17.31)	0.001[S]
Any revascularization	1	10 (19.23)	0.002[s]
Composite of death, MI or any revascularization	4 (6.89)	16 (30.77)	0.001[s]
Composite of death or MI	4 (6.89)	8 (15.38)	0.161

*p value calculated by survival analysis (Log rank test); ns-not significant; s-significant. MVR-Multi vessel revascularization; SVR-Single vessel revascularization; HR-Hazard ratio; CI-Confidence interval; MI: Myocardial infarction; MACCE: Major adverse cardiac and cerebrovascular events.

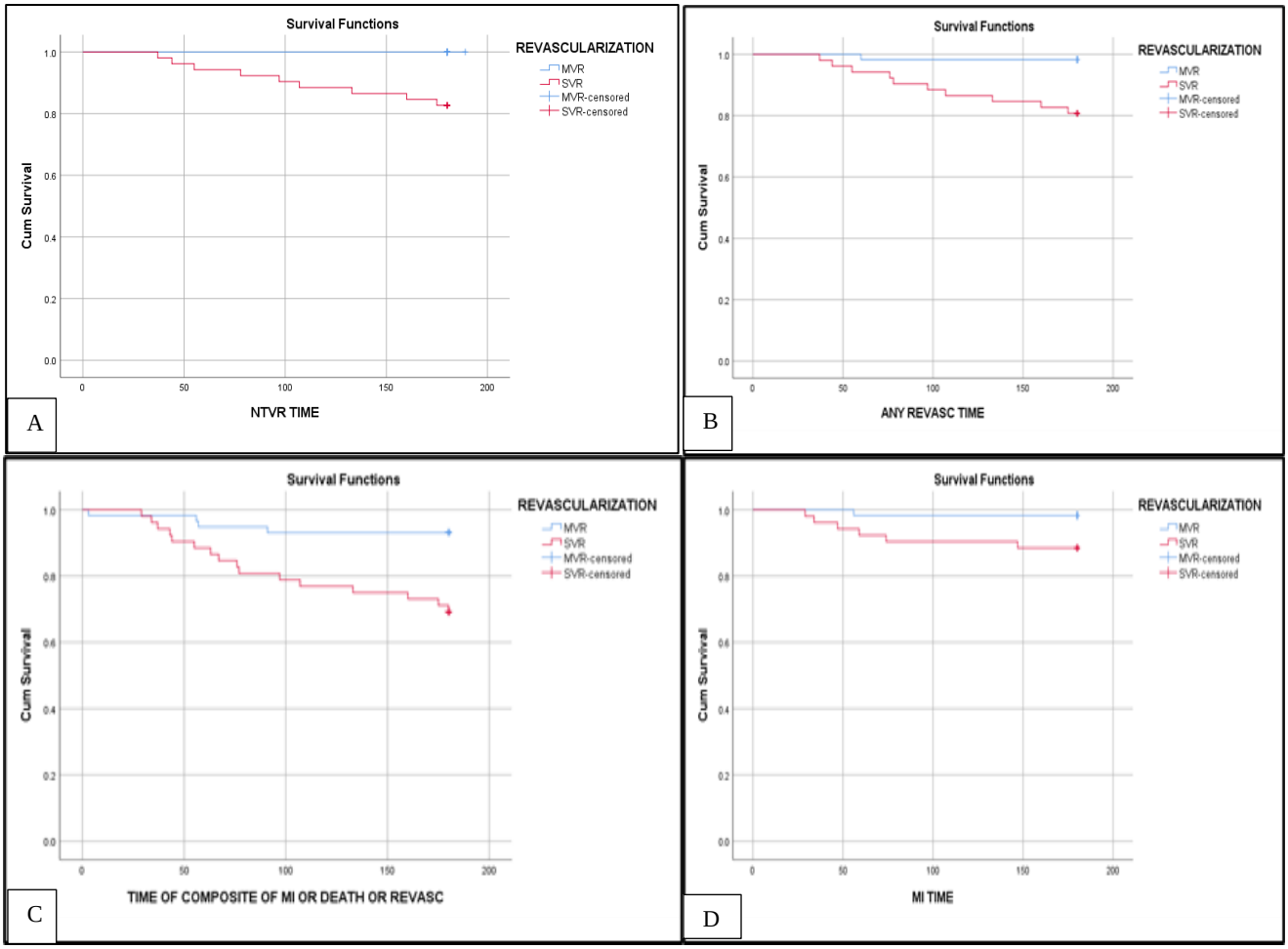

Figure 1 (A-D): Kaplan Meir survival curve showing superiority of MVR compared to SVR in NSTEMI having MVD and DM. A-non-target vessel revascularization, B-Any revascularization, C-Composite of MI, death or revascularization and D-Myocardial infarction

Figure 1 illustrates Kaplan-Meier survival estimates comparing MVR and SVR strategies for four outcome measures. (A) The curve for non-target vessel revascularization (NTVR) demonstrates significantly better survival in the MVR group, with no events recorded, compared to a steep decline in the SVR group. (B) Similarly, the curve for any revascularization shows higher event-free survival in the MVR group versus SVR, indicating reduced re-intervention needs. (C) The composite outcome of myocardial infarction, death, or any revascularization shows a markedly lower event rate in the MVR group, reinforcing its clinical benefit. (D) The myocardial infarction-specific survival curve indicates a significantly lower incidence in the MVR group compared to the SVR group.

Overall, these survival curves consistently show superior outcomes with MVR, supporting its effectiveness in reducing adverse cardiovascular events over the 6-month follow-up period.

Both MVR and SVR groups showed statistically significant improvement in LVEF after PCI (SVR: p=0.032; MVR: p=0.014). The proportion of patients with LVEF ≥50% increase in both groups, indicating improved systolic function. However, intergroup comparisons of

LVEF categories before and after PCI showed no statistically significant differences between MVR and SVR groups at baseline or follow-up (all p=0.05).

Functional capacity improved significantly in both groups post-PCI (p<0.01). In the SVR group, the percentage of patients achieving >7 METs rose from 1.92% to 65.22%, while in the MVR group it increased from 1.72% to 80%. Intergroup comparisons of METs before and after PCI revealed no significant differences between MVR and SVR groups (p>0.05), suggesting that both strategies led to comparable improvements in exercise tolerance.

Table 4: Inter group comparison of LVEF before and after PCI between SVR and MVR groups.

Intra group comparison of LVEF						
	LVEF category	**Before PCI, N (%)**		**After PCI, N (%)**	**P value**	
SVR group, (n=52)	≤40%	1 (1.93)		1 (2.17)	[a]0.032[S]	
	41-49	23 (44.23)		6 (13.04)		
	≥50%	28 (53.85)		39 (84.78)		
MVR group, (n=58)	≤40%	1 (1.72)		1 (1.82)		
	41-49	18 (31.03)		5 (9.09)	[a]0.014[S]	
	≥50%	39 (67.24)		49 (89.09)		
Intergroup comparison of LVEF						
LVEF	**Before PCI**			**After PCI**		
	SVR, (n=52) (%)	**MVR, (n=58) (%)**	**P value**	**SVR, (n=52) (%)**	**MVR, (n=58) (%)**	**P value**
≤40%	1 (1.93)	1 (1.72)		1 (2.17)	1 (1.82)	
41-49%	23 (44.23)	18 (31.03)	0.351[ns]	6 (13.04)	5 (9.09)	0.897[ns]
≥50%	28 (53.85)	39 (67.24)		39 (84.78)	49 (89.09)	

Data presented as n (%); The level of significance was measured using Chi-Square tests; p<0.05-significant and >0.05-not significant.

Table 5: Intra and inter group comparison of METs before and after PCI.

Intragroup comparison of METs						
	METs	**Before PCI, N (%)**		**6 months after PCI, N (%)**		**P value**
SVR (52)	<4	35 (67.31)		2 (4.35)		
	4-7	16 (30.77)		14 (30.43)		<0.01[s]
	>7	1 (1.92)		30 (65.22)		
MVR (58)	<4	33 (56.90)		1 (1.82)		
	4-7	24 (41.38)		10 (18.18)		<0.01[s]
	>7	1 (1.72)		44 (80)		
Intergroup Comparison of METs						
METs	**Before PCI, N (%)**			**After PCI, N (%)**		
	SVR	**MVR**	**P value**	**SVR**	**MVR**	**P value**
<4	35 (67.31)	33 (56.90)		2 (4.35)	1 (1.82)	
4-7	16 (30.77)	24 (41.38)	0.513[ns]	14 (30.43)	10 (18.18)	0.238[ns]
>7	1 (1.92)	1 (1.72)		30 (65.22)	44 (80)	

Level of significance was determined by chi square test; Value within parentheses indicate percentage. SVR: Single vessel revascularization; MVR: Multi vessel revascularization; METs: Metabolic equivalents (Index of Functional capacity).

DISCUSSION

The findings of this study provide valuable insight into the comparative outcomes of multivessel versus single-vessel PCI in diabetic patients presenting with NSTEMI and MVD. The demographic and baseline clinical characteristics were comparable between the MVR and SVR groups, consistent with large registry and trial populations where similar distributions of age, sex, hypertension, dyslipidemia, smoking, and comorbid conditions were reported.[7,8] Notably, our population's mean age and risk factor profile align with those described in the FREEDOM trial and the PRESTO sub-group analysis, where the baseline parity was observed and not predictive of major adverse outcomes, reinforcing the reliability of downstream clinical comparisons.[9,10]

Regarding procedural variables, the MVR group received significantly more stents and longer total stent lengths-outcomes that mirror findings from studies evaluating complex lesion burdens and anatomical completeness in multivessel PCI strategies. Hillegass et al observed that diabetic patients undergoing multivessel PCI typically required more extensive stenting and experienced higher procedural complexity.[11] Our study also demonstrated a significantly greater incidence of periprocedural renal dysfunction in the MVR group, a finding echoed by Brener et al who reported increased contrast load and renal events

associated with MVR strategies.[8] Despite these procedural risks, the SYNTAX scores and angiographic disease distribution were similar between groups, indicating that anatomical complexity alone did not dictate outcomes.

Importantly, our study found that the MVR group had superior MACCE outcomes compared to the SVR group, particularly in terms of reduced myocardial infarction, non-target vessel revascularization, and the composite of death, MI, or any revascularization. These findings are congruent with those of Hung et al., who demonstrated a significantly lower MACCE rate in complete revascularization cohorts over a 3-year period in NSTEMI patients.[1] Likewise, Rathod et al reported that complete revascularization was associated with significantly improved long-term mortality in NSTEMI patients, as evidenced by Kaplan-Meier survival curves and adjusted hazard ratios.[12] Our survival analysis aligns closely with these studies, showing that MVR resulted in superior event-free survival across multiple endpoints. Conversely, other studies such as Nathan et al reported no significant differences in MACE-free survival between SVR and MVR in selected populations, suggesting that institutional practices, patient risk profiles, and completeness of revascularization may influence outcomes.[13]

In terms of LVF, both MVR and SVR groups showed significant improvement in LVEF following PCI. However, absence of a statistically significant intergroup difference reflects findings from Kyhl et al and Calvo et al who showed that while LVEF improves post revascularization, magnitude of improvement is not necessarily greater with multivessel PCI compared to culprit-only PCI in short term.[14,15] These findings imply that myocardial salvage is largely driven by relief of ischemia in viable territories, regardless of whether complete revascularization is achieved in a single setting.

Our evaluation of functional recovery using METs revealed substantial within-group improvements in both MVR and SVR arms, with no statistically significant intergroup differences. This is supported by observations of Tiksnadi et al who demonstrated meaningful gains in functional capacity post-PCI among diabetic CAD patients irrespective of revascularization strategy.[16] Similarly, Kapur et al noted that both PCI and CABG in diabetic MVD patients led to comparable improvements in ischemic burden and exercise tolerance, aligning with our METs-based outcomes.[17] Thus, while MVR may reduce recurrent ischemic events more effectively, functional recovery appears achievable across both strategies.

Finally, the Kaplan-Meier survival analysis in our study demonstrated superior MI-free and revascularization-free survival in the MVR group. These findings are strongly corroborated by survival trends reported in Rathod et al Hung et al and Akber et al which collectively highlight long-term benefit of complete revascularization strategies in reducing repeat interventions and improving cardiovascular event-free survival.[1,2,12] However, it is worth noting that other large-scale analyses such as Jia et al have suggested that multivessel intervention, especially when performed acutely in high-risk NSTEMI patients, may be associated with increased risks if not appropriately staged or patient-selected.[18]

In summary, the present study supports the clinical utility of multivessel PCI in diabetic patients with NSTEMI and MVD, showing clear advantages in reducing adverse cardiovascular events and improving intermediate-term outcomes. However, the comparable improvements in LVEF and functional status between groups underscore the need for individualized revascularization strategies tailored to anatomical and clinical complexity.

Limitations

This study's observational design and short follow-up period limit causal inference and long-term outcome assessment. Lack of randomization may introduce selection bias.

CONCLUSION

This prospective study demonstrates that in diabetic patients presenting with NSTEMI and MVD, multivessel PCI is associated with superior clinical outcomes compared to single-vessel PCI. Specifically, multivessel revascularization resulted in significantly lower rates of myocardial infarction, non-target vessel revascularization, and composite MACCE. Despite requiring more stents and longer total stent lengths, the MVR group experienced similar rates of periprocedural complications and demonstrated comparable improvements in left ventricular ejection fraction and functional capacity. Kaplan-Meier survival analysis further confirmed superior event-free survival among MVR patients. These findings suggest that a complete revascularization strategy is not only feasible but clinically beneficial in carefully selected diabetic NSTEMI patients with multivessel disease.

Recommendations

Multivessel PCI should be considered the preferred strategy in diabetic NSTEMI patients with anatomically suitable multivessel disease. Decision-making should be individualized based on clinical stability, renal function, and lesion complexity. Longer-term, multicenter studies in low-resource settings like Bangladesh are recommended to validate these findings. Routine follow-up with functional capacity assessment and echocardiographic monitoring should be integrated into post-PCI care pathways. Strategies to minimize contrast use during MVR procedures should be employed to mitigate renal complications.

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