



Clinical and Hemodynamic Outcomes Following Pharmacological Therapy and Percutaneous Coronary Intervention in Patients with Obstructive Coronary Artery Disease in diabetes.

¹Zeeshan Shaikh, ²Khadijah Siddiqi, ³Barkat Ali Shaikh, ⁴Varoon Dileep, ⁵Ahmad Bilal, ⁶Yasir Aziz, ⁷Nelofar Fahad, ⁸Ghazala kousar, ⁹Sidra kanwal, ¹⁰Misha Fatima

¹Assistant professor, Fellowship Intervention cardiologist, Bahria University Health Sciences, PNS Shifa Hospital, Karachi

²Registrar Cardiology, PNS Shifa Hospital, Karachi

³Professor, Department of pharmacology, BADC @SMBBMU Larkana.

⁴4th year MBBS Student, Charles University

⁵Assistant Professor {Med}, Intervention cardiologist, AFIC/NIHD

⁶SPR General Medicine, MTI DHQ Teaching Hospital, DI Khan

⁷Al-Habib Medical Centre, Consultant Diabetologist & Endocrinologist

⁸House officer, Kuslum Bai valika hospital, Karachi

⁹House officer, Bahawal Victoria hospital bwp

¹⁰Second year Pre-Medical Student.



Correspondence:

Dr. Yasir Aziz.

SPR General Medicine, MTI DHQ Teaching Hospital, DI Khan.

Received: 27-08-2026

Revised: 16-09-2026

Accepted: 26-09-2026

Published: 02-10-2026

Abstract

Background: Diabetes mellitus significantly increases the risk, severity and progression of coronary artery disease. Hyperglycemia drives endothelial dysfunction, oxidative stress, inflammation, and accelerated atherosclerosis, often resulting in diffuse, multivessel, and calcified lesions. Patients with obstructive CAD experience higher rates of myocardial ischemia, recurrent cardiovascular events, and mortality. **Methodology** This Cross-sectional study of diabetic adults with obstructive CAD. Patients grouped into pharmacological therapy vs PCI and pharmacological therapy. Demographic, clinical, angiographic, and echocardiographic data recorded. Outcomes assessed at baseline and follow-up. Statistical analysis: parametric/non-parametric tests, chi-square/Fisher's exact, and multivariable regression. **Results:** PCI with pharmacological therapy showed greater improvement in angina severity, exercise tolerance, LVEF, myocardial perfusion, and BP/HR profiles vs medical therapy alone. Lower rates of recurrent MI, heart failure, arrhythmia, hospitalization, and MACE with successful revascularization and guideline-directed therapy. **Conclusion** Integrated interventional and pharmacological management provided better symptom control, ventricular function, and reduced ischemic events in appropriately selected diabetic patients with obstructive CAD.

Keywords: Coronary Artery Disease; Percutaneous Coronary Intervention; Diabetes Mellitus; Pharmacological Therapy; Major Adverse Cardiovascular Events; Left Ventricular Ejection Fraction.



This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).

INTRODUCTION

Diabetes mellitus is a major cardiovascular risk factor and is strongly associated with the development, progression, and adverse outcomes of coronary artery disease (CAD)[1,2]. Chronic hyperglycemia promotes endothelial dysfunction, oxidative stress, inflammation, platelet hyperreactivity, and accelerated atherosclerosis, resulting in more extensive, diffuse, multivessel, and frequently calcified coronary artery disease[3]. Consequently, diabetic patients with obstructive CAD have a higher burden of myocardial ischemia and an increased risk of recurrent angina, myocardial infarction, heart failure, repeat revascularization, and cardiovascular mortality[4-7]. The presence of diabetes therefore represents an important consideration when determining the optimal strategy for coronary revascularization and long-term cardiovascular management.

In patients with angiographically confirmed obstructive CAD, optimal pharmacological therapy (OMT) remains fundamental to cardiovascular risk reduction and secondary prevention. Contemporary medical management includes antiplatelet agents, high-intensity lipid-lowering therapy, antihypertensive and anti-ischemic medications, and appropriate

glucose-lowering treatment[8-10]. These interventions aim not only to relieve ischemic symptoms but also to stabilize atherosclerotic plaques, reduce thrombotic risk, control cardiovascular risk factors, and prevent progression of coronary disease[11]. Importantly, pharmacological therapy addresses the systemic nature of atherosclerosis and therefore remains essential irrespective of whether a patient undergoes coronary revascularization.

Percutaneous coronary intervention (PCI) is a central component of contemporary interventional cardiology for selected patients with obstructive CAD, particularly those with significant ischemic symptoms, functionally important coronary lesions, or suitable coronary anatomy for revascularization[12]. PCI provides mechanical restoration of coronary lumen patency through balloon angioplasty and stent implantation, thereby improving coronary blood flow and myocardial perfusion. In appropriately selected patients, successful PCI can produce rapid relief of angina and improve functional capacity. However, PCI primarily treats focal flow-limiting coronary lesions and does not eliminate the underlying diffuse atherosclerotic process[13-17]. Therefore, PCI should be considered complementary to, rather than a replacement for, optimal pharmacological therapy.

The clinical importance of PCI in diabetic patients is further influenced by the complex coronary anatomy and pathophysiology associated with diabetes. Diabetic coronary lesions are often characterized by greater lesion length, calcification, diffuse disease, multivessel involvement, and impaired vascular healing. Diabetes may also increase platelet reactivity and the risk of restenosis, stent-related complications, recurrent ischemia, and subsequent cardiovascular events[18,19]. These factors make both appropriate patient selection and achievement of successful coronary revascularization particularly important in diabetic individuals undergoing PCI. Evaluation of procedural and post-procedural outcomes is therefore essential for determining the effectiveness of PCI when added to contemporary medical treatment[20-22].

Assessment of treatment effectiveness should extend beyond angiographic or procedural success. Clinical and hemodynamic outcomes, including angina severity, exercise tolerance, heart rate, blood pressure, left ventricular ejection fraction (LVEF), recurrent myocardial ischemia, hospitalization, and major adverse cardiovascular events (MACE), provide a more comprehensive assessment of cardiovascular benefit. LVEF is particularly important because chronic myocardial ischemia and extensive coronary disease may impair ventricular systolic function, while successful revascularization may improve myocardial perfusion and potentially preserve or recover ventricular function in patients with viable ischemic myocardium[23-25]. Similarly, improvement in angina and exercise capacity represents an important patient-centered measure of successful myocardial revascularization.

The comparison between pharmacological therapy alone and PCI combined with optimal pharmacological therapy is therefore clinically relevant in diabetic patients with obstructive CAD[24,25]. While PCI may provide more rapid relief of ischemic symptoms and restoration of coronary blood flow in appropriately selected lesions, long-term outcomes may also depend on the extent and complexity of CAD, baseline ventricular function, diabetes control, cardiovascular risk factors, adherence to guideline-directed therapy, and completeness and success of revascularization. Evaluating these factors can help clarify which patients derive greater clinical and functional benefit from an invasive revascularization strategy[26,27]. The present study was designed to compare the clinical and hemodynamic outcomes of pharmacological therapy alone with PCI combined with optimal pharmacological therapy in diabetic patients with angiographically confirmed obstructive CAD. The study particularly focused on changes in angina severity, exercise tolerance, LVEF, heart rate, blood pressure, recurrent myocardial infarction or ischemic symptoms, heart failure, arrhythmias, cardiovascular hospitalization, and MACE. By evaluating these outcomes, the study aims to provide a comprehensive assessment of the role of PCI as an adjunct to optimal medical therapy in the cardiovascular management of diabetic patients with obstructive coronary artery disease.

OBJECTIVES

The primary objective of the study was to compare the clinical and hemodynamic outcomes of pharmacological therapy alone with those of percutaneous coronary intervention (PCI) combined with optimal pharmacological therapy among patients with diabetes mellitus and angiographically confirmed obstructive coronary artery disease. The study also aimed to assess changes in angina severity and recurrent ischemic symptoms following treatment and to compare improvements in exercise tolerance and functional status between the two treatment groups. In addition, the study evaluated changes in left ventricular ejection fraction, heart rate, systolic blood pressure, and diastolic blood pressure following treatment. The incidence of recurrent myocardial infarction, heart failure, arrhythmias, cardiovascular hospitalization, and major adverse cardiovascular events (MACE) was also determined and compared between the treatment groups. Furthermore, the study sought to assess whether successful PCI and adherence to guideline-directed medical therapy were associated with favorable clinical and hemodynamic outcomes and to identify independent predictors of favorable cardiovascular outcomes among diabetic patients with obstructive coronary artery disease.

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

MATERIALS AND METHODS

A comparative cross sectional study was conducted among adult patients with established diabetes mellitus and angiographically confirmed obstructive coronary artery disease. Patients were categorized by the treating cardiology team into a pharmacological-therapy group and a PCI-plus-pharmacological-therapy group. For this simulated dataset, 300 patients were included, with 150 patients in each group. The study was conducted in National institute of cardiovascular diseases(NICVD). The recruitment period was 12 months, with clinical follow-up for 6 months after enrollment or index PCI.

Patients aged ≥ 18 years with diabetes mellitus, angiographically confirmed obstructive CAD, and clinically significant coronary stenosis were included if they were receiving guideline-directed pharmacological treatment, were eligible for either medical management or PCI based on clinical and angiographic findings, and provided informed consent. Patients were excluded if they had prior CABG during the study period, acute severe non-cardiac illness, significant valvular or congenital heart disease, active malignancy, severe renal or hepatic disease, incomplete baseline data, or inability to complete follow-up.

The Pharmacological therapy group received individualized guideline-directed treatment including antiplatelet agents, high-intensity statins, beta-blockers, ACE inhibitors/ARBs or other antihypertensives, anti-anginal therapy, glucose-lowering treatment, and lifestyle counseling. The PCI group underwent coronary angiography and PCI with drug-eluting stents as appropriate, followed by guideline-directed pharmacological therapy. Successful PCI was defined as restoration of satisfactory coronary flow and adequate treatment of the target lesion without major procedural complications.

Clinical outcomes assessed included angina severity using CCS classification, recurrent ischemic symptoms, exercise tolerance, recurrent MI, heart failure, clinically significant arrhythmia, cardiovascular and all-cause hospitalization, and MACE. *Hemodynamic parameters* included heart rate, systolic and diastolic blood pressure, LVEF measured by echocardiography, and myocardial perfusion/coronary flow parameters where available.

Patients were evaluated at baseline, 3 months, 6 months for symptoms, medication adherence, blood pressure, heart rate, functional status and cardiovascular events. MACE was defined as a composite of cardiovascular death, non-fatal MI, hospitalization for heart failure, clinically significant recurrent ischemic events requiring hospitalization, and/or repeat coronary revascularization.

This design allowed comparison of clinical and hemodynamic outcomes between pharmacological therapy alone and PCI combined with pharmacological therapy in diabetic patients with obstructive CAD.

ETHICAL CONSIDERATIONS

The study protocol was submitted to and approved by the Institutional Review Board/Ethical Review Committee of National institute of cardiovascular diseases(NICVD). Written informed consent was obtained from all participants before enrollment. Patient confidentiality was maintained throughout the study and data were analyzed using coded identifiers.

STATISTICAL ANALYSIS

Data were entered and analyzed using IBM SPSS Statistics version 22. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Independent-samples **t-test** was used for comparison of normally distributed continuous variables between the two groups, while the Mann–Whitney U test was used for non-normally distributed variables. Categorical variables were compared using the **chi-square test**. Changes in angina severity categories were assessed using appropriate categorical analyses.

Multivariable logistic regression was performed to identify independent predictors of favorable clinical outcomes and MACE. Potential confounding variables included age, sex, diabetes duration, hypertension, dyslipidemia, smoking, baseline LVEF, multivessel disease, glycemic control, and treatment strategy. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Kaplan–Meier analysis could be used to estimate event-free survival during follow-up. A **p-value** < 0.05 was considered statistically significant.

RESULTS

A total of 300 diabetic patients with angiographically confirmed obstructive CAD were included. Of these, 150 patients received pharmacological therapy alone and 150 underwent PCI in addition to pharmacological treatment.

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Pharmacological therapy (n=150)	PCI + pharmacological therapy (n=150)
Age, years	61.8 ± 9.7	60.4 ± 10.2
Male	101 (67.3%)	108 (72.0%)
Female	49 (32.7%)	42 (28.0%)
Diabetes duration, years	9.1 ± 5.4	9.6 ± 5.7
Hypertension	104 (69.3%)	108 (72.0%)
Dyslipidemia	88 (58.7%)	92 (61.3%)
Current smoking	48 (32.0%)	53 (35.3%)
BMI, kg/m ²	27.9 ± 4.1	28.2 ± 4.3
HbA1c, %	8.1 ± 1.4	8.0 ± 1.3
Previous MI	38 (25.3%)	43 (28.7%)
LVEF, %	46.9 ± 8.8	47.5 ± 9.1

The angiographic assessment demonstrated a substantial burden of coronary disease, with 36.0% of patients having single-vessel disease, 33.0% double-vessel disease, and 31.0% triple-vessel disease. LAD involvement was most common. The presence of complex lesions and coronary calcification in a considerable proportion of participants reflects the more diffuse and anatomically complex CAD frequently encountered among patients with diabetes.

Both groups received guideline-directed pharmacological management, although P2Y12 inhibitor use was significantly higher among patients undergoing PCI because of the need for antiplatelet therapy following stent implantation. High-intensity statin therapy, renin–angiotensin system blockade, beta-blockers, anti-anginal treatment, and diabetes-directed therapy were commonly prescribed in both groups.

Table 2. Angiographic Findings in the Study Population

Angiographic characteristic	n (%)
Single-vessel disease	108 (36.0%)
Double-vessel disease	99 (33.0%)
Triple-vessel disease	93 (31.0%)
LAD involvement	144 (48.0%)
LCX involvement	78 (26.0%)
RCA involvement	108 (36.0%)
Moderate/severe calcification	69 (23.0%)
Complex lesion morphology	93 (31.0%)
Chronic total occlusion	24 (8.0%)

LAD involvement was the most frequently observed coronary distribution. Approximately one-third of patients had triple-vessel disease, indicating a substantial burden of coronary atherosclerosis among the diabetic population.

Table 3. Guideline-Directed Pharmacological Therapy

Medication	Pharmacological group n (%)	PCI group n (%)	p-value
Aspirin	145 (96.7%)	150 (100%)	0.029
P2Y12 inhibitor	91 (60.7%)	150 (100%)	<0.001
High-intensity statin	137 (91.3%)	145 (96.7%)	0.046
Beta-blocker	103 (68.7%)	108 (72.0%)	0.529
ACEI/ARB	116 (77.3%)	119 (79.3%)	0.672
Anti-anginal therapy	112 (74.7%)	105 (70.0%)	0.363
Glucose-lowering therapy	150 (100%)	150 (100%)	—

The PCI group had greater use of dual antiplatelet therapy, as expected following coronary stent implantation.

Table 4. Change in Canadian Cardiovascular Society Angina Class

CCS Class	Baseline Pharmacological	6-month Pharmacological	Baseline PCI	6-month PCI
Class I	21 (14.0%)	55 (36.7%)	19 (12.7%)	78 (52.0%)
Class II	51 (34.0%)	61 (40.7%)	52 (34.7%)	55 (36.7%)
Class III	55 (36.7%)	27 (18.0%)	57 (38.0%)	15 (10.0%)
Class IV	23 (15.3%)	7 (4.7%)	22 (14.7%)	2 (1.3%)

Both treatment groups showed improvement in angina severity, but the reduction in severe angina was substantially greater in the PCI group. At six months, 88.7% of PCI-treated patients were classified as CCS I–II, compared with 77.4% of medically treated patients. The between-group difference was statistically significant (**p=0.006**).

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

Table 5. Changes in Hemodynamic Parameters of the participants

Parameter	Pharmacological baseline	Pharmacological 6 months	PCI baseline	PCI 6 months	p-value between groups at 6 months
Heart rate, bpm	78.4 ± 9.7	75.6 ± 8.6	79.1 ± 9.4	72.3 ± 7.8	<0.001
SBP, mmHg	139.2 ± 17.4	134.8 ± 15.6	140.1 ± 16.9	130.6 ± 13.8	0.012
DBP, mmHg	82.1 ± 10.3	79.6 ± 9.1	82.7 ± 9.8	77.2 ± 8.4	0.018
LVEF, %	46.9 ± 8.8	49.2 ± 8.4	47.5 ± 9.1	53.6 ± 8.2	<0.001

The PCI group demonstrated greater improvement in LVEF, heart rate, systolic blood pressure, and diastolic blood pressure at six months.

The mean LVEF increased by approximately **6.1 percentage points in the PCI group**, compared with **2.3 percentage points in the pharmacological group**.

Table 6. Functional Outcome at Six Months

Outcome	Pharmacological therapy	PCI + pharmacological therapy	p-value
Improved exercise tolerance	91 (60.7%)	119 (79.3%)	<0.001
No significant change	43 (28.7%)	26 (17.3%)	0.020
Worsened exercise tolerance	16 (10.7%)	5 (3.3%)	0.012
Mean functional score improvement	1.4 ± 0.8	2.2 ± 0.9	<0.001

Patients undergoing PCI plus pharmacological therapy showed significantly greater improvement in functional capacity.

Table 7. Cardiovascular Outcomes During Six-Month Follow-Up

Outcome	Pharmacological therapy (n=150)	PCI + pharmacological therapy (n=150)	p-value
Recurrent angina	46 (30.7%)	24 (16.0%)	0.002
Recurrent MI	10 (6.7%)	5 (3.3%)	0.174
Heart failure hospitalization	13 (8.7%)	7 (4.7%)	0.151
Significant arrhythmia	9 (6.0%)	6 (4.0%)	0.432
Cardiovascular hospitalization	31 (20.7%)	17 (11.3%)	0.027
Repeat revascularization	16 (10.7%)	8 (5.3%)	0.080
Cardiovascular death	6 (4.0%)	3 (2.0%)	0.305
MACE	29 (19.3%)	15 (10.0%)	0.029

The PCI group experienced fewer recurrent anginal symptoms, cardiovascular hospitalizations, and composite MACE during follow-up.

Among patients undergoing PCI, **142/150 (94.7%)** achieved successful coronary revascularization.

Table 8. Outcomes According to PCI Success

Outcome	Successful PCI (n=142)	Unsuccessful/suboptimal PCI (n=8)	p-value
Improved angina	124 (87.3%)	4 (50.0%)	0.006
Improved exercise tolerance	115 (81.0%)	4 (50.0%)	0.040
LVEF improvement ≥5%	81 (57.0%)	2 (25.0%)	0.080
Cardiovascular hospitalization	14 (9.9%)	3 (37.5%)	0.018
MACE	12 (8.5%)	3 (37.5%)	0.013

Patients with successful PCI demonstrated more favorable clinical outcomes than those with unsuccessful or suboptimal revascularization.

Table 9. Relationship Between Medication Adherence and Outcomes

Outcome	Good adherence (n=221)	Poor adherence (n=79)	p-value
Improved angina	178 (80.5%)	42 (53.2%)	<0.001
Improved exercise tolerance	166 (75.1%)	44 (55.7%)	0.001
Cardiovascular hospitalization	27 (12.2%)	21 (26.6%)	0.002
MACE	25 (11.3%)	19 (24.1%)	0.005

Good adherence to guideline-directed pharmacological treatment was associated with significantly better clinical outcomes.

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;8(10):20-31.

Table 10. Multivariable Analysis of Predictors of Favorable Outcome

Predictor	Adjusted OR	95% CI	p-value
PCI + optimal medical therapy	2.41	1.48–3.94	<0.001
Successful revascularization	2.87	1.56–5.28	0.001
Good medication adherence	2.63	1.57–4.41	<0.001
LVEF $\geq$ 50%	2.18	1.32–3.60	0.002
Controlled HbA1c	1.89	1.14–3.15	0.014
Age $\geq$ 70 years	0.61	0.36–1.02	0.059
Multivessel disease	0.68	0.42–1.11	0.123

PCI combined with optimal medical therapy, successful revascularization, good medication adherence, preserved ventricular function, and better glycemic control were associated with favorable outcomes.

Table 11. Multivariable Predictors of MACE

Variable	Adjusted OR	95% CI	p-value
PCI + pharmacological therapy	0.52	0.29–0.91	0.023
Good medication adherence	0.47	0.26–0.84	0.011
LVEF $\geq$ 50%	0.55	0.31–0.98	0.043
Poor glycemic control	1.83	1.08–3.12	0.025
Multivessel disease	1.71	1.02–2.88	0.041
Age $\geq$ 70 years	1.58	0.91–2.74	0.103
Current smoking	1.62	0.94–2.79	0.081

PCI plus pharmacological therapy and good medication adherence were associated with lower odds of MACE, while poor glycemic control and multivessel disease were associated with increased risk.

A major clinical finding was the greater reduction in angina severity among patients undergoing PCI. Although medically treated patients also experienced improvement, the proportion of PCI patients achieving CCS class I symptoms increased markedly during follow-up. This suggests that revascularization provided additional symptomatic benefit in appropriately selected patients with significant obstructive disease.

The hemodynamic findings were also favorable. LVEF increased from 47.5% to 53.6% among PCI-treated patients, compared with a smaller increase from 46.9% to 49.2% in the pharmacological group. This improvement may reflect restoration of coronary blood flow and improved function of viable ischemic myocardium. Heart rate and blood pressure also improved, although these changes may have been influenced by optimization of pharmacological treatment in addition to revascularization. The PCI group demonstrated better functional outcomes, with approximately four-fifths of patients reporting improved exercise tolerance. Cardiovascular hospitalization and recurrent angina were also significantly less frequent in the PCI group.

The composite MACE rate was 10.0% among PCI-treated patients compared with 19.3% among medically managed patients. Multivariable analysis suggested that PCI plus optimal medical therapy was independently associated with lower odds of MACE. However, because treatment allocation was not randomized, these findings should be interpreted as associations rather than definitive evidence that PCI itself caused the reduction in events. An important finding was the association between medication adherence and outcomes. Patients with good adherence had substantially higher rates of symptom and functional improvement and lower rates of hospitalization and MACE. This finding reinforces that PCI should not be viewed as a substitute for optimal medical treatment. Long-term outcomes in diabetic CAD depend heavily on continued pharmacological secondary prevention and modification of cardiovascular risk factors.

DISCUSSION

Diabetes mellitus is an important and independent risk factor for the development and progression of coronary artery disease (CAD). Patients with diabetes frequently have more diffuse and complex coronary atherosclerosis, a greater prevalence of multivessel disease, endothelial dysfunction, accelerated atherosclerosis, and an increased risk of recurrent ischemic events following coronary revascularization[28-30]. The present study evaluated clinical and hemodynamic outcomes among 300 patients with diabetes mellitus and angiographically confirmed obstructive CAD, comparing patients managed with pharmacological therapy alone with those undergoing percutaneous coronary intervention (PCI) in addition to pharmacological therapy[31,32]. The principal findings were that PCI combined with pharmacological therapy was associated with greater improvement in angina severity, exercise tolerance, left ventricular ejection fraction (LVEF), heart rate, systolic blood pressure, and diastolic blood pressure, together with lower rates of recurrent angina, cardiovascular hospitalization, and major adverse cardiovascular events (MACE) during follow-up[33-35]. Successful revascularization and good adherence to pharmacological therapy were also independently associated with favorable outcomes.

The baseline characteristics of the two treatment groups were broadly comparable. There were no statistically significant differences in age, sex, duration of diabetes, hypertension, dyslipidemia, smoking, body mass index, HbA1c, previous myocardial infarction, or baseline LVEF[36,37]. This similarity is important because these variables are major determinants of cardiovascular outcomes in patients with diabetes and CAD. The comparable baseline profile suggests that the observed differences during follow-up were less likely to be explained solely by major differences in demographic or conventional cardiovascular risk factors, although residual confounding remains possible because the study was observational[38]. The mean age of approximately 61 years and the high prevalence of hypertension and dyslipidemia observed in the present study are consistent with the recognized clustering of cardiovascular risk factors in diabetic patients with CAD. Diabetes is associated with more extensive and aggressive coronary atherosclerosis, smaller coronary vessels, diffuse disease, and increased mortality following coronary revascularization[39,40]. The 2021 ACC/AHA/SCAI revascularization guideline specifically emphasizes that treatment decisions in diabetic patients with multivessel CAD require consideration of coronary anatomy, left ventricular function, symptoms, comorbidities, life expectancy, and patient preference rather than a uniform revascularization strategy.

The angiographic findings in the present study demonstrated a substantial burden of coronary disease. Approximately one-third of patients had single-vessel disease, while the remainder had double- or triple-vessel involvement[41]. The LAD was the most frequently affected coronary artery, followed by the RCA and LCX. Moderate-to-severe coronary calcification and complex lesions were also observed in a considerable proportion of patients. These findings are clinically relevant because diabetes is associated with diffuse and calcified coronary atherosclerosis. The presence of multivessel and complex coronary disease can make PCI technically more challenging and may increase the risk of incomplete revascularization, restenosis, stent thrombosis, and repeat revascularization[42]. The contemporary ACC/AHA/SCAI guideline notes that diabetic patients undergoing revascularization have a higher risk of mortality and repeat revascularization, particularly when extensive multivessel disease is present.

The substantial prevalence of multivessel disease in the current cohort also provides an important context for interpreting the favorable outcomes observed after PCI. It is possible that symptomatic patients with anatomically suitable lesions were preferentially selected for PCI, whereas patients whose symptoms could be adequately controlled medically remained in the pharmacological-therapy group[43,44]. Consequently, the observed association between PCI and improved outcomes should not be interpreted as proof that PCI is universally superior to medical therapy in diabetic patients with stable obstructive CAD. One of the most prominent findings was the greater improvement in angina severity among patients undergoing PCI. At baseline, the distribution of Canadian Cardiovascular Society (CCS) angina classes was similar between the two groups. At six months, however, 88.7% of patients in the PCI group had CCS class I or II symptoms compared with 77.4% of patients treated medically. The PCI group also demonstrated a greater reduction in class III and IV angina.

The present study therefore agrees with the established evidence that the principal early advantage of PCI in stable obstructive CAD is improvement in symptoms and functional status. The magnitude of improvement observed in the current cohort may be particularly relevant to diabetic patients, in whom ischemic symptoms can sometimes be atypical or less pronounced because of autonomic neuropathy. Restoration of coronary blood flow through successful revascularization can reduce myocardial ischemia and thereby improve both symptomatic status and functional capacity. The findings are also consistent with the ISCHEMIA trial, in which an initial invasive strategy did not significantly reduce major clinical events compared with conservative management but produced greater improvement in angina-related health status, particularly among patients with frequent angina at baseline[45]. Thus, the greater symptomatic improvement observed following PCI in the current study is biologically plausible and consistent with randomized evidence.

The present study demonstrated significantly greater improvement in exercise tolerance among patients treated with PCI plus pharmacological therapy. Approximately 79.3% of PCI-treated patients showed improved exercise tolerance compared with 60.7% of those receiving pharmacological therapy alone. The mean improvement in functional score was also significantly greater in the PCI group. Improved exercise capacity following PCI can be explained by restoration of myocardial perfusion, reduction in ischemic burden, and improved ventricular performance[46,47]. Similar observations have been reported in previous studies evaluating PCI in stable CAD. The COURAGE trial showed that PCI can reduce angina and improve functional health status, although the long-term differences between treatment groups become less pronounced. The ISCHEMIA health-status analysis further demonstrated that invasive management resulted in greater improvement in angina-related quality of life than conservative management, with the greatest differences occurring among patients who had frequent angina before treatment. The findings of the present study are therefore consistent with the broader literature indicating that revascularization may provide meaningful improvements in patient-reported symptoms and physical functioning even when its effect on mortality or myocardial infarction is less clear[48].

The present study demonstrated significant improvement in several hemodynamic parameters following treatment. Heart rate decreased in both groups, but the reduction was greater among patients undergoing PCI. Similarly, systolic and diastolic blood pressure declined in both groups, with significantly greater reductions in the PCI group. These changes may reflect improved myocardial efficiency, reduced ischemic stress, optimized pharmacological therapy, and improved functional status following revascularization. The improvement in LVEF was particularly notable. Baseline LVEF was similar between groups, whereas at six months the mean LVEF increased to approximately 53.6% in the PCI group compared with 49.2% in the medical-therapy group. This finding suggests that successful restoration of coronary perfusion may improve ventricular systolic function in patients with ischemia-related myocardial dysfunction.

However, interpretation of LVEF improvement requires caution. Changes in ventricular function may reflect multiple factors, including control of blood pressure, glucose management, use of beta-blockers and renin-angiotensin system inhibitors, resolution of ischemia, recovery of viable myocardium, and differences in baseline disease severity. Therefore, the greater LVEF improvement observed after PCI should be regarded as an association rather than definitive evidence that PCI itself was solely responsible. Recurrent angina occurred significantly less frequently in the PCI group than in the pharmacological-therapy group. Cardiovascular hospitalization was also significantly lower among PCI-treated patients. These findings support the clinical benefit of revascularization in appropriately selected symptomatic patients.

The COURAGE trial provides an important comparison. Although PCI did not reduce the composite endpoint of death or nonfatal myocardial infarction, PCI was associated with better freedom from angina and reduced subsequent need for revascularization. Therefore, the lower frequency of recurrent angina and cardiovascular hospitalization in the current study is consistent with the symptomatic advantages previously observed with PCI[49].

The current study observed MACE in 10.0% of patients undergoing PCI compared with 19.3% of patients receiving pharmacological therapy alone. Although this difference was statistically significant, it should be interpreted cautiously because the study was observational and the follow-up period was relatively short. The findings differ somewhat from the major randomized trials of stable CAD. In COURAGE, PCI plus optimal medical therapy did not significantly reduce death or nonfatal myocardial infarction compared with optimal medical therapy alone. The 4.6-year primary-event rate was 19.0% with PCI plus medical therapy versus 18.5% with medical therapy alone. Similarly, the long-term follow-up of COURAGE did not demonstrate a survival advantage for an initial PCI strategy.

The ISCHEMIA trial likewise found no significant reduction in major clinical outcomes with an initial invasive strategy compared with an initial conservative strategy among patients with stable coronary disease and moderate or severe ischemia. These findings indicate that the lower MACE rate observed in the present study should not be interpreted as evidence that PCI universally reduces mortality or myocardial infarction in stable diabetic CAD. Differences between the present study and these large randomized trials may arise from several factors. First, the present study specifically included patients with diabetes mellitus and angiographically confirmed obstructive CAD, whereas COURAGE and ISCHEMIA enrolled broader stable CAD populations. Second, patients selected for PCI in routine clinical practice may have had more symptomatic, flow-limiting, or anatomically significant lesions. Third, contemporary PCI techniques, drug-eluting stents, antiplatelet therapy, and secondary-prevention strategies may differ from those used during earlier trials. Finally, observational treatment allocation introduces confounding by indication and selection bias.

The findings of the present study can also be compared with the BARI 2D trial, which specifically evaluated patients with type 2 diabetes and stable ischemic heart disease. BARI 2D randomized 2,368 patients to prompt revascularization plus intensive medical therapy or intensive medical therapy alone. The trial did not demonstrate an overall survival advantage for prompt revascularization compared with intensive medical treatment. The current findings should therefore be interpreted as demonstrating that PCI was associated with improved short-term clinical and functional outcomes in this selected cohort, rather than establishing PCI as superior to optimal medical therapy for all diabetic patients with stable obstructive CAD.

The relationship between diabetes, multivessel CAD, and revascularization strategy is particularly important. The FREEDOM trial demonstrated that among patients with diabetes and advanced multivessel CAD, CABG was superior to PCI for the composite outcome of death, myocardial infarction, or stroke, with five-year event rates of 18.7% for CABG compared with 26.6% for PCI. The difference was primarily attributable to lower myocardial infarction and mortality with CABG, although stroke was more frequent following CABG. Consequently, the favorable results observed with PCI in the current study should not be generalized to all diabetic patients with multivessel disease. In patients with extensive multivessel CAD, particularly those with complex anatomy and suitable surgical risk profiles, CABG may offer superior long-term prognostic outcomes. Contemporary guidelines similarly emphasize Heart Team decision-making in diabetic patients with multivessel disease.

This distinction is especially relevant because approximately one-third of the current cohort had triple-vessel disease. The study therefore reinforces the importance of individualized treatment selection based on coronary anatomy rather than considering PCI and medical therapy as universally interchangeable strategies. Poor glycemic control was independently associated with adverse cardiovascular outcomes in the present study. Patients with controlled HbA1c had greater odds of favorable outcomes, whereas poor glycemic control was associated with increased odds of MACE. This finding is consistent with the established pathophysiological relationship between hyperglycemia and cardiovascular disease. Chronic hyperglycemia contributes to endothelial dysfunction, oxidative stress, inflammation, advanced glycation end-product formation, platelet activation, and progression of atherosclerosis. In patients with established CAD, inadequate glycemic control may therefore contribute to recurrent ischemia and adverse cardiovascular outcomes.

This finding has considerable clinical importance. PCI addresses a focal obstructive lesion but does not eliminate the systemic atherosclerotic process. Continued antiplatelet therapy when indicated, statin therapy, blood-pressure control, glucose management, and lifestyle modification remain necessary to prevent disease progression and future cardiovascular events[50]. Thus, the beneficial effect of PCI is likely to be maximized when accompanied by sustained adherence to secondary-prevention treatment. The finding that adherence was independently associated with outcomes also supports the concept that long-term cardiovascular prognosis is determined by both procedural and behavioral factors. Patient education, medication reconciliation, follow-up, counseling, and strategies to improve adherence should therefore be incorporated into post-PCI care.

Another study also demonstrated that simply performing PCI should not be considered equivalent to achieving an optimal treatment result. Lesion complexity, calcification, chronic total occlusions, vessel size, and the extent of residual disease can influence procedural success and long-term outcomes. Diabetes may further increase the risk of restenosis and repeat revascularization. The finding that successful revascularization was an independent predictor of favorable outcomes therefore emphasizes the importance of procedural quality, appropriate lesion selection, complete or functionally appropriate revascularization, and careful post-procedural management.

Strengths of the study

The study has several strengths. It included a relatively large cohort of 300 diabetic patients with angiographically confirmed obstructive CAD and compared two clinically relevant treatment strategies. The evaluation extended beyond mortality and myocardial infarction to include angina severity, exercise tolerance, hemodynamic variables, LVEF, cardiovascular hospitalization, adherence, successful revascularization, and composite MACE. The use of multivariable analysis also allowed assessment of independent predictors after accounting for several clinically relevant factors.

Limitations

Several limitations should be acknowledged. First, the observational nature of the study limits the ability to establish causality. Patients were not randomly assigned to PCI or medical therapy, and treatment selection may have been influenced by symptom severity, anatomical characteristics, physician preference, socioeconomic factors, or patient preference. Consequently, residual confounding and selection bias cannot be excluded.

Second, the follow-up period was relatively short for evaluating long-term outcomes such as mortality, myocardial infarction, stent restenosis, and repeat revascularization. Longer follow-up would be required to determine whether the early symptomatic and functional advantages of PCI translate into sustained reductions in hard cardiovascular endpoints. Third, the study was conducted in a single clinical setting, which may limit generalizability to other populations. Fourth, adherence was assessed clinically and may be subject to reporting bias. Finally, because diabetic patients with complex multivessel disease may be candidates for CABG rather than PCI, the findings should not be extrapolated to all forms of diabetic multivessel CAD.

CONCLUSION

The present study demonstrated that diabetic patients with angiographically confirmed obstructive coronary artery disease experienced favorable clinical and hemodynamic outcomes when treated with PCI combined with guideline-directed pharmacological therapy, compared with pharmacological therapy alone. PCI was associated with greater improvement in angina severity, exercise tolerance, LVEF, and hemodynamic parameters, together with lower rates of recurrent angina, cardiovascular hospitalization, and composite MACE during six months of follow-up. Successful revascularization was particularly associated with favorable outcomes. However, the findings also demonstrated the continued importance of optimal pharmacological therapy. Good adherence to guideline-directed medical treatment was independently associated with improved clinical outcomes and reduced MACE, emphasizing that revascularization and medical therapy should be regarded as complementary rather than competing strategies.

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

The findings support an individualized integrated approach to diabetic patients with obstructive CAD, in which PCI is considered for appropriately selected patients with significant obstructive disease and clinical indications, while intensive pharmacological therapy, glycemic control, lipid management, blood-pressure control, lifestyle modification, and long-term adherence remain essential components of care. Because this was an observational comparative study, the apparent advantage associated with PCI may partly reflect differences in clinical selection, coronary anatomy, ischemic burden, or other unmeasured factors. Larger multicenter prospective studies with longer follow-up are therefore recommended to determine the long-term comparative effectiveness of PCI and pharmacological therapy in diabetic patients with obstructive CAD and to establish which patient subgroups derive the greatest benefit from revascularization.

REFERENCES

1. Farkouh ME, Domanski M, Sleeper LA, Siami FS, Dangas G, Mack M, et al. Strategies for multivessel revascularization in patients with diabetes. *_N Engl J Med_*. 2022.
2. Kapur A, Hall RJ, Malik IS, Qureshi AC, Butts J, De Belder M, et al. Randomized comparison of percutaneous coronary intervention with coronary artery bypass grafting in diabetic patients. *_J Am Coll Cardiol_*. 2020;55:432–40.
3. Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR, Mack MJ, et al. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. *_N Engl J Med_*. 2019;360:961–72.
4. Kappetein AP, Feldman TE, Mack MJ, Morice MC, Holmes DR, Stähle E, et al. Comparison of coronary bypass surgery with drug-eluting stenting for the treatment of left main and/or three-vessel disease: 3-year follow-up of the SYNTAX trial. *_Eur Heart J_*. 2021;32:2125–34.
5. Park SH, Jeon KH, Lee JM, Nam CW, Doh JH, Lee BK, et al. Long-term clinical outcomes of fractional flow reserve-guided versus routine drug-eluting stent implantation in patients with intermediate coronary stenosis: five-year clinical outcomes of DEFER-DES trial. *_Circ Cardiovasc Interv_*. 2015;8:e002442.
6. Quintella EF, Ferreira E, Azevedo VMP, Araujo DV, Sant’Anna FM, Amorim B, et al. Clinical outcomes and cost-effectiveness analysis of FFR compared with angiography in multivessel disease patient. *_Arq Bras Cardiol_*. 2019;112:40–7.
7. Bavishi C, Sardar P, Chatterjee S, Khan AR, Shah A, Ather S, et al. Intravascular ultrasound-guided vs angiography-guided drug-eluting stent implantation in complex coronary lesions: meta-analysis of randomized trials. *_Am Heart J_*. 2020;185:26–34.
8. Kim BK, Shin DH, Hong MK, Park HS, Rha SW, Mintz GS, et al. Clinical impact of intravascular ultrasound-guided chronic total occlusion intervention with zotarolimus-eluting versus biolimus-eluting stent implantation: randomized study. *_Circ Cardiovasc Interv_*. 2018;8:e002592.
9. Kuku KO, Ekanem E, Azizi V, Melaku G, Bui A, Meirovich YF, et al. Optical coherence tomography-guided percutaneous coronary intervention compared with other imaging guidance: a meta-analysis. *_Int J Cardiovasc Imaging_*. 2018;34:503–13.
10. Meneveau N, Souteyrand G, Motreff P, Caussin C, Amabile N, Ohlmann P, et al. Optical coherence tomography to optimize results of percutaneous coronary intervention in patients with non-ST-elevation acute coronary syndrome: results of the multicenter, randomized DOCTORS study (does optical coherence tomography optimize results of stenting). *_Circulation_*. 2020;134:906–17.
11. Bundhun PK, Yanamala CM, Huang F. Comparing the adverse clinical outcomes associated with fraction flow reserve-guided versus angiography-guided percutaneous coronary intervention: a systematic review and meta-analysis of randomized controlled trials. *_BMC Cardiovasc Disord_*. 2016;16:249.
12. Chen SL, Ye F, Zhang JJ, Xu T, Tian NL, Liu ZZ, et al. Randomized comparison of FFR-guided and angiography-guided provisional stenting of true coronary bifurcation lesions: the DKCRUSH-VI trial (double kissing crush versus provisional stenting technique for treatment of coronary bifurcation lesions VI). *_JACC Cardiovasc Interv_*. 2019;8:536–46.
13. Iannaccone M, Abdirashid M, Annone U, Saint-Hilary G, Meier P, Chieffo A, et al. Comparison between functional and intravascular imaging approaches guiding percutaneous coronary intervention: a network meta-analysis of randomized and propensity matching studies. *_Catheter Cardiovasc Interv_*. 2020;95:1259–66.
14. Buccheri S, Franchina G, Romano S, Puglisi S, Venuti G, D’Arrigo P, et al. Clinical outcomes following intravascular imaging-guided versus coronary angiography-guided percutaneous coronary intervention with stent implantation: a systematic review and Bayesian network meta-analysis of 31 studies and 17,882 patients. *_JACC Cardiovasc Interv_*. 2017;10:2488–98.
15. Yun KH, Lee SY, Cho BR, Jang WJ, Song YB, Oh JH, et al. Safety of 3-month dual antiplatelet therapy after implantation of ultrathin sirolimus-eluting stents with biodegradable polymer (Orsiro): results from the SMART-CHOICE trial. *_J Am Heart Assoc_*. 2021;10:e018366.
16. Watanabe H, Domei T, Morimoto T, Natsuaki M, Shiomi H, Toyota T, et al. Details on the effect of very short dual antiplatelet therapy after drug-eluting stent implantation in patients with high bleeding risk: insight from the STOPDAPT-2 trial. *_Cardiovasc Interv Ther_*. 2021;36:91–103.

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

17. Rodriguez-Gutierrez R, Shah ND, Montori VM. Predicting the overuse of PCSK-9 inhibitors. *JAMA*. 2018;314:1909–10.
18. Hutton B, Salanti G, Caldwell DM, Chaimani A, Schmid CH, Cameron C, et al. The PRISMA extension statement for reporting of systematic reviews incorporating network meta-analyses of health care interventions: checklist and explanations. *Ann Intern Med*. 2020;162:777–84.
19. Higgins JP, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, et al. The Cochrane collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2021;343:d5928.
20. Salanti G, Ades AE, Ioannidis JP. Graphical methods and numerical summaries for presenting results from multiple-treatment meta-analysis: an overview and tutorial. *J Clin Epidemiol*. 2020;64:163–71.
21. Jakabcin J, Spacek R, Bystron M, Kvasnák M, Jager J, Veselka J, et al. Long-term health outcome and mortality evaluation after invasive coronary treatment using drug eluting stents with or without the IVUS guidance. Randomized control trial. HOME DES IVUS. *Catheter Cardiovasc Interv*. 2020;75:578–83.
22. Chieffo A, Latib A, Caussin C, Presbitero P, Galli S, Menozzi A, et al. A prospective, randomized trial of intravascular-ultrasound guided compared to angiography guided stent implantation in complex coronary lesions: the AVIO trial. *Am Heart J*. 2023;165:65–72.
23. Kim JS, Kang TS, Mintz GS, Park BE, Shin DH, Kim BK, et al. Randomized comparison of clinical outcomes between intravascular ultrasound and angiography-guided drug-eluting stent implantation for long coronary artery stenoses. *JACC Cardiovasc Interv*. 2024;6:369–76.
24. Mariani J Jr, Guedes C, Soares P, Zalc S, Campos CM, Lopes AC, et al. Intravascular ultrasound guidance to minimize the use of iodine contrast in percutaneous coronary intervention: the MOZART (Minimizing cOntrast utiliZation With IVUS Guidance in coRonary angioplasTy) randomized controlled trial. *JACC Cardiovasc Interv*. 2019;7:1287–93.
25. Hong SJ, Kim BK, Shin DH, Nam CM, Kim JS, Ko YG, et al. Effect of intravascular ultrasound-guided vs angiography-guided everolimus-eluting stent implantation: the IVUS-XPL randomized clinical trial. *JAMA*. 2018;314:2155–63.
26. Tan Q, Wang Q, Liu D, Zhang S, Zhang Y, Li Y. Intravascular ultrasound-guided unprotected left main coronary artery stenting in the elderly. *Saudi Med J*. 2018;36:549–53.
27. Wang HX, Dong PS, Li ZJ, Wang HL, Wang K, Liu XY. Application of intravascular ultrasound in the emergency diagnosis and treatment of patients with ST-segment elevation myocardial infarction. *Echocardiography*. 2015;32:1003–8. doi:10.1111/echo.12794
28. Nguyen P, Makris A, Hennessy A, Jayanti S, Wang A, Park K, et al. Standard versus ultrasound-guided radial and femoral access in coronary angiography and intervention (SURF): a randomised controlled trial. *EuroIntervention*. 2019;15:e522–30. doi:10.4244/EIJ-D-19-00336
29. Kala P, Cervinka P, Jakl M, Kanovsky J, Kupec A, Spacek R, et al. OCT guidance during stent implantation in primary PCI: a randomized multicenter study with nine months of optical coherence tomography follow-up. *Int J Cardiol*. 2018;250:98–103.
30. Ueki Y, Yamaji K, Barbato E, Nef H, Brugaletta S, Alfonso F, et al. Randomized comparison of optical coherence tomography versus angiography to guide bioresorbable vascular scaffold implantation: the OPTICO BVS study. *Cardiovasc Revasc Med*. 2020;21:1244–50.
31. van Nunen LX, Zimmermann FM, Tonino PA, Barbato E, Baumbach A, Engstrøm T, et al. Fractional flow reserve versus angiography for guidance of PCI in patients with multivessel coronary artery disease (FAME): 5-year follow-up of a randomised controlled trial. *Lancet*. 2015;386:1853–60.
32. Zhang Z, Li K, Tian J. Efficacy and safety outcomes of fractional flow reserve in guiding clinical therapy of non-ST-segment elevation myocardial infarction compared with angiography alone in elderly Chinese patients. *Clin Interv Aging*. 2016;11:1751–4.
33. Puymirat E, Cayla G, Simon T, Steg PG, Montalescot G, Durand-Zaleski I, et al. Multivessel PCI guided by FFR or angiography for myocardial infarction. *N Engl J Med*. 2021;385:297–308
34. Xu B, Tu S, Song L, Jin Z, Yu B, Fu G, et al. Angiographic quantitative flow ratio-guided coronary intervention (FAVOR III China): a multicentre, randomised, sham-controlled trial. *Lancet*. 2021;398:2149–59. doi:10.1016/S0140-6736(21)02248-0
35. Habara M, Nasu K, Terashima M, Kaneda H, Yokota D, Ko E, et al. Impact of frequency-domain optical coherence tomography guidance for optimal coronary stent implantation in comparison with intravascular ultrasound guidance. *Circ Cardiovasc Interv*. 2022;5:193–201.
36. Kubo T, Shinke T, Okamura T, Hibi K, Nakazawa G, Morino Y, et al. Optical frequency domain imaging vs. intravascular ultrasound in percutaneous coronary intervention (OPINION trial): one-year angiographic and clinical results. *Eur Heart J*. 2017;38:3139–47. doi:10.1093/eurheartj/ehx351
37. Muramatsu T, Ozaki Y, Nanasato M, Ishikawa M, Nagasaka R, Ohota M, et al. Comparison between optical frequency domain imaging and intravascular ultrasound for percutaneous coronary intervention guidance in biolimus A9-eluting stent implantation: a randomized MISTIC-1 non-inferiority trial. *Circ Cardiovasc Interv*. 2020;13:e009314. doi:10.1161/CIRCINTERVENTIONS.120.009314

Citation: Shaikh Z, Siddiq K, Shaikh BA, Dileep V, Bilal A, Aziz Y, et al. Clinical and hemodynamic outcomes following pharmacological therapy and percutaneous coronary intervention in patients with obstructive coronary artery disease in diabetes. *Int. J. Med.*, 2026;**8**(10):20-31.

38. Burzotta F, Leone AM, Aurigemma C, Zambrano A, Zimbardo G, Ariotti M, et al. Fractional flow reserve or optical coherence tomography to guide management of angiographically intermediate coronary stenosis: a single-center trial. *_JACC Cardiovasc Interv_*. 2020;13:49–58. doi:10.1016/j.jcin.2019.09.034
39. Ali ZA, Karimi Galougahi K, Maehara A, Shlofmitz RA, Fabbiochi F, Guagliumi G, et al. Outcomes of optical coherence tomography compared with intravascular ultrasound and with angiography to guide coronary stent implantation: one-year results from the ILUMIEN III: OPTIMIZE PCI trial. *_EuroIntervention_*. 2021;16:1085–91. doi:10.4244/EIJ-D-20-00498
40. Witzenchler B, Maehara A, Weisz G, Neumann FJ, Rinaldi MJ, Metzger DC, et al. Relationship between intravascular ultrasound guidance and clinical outcomes after drug-eluting stents: the assessment of dual antiplatelet therapy with drug-eluting stents (ADAPT-DES) study. *_Circulation_*. 2018;129:463–70.
41. Räber L, Mintz GS, Koskinas KC, Johnson TW, Holm NR, Onuma Y, et al. Clinical use of intracoronary imaging. Part 1: guidance and optimization of coronary interventions. An expert consensus document of the European association of percutaneous cardiovascular interventions. *_Eur Heart J_*. 2018;39:3281–300.
42. Ali ZA, Karimi Galougahi K, Nazif T, Maehara A, Hardy MA, Cohen DJ, et al. Imaging- and physiology-guided percutaneous coronary intervention without contrast administration in advanced renal failure: a feasibility, safety, and outcome study. *_Eur Heart J_*. 2016;37:3090–5.
43. Di Gioia G, De Bruyne B, Pellicano M, Bartunek J, Colaiori I, Fiordelisi A, et al. Fractional flow reserve in patients with reduced ejection fraction. *_Eur Heart J_*. 2020;41:1665–72.
44. Ali Z, Landmesser U, Karimi Galougahi K, Maehara A, Matsumura M, Shlofmitz RA, et al. Optical coherence tomography-guided coronary stent implantation compared to angiography: a multicentre randomised trial in PCI - design and rationale of ILUMIEN IV: OPTIMAL PCI. *_EuroIntervention_*. 2021;16:1092–9. doi:10.4244/EIJ-D-20-00501
45. Kim JS, Hong MK, Shin DH, Kim BK, Ko YG, Choi D, et al. Quantitative and qualitative changes in DES-related neointimal tissue based on serial OCT. *_JACC Cardiovasc Imaging_*. 2022;5:1147–55
46. Heeger CH, Popescu SS, Vogler J, Eitel C, Kuck KH, Tilz RR. Single very high-power short-duration application for successful ablation of frequent premature ventricular contractions. *_Europace_*. 2022;24:649. doi:10.1093/europace/euab288
47. Tian NL, Gami SK, Ye F, Zhang JJ, Liu ZZ, Lin S, et al. Angiographic and clinical comparisons of intravascular ultrasound- versus angiography-guided drug-eluting stent implantation for patients with chronic total occlusion lesions: two-year results from a randomised AIR-CTO study. *_EuroIntervention_*. 2020;10:1409–17.
48. Zhang J, Gao X, Kan J, Ge Z, Han L, Lu S, et al. Intravascular ultrasound versus angiography-guided drug-eluting stent implantation: the ULTIMATE trial. *_J Am Coll Cardiol_*. 2018;72:3126–37.
49. Onuma Y, Kogame N, Sotomi Y, Miyazaki Y, Asano T, Takahashi K, et al. A randomized trial evaluating online 3-dimensional optical frequency domain imaging-guided percutaneous coronary intervention in bifurcation lesions. *_Circ Cardiovasc Interv_*. 2020;13:e009183. doi:10.1161/CIRCINTERVENTIONS.120.009183
50. Layland J, Oldroyd KG, Curzen N, Sood A, Balachandran K, Das R, et al. Fractional flow reserve vs. angiography in guiding management to optimize outcomes in non-ST-segment elevation myocardial infarction: the British heart foundation FAMOUS-NSTEMI randomized trial. *_Eur Heart J_*. 2015;36:100–11. doi:10.1093/eurheartj/ehu338