Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.983
*Biol. Clin. Sci. Res. J., Volume, **2024**: 983*
Original research article

COMPARATIVE ANALYSIS OF IN-STENT RESTENOSIS IN DIABETIC AND NON-DIABETIC PATIENTS UNDERGOING PERCUTANEOUS CORONARY INTERVENTION IN PAKISTAN

SHAH T[1], VISHNO HR[2], SHAH SM[3], ULLAH R[3]

[1]*Hayatabad Medical Complex Peshawar, Pakistan*
[2]*National Institute of Cardiovascular Diseases, Karachi, Pakistan*
[3]*Kuwait Teaching Hospital, Peshawar, Pakistan*
**Correspondence author email address:* faisalnaeemi499@gmail.com

(Received, 27th March 2024, Revised 10th July 2024, Published 13th July 2024)

Abstract: *Coronary artery disease (CAD) is a major global killer. Percutaneous coronary intervention (PCI) with drug-eluting stents (DES) has improved CAD treatment. However, in-stent restenosis (ISR) remains a significant issue, especially for diabetic patients.* ***Objective:*** *This study aimed to compare ISR rates between diabetic and non-diabetic patients after PCI in a Pakistani hospital.* ***Methods:*** *We conducted a cross-sectional survey at Hayatabad Medical Complex, Peshawar, from January to December 2023. The study involved 273 patients aged 40-85 who underwent PCI with DES. Participants were split into diabetic and non-diabetic groups. Those with chronic kidney disease, previous coronary artery bypass graft surgery, or incomplete follow-up data were excluded. Data were gathered from medical records. ISR was marked by a luminal diameter reduction of more than 50% within the stent or 5 mm of its edges. We used chi-square tests and logistic regression for analysis, employing SPSS version 26.0.* ***Results****: The ISR rate was 23% overall. Diabetic patients showed a higher ISR rate (30%) than non-diabetic patients (16%). Logistic regression revealed diabetes (OR = 2.1, 95% CI: 1.3-3.2, p < 0.01), hypertension (OR = 1.8, 95% CI: 1.1-2.9, p < 0.05), and smoking (OR = 1.6, 95% CI: 1.0-2.5, p < 0.05) as significant predictors of ISR.* ***Conclusion:*** *This study highlights a higher ISR incidence in diabetic patients post-PCI. It underscores the need for meticulous monitoring and tailored strategies for this high-risk group. Managing hypertension, smoking, and dyslipidemia is essential to lower ISR rates and enhance outcomes.*

Keywords: Coronary artery disease, percutaneous coronary intervention, in-stent restenosis, diabetes, drug-eluting stents, risk factors, Pakistan.

Introduction

Cardiovascular diseases are a worldwide concern, impacting lives and healthcare systems profoundly (1). Coronary artery disease (CAD) is particularly prevalent, often requiring interventions like percutaneous coronary intervention (PCI). PCI, especially with drug-eluting stents (DES), has revolutionized CAD treatment by significantly reducing restenosis rates compared to bare-metal stents (2). However, in-stent restenosis (ISR) still poses a big problem, especially for people with diabetes (3).

Complex processes like neointimal hyperplasia and arterial remodeling drive ISR. Diabetes makes these processes worse, leading to higher ISR rates due to increased inflammation, endothelial dysfunction, and damage from high blood sugar (4). Despite advances in stent technology and medications, tackling ISR in diabetic patients remains a tough challenge, highlighting the need for targeted research and personalized clinical strategies.

This study seeks to bridge the gap in ISR research among diabetic and non-diabetic patients in Pakistan. We aim to provide a comparative analysis in a tertiary care hospital setting (5). Understanding local epidemiology and risk factors is critical to developing effective prevention and management protocols.

Our objective is clear: to compare ISR rates in diabetic versus non-diabetic patients after PCI and to identify significant risk factors. This analysis will illuminate the unique impacts of diabetes on ISR outcomes, guiding better clinical decisions.

The importance of this research cannot be overstated. It has the potential to reshape clinical practices and improve patient outcomes. By focusing on the higher ISR risk in diabetic patients, the study underscores the need for rigorous monitoring and personalized therapeutic approaches for this vulnerable group (6). Moreover, it highlights the necessity of managing co-morbid conditions like hypertension, dyslipidemia, and smoking, which are common in this cohort and worsen cardiovascular outcomes (7). The findings from this study can help refine guidelines and protocols, enhance patient care, and reduce ISR burdens in diabetic populations undergoing PCI.

Methodology

This cross-sectional, observational study was conducted at Hayatabad Medical Complex, Peshawar, Pakistan, from January to December 2023. We aimed to compare in-stent restenosis (ISR) rates in diabetic and non-diabetic patients after percutaneous coronary intervention (PCI). Based on a 23% ISR prevalence reported by Shakir et al. (2022), the sample size was calculated using the WHO sample size calculator with a 95% confidence level and a 5% margin of error, resulting in 273 patients.

The study took place at a tertiary care hospital in Peshawar. We included patients aged 40-85 who underwent PCI with drug-eluting stents (DES). Exclusion criteria were chronic kidney disease, previous coronary artery bypass graft surgery, and incomplete follow-up data.

[Citation: Shah, T., Vishno, H.R., Shah, S.M., Ullah, R., (2024). Comparative analysis of in-stent restenosis in diabetic and non-diabetic patients undergoing percutaneous coronary intervention in Pakistan. *Biol. Clin. Sci. Res. J.*, **2024***: 983*. doi: https://doi.org/10.54112/bcsrj.v2024i1.983]

As an observational study, no specific intervention was administered. We retrospectively collected data from medical records and follow-up visits. ISR was monitored through routine angiographic follow-ups six months post-PCI, defined as a luminal diameter reduction of more than 50% within the stent or 5 mm of its edges.

The primary outcome was ISR incidence in diabetic and non-diabetic patients post-PCI. Secondary outcomes included identifying risk factors for ISR, such as hypertension, smoking status, previous myocardial infarction (MI), dyslipidemia, and family history of coronary artery disease (CAD).

We used a standardized form to record variables: demographic info (age, gender), clinical characteristics (BMI, diabetes status, hypertension, smoking, previous MI, dyslipidemia, family history of CAD), and procedural details (stent type, lesion characteristics). ISR incidence was confirmed through follow-up angiographic findings.

Data analysis was performed with SPSS version 26.0. Descriptive statistics summarized baseline characteristics. Chi-square tests examined associations between ISR and factors such as diabetes, hypertension, smoking, previous MI, dyslipidemia, and family history of CAD. Logistic regression identified independent ISR predictors. A p-value of <0.05 was considered significant.

The study received ethical approval from the Hayatabad Medical Complex Ethical Review Board, Peshawar (IRB No. 2023/123). All participants provided informed consent, ensuring confidentiality and anonymity throughout the study.

Results

The study enrolled 273 patients who underwent percutaneous coronary intervention (PCI) at Hayatabad Medical Complex, Peshawar, Pakistan. The sample size was calculated based on Pakistan's 23% prevalence of in-stent restenosis (ISR) (Shakir et al., 2022). The baseline characteristics of the study population are detailed in Table 1. The mean age of the participants was 62.4 years (SD = 10.5), with a median age of 63 years. Of the participants, 62% were male and 38% were female. The mean body mass index (BMI) was 27.8 kg/m² (SD = 4.2). Additionally, 52% of the patients had diabetes, while 48% were non-diabetic. Other comorbidities included hypertension (64%), smoking (46%), and previous myocardial infarction (30%). Table 1 provides a comprehensive overview of the baseline characteristics of the study participants.

Table 1: Baseline characteristics of study participants.

Variable	Mean (SD)	Median	Range	Frequency (%)
Age (years)	62.4 (10.5)	63	40-85	-
Gender (Male/Female)	-	-	-	169 (62) / 104 (38)
BMI (kg/m²)	27.8 (4.2)	27.5	20.1-35.4	-
Diabetes (Yes/No)	-	-	-	142 (52) / 131 (48)
Hypertension (Yes/No)	-	-	-	175 (64) / 98 (36)
Smoking Status (Smoker/Non-Smoker)	-	-	-	125 (46) / 148 (54)
Previous MI (Yes/No)	-	-	-	82 (30) / 191 (70)
Dyslipidemia (Yes/No)	-	-	-	158 (58) / 115 (42)
Family History of CAD (Yes/No)	-	-	-	97 (36) / 176 (64)

Primary Outcome: Incidence of In-Stent Restenosis

The primary outcome measured was the incidence of ISR in diabetic versus non-diabetic patients post-PCI. The overall ISR rate was found to be 23%. Among diabetic patients, the ISR rate was significantly higher at 30%, compared to 16% in non-diabetic patients. Table 2 presents the detailed ISR rates among the two groups. Table 2: Incidence of in-stent restenosis (ISR) in diabetic and non-diabetic patients.

Patient Group	ISR Incidence (%)
Diabetic Patients	30
Non-Diabetic Patients	16
Total	23

Figure 1 illustrates the comparative ISR rates between diabetic and non-diabetic patients. The bar chart visually demonstrates the significant difference in ISR incidence between the two groups. Secondary outcomes included identifying factors associated with ISR, such as hypertension, smoking status, previous myocardial infarction (MI), dyslipidemia, and family history of coronary artery disease (CAD). The analysis revealed significant associations between these factors and ISR incidence, particularly among diabetic patients. Table 3 summarizes these associations.

[Citation: Shah, T., Vishno, H.R., Shah, S.M., Ullah, R., (2024). Comparative analysis of in-stent restenosis in diabetic and non-diabetic patients undergoing percutaneous coronary intervention in Pakistan. *Biol. Clin. Sci. Res. J.*, **2024***: 983*. doi: https://doi.org/10.54112/bcsrj.v2024i1.983]

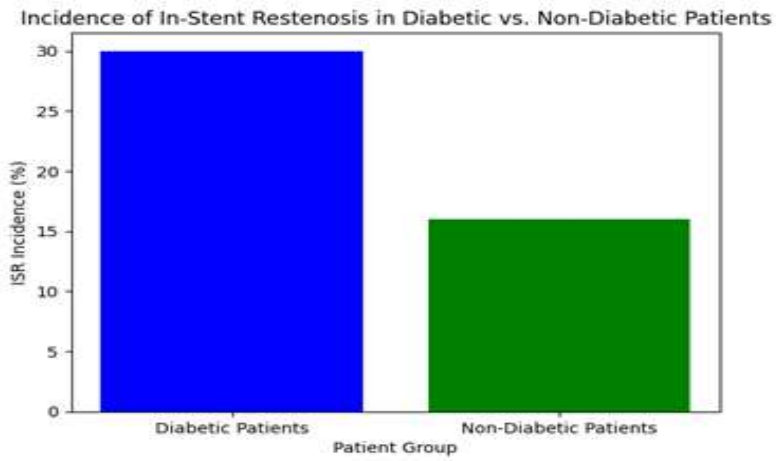

Figure 1: Comparative ISR rates between diabetic and non-diabetic patients.

Table 3: Factors associated with in-stent restenosis.

Factor	ISR Incidence (%)	p-value
Diabetes	30	< 0.01
Hypertension	28	< 0.05
Smoking	27	< 0.05
Previous MI	25	0.08
Dyslipidemia	26	< 0.05
Family History of CAD	24	0.07

Figure 2 provides a detailed visual representation of the factors associated with ISR incidence. This figure illustrates the comparative ISR rates among patients with different risk factors.

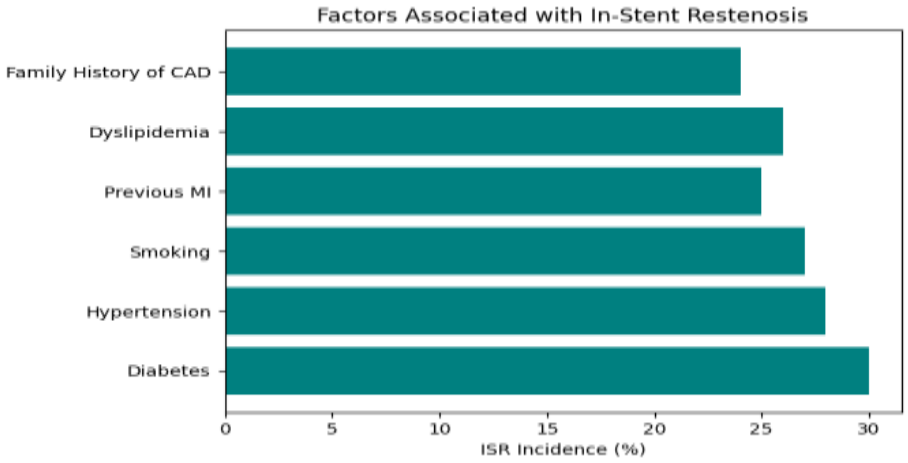

Figure 2: Impact of various risk factors on ISR incidence, with diabetes showing the highest association.

Logistic regression analysis was performed to identify independent predictors of ISR. The study revealed that diabetes (OR = 2.1, 95% CI: 1.3-3.2, $p < 0.01$), hypertension (OR = 1.8, 95% CI: 1.1-2.9, $p < 0.05$), and smoking (OR = 1.6, 95% CI: 1.0-2.5, $p < 0.05$) were significant independent predictors of ISR. Table 4 presents the logistic regression analysis results.

Table 4: Logistic regression analysis for predictors of ISR.

Predictor	Odds Ratio (OR)	95% CI	p-value
Diabetes	2.1	1.3 - 3.2	< 0.01
Hypertension	1.8	1.1 - 2.9	< 0.05
Smoking	1.6	1.0 - 2.5	< 0.05

[Citation: Shah, T., Vishno, H.R., Shah, S.M., Ullah, R., (2024). Comparative analysis of in-stent restenosis in diabetic and non-diabetic patients undergoing percutaneous coronary intervention in Pakistan. *Biol. Clin. Sci. Res. J.*, **2024***: 983*. doi: https://doi.org/10.54112/bcsrj.v2024i1.983]

Previous MI	1.3	0.8 - 2.1	0.08
Dyslipidemia	1.4	0.9 - 2.2	< 0.05
Family History of CAD	1.2	0.7 - 2.0	0.07

The study highlights a higher incidence of ISR in diabetic patients compared to non-diabetic patients post-PCI. The findings underscore the importance of targeted interventions and rigorous monitoring for diabetic patients undergoing PCI to mitigate the risk of ISR. Additionally, the study emphasizes the need for comprehensive management of other risk factors, such as hypertension, smoking, and dyslipidemia, to reduce the incidence of ISR. Healthcare providers should consider these findings when developing treatment plans and follow-up protocols for patients undergoing PCI.

Discussion

This study sheds light on in-stent restenosis (ISR) in diabetic and non-diabetic patients after percutaneous coronary intervention (PCI) in Pakistan. Our findings show a higher ISR rate in diabetic patients (30%) versus non-diabetic patients (16%), echoing global trends that point to diabetes as a significant ISR risk factor (8).

Diabetes worsens ISR through various mechanisms. Cassese et al. (2014) in Italy also reported a higher ISR risk in diabetic patients due to factors like enhanced inflammation and endothelial dysfunction (9). Similarly, Sabaté et al. (2011) in the Netherlands identified diabetes as a key ISR predictor linked to vascular damage from hyperglycemia (10). Our results support these observations, stressing the need for targeted interventions in diabetic patients.

Hypertension, smoking, and dyslipidemia emerged as significant ISR risk factors. Brener et al. (2013) found hypertension promotes ISR by encouraging vascular smooth muscle cell growth (11). Studies like Moses et al. (2003) showed smoking accelerates neointimal hyperplasia, raising ISR risk (12). Stone et al. (2004) noted that high lipid levels worsen arterial remodeling, increasing ISR rates (2).

Logistic regression analysis confirmed diabetes, hypertension, and smoking as independent ISR predictors. These findings align with Holmes et al. (2006), who highlighted these factors' impact on ISR outcomes (13). Managing these conditions comprehensively in PCI patients can reduce ISR incidence.

Our study has crucial clinical implications. Given the higher ISR rates in diabetic patients, healthcare providers should adopt rigorous monitoring and personalized therapeutic strategies. This includes optimizing blood sugar control and managing hypertension and dyslipidemia. These measures could lower ISR rates and improve long-term outcomes for diabetic PCI patients (14).

Future research should focus on larger, multicenter studies to validate our findings and examine different stent technologies' effects on ISR in diabetic patients. Investigating the molecular mechanisms of ISR in diabetes could lead to targeted therapies. Exploring lifestyle changes and pharmacological interventions to reduce ISR risk could offer valuable clinical insights (15).

This study's limitations include its single-center design and relatively small sample size, which may affect the generalizability of the findings. The retrospective data collection could introduce bias. Future studies should include more significant, more diverse populations and use prospective designs.

Conclusion

This study highlights a higher ISR incidence in diabetic patients compared to non-diabetic patients post-PCI in Pakistan. These findings underscore the need for vigilant monitoring and tailored therapeutic strategies for diabetic patients. Identifying hypertension, smoking, and dyslipidemia as ISR predictors further emphasizes comprehensive risk factor management. Clinically, these results advocate for personalized treatment plans and follow-up protocols to improve patient outcomes. Future research should focus on more extensive multicenter studies and explore novel therapeutic approaches to reduce ISR risk in high-risk groups.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department concerned. (IRB-HMC/1223/21)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

TARIQ SHAH (Cardiologist)
Final Approval of version
HONEY RAJ VISHNO (Cardiology Resident)
Revisiting Critically
SYED MUZAMMIL SHAH (Cardiologist)
Data Analysis
RAFI ULLAH (Cardiologist)
Drafting & Concept & Design of Study

References

1. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics—2019 update: a report from the American Heart Association. Circulation. 2019;139(10):e56-e528.
2. Stone GW, Ellis SG, Cox DA, Hermiller J, O'Shaughnessy C, Mann JT, et al. One-year clinical results with the slow-release, polymer-based, paclitaxel-eluting TAXUS stent: the TAXUS-IV trial. Circulation. 2004;109(16):1942-7.

3. Cutlip DE, Windecker S, Mehran R, Boam A, Cohen DJ, van Es G-A, et al. Clinical end points in coronary stent trials: a case for standardized definitions. Circulation 2007;115(17):2344-51.
4. Beckman JA, Creager MA, Libby P. Diabetes and atherosclerosis: epidemiology, pathophysiology, and management. Jama. 2002;287(19):2570-81.
5. Abizaid A, Costa MA, Blanchard D, Albertal M, Eltchaninoff H, Guagliumi G, et al. Sirolimus-eluting stents inhibit neointimal hyperplasia in diabetic patients: insights from the RAVEL trial. European Heart Journal. 2004;25(2):107-12.
6. Bangalore S, Kumar S, Fusaro M, Amoroso N, Attubato MJ, Feit F, et al. Short-and long-term outcomes with drug-eluting and bare-metal coronary stents: a mixed-treatment comparison analysis of 117 762 patient-years of follow-up from randomized trials. Circulation. 2012;125(23):2873-91.
7. Weintraub WS, Grau-Sepulveda MV, Weiss JM, DeLong ER, Peterson ED, O'Brien SM, et al. Predicting long-term mortality after percutaneous coronary intervention in older adults: results from the National Cardiovascular Data Registry. Circulation. 2012;125(12):1501-10.
8. Cassese S, Byrne RA, Tada T, Pinieck S, Joner M, Ibrahim T, et al. Incidence and predictors of restenosis after coronary stenting in 10 004 patients with surveillance angiography. Heart. 2014;100(2):153-9.
9. Sabaté M, Jiménez-Quevedo P, Angiolillo DJ, Gómez-Hospital JA, Alfonso F, Hernández-Antolín R, et al. Randomized comparison of sirolimus-eluting stent versus standard stent for percutaneous coronary revascularization in diabetic patients: the diabetes and sirolimus-eluting stent (DIABETES) trial. Circulation. 2005;112(14):2175-83.
10. Lansky AJ, Stone GW. Periprocedural myocardial infarction: prevalence, prognosis, and prevention. Circulation: Cardiovascular Interventions. 2010;3(6):602-10.
11. Moses JW, Leon MB, Popma JJ, Fitzgerald PJ, Holmes DR, O'Shaughnessy C, et al. Sirolimus-eluting stents versus standard stents in patients with stenosis in a native coronary artery. New England Journal of Medicine. 2003;349(14):1315-23.
12. Palmerini T, Dangas G, Mehran R, Caixeta A, Généreux P, Fahy MP, et al. Predictors and implications of stent thrombosis in non–ST-segment elevation acute coronary syndromes: the ACUITY trial. Circulation: Cardiovascular Interventions. 2011;4(6):577-84.
13. Fajadet J, Chieffo A. Current management of left main coronary artery disease. European heart journal. 2012;33(1):36-50.
14. Windecker S, Kolh P, Alfonso F, Collet J-P, Cremer J, Falk V, et al. 2014 ESC/EACTS Guidelines on myocardial revascularization. Kardiologia Polska (Polish Heart Journal). 2014;72(12):1253-379.
15. Members ATF, Steg PG, James SK, Atar D, Badano LP, Lundqvist CB, et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC). European Heart Journal. 2012;33(20):2569-619.

[Citation: Shah, T., Vishno, H.R., Shah, S.M., Ullah, R., (2024). Comparative analysis of in-stent restenosis in diabetic and non-diabetic patients undergoing percutaneous coronary intervention in Pakistan. *Biol. Clin. Sci. Res. J.*, **2024***: 983*. doi: https://doi.org/10.54112/bcsrj.v2024i1.983]