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Original Research Article

A Hospital Based Observational Study Evaluating the Outcomes of Primary Angioplasty in Myocardial Infarction in Diabetics and Non-Diabetics

Mukesh Shandilya[1], Ravivishnu Prasad[2]

[1]Senior Resident (Academic) Department of Cardiology, IGIMS, PATNA, Bihar, India
[2]Additional Professor, Department of Cardiology, IGIMS, PATNA, Bihar, India

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Corresponding Author: Dr. Mukesh Shandilya
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Abstract

Aim: The aim of the present study was to assess the outcomes of primary angioplasty in myocardial infarction as a comparison between diabetics and non-diabetics.

Methods: The present study was conducted in the Department of Cardiology, IGIMS, PATNA, Bihar for the period of one year. 100 patients were included in the diabetic group and 100 subjects in the non-diabetic group.

Results: Diabetic patients had worse cardiac risk factor profiles and initial presentation characteristics. Left ventricular ejection fraction was lower and multivessel disease (>50% diameter steno- sis in ≥2 coronary arteries) was more common in diabetics. However, diabetic subjects had a higher incidence of TIMI flow ≥2 before PCI. Fewer diabetic than nondiabetic patients underwent primary PCI. Diabetics who underwent PCI were more likely to have baseline TIMI flow ≤1 but otherwise had similar baseline clinical and angiographic characteristics as diabetics who did not undergo PCI. Bypass surgery during the initial hospitalization was performed more frequently in diabetics. The 2 groups were similar with respect to maximum balloon diameter (an indicator of vessel diameter), use of stents and intravenous abciximab and final stenosis and TIMI flow. Diabetics who had primary PCI had higher in-hospital mortality than nondiabetics who had PCI. At 6-month follow-up, diabetics who underwent primary PCI had higher incidences of death and tended to have higher MACE rates, but also had similar reinfarction and ischemia-driven TVR rates as nondiabetics who underwent primary PCI.

Conclusion: We concluded that diabetics with AMI have less favorable baseline characteristics and are less likely to undergo primary PCI than nondiabetics. Despite excellent angiographic results, diabetics had significantly worse 6-month mortality.

Keywords: Outcomes, Primary Angioplasty, Myocardial Infarction, Diabetics, Non-Diabetics.

Introduction

The relation between diabetes and coronary artery disease is marked by two circumstances: the high incidence of coronary artery disease in diabetic patients and its poor prognosis in diabetics compared to non-diabetics. It is estimated that more than 50% of adult diabetics have significant coronary atherosclerosis, a prevalence 10 times greater than that of the general population, which is about 2%-4%. [1-3] In fact, at present diabetes is considered not only a risk factor, but also a marker of cardiovascular disease from the point of view of prevention. Consequently, the recommended prevention interventions are the same for diabetics as for patients with coronary artery disease. [3,4] Diabetes not only increases the incidence of coronary disease, but also contributes to a less favorable prognosis. Thus, cardiovascular mortality is twice as frequent in diabetic men and four times as frequent in diabetic women. In general, if we analyze any subgroup of diabetics with coronary artery disease, they have a worse long-term clinical evolution in terms of cardiovascular morbidity and mortality. [2,3]

Patients with diabetes mellitus (DM) and acute myocardial infarction (AMI) are at high risk for recurrent cardiovascular events [5,6], in part due to a greater tendency towards thrombosis. [7,8] Diabetics are characterized by increased platelet reactivity [9] including higher reactivity while on antiplatelet treatment. [10,11] ST-segment elevation myocardial infarction (STEMI) is characterized by a highly prothrombotic state [12], the highest of which can be observed in diabetic STEMI patients. [13]

Primary percutaneous coronary intervention (pPCI) is the most effective and most recommended therapeutic approach in patients with STEMI and in those at very high-risk myocardial infarction without persistent ST-segment elevation (non-STEMI with ongoing ischemia). [14] Prasugrel and ticagrelor are the currently recommended treatment in patients with acute coronary syndromes, including STEMI, since they have been shown to reduce ischemic events compared to clopidogrel. [15]

The aim of the present study was to assess the outcomes of primary angioplasty in myocardial infarction as a comparison between diabetics and non-diabetics.

Materials and Methods

The present study was conducted in the Department of Cardiology, IGIMS, PATNA, Bihar for the period of one year. 100 patients were included in the diabetic group and 100 subjects in the non-diabetic group.

Patients were included if they were ≥18 years old, if symptoms of myocardial infarction had begun <12 hours before written informed consent was requested, and if they had either ST-segment elevation of ≥1 mm in ≥2 contiguous leads or a non diagnostic electrocardiogram (including left bundle branch block, a paced rhythm, ST-segment depression, or T-wave inversion) with documentation of AMI in the catheterization laboratory (i.e., high-grade coronary stenosis and as- sociated left ventricular wall motion abnormalities). Clinical criteria for exclusion were previous administration of thrombolytic agents for the index infarction, current use of warfarin, stroke during the previous month, renal failure, cardiogenic shock, remaining life expectancy of <1 year, childbearing potential (unless the result of a recent pregnancy test was negative), and known contraindications to aspirin or heparin, or contraindications to ticlopidine in later PAMI studies. [16-18] Informed consent was obtained from all patients by the study investigators or coordinators at their respective institutions.

Data collection and comparisons: For each of the clinical trials, research nurses or coordinators at each site collected data prospectively and completed de- tailed case report forms. Independent data monitors traveled to the participating sites to verify hospital records for all patients. Cineangiograms, obtained at the time of the acute coronary intervention, were an- alyzed by the individual operators and subsequently by core laboratories, to assess coronary anatomy, estimate Thrombolysis In Myocardial Infarction (TIMI) flow grades, percentage diameter stenosis, left ventricular ejection fraction, and angiographic outcomes of intervention.

We compared baseline clinical, demographic, and angiographic characteristics (TIMI flow, diameter stenosis, location of infarct-related artery, and multivessel disease) between diabetic and nondiabetic patients. We also compared angiographic outcomes (TIMI flow and diameter stenosis after percutaneous coronary intervention [PCI]), maximum balloon diameter, and utilization of stents and intravenous abciximab be- tween the groups. Core laboratory data were considered incomplete for left ventricular ejection fraction and initial TIMI flow grade; therefore, operator-de-fined data were used for these variables.

Study end-points and definitions: The primary study outcomes included in-hospital mortality, 6-month mortality, and 6-month incidence of major adverse cardiovascular events (MACEs), defined as death, or reinfarction, or ischemia-driven target vessel revascularization (TVR). Reinfarction was defined as recur- rent clinical symptoms (or the development of new electrocardiographic changes) accompanied by new elevation of creatine kinase and creatine kinase-MB enzyme levels. Ischemia-driven TVR was defined as TVR (either PCI or bypass surgery) prompted by symptoms or objective evidence of ischemia.

The incidence of in-hospital complications (pulmonary edema, dialysis, sustained hypotension, cardio- pulmonary resuscitation, disabling stroke, reinfarction, and ischemic TVR) and need for coronary artery bypass graft surgery were also compared between the 2 groups. Sustained hypotension was defined as systolic blood pressure <80 mm Hg unresponsive to intravenous fluids, requiring pressors for >1 hour or intra-aortic balloon pump.

Statistical analysis: All categorical variables are ex-pressed as percentages and continuous variables as mean ± 1 SD. We used the chi-square test or Fisher's 2-sided exact test for comparisons of categorical variables, and the Wilcoxon rank test for comparisons of continuous variables. For comparison of cumulative 6-month mortality rates between the 2 groups, we used Kaplan-Meier survival analysis and the log-rank t test. To assess the independent effect of a history of diabetes on in-hospital and 6-month outcomes, we performed multivariate analyses using Cox propoional hazards regression (for 6-month mortality) or step-down multiple logistic regression (for other clinical outcomes that showed an univariate association with diabetes [p <0.05]). Baseline clinical and angiographic variables that showed a significant or border- line univariate association (p <0.10) with a history of diabetes were included in the multivariate analyses. Adjusted odds ratios (ORs) (or hazard ratios) and 95% confidence intervals (CIs) were calculated for each variable in the final

model. History of diabetes mellitus remained in these models, irrespective of its significance.

Results

Table 1: Baseline Clinical Characteristics

Variables	Diabetic group (n = 100)	Non-diabetic group 0 (n = 100)	p Value
Age (years) Women	62 ± 12	58 ± 10	<0.0001
Systemic hypertension Peripheral vascular disease Current smoker	40%	28%	<0.0001
	65%	41%	<0.0001
Chronic obstructive pulmonary disease Dyslipidemia	15%	7%	<0.0001
	30%	44%	<0.0001
Cerebrovascular accident Prior angina pectoris	7%	4%	0.22
	44%	40%	0.18
Prior myocardial infarction Prior PCI	9%	5%	<0.0001
Prior heart failure	22%	18%	0.075
Prior coronary artery bypass grafting	22%	15%	<0.0001
Initial presentation			
Killip class ≥2	16%	9%	<0.0001
Heart rate (beats/min) Heart rate >100 beats/min	6%	2%	<0.0001
	8%	5%	0.003
Systolic blood pressure (mm Hg)	17%	13%	0.007
Systolic blood pressure <100 mm Hg†	90 ± 18	88 ± 22	<0.0001
Aspirin before intervention	25%	22%	0.062
Intravenous heparin before intervention	117 ± 23	112 ± 28	0.001
Time from symptom onset to arrival at emergency department (min)	28%	34%	0.020
	90%	89%	0840
Time from arrival at emergency depart-ment to balloon inflation (min)	82%	85%	0.066
	174 ± 166	158 ± 176	0.044
	162 ± 220	138 ± 140	0.0005

Diabetic patients had worse cardiac risk factor profiles and initial presentation characteristics.

Table 2: Angiographic Characteristics

	Diabetic group	Non-diabetic group	p Value
Baseline angiographic characteris-tics Ejection fraction (%)	46 ± 14	49 ± 11	0.0046
TIMI flow before intervention	70%	75%	0.0007
0–1	30%	25%	
2–3	44%	42%	0.78
Infarct-related coronary artery Left anterior descending Right	42%	43%	0.64
	15%	15%	0.76
Left circumflex Multivessel disease	62%	48%	<0.0001
Underwent PCI	87%	90%	0.007
PCI characteristics	3.2 ± 0.5	3.2 ± 0.5	0.70
Maximum balloon size (mm)§	32	35	0.24
Stent implantation Intravenous abciximab	9.8%	9.2%	0.70
	94%	95%	0.60
Final TIMI 3 flow	20 ± 16	20 ± 16	0.96
Final diameter stenosis (%)			

Left ventricular ejection fraction was lower and multivessel disease (>50% diameter steno- sis in ≥2 coronary arteries) was more common in diabetics. However, diabetic subjects had a higher incidence of TIMI flow ≥2 before PCI. Fewer diabetic than nondiabetic patients underwent primary PCI. Diabetics who underwent PCI were more likely to have baseline TIMI flow ≤1 but otherwise had similar baseline clinical and angiographic characteristics as diabetics who did not undergo PCI. Bypass surgery during the initial hospitalization was performed more frequently in diabetics. The 2 groups were similar with respect to maximum balloon diameter (an indicator of vessel diameter), use of stents and intravenous abciximab and final stenosis and TIMI flow.

Table 3: Six-Month Outcomes

6-Months Outcomes	Diabetes Mellitus		Unadjusted Hazard Ratio	p Value
	Present	Absent		
Intention-to-treat analysis				
Death	9%	4%	1.94	<0.0001
MACE	18%	15%	1.25	0.032
Reinfarction	4%	3%	1.20	0.42
I-TVR	8%	10%	0.84	0.20
Subset analysis of patients who had PCI	7%	4%	1.86	0.0003
Death	18%	16%	1.22	0.07
MACE	4%	3%	1.18	0.50
Reinfarction I-TVR	9%	12%	0.88	0.36

Diabetics who had primary PCI had higher in-hospital mortality than nondiabetics who had PCI. At 6-month follow-up, diabetics who underwent primary PCI had higher incidences of death and tended to have higher MACE rates, but also had similar reinfarction and ischemia-driven TVR rates as nondiabetics who underwent primary PCI.

Discussion

Although thrombolytic therapy has improved outcomes among diabetics with AMI [19], their outcomes remain unacceptably poor. The underlying mechanisms for these poor outcomes are not clearly understood; diabetics undergoing thrombolysis in the Global Utilization of Streptokinase and TPA (alteplase) for Occluded Coronary Arteries (GUSTO-I) study had similarly-sized or smaller infarctions compared with nondiabetics, similar 90-min patency rates, comparable 30-day reinfarction rates and equivalent left ventricular systolic function, yet their adjusted 30-day mortality was significantly higher. [20]

Primary angioplasty is an alternative strategy to achieve reperfusion in AMI [21], but the effect of diabetic status on angiographic and clinical outcomes of this strategy have not been well documented. Primary angioplasty may be less successful among diabetics owing to the more extensive atherosclerosis, impaired microvascular autoregulation and prothrombotic and vasospastic effects of diabetes. [22,23] Diabetic patients had worse cardiac risk factor profiles and initial presentation characteristics. Left ventricular ejection fraction was lower and multivessel disease (>50% diameter steno- sis in ≥2 coronary arteries) was more common in diabetics. However, diabetic subjects had a higher incidence of TIMI flow ≥2 before PCI. Fewer diabetic than nondiabetic patients underwent primary PCI. Diabetics who underwent PCI were more likely to have baseline TIMI flow ≤1 but otherwise had similar baseline clinical and angiographic characteristics as diabetics who did not undergo PCI. Bypass surgery during the initial hospitalization was performed more frequently in diabetics.

The 2 groups were similar with respect to maximum balloon diameter (an indicator of vessel diameter), use of stents and intravenous abciximab and final stenosis and TIMI flow. Diabetics who had primary PCI had higher in-hospital mortality than nondiabetics who had PCI. At 6-month follow-up, diabetics who underwent primary PCI had higher incidences of death and tended to have higher MACE rates, but also had similar reinfarction and ischemia-driven TVR rates as nondiabetics who underwent primary PCI. Consistent with prior studies [24-26] we found that patients with diabetes who had AMI had worse base- line clinical characteristics, such as older age and later presentation, were more likely to be women, and had higher atherosclerotic burden (i.e., higher incidence of peripheral vascular disease, prior cerebrovascular accident, myocardial infarction, PCI, or coronary artery bypass graft surgery, and multivessel coronary dis- ease). Unlike 1 angiographic study that showed more severe stenosis and poorer flow in the infarct-related artery [27], diabetics in our study had better baseline TIMI flow than nondiabetics. Given the similar utilization of adjunctive medical therapy—aspirin, intra- venous heparin, and abciximab—between the groups, this finding is surprising. It is possible that the longer time from chest pain onset to treatment in diabetics allowed more endogenous reperfusion, and thus better baseline TIMI flow. Alternatively, one could argue that this finding reflects selection bias, because diabetic patients with poor TIMI flow may have been excluded because of cardiogenic shock at presentation or death before arrival to the hospital.

Conclusion

We concluded that diabetics with AMI have less favorable baseline characteristics and are less likely to undergo primary PCI than nondiabetics. Despite excellent angiographic results, diabetics had significantly worse 6-month mortality.

References

1. Fein F. Heart disease in diabetes mellitus: theory and practice. Diabetes mellitus: theory and practice. 1990:812-23.
2. Boden WE. Management of patients with diabetes and coronary artery disease. Medical management of diabetes and Heart disease. New York: Marcel Deker Inc. 2002 Mar 6:185 -209.
3. Douglas Jr JS. Special therapeutic considerations: coronary interventions and coronary surgery. Medical management of diabetes and Heart disease. New York: Marcel Dekker Inc. 2002 Mar 6:231-57.
4. Expert Panel on Detection E. Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). Jama. 2001 May 16;285 (19):2486-97.
5. James S, Angiolillo DJ, Cornel JH, Erlinge D, Husted S, Kontny F, Maya J, Nicolau JC, Spinar J, Storey RF, Stevens SR, Wallentin L; PLATO Study Group. Ticagrelor vs. clopidogrel in patients with acute coronary syndromes and diabetes: a substudy from the PLATelet inhibition and patient Outcomes (PLATO) trial. Eur Heart J. 2010 Dec;31(24): 3006-16.
6. Norhammar A, Malmberg K, Diderholm E, Lagerqvist B, Lindahl B, Rydén L, Wallentin L. Diabetes mellitus: the major risk factor in unstable coronary artery disease even after consideration of the extent of coronary artery disease and benefits of revascularization. J Am Coll Cardiol. 2004 Feb 18;43(4):585-91.
7. Norhammar A, Malmberg K, Rydén L, Tornvall P, Stenestrand U, Wallentin L; Register of Information and Knowledge about Swedish Heart Intensive Care Admission (RIKS-HIA). Under utilisation of evidence-based treatment partially explains for the unfavourable prognosis in diabetic patients with acute myocardial infarction. Eur Heart J. 2003 May;24(9):838-44.
8. Sobel BE. Optimizing cardiovascular outcomes in diabetes mellitus. Am J Med. 2007 Sep;120(9 Suppl 2):S3-11.
9. Colwell JA, Halushka PV, Sarji K, Levine J, Sagel J, Nair RM. Altered platelet function in diabetes mellitus. Diabetes. 1976;25(2 SUPPL): 826-31.
10. Angiolillo DJ, Bernardo E, Sabaté M, Jimenez-Quevedo P, Costa MA, Palazuelos J, Hernández-Antolin R, Moreno R, Escaned J, Alfonso F, Bañuelos C, Guzman LA, Bass TA, Macaya C, Fernandez-Ortiz A. Impact of platelet reactivity on cardiovascular outcomes in patients with type 2 diabetes mellitus and coronary artery disease. J Am Coll Cardiol. 2007 Oct 16; 50(16):1541-7.
11. Angiolillo DJ, Shoemaker SB, Desai B, Yuan H, Charlton RK, Bernardo E, Zenni MM, Guzman LA, Bass TA, Costa MA. Randomized comparison of a high clopidogrel maintenance dose in patients with diabetes mellitus and coronary artery disease: results of the Optimizing Antiplatelet Therapy in Diabetes Mellitus (OPTIMUS) study. Circulation. 2007 Feb 13;115(6):708-16.
12. Knudsen EC, Seljeflot I, Abdelnoor M, Eritsland J, Mangschau A, Müller C, Arnesen H, Andersen GØ. Elevated levels of PAI-1 activity and t-PA antigen are associated with newly diagnosed abnormal glucose regulation in patients with ST-elevation myocardial infarction. J Thromb Haemost. 2011 Aug;9(8): 1468-74.
13. Jakl M, Sevcik R, Fatorova I, Horacek JM, Pudil R. High on-treatment platelet reactivity: risk factors and 5-year outcomes in patients with acute myocardial infarction. Anatol J Cardiol. 2017 Feb;17(2):113-118.
14. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U, Byrne RA, Collet JP, Falk V, Head SJ, Juni P, Kastrati A, Koller A, Kristensen SD, Niebauer J, Richter DJ, Seferović PM, Sibbing D, Stefanini GG, Windecker S, Yadav R, Zembala MO. 2018 ESC/EACTS Guidelines onmyocardial revascularization [2018 ESC/EACTS Guidelines on myocardial revascularization]. Kardiol Pol. 2018;76(12):1585-1664.
15. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, Goudevenos JA, Halvorsen S, Hindricks G, Kastrati A, Lenzen MJ, Prescott E, Roffi M, Valgimigli M, Varenhorst C, Vranckx P, Widimský P; ESC Scientific Document Group. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2018 Jan 7;39(2):119-177.
16. Stone GW, Brodie BR, Griffin JJ, Morice MC, Costantini C, St. Goar FG, Overlie PA, Popma JJ, McDonnell J, Jones D, O'Neill WW. Prospective, multicenter study of the safety and feasibility of primary stenting in acute myocardial infarction: in-hospital and 30-day results of the PAMI stent pilot trial. Journal of the American College of Cardiology. 1998 Jan; 31(1):23-30.
17. Stone GW, Brodie BR, Griffin JJ, Costantini C, Morice MC, St. Goar FG, Overlie PA, Popma JJ, McDonnell J, Jones D, O'Neill

WW. Clinical and angiographic follow-up after primary stenting in acute myocardial infarction: the Primary Angioplasty in Myocardial Infarction (PAMI) stent pilot trial. Circulation. 1999 Mar 30;99(12):1548-54.
18. Grines CL, Cox DA, Stone GW, Garcia E, Mattos LA, Giambartolomei A, Brodie BR, Madonna O, Eijgelshoven M, Lansky AJ, O'Neill WW. Coronary angioplasty with or without stent implantation for acute myocardial infarction. New England Journal of Medicine. 1999 Dec 23;341(26):1949-56.
19. Trialists FT. Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. The lancet. 1994 Feb 5;343(8893):311-22.
20. Woodfield SL, Lundergan CF, Reiner JS, Greenhouse SW, Thompson MA, Rohrbeck SC, Deychak Y, Simoons ML, Califf RM, Topol EJ, Ross AM. Angiographic findings and outcome in diabetic patients treated with thrombolytic therapy for acute myocardial infarction: the GUSTO-I experience. Journal of the American College of Cardiology. 1996 Dec ;28(7):1661-9.
21. Weaver WD, Simes RJ, Betriu A. Primary coronary angioplasty vs. intravenous thrombolysis for treatment of acute myocardial infarction: a quantitative overview of their comparative effectiveness. JAMA. 1997;278(23):2093-8.
22. Aronson D, Rayfield EJ, Chesebro JH. Mechanisms determining course and outcome of diabetic patients who have had acute myocardial infarction. Annals of internal medicine. 1997 Feb 15;126(4):296-306.
23. McGill JB, Schneider DJ, Arfken CL, Lucore CL, Sobel BE. Factors responsible for impaired fibrinolysis in obese subjects and NIDDM patients. Diabetes. 1994 Jan 1;43(1): 104-9.
24. Granger CB, Califf RM, Young S, Candela R, Samara J, Worley S, Kereiakes DJ, Topol EJ. Outcome of patients with diabetes mellitus and acute myocardial infarction treated with thrombolytic agents. Journal of the American College of Cardiology. 1993 Mar 15;21(4):9 20-5.
25. Mak KH, Moliterno DJ, Granger CB, Miller DP, White HD, Wilcox RG, Califf RM, Topol EJ, GUSTO-I Investigators. Influence of diabetes mellitus on clinical outcome in the thrombolytic era of acute myocardial infarction. Journal of the American College of Cardiology. 1997 Jul;30(1):171-9.
26. Waldecker B, Waas WO, Haberbosch W, Voss R, Steen-Müller MK, Hiddessen AN, Bretzel RE, Tillmanns HA. Type 2 diabetes and acute myocardial infarction. Angiographic findings and results of an invasive therapeutic approach in type 2 diabetic versus nondiabetic patients. Diabetes Care. 1999 Nov 1;22(11):1832-8.
27. Hasdai D, Granger CB, Srivatsa SS, Criger DA, Ellis SG, Califf RM, Topol EJ, Holmes DR. Diabetes mellitus and outcome after primary coronary angioplasty for acute myocardial infarction: lessons from the GUSTO-IIb angioplasty substudy. Journal of the American College of Cardiology. 2000 May;35(6):1502-12.