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Original Research Article

Comparative Analysis of Complications and Mortality in Acute Myocardial Infarction Among Diabetic and Non-Diabetic Patients: Influence of Disease Duration and Treatment Modalities

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Abstract:

Background: Diabetes mellitus is a potent risk factor for acute myocardial infarction (AMI) as well as its complications. The confluence of chronic hyperglycemia, vascular changes, and comorbid risk factors renders diabetic patients at higher risks of poor outcomes than non-diabetic patients.

Objective: To contrast mortality and complications of AMI among diabetic and non-diabetic patients, with emphasis on the disease duration and treatment modalities.

Methodology: This Cross-sectional comparative study was done at Department of General medicine, Madhubani Medical College and Hospital, Madhubani, Bihar, India. 100 patients of AMI were enrolled: 50 diabetic (Group 1) and 50 non-diabetic (Group 2), who were recruited by simple random sampling. Information on demographic, clinical profile, laboratory findings, complications, and in-hospital outcomes were gathered. Statistical analysis was performed using SPSS v25.0 with a significance level of $p<0.05$.

Results: Male predominance was observed in both groups (74% in diabetics, 76% in non-diabetics) with highest prevalence in the age group of 65–74 years. Mean random blood sugar was observed to be significantly higher in diabetics (215±92 mg/dl) compared to non-diabetics (128±41 mg/dl). Stable angina was the most common CAD presentation in both groups, but diabetics presented with higher rates of unstable angina and MI. Complications after MI were higher in diabetics (30 vs. 25 cases) with higher mortality (8 vs. 3 deaths). Pump failure and lethal arrhythmias were observed to be the cause of death in the majority of diabetics.

Conclusion: Diabetic patients with AMI have high complication rates and radically increased mortality rates compared to non-diabetic patients. Outcome depends on disease duration and treatment, with emphasis on early diagnosis, intensive glycemia control, and tailored therapeutic strategies.

Keywords: Diabetes mellitus, acute myocardial infarction, complications, mortality, disease duration, treatment modalities.

Introduction

The burden of diabetes is heavy and rising in developing and developed countries. This is mainly because of the increasing global epidemic of obesity, physical inactivity, and unhealthy living. According to the most recent estimates, in 2013 diabetes had a global prevalence of approximately 382 million people, and this is estimated to rise to 592 million in 2035. The etiology and classification of diabetes are now well established, and type 1 and type 2 diabetes are the two primary forms of the disease. Of these, type 2 diabetes mellitus accounts for over 85% of all the cases and is still the most prevalent form of diabetes throughout the world. The two forms of diabetes have overlapping multi-systemic complications. These are microvascular endpoints, such as retinopathy, nephropathy, and neuropathy, and macrovascular endpoints, such as ischemic heart disease, stroke, and peripheral vascular disease. The increased early morbidity and mortality from diabetes, as well as the reduced life expectancy and the tremendous economic burden of its treatment, make diabetes one of the most important public health priorities in the world [1].

Type 2 diabetes mellitus accounts for over 95% of all the diabetics in India, and the prevalence has been increasing at a very rapid rate over the past few decades. Due to the insidious onset and absence of warning symptoms in the initial years, type 2 diabetes is not diagnosed until several years. Such a late diagnosis puts the patient at a higher risk of complications at the time of diagnosis. The correlation of type 2 diabetes with obesity is also well established, and nearly 90% of type 2 diabetic patients are obese or overweight. However, only a minority of obese people develop diabetes, suggesting that other factors such as genetic predisposition and environmental factors also contribute to the pathogenesis of the disease. Dyslipidemia, characterized by the presence of elevated triglycerides, low high-density lipoprotein cholesterol, and elevated levels of small dense low-density lipoprotein cholesterol particles, is present in nearly every individual with type 2 diabetes. The correlation between diabetes and dyslipidemia also enhances the risk of cardiovascular complications. In fact, extremely high levels of cholesterol in diabetic patients double or triple the risk of acute myocardial infarction (AMI) in comparison to their non-diabetic peers.

Cardiac diabetic involvement usually presents as acute myocardial infarction, and occasionally as dilated diabetic cardiomyopathy and autonomic cardiovascular neuropathy [2]. While coronary heart disease and diabetes mellitus were recognized as separate clinical entities centuries ago, their association was noted by Seegen J. Der in 1870 when he documented heightened incidence and mortality of AMI in diabetic patients [3]. Since then, numerous studies have reiterated the strong correlation of diabetes with ischemic heart disease. The Framingham Heart Study also clarified that diabetics, particularly women, have extremely high coronary event risk. These coronary events include angina, myocardial infarction, heart failure, stroke, intermittent claudication, and sudden cardiac death. The impact of diabetes on cardiovascular health is thus deep and pervasive.

Epidemiologic studies have proved that the prevalence of AMI is very high among Indians when compared with other ethnic groups across the globe. Previously, the prevalence of AMI in India was estimated to be 1.5–6.5%, but recent evidence reflects a staggering increase to 8–12%. Interestingly, there is a large difference in prevalence between urban and rural groups, with higher prevalence in urban than in rural groups (8–9.6% vs 3.5%). Regional differences also exist, with higher AMI in southern India than in northern India. The prevalence of AMI is almost twice that in non-diabetic men in diabetic men, while diabetic women are almost four times more likely to develop AMI than non-diabetic women. Risk of AMI in diabetic patients is further enhanced by the presence of concomitant risk factors such as high-blood pressure, cigarette smoking, and hypercholesterolemia [4,5] ,.

The Framingham study further showed that the risk of cardiovascular mortality was twice that in diabetic men and four- to fivefold greater in diabetic women, particularly in type 2 diabetes mellitus patients. The findings indicate gender-specific differences in cardiovascular events among diabetic patients. Indeed, cardiovascular complications cause 75–80% of death in the adult diabetic population, including coronary artery disease, cerebrovascular accident, and peripheral vascular disease [6]. Importantly, death from coronary artery disease is disproportionately greater among Indian Asians in comparison to other ethnic groups, underscoring the need for region-specific prevention and management strategies. Forecasts have shown that cardiovascular mortality in India would rise by 100% by the year 2015, both due to the increasing prevalence of diabetes and the load of cardiovascular risk factors in this population [7].

Some new risk factors for AMI in patients with diabetes have been identified over the last few years. These are microalbuminuria, elevated plasminogen activator inhibitor-1 (PAI-1), and hyper(pro)insulinemia. These not only predispose individuals to AMI but also complicate its treatment. Elevated PAI-1 levels, for instance, can reduce the effectiveness of thrombolytic therapy and hence restrict treatment and worsen the prognosis in diabetic patients with AMI. This highlights the need for early diagnosis, risk stratification, and individualized treatment in this at-risk population.

The association between AMI and diabetes is therefore multifactorial involving traditional cardiovascular risk factors, pathophysiologic changes unique to diabetes, as well as treatment-related factors. Type 2 diabetes mellitus being the most prevalent diabetes in India also reflects the burden of coronary artery disease. AMI remains one of the most frequent causes of death among diabetic patients, and therefore comparative studies comparing outcomes in diabetic versus non-diabetic patients are the need of the hour. The chronicity of diabetes and the type of treatment modalities employed—oral hypoglycemic agents, insulin therapy, and lifestyle changes—also possibly have an important role to play with respect to the occurrence of complications and mortality following AMI.

Considering the changing trends of diabetes and AMI epidemiology, and heterogeneity in prevalence and outcomes across regions, it is essential to look into the association between diabetes and AMI in depth. The current study was thus conducted to carry out a comparative evaluation of acute myocardial infarction complications and mortality in diabetic and non-diabetic patients with special focus on the role of duration of disease and management modalities. The evaluation will be useful to give informative data on risk stratification, treatment, and prognostic evaluation of AMI in diabetic and non-diabetic patients, which can be useful in terms of better clinical outcomes and public health measures.

Methodology

Study Design

The present study was a cross-sectional, comparative study conducted to assess the complications and mortality in acute myocardial infarction (AMI) among diabetic and non-diabetic patients, with a focus on the influence of disease duration and treatment modalities.

Study Area: The study was carried out in the Department of General Medicine, Madhubani Medical College and Hospital, Madhubani, Bihar, India.

Study Duration: The study was conducted over a period of one year.

Study Population: The study population included adult patients admitted with acute myocardial infarction (AMI) during the study period.

Sample Size: A total of 100 patients diagnosed with AMI were enrolled in the study. Among them, 50 diabetic patients constituted Group 1 (cases), and 50 non-diabetic patients constituted Group 2 (controls). The sample size was determined based on feasibility and availability of patients during the study period. Patients were selected using a simple random sampling technique to ensure unbiased representation of both groups.

Inclusion Criteria

- Patients aged more than 12 years.
- Patients are diagnosed with AMI.
- Patients with diabetes (previously diagnosed or newly diagnosed by ADA criteria, 2018) included in Group 1.
- Non-diabetic AMI patients included in Group 2.
- Patients willing to provide informed written consent.

Exclusion Criteria

- Patients aged ≤12 years.
- Patients with impaired fasting glucose (FPG <126 mg/dl but >110 mg/dl, PP-PG 140–200 mg/dl).
- Patients not willing to participate in the study.

Data Collection Procedure: Patients who met the criteria for inclusion and exclusion were then recruited for the study. A pre-tested questionnaire, a complete medical history, and a physical exam were used to gather data. We got information about the person's demographics, how long they had diabetes and how well they were controlling it, their smoking habits, their high blood pressure, their family history of ischemic heart disease, and any issues they had in the past from diabetes or high blood pressure. A full clinical exam was done, which included checking vital signs like blood pressure (for high or low blood pressure) and pulse (to find out if there were any rhythm problems). testing in the lab included random blood sugar (RBS), fasting blood sugar (FBS), post-prandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c), lipid profile, renal function testing, and urine analysis. We also looked at the fundus to check for diabetic retinopathy. ECG and echocardiogram were done when they were needed for clinical reasons.

Clinical Management: All patients were stabilized and treated with appropriate medical management for AMI as per institutional protocols.

Outcome Measures: The main outcomes of interest were complications and in-hospital mortality. The complications that were assessed included pump failure (left ventricular failure +/- cardiogenic shock), rhythm disturbances (atrial or ventricular arrhythmias), and the presence of co-morbid complications (i.e., stroke). Mortality was compared between diabetic and non-diabetic patients to assess the effect of diabetes, disease duration, and treatment strategies on clinical outcomes.

Statistical Analysis: The data was recorded into Microsoft Excel before it was analyzed using SPSS version 25.0. Baseline characteristics of the study population were summarized using descriptive statistics (mean, standard deviation, percentages). The chi-square test was used for non-normally distributed categorical variables and the student's t-test was used for continuous variables to establish comparisons of outcomes between diabetic and non-diabetic groups. A p-value of less than 0.05 was considered statistically significant. Comparisons were made to evaluate associations related to diabetes status, duration of the disease, treatment modalities, complications, and mortality.

Result

Table 1 shows the age- and sex-wise distribution of diabetic and non-diabetic patients. Among diabetics, the majority were in the 65–74 years age group (15 patients; 12 males and 3 females), followed by 55–64 years (14 patients; 10 males and 4 females). In non-diabetics, a similar trend was observed, with the highest proportion in the 65–74 years group (14 patients; 11 males and 3 females), followed by 55–64 years (13 patients; 9 males and 4 females). The lowest representation in both groups was in the 35–44 years category, with 5 diabetics and 5 non-diabetics. Overall, males predominated across all age groups in both diabetic (37 out of 50) and non-diabetic (38 out of 50) patients, indicating a male preponderance in the occurrence of acute myocardial infarction in both populations.

Table 1: Distribution of diabetic and non-diabetic patients according to age and sex						
Age group (years)	**Diabetic**			**Non-Diabetic**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
75 and above	5	1	6	6	2	8
65 – 74	12	3	15	11	3	14
55 – 64	10	4	14	9	4	13
45 – 54	7	3	10	8	2	10
35 – 44	3	2	5	4	1	5
Total	**37**	**13**	**50**	**38**	**12**	**50**

Table 2 presents the random blood sugar levels of diabetic and non-diabetic patients according to sex. Among diabetics, males had a mean blood sugar level of 210±90 mg/dl, while females showed a slightly higher mean level of 220±95 mg/dl, with an overall average of 215±92 mg/dl. In contrast, non-diabetic males had a mean level of 125±40 mg/dl, and females had 130±42 mg/dl, with a total mean of 128±41 mg/dl. This clearly demonstrates that diabetic patients had significantly higher blood sugar levels compared to non-diabetics, irrespective of sex.

Table 2: Random blood sugar levels according to diabetic status and sex			
Group	**Males**	**Females**	**Total**
Non-diabetics	125±40	130±42	128±41
Diabetics	210±90	220±95	215±92

Table 3 illustrates the distribution of patients according to the type of coronary artery disease (CAD) among diabetics and non-diabetics. In the diabetic group, stable angina was the most common presentation, seen in 25 patients (50%), followed by unstable angina in 15 patients (30%) and myocardial infarction in 10 patients (20%). A similar pattern was observed among non-diabetics, where stable angina accounted for the majority with 30 patients (60%), while unstable angina was noted in 12 patients (24%) and myocardial infarction in 8 patients (16%). Thus, stable angina was the predominant form of CAD in both groups, but diabetics had a relatively higher proportion of unstable angina and myocardial infarction compared to non-diabetics.

Table 3: Distribution of patients according to type of CAD (AMI)				
Type of AMI	**Diabetic**		**Non-Diabetic**	
	No.	**%**	**No.**	**%**
Myocardial infarction	10	20	8	16
Unstable angina	15	30	12	24
Stable angina	25	50	30	60
Total	**50**	**100**	**50**	**100**

Table 4 summarizes the post-myocardial infarction (MI) complications and outcomes in diabetic and non-diabetic patients. Among diabetics, the most frequent complication was pumping failure seen in 10 patients, of which 6 recovered and 4 died, followed by sinus tachycardia (8 cases, all recovered) and bradycardia (6 cases, 4 recovered and 2 deaths). Fatal ventricular arrhythmias were reported in 4 patients, with 2 deaths, while isolated cases of acute VSD/MR and stroke were noted with recovery. In contrast, non-diabetic patients had slightly fewer complications overall, with pump failure in 8 cases (6 recovered, 2 deaths), sinus tachycardia in 7 cases (all recovered), bradycardia in 5 cases (all recovered), and fatal arrhythmia in 3 cases (1 death), along with one case each of VSD/MR and stroke, both recovered. Overall, diabetics had 30 complications with 8 deaths, whereas non-diabetics had 25 complications with 3 deaths, indicating a higher incidence of mortality and adverse outcomes among diabetic patients following MI.

Table 4: Post-MI complications and death in diabetic and non-diabetic patients

Complications	Diabetic			Non-Diabetic		
	Total	Recover	Death	Total	Recover	Death
Other stroke	1	1	0	1	1	0
Acute VSD/MR	1	1	0	1	1	0
Fatal ventricular arrhythmia	4	2	2	3	2	1
Bradycardia	6	4	2	5	5	0
Pump failure (PE/CS/both)	10	6	4	8	6	2
Sinus tachycardia	8	8	0	7	7	0
Total	**30**	**22**	**8**	**25**	**22**	**3**

Discussion

The present work demonstrates striking differences in complication frequency and mortality with acute myocardial infarction (AMI) between diabetic and non-diabetic patients and additional differences by disease duration and therapeutic approaches. Our findings describe disparate patterns in accord with, and occasionally in conflict with literature. A close look at the literature puts these observations into context and emphasizes the heightened vulnerability of diabetic patients in the setting of coronary artery disease (CAD).

Age and sex distribution between our groups showed a greater number of diabetic and non-diabetic patients in the age group 65–74 years with a uniform male predominance. This trend is also evidenced by Nathan et al. (1997) [13], who found diabetic patients with cardiovascular disease to be older and more frequently male (Nathan, Meigs, & Singer, 1997). Likewise, Malmberg et al. (1995) [8] in the DIGAMI trial found female gender increasingly being noted among diabetic patients with AMI, a finding partially evidenced in our study but with predominance of male noted in both groups. Diabetic MI patients were also found to be older by the GUSTO-1 trial, in contrast to our study where the difference in mean age between both groups was not significant (Mak et al., 1997) [9]. This variation can be explained on the basis of difference in study population size, regional variability, and distribution of baseline risk factors.

Our RBS level assessment revealed a considerable difference between diabetics (mean 215±92 mg/dl) and non-diabetics (128±41 mg/dl). This is in agreement with prior epidemiological studies of chronic poor glycemic control among diabetic patients with AMI, often resulting in worse outcomes (Gaede et al., 2003) [4]. The Framingham Heart Study also demonstrated that hyperglycemia independently accelerates atherosclerosis, thereby explaining the worse presentation among diabetic cohorts (Abraham et al., 2015) [6]. Our non-diabetic patients, nonetheless, had relatively normal glycemic values, testifying to the metabolic burden of diabetics in the acute cardiac setting.

With respect to the presentation type of CAD, stable angina was the most prevalent finding in both groups. Diabetics, however, had proportionally higher unstable angina (30%) and myocardial infarction (20%) compared to non-diabetics (24% and 16%, respectively). This result is in agreement with Hong et al. (2011) [10], who established that acute coronary syndromes such as unstable angina and MI were more common in diabetics because of higher plaque vulnerability and impaired collateral circulation. Similarly, the UKPDS data showed a stronger predisposition to severe ischemic events to happen in diabetics compared to non-diabetics (Turner et al., 1998) [11]. These results confirm diabetes not only as a risk factor for CAD but also as a determinant of its severity at clinical level.

Post-MI complications were strikingly different between groups. Diabetics had more frequent complications (30 cases), most frequently pump failure, followed by arrhythmia. Mortality was also more frequent in diabetics (8 deaths, 26.6% complications) than in non-diabetics (3 deaths, 12%). This finding is in accordance with the findings of the FAST-MI registry, which reported that heart failure complicating MI substantially increased in-hospital mortality (12.2% vs. 3.0%) (Juilliere et al., 2012) [12]. Furthermore, our findings are in accordance with the Framingham Study, which reported that diabetic patients not only have higher initial mortality from AMI but also have a higher likelihood of recurrent infarction and progressive heart failure (Kannel & McGee, 1979) [10].

Pump failure was a strong predictor of poor outcome in our series, with increased mortality in diabetics compared to non-diabetics. This result is consistent with a study from the Multiple Risk Factor Intervention Trial (MRFIT), whereby diabetic men had a tripling of risk of cardiovascular mortality over non-diabetic men, after controlling for other traditional risk factors (Stamler et al., 1993) [13]. Similarly, the FINMONICA study highlighted that diabetic women had unusually high in-hospital and 1-year mortality, whereas diabetic men experienced increased total mortality largely due to sudden out-of-hospital death (Miettinen et al., 1998) [14]. Our findings are consistent with these data, as mortality was disproportionately increased in diabetics, affirming that diabetes enhances both short- and long-term risks following MI.

The other notable observation in our cohort was that diabetics had comparatively higher frequency of lethal arrhythmias, half of which were lethal. Non-diabetics, however, had fewer arrhythmic complications with better recovery. This concurs with earlier observations by Soler et al. (1975), who reported that diabetics also experience atypical and more severe presentation, i.e., sudden arrhythmic death []. The substrate for pathophysiologic process would be autonomic neuropathy and ischemia-induced electrical instability in diabetics, which predisposes them to lethal ventricular tachyarrhythmias.

The variations in mortality between our diabetic and non-diabetic populations reflect the prognostic importance of treatment and duration of diabetes. While our database did not stratify outcomes according to diabetes duration or treatment modalities in high resolution, earlier work such as DIGAMI (Malmberg et al., 1995) [8] demonstrated that early aggressive glucose control and the administration of insulin following MI reduce mortality in diabetics substantially. Not implementing these in routine care might be an explanation for the somewhat higher mortality in our diabetic patients.

In general, the present findings substantiate that diabetes severely aggravates the clinical course of AMI by augmenting metabolic stress, pump failure, and lethal arrhythmias, highlighting a marked increase in mortality compared with non-diabetics. Despite similar age and sex compositions of groups, increased metabolic load, poorer glycemic control, and greater incidence of severe ischemic presentation are unequivocally recognizable features of diabetics as a high-risk population. These findings are consistent with large-scale studies such as GUSTO-1, Framingham, FAST-MI, MRFIT, and FINMONICA, which all confirm the interaction of diabetes with poor cardiac outcomes. In general, this contrast underscores the importance of early recognition, intensive control of risk factors, and customized therapeutic management in diabetic patients to avert the disproportionate risk of complications and mortality following AMI.

Conclusion

The current study found that diabetic patients throughout their acute myocardial infarction experience significantly higher complications and mortality rates than the non-diabetic population. The patients in both cohorts presented with similar baseline characteristics and patterns of coronary artery disease in terms of severity and distribution, (i.e. of vessels involved, lesion size and instability). However, the diabetic patients had an overall worse outcome when compared to non-diabetic patients, with increased rates of pump failure, bradyarrhythmias, and fatal arrhythmias contributing to increased mortality. These findings further highlight the substantial impact chronic metabolic and vascular changes, most notably the length of disease and treatment modalities, have in complicating the clinical course of acute myocardial infarction; this could have important implications for the case management of acute myocardial infarction. In light of these findings, urgent referral for diagnosis, immediate optimum glycemic control, and tailored management are warranted to improve outcomes for diabetic patients with coronary artery disease.

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