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The Study of Mortality in Hospitalized Patients with Impaired Fasting Glucose in Acute Myocardial Infarction

Mahesh Dave[1], Ravi Goyal[2], Saurabh Jain[3], Aniruddha Burli[4]

ABSTRACT

Introduction: Changes in human behavior and lifestyle over the last century have resulted in a dramatic increase in the incidence of diabetes worldwide. Diabetes mellitus is an important cardiovascular risk factor. The rate of death due to cardiovascular disease in diabetic patients is 2-4 times higher than in non-diabetic population. In this study, we aimed to investigate the mortality rate among diabetic, Impaired fasting Glucose and Non-Diabetic groups who are having acute myocardial infarction (AMI) during the first 7 days of hospitalization.

Material and methods: The study was conducted in R.N.T. Medical College and Associated Group of Hospitals in Udaipur (Rajasthan). The main catchment area was rural with few township and municipal area. This study involved Department of General Medicine, Intensive cardiac Care Unit for patient's selection and Departments of Biochemistry, Pathology and Radiology for the necessary laboratory tests and investigation data.

Result: In our study we found that the mortality was 4% in non-diabetic group, 20% in diabetic group and 18% in patients with impaired fasting glucose (IFG). Mortality in patients having IFG and DM were significantly higher compared to NON-DM patients.

Conclusion: In conclusion, mortality in patients having Impaired Fasting Glucose (IFG) and the Diabetes Mellitus (DM) during the acute phase (first 7 days) of Myocardial Infarction (AMI) were significantly higher compared to NON-DM patients; and mortality in patients having IFG was like that of patients having DM.

Keywords: Acute Myocardial Infarction (AMI), Diabetes Mellitus (DM), Impaired Fasting Glucose (IFG) Non-Diabetic (NON-DM)

INTRODUCTION

Changes in human behavior and lifestyle have resulted in a dramatic increase in the incidence of diabetes worldwide. The epidemic is chiefly of type 2 diabetes and the associated conditions known as "diabesity" and "metabolic syndrome". In conjunction with genetic susceptibility, type 2 diabetes in brought on by environmental and behavioral factors such as sedentary lifestyle, overly rich nutrition, obesity and stress.[1] Diabetes mellitus is an important cardiovascular risk factor. The rate of death due to cardiovascular disease in diabetic patients in 2-4 times higher than in non-diabetic population.[1] Impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) are conditions where the plasma glucose level is lower than the required level for the diagnosis of diabetes mellitus (DM) but higher than normal.[1]

In diabetics, coronary artery atherosclerosis is aggressive and has an early onset.[2] It is thought that in the pathogenesis of diabetes, long before overt hyperglycemia occurs and diabetes is diagnosed, there is a long period of insulin resistance, when the blood glucose is maintained at normal levels by compensatory hyperinsulinemia.[3]

In this study, we aimed to investigate the mortality rate among different groups of acute myocardial infarction (AMI) patients during the first 7 days of hospitalization. The patients admitted to Coronary Intensive Care Unit of our hospital due to acute myocardial infarction (AMI) were divided in three groups- (1) the patients with diabetes, (2) patients with IFG and (3) NON-DM patients; and followed up.

Study objectives were to compare the mortality in acute myocardial infarction patients with NON-DM, impaired fasting glucose and DM during first 7 days of hospitalization admitted in Intensive Care Unit of Cardiology Department, MBGH Hospital and RNT Medical College Udaipur.

Specific objectives were to study the patients of acute myocardial infarction DM, impaired fasting glucose and NON-DM, to follow these 3 groups of patients for 7 days and find out the outcome in form of discharged and death and to compare the mortality rate among impaired fasting glucose and diabetic groups and compare with age and sex matched NON-DM group.

MATERIAL AND METHODS

The study was conducted in R.N.T. Medical College and Associated Group of Hospitals in Udaipur (Rajasthan). The study was an Institution based comparative observational cross-sectional study.

This study involved Department of General Medicine and Intensive cardiac Care Unit for patient's selection and Departments of Biochemistry, Pathology and Radiology for

[1]Senior Professor and Head, Department of General Medicine, [2]Senior Resident, Department of General Medicine, [3]Post Graduate Resident, Department of General Medicine, [4]Post Graduate Resident, Department of General Medicine, Rabindra Nath Tagore Medical College and Associated Group of Hospitals, Udaipur Rajasthan, India

Corresponding author: Dr. Saurabh Jain, Room No. 408, Dilshad Bhavan, Chetak Circle, Udaipur - 313001, Rajasthan, India

the necessary laboratory tests and investigation data.

Study population and size

A total of 150 patients admitted in Intensive Cardiac Unit, diagnosed as AMI by clinical and relevant investigations, (Electrocardiogram, Biochemical, Radiological) were selected as cases.

Sample Design

A sample of patients was designed and categorized into three groups, 50 patients having Diabetes Mellitus, 50 with impaired fasting glucose (IFG) and 50 NON-DM patients according to the fasting blood glucose levels of the patients.

NON-DM group: Non-diabetic patients and with a fasting glucose level of <100mg/dl.

IFG group: patients with a fasting glucose level of 100-125 mg/dl (ADA Guidelines 2014).

DM group: patients with a fasting glucose level of ≥126 mg/dl or having history of diabetes mellitus. The patients in these three groups were monitored during their hospitalization periods (first 7 days) and mortality and recovery were investigated.

Inclusion criteria

Patients admitted and diagnosed as case of acute myocardial infarction (AMI) confirmed clinically and with the help of electrocardiography, Echocardiography and cardiac injury markers.

Exclusion criteria

1. Age > 65 years.
2. Rheumatic and congenital heart diseases.
3. Chronic major illnesses like stroke, lung disease like COPD, bronchial asthma, chronic liver disease, renal failure or chronic kidney disease.

Study techniques

A. Data collection: All the patients admitted in Intensive care unit with suspected AMI underwent a careful history, Examination and were investigated to confirm the diagnosis. All these patients were followed up during hospitalization period and their outcome in form of discharged or death were noted.

B. Blood pressure: Blood pressure was measured with standard mercury sphygmomanometer. Hypertension was diagnosed when a patient had received medicine for hypertension or had systolic blood pressure≥140mmHg and/or diastolic blood pressure ≥90mm Hg.

C. Smoking: Patients were classified as non-smoker if they responded that they had smoked fewer than 100 cigarettes or 5 packs of cigarettes during their lifetime.

D. Blood sampling and biochemical assays: Venous blood samples were taken in the morning after an overnight fast for at least 12 hours for biochemical analysis. Plasma glucose and Total Cholesterol were measured by glucose oxidase and enzymatic methods respectively.

E. Electrocardiography and Echocardiography: Electrocardiography and Echocardiography were done in all the patients at the time of hospitalization and at the time of discharge.

F. Cardiac Injury Markers: To confirm the diagnosis of AMI, cardiac injury markers were sent in form of troponin T/I (trop T/I kit) and CPK-MB.

RESULTS

Age distribution

The mean age of the total 150 patients were 53.93 ± 6.04; and in non-DM group it was 52.92 ± 6.60; in IFG group 54.76 ± 5.82; and in DM group 54.10 ± 5.65. There was no significant difference between the mean age distribution among the three study groups ($p=0.307$, more than 0.05).

Sex distribution

In this study of total 150 patients of AMI 127 (84.7%) were

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for mean		Minimum	Maximum
						Lower bound	Upper bound		
CHO	Non-DM	50	203.3	27.7	3.9	195.4	211.1	152.0	272.0
	IFG	50	199.1	26.0	3.6	191.7	206.5	152.0	242.0
	DM	50	200.5	23.6	3.3	193.8	207.2	152.0	242.0
Total		150	200.9	25.7	2.1	196.8	205.1	152.0	272.0
TG	Non-DM	50	181.7	27.6	3.9	173.8	189.5	124.0	236.0
	IFG	50	198.9	30.6	4.3	190.1	207.6	133.0	272.0
	DM	50	225.9	32.0	4.5	216.8	235.0	152.0	280.0
Total		150	202.1	35.1	2.8	196.5	207.8	124.0	280.0
LDL	Non-DM	50	129.0	20.5	2.9	123.1	134.8	86.0	177.0
	IFG	50	126.9	17.5	2.4	121.9	131.8	86.0	156.0
	DM	50	144.7	14.8	2.0	140.5	148.9	102.0	176.0
Total		150	133.5	19.3	1.5	130.4	136.6	86.0	177.0
HDL	Non-DM	50	41.8	3.4	0.4	40.8	42.8	37.0	51.0
	IFG	50	41.7	3.1	0.4	40.8	42.5	36.0	52.0
	DM	50	42.0	3.4	0.4	41.1	43.0	36.0	50.0
Total		150	41.8	3.3	0.2	41.3	42.4	36.0	52.0

Table-1: Descriptive- distribution of mean lipid profile levels in study groups

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Dependent variable	(I) Group	(j) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower bound	Upper bound
TG	Non-DM	IFG	-17.2*	6.0	0.01	-31.5	-2.8
		DM	-44.2*	6.0	0.00	-58.5	-29.9
	IFG	Non-DM	17.2*	6.0	0.01	2.8	31.5
		DM	-27.0*	6.0	0.00	-41.3	-12.7
	DM	Non-DM	44.2*	6.0	0.00	29.9	58.5
		IFG	27.0*	6.0	0.00	12.7	41.3
LDL	Non-DM	IFG	2.1	3.5	0.82	-6.3	10.5
		DM	-15.7*	3.5	0.00	-24.1	-7.3
	IFG	Non-DM	-2.1	3.5	0.82	-10.5	6.3
		DM	-17.8*	3.5	0.00	-26.2	-9.4
	DM	Non-DM	15.7*	3.5	0.00	7.3	24.1
		IFG	17.8*	3.5	0.00	9.4	26.2

*The mean difference is significant at the 0.05 level.

Table-2: Multiple Comparisons by Tukey HSD post hoc test- TG and LDL

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% confidence Interval Lower Bound	Upper Bound
Non-DM	IFG	-26.78*	3.56	.000	-35.23	-18.32
	DM	-106.00*	3.56909	.000	-114.45	-97.54
IFG	Non-DM	26.78*	3.56909	.000	18.32	35.23
	DM	-79.22*	3.56	.000	-87.67	-70.76
DM	Non-DM	106.00*	3.56	.000	97.54	114.45
	IFG	79.22*	3.56	.000	70.76	87.67

Table-3: Multiple Comparisons Tukey HSD Dependent Variable: fasting plasma glucose

Outcome		Age	BMI	FPG	CH	TG	LDL	HDL	SBP	DBP
Discharge	Mean	53.59	27.88	129.10	200.55	198.9535	132.86	42.03	121.44	81.24
	N	129	129	129	129	129	129	129	129	129
	Std Dev.	6.26	2.68	48.02	25.65	32.35	19.97	3.37	15.75	10.32
Death	Mean	56.00	27.70	148.95	203.66	222.09	137.76	41.0	126.14	81.48
	N	21	21	21	21	21	21	21	21	21
	Std Dev.	4.037	2.55	49.149	26.71	34.03	15.12	2.96	16.79	9.29
Total	Mean	53.93	27.86	131.88	200.99	202.19	133.55	41.88	122.10	81.27
	N	150	150	150	150	150	150	150	150	150
	Std Dev.	6.04	2.65	48.51	25.73	35.13	19.39	3.32	15.92	10.16

Table-4: Comparing outcome with mean distribution of age of the patients, Body Mass Index (BMI). serum FPG level, lipid profile and blood pressure-

male and 23 (15.3%) were female. IFG group had 43 male and 7 female patients; and non-DM group and DM group comprised 42 male and 8 female patients each.

From the cross tabulation between gender distribution among the three study groups it was evident that there was no significant difference in gender distribution (p=0.95).

Smoking
32.7% patients were smoker and 67.3% patients were non-smoker. All the females were non-smoker. Among males 49 patients out of 127 i.e., (38.58%) are smoker. Of which 18 patients (42.85%) in non-DM group; 15 patients (34.88%) in IFG group; and 16 patients (38.09%) in DM group.

It was evident that there was no significant difference in the smoking habits among all three groups (p=0.809).

Hypertension
Among 150 patients 44.7% were hypertensive and 55.3%

were non-hypertensive. Out of which 19 patients (38%) in non-DM group, 20 patients (40%) in IFG group and 28 patients (56%) in DM group were found hypertensive.

It was observed that a greater number of patients were found hypertensive in DM group, but the difference was not significant (p=0.140).

Lipid profile
Serum levels of total cholesterol, triglyceride, LDL and HDL are compared among three study groups and analyzed.

Table 1: Descriptive- distribution of mean lipid profile levels in study groups

The mean serum cholesterol level is 200.99±25.73; and it was 203.30±27.73 in non-DM group; 199.14±26.00 in IFG group; and 200.54±23.66 in DM group.

The mean serum triglyceride level was 202.19±35.13; and it was 181.70±27.68 in non-DM group; 198.90±30.68 in IFG

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		Sun of Squares	Df	Mean Square	F	Sig.
Age* outcome	Between Groups (Combined)	104.96	1	104.96	2906	0.09
	Within Groups	5345.22	148	36.11		
	Total	5450.19	149			
BMI * Outcome	Between Groups (Combined)	0.621	1	0.621	0.87	0.76
	Within Groups	1051.35	148	7.10		
	Total	1051.97	149			
FPG * Outcome	Between Groups (Combined)	7117.19	1	7117.19	3.06	0.08
	Within Groups	343512.64	148	2321.03		
	Total	350629.84	149			
CH *Outcome	Between Groups (Combined)	174.51	1	174.51	0.262	0.60
	Within Groups	98538.48	148	665.801		
	Total	98712.99	149			
TG*Outcome	Between Groups (Combined)	9671.86	1	9671.86	8.21	0.00
	Within Groups	174273.53	148	1177.52		
	Total	183945.39	149			
LDL *Outcome	Between Groups (Combined)	432.50	1	432.50	1.150	0.28
	Within Groups	55644.56	148	375.97		
	Total	56077.07	149			
HDL *Outcome	Between Groups (Combined)	19.197	1	19.19	1.74	0.18
	Within Groups	1629.87	148	11013		
	Total	1649.07	149			
SBP *Outcome	Between Groups (Combined)	399.11	1	399.11	1.57	.211
	Within Groups	37398.38	148	252.69		
	Total	37797.50	149			
DBP *Outcome	Between Groups (Combined)	1.00	1	1.00	.010	.92
	Within Groups	15380.78	148	103.92		
	Total	15381.79	149			

Table-5: ANOVA Table

group; and 225.98±32.07 in DM group.

The mean serum LDL level was 133.55±19.39; and it was 129.00±20.57 in non-DM group; 126.90±17.51 in IFG group; and 144.76±14.81 in DM group.

The mean serum HDL level was 41.88±3.32; and it was 41.88±3.45 in non-DM group; 41.70±3.13 in IFG group; and 42.08±3.44 in DM group.

From the ANOVA table-1 it was observed that there was no significant difference in serum cholesterol level and serum HDL level (p>0.05). But there was significant difference present in serum triglyceride, serum LDL level among three study groups (p<0.05).

Applying Tukey HSD as post hoc test for multiple comparisons it was observed that the mean serum Cholesterol and serum HDL level were not significantly different when compared between different groups (p>0.05).

The mean serum Triglyceride level was significantly different when it was compared among the three study groups- NON-DM and IFG group (p<0.05), NON-DM and DM group (p<0.05) and IFG and DM group (p<0.05).

From the multiple comparison by post hoc test in it observed that the means of FPG levels are significantly different in between Non-DM and IFG group (p<0.05), Non-DM and DM group (p<0.05), and IFG and DM group (p<0.05) (table-2,3).

Complications and Outcome of the patients

Out of 150 patients studied, 21 patients (14%) died and 129 patients (86%) were discharged. Among them 2 patients (4%) were in Non-DM group, 9 patients (18%) were in IFG group; and 10 patients (20%) were in DM group who died. The difference in mortality in three study groups were significant (p<0.05).

The difference in mortality in between Non-DM and IFG group was significant (p<0.05). The difference in mortality in between Non-DM and DM group was also significant (p<0.05).

Female mortality in our study was 26.08% (6 died out of 23 female) and it is quite higher than male mortality (11.81%, 15 out of 127 males died) though it was not statistically significant (p >0.10).

15 out of 121 patients (71%) died were non-smoker and 6 patients (29%) were smoker. Mortality was not significantly related with history of smoking (p>0.05).

13 out of 21 patients (61.9%) died were hypertensive and 8 patients (38.1%) were non-hypertensive. Mortality was not significantly related with history of hypertension (p>0.05).

Among total 150 study patients 92 patients (61.33%) did not develop any complication like arrhythmia, heart failure, hypotension etc. 58 patients (38.67%) developed complication. 21 patients (36.2%) died among them. Mortality was significantly high in patients who developed complications. (p>0.05) (table-4).

Table 4: Comparing outcome with mean distribution of age of the patients, Body Mass Index (BMI). serum FPG level,

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lipid profile and blood pressure-

The mean age among patients discharged was 53.59±6.26 and among dead was 56.00±4.03. The mean BMI among patients discharged was 27.88±2.68 and among dead was 27.70±2.55. The mean FPG among patients discharged was 129.10 ±48.02 and among dead was 148.95±49.14. The mean Cholesterol among patients discharged was 200.55±25.65 and among dead was 203.66±26.71. The mean Triglyceride among patients discharged was 198.95±34.36 and among dead was 222.09±34.03. The mean LDL among patients discharged was 132.86±19.97 and among dead was 137.76±15.12.

The mean HDL among patients discharged was 42.03±3.37 and among dead was 41.00±2.96. The mean SBP among patients discharged was 121.44±15.75 and among dead was 126.14±16.79. The mean DBP among patients discharged was 81.2±10.32 and among dead was 81.48±9.29 (table-5). From the ANOVA it can be concluded that only higher serum Triglyceride level was significantly associated with increased mortality ($p<0.05$) (table-5).

DISCUSSION

In our study, the mean age of the patients was 53.93 ± 6.04 Years; having no significant inter group difference (52.92± 6.60 in non - DM group; 54.76 ± 5.82 in IFG group; and 54.10 ± 5.65 in DM Group) and also not significantly related to hospital outcome regarding mortality though higher mean age was observed in patients who died (56.00± 4.03 years) than in patients who were discharged (53.59 ± 6.26 years).

Out of 150 patients studied, Males were 127 (84.7%) and females were 23 (15.3%) and there was no significant intergroup difference in gender distribution; thus, our study was matched for age and gender.

Female mortality in our study (26.08%, 6 died out of 23 female) was higher compared to male mortality (11.81%, 15 out of 127 males died) though not significant statistically (p> 0.10).[4]

The mean BMI is significantly higher in diabetic group (29.37±2.60) as compared to NON-DM group (27.37±2.53) and IFG group (26.83±2.14); but this study didn't affect the outcome.[5,6]

In our study all females were non -smokers (27) and 49 male patients were smokers (38.58%). The intergroup differences of number of smokers (42.85% in non-DM, 38.58% in IFG and 38.09% in DM group) and hospital outcome regarding mortality were not significant statistically.

In our study 44.7% patients were hypertensives and 55.3% patients were non-hypertensives. The frequency of hypertension in DM group was more (56% in DM, 40% in IFG and 38% in non-DM group) though not significant statistically. The hospital outcome regarding mortality was also not significantly related with hypertension.[7,8]

In our study the mean serum level of total Cholesterol was 200.09 ± 25.73 mg/dl and HDL level were 41.88 ± 3.32 mg/dl; and there were no significant intergroup differences. Both the mean serum Triglyceride and LDL levels were significantly higher in diabetic patients (225.98±32.07 mg/dl

and 144.76 ± 14.81 mg/dl respectively) compared to non-DM (181.70±27.68 mg/dl and 129.00±20.57 mg/dl respectively) and IFG (198.90±30.68 mg/dl and 126.90±17.51 mg/dl respectively) groups.

But only the higher serum Triglyceride level was significantly associated with outcome regarding hospital mortality. The mean Triglyceride level was found to be 222.09±34.03 mg/dl among who died and 198.95±34.36 mg/dl among patients who were discharged.[9,10]

In our study 8 cases were newly diagnosed and 42 cases were previously diagnosed as diabetes among the patients in DM group. Though the intergroup difference of mean FPG levels were significant (87.62± 7.34 mg/dl in DM group) it was not significantly related with in-hospital outcome regarding mortality.

58(38.67%) patients developed complication like arrhythmia, heart failure, hypotension etc. during the hospitalization. of them 21 (36.2%) patients died. Among them 2 (4%) patients died in non-DM group; 9 (18%) patients died in IFG group; and 10 (20%) patients died in DM group. Mortality in patients having IFG and DM were significantly higher compared to NON-DM patients. However, it was similar between patients with IFG and diabetic patients.

Thus, the mortality in this study population was significantly related with IFG, DM, increased serum Triglyceride and increased BMI.[11,12]

In our study, the early stage mortality rates of the acute MI patients with diabetes (20%) and with IFG (18%) were almost the same and significantly higher compared to patients without diabetes (4%). This shows that the atherosclerotic process starts well before the impaired fasting glucose stage, which is the earliest stage of DM.

CONCLUSION

In conclusion, mortality was found to be higher in patients having Impaired Fasting Glucose (IFG) and Diabetes Mellitus (DM) during the acute phase (first 7 days) of Myocardial Infarction (AMI) as compared to Non-Diabetic (NON-DM) group; and mortality in patients having IFG was similar to that of patients having DM.

Mortality was also found higher in those patients were there was high serum Triglyceride, high BMI which are common associates of DM. The mortality was not significantly related with fasting plasma glucose (FPG).

So, IFG may be a marker or risk factor for mortality but lowering FPG in AMI patients is unlikely to yield beneficial effect as per this study.

Controlling obesity (lowering BMI), lowering serum Triglyceride level and treating IFG in the general population may improve the outcome of AMI patients.

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