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Original Article

Glycaemic status in patients of acute myocardial infarction: A detailed analysis

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ABSTRACT

Aims: Diabetes mellitus (DM) is considered to be one of the important risk factors for cardiac diseases. Frank diabetes is usually preceded by long term abnormality in glucose homeostasis which is called pre-diabetes. The hypothesis that diabetic patients have greater risk and worse prognosis of Acute Myocardial Infarction (AMI) than pre-diabetics is controversial.Considering that India has been declared as a diabetic capital of the world, the study aimed to assess the load of pre diabetics, diabetics and non-diabetics landing in myocardial infarction.

Materials and methods: The study consisted of through physiological and biochemical evaluation of 200 patients of newly diagnosed AMI and evaluating the load of non-diabetics, pre-diabetics and diabetics among them.

Result: It was found that the total non-diabetic population (normoglycaemic and pre-diabetic) formed the bulk of AMI patient (69%) in our study. The degree of biochemical alterations seen among the three groups suggests that abnormal glucose homeostasis is not the sole determinant of the severity of AMI. The study data also suggests that glycaemic status, which poses a risk for AMI, differs in male and female individuals. Males even with normal glucose level are at increased risk to develop MI.

Conclusion: The study concludes that both males and females with their blood glucose in pre-diabetic range are seen to be vulnerable to develop AMI. Thus all individuals irrespective of their glycaemic status around the age of forty should be screened and individuals with fasting sugar in pre-diabetic range should take extra precaution in terms of healthy diet, life style and regular check up

1. Introduction

India has been declared as a diabetic capital of the world with an estimated load of about 4.1 million diabetic patients. Every fifth diabetic in the world is an Indian [1]. Diabetes is associated with accelerated atherosclerotic macrovascular disease affecting arteries that supply the heart, brain and lower extremities. As a result, patients with diabetes have a much higher risk of myocardial infarction, stroke and limb amputation [2]. About 75% of diabetics succumb to a cardiovascular disease and of this a major chunk, almost to the tune of 75% is contributed by acute myocardial infarction, the remaining 25% by cerebrovascular disease and peripheral vascular disease [3].

AMI is one of the major causes of mortality and morbidity in the world [4]. The most common cause of an AMI is atherosclerotic Coronary Artery Disease (CAD) with erosion or rupture of a plaque causing transient, partial or complete coronary arterial occlusion. Factors unique to diabetes increase atherosclerotic plaque formation and thrombosis, thereby contributing to myocardial infarction [5].

Pre-diabetes refers to an increasingly common condition in which blood glucose levels are higher than normal but not yet diabetic such as impaired glucose tolerance and impaired fasting glucose. Most people with this condition go on to develop type 2 diabetes within 10 years [6]. The prediabetic patient load in India was around 85.6 million in 2003 and it is expected to rise up to 132 million by the year 2025 [7]. Epidemiological studies, including the Paris Prospective Study [8] have shown that pre-diabetes confers an increased risk of cardiovascular disease (CVD). However, the exact load of normoglycaemic form of MI is not clearly known.

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Considering that India has been declared as a diabetic capital of the world it deemed pertinent to assess the exact load of prediabetics and non-diabetics landing in myocardial infarction. There's a plethora of studies related to the incidence of AMI in diabetic and non-diabetic individuals [9–11] but the pre-diabetic group is largely unexplored. Hence, in the present study we analysed the data of all patients admitted for the first time for AMI and evaluated the load of non-diabetics, pre diabetics and diabetics among them. Patients were analysed for their biochemical and physiological parameters and cardiac markers at the time of admission.

2. Materials and method

Study design: The study involved through physiological and biochemical evaluation of 200 patients of newly diagnosed AMI admitted in the Coronary Care Unit of Jawaharlal Nehru Medical College Hospital, Aligarh Muslim University, Aligarh, India. The diagnosis of AMI was based on a history of prolonged ischemic chest pain, which lasted for up to 3 h, ECG changes (ST elevation of 2 mm or more in at least two leads) and elevated creatine kinase isoenzyme MB (CK-MB) and troponin T within 12 h after the onset of pain. The study was duly approved by the Board of Studies/Institutional Ethical Committee and a valid and informed consent was obtained from all the patients of our study.

The physiological and anthropometric parameters such as age, heart rate, weight and blood pressures were noted down at the time of admission.

2.1. Biochemical analysis

Plasma glucose: Fasting and post-prandial blood glucose levels were determined by glucose oxidase peroxidase method using kit supplied by Sigma–Aldrich Inc., USA.

Estimation of Glycosylated Haemoglobin (HbA_{1C}): HbA_{1C} was determined utilizing principles of ion exchange high-performance liquid chromatography (HPLC) using reagent supplied by Pointe Scientific Inc., Michigan, USA.

Serum lipid profile: Serum Lipid profile parameters such as total cholesterol, triglyceride LDL and HDL cholesterol were analysed by using kits supplied by Pointe Scientific Inc., Michigan, USA.

Cardiac biomarkers: CKMB was assessed by kits from Enzopak (Reckon Diagnostics, India). Troponin-I assay was based on Microparticle Enzyme Immunoassay (MEIA) technology using AxSYM Troponin-I ADV Reagent Pack (Abbott Laboratories, USA).

The patients were the divided into three broad categories depending upon their fasting and post prandial blood glucose levels as: *Non diabetic/normoglycaemic* (fasting plasma glucose $\leq$100 mg/dL), *Pre-diabetic* (fasting plasma glucose with $\geq$100 mg/dL but $\leq$126 mg/dL and/or post prandial 2 h plasma glucose with $\geq$140 mg/dL but $\leq$200 mg/dL) and *Diabetic* (fasting plasma glucose $\geq$126 mg/dL.

2.2. Statistical analysis

Statistical analysis was done, using the Statistical Package for Social Science (SPSS 21.0) for Windows Software and Microsoft Excel 2007. Continuous variables were tested for normal distribution by Kolmogorov–Smirnov test and expressed as mean ± standard deviation. Categorical data are expressed as counts and percentages. For comparison of continuous data unpaired Student *t*-tests or ANOVA tests were used. For all analyses, a 2-sided value of $P < 0.05$ was considered statistically significant.

Table 1
Percentage load of AMI patients in different groups with their physiological vital parameters.

	Non-diabetic ($n=73$)	Pre-diabetic ($n=65$)	Diabetic ($n=62$)
Percentage	36.50%	32.50%	31%
Female: Males	09: 64	14: 51	18: 44
Incidence in females	09/41 (21.93%)	14/41 (34.16%)	18/41 (43.95%)
Incidence in males	64/159 (40.25%)	51/159 (32.07%)	44/159 (27.67%)
Age (years)	57.22 ± 12.42	59.40 ± 11.34	62.21 ± 10.15
Weight (kg)	65.13 ± 6.21	66.30 ± 6.15	70.80 ± 7.59
BMI	27.2 ± 5.3	27.9 ± 4.4	28.2 ± 6.9
Heart rate (per min)	81.32 ± 10.13	84.36 ± 9.04	86.00 ± 11.58
SBP (mm Hg)	129.94 ± 22.58	131.82 ± 23.89	143.18 ± 38.01
DBP (mm Hg)	79.06 ± 9.51	80.30 ± 12.82	88.73 ± 12.91$^{*,\#}$

Data presented are mean ± SD. # depicts comparison with Diabetic group, * depicts comparison with non-diabetic group; $^{*}P < 0.05$; $^{\#}P < 0.05$.

3. Result

The whole study consisted of 200 subjects divided according to their fasting and random blood glucose levels into 3 groups: non-diabetic, pre-diabetic and diabetic. The number of non-diabetic subject was 73, pre-diabetic were 65 and diabetics were 62. This made non-diabetic cases 36.5%, pre-diabetic cases as 32.5% cases and diabetic case 31% in our study population. It was found that the total non-diabetic population (normoglycaemic and pre-diabetic), which excludes MI cases simultaneously diagnosed as diabetic, was around 69% in our study (Table 1).

There was no statistical difference among the 3 groups in their heart rate, weight, BMI and systolic blood pressure, at the time of admission (Table 1). However, diastolic blood pressure was significantly high in diabetic MI patients.

Troponin I and CKMB levels were seen to be significantly increased in diabetic group as compared to non-diabetic group. In pre-diabetic group the Troponin I level were in par with the non-diabetic group but the CKMB levels were significantly increased. As expected, diabetics had significantly higher levels of fasting glycaemia, post prandial glycaemia and HbA1c level than pre-diabetics and non-diabetics. The pre-diabetics also showed a significant increase in all these levels when compared to the non-diabetic groups. Diabetics also presented a significantly higher total cholesterol and

LDL-cholesterol than non-diabetics and pre-diabetics. No significant changes were observed in the level of HDL cholesterol and triglyceride in the three subgroups (Table 2).

Table 2
Cardiac markers, enzymes and biochemical profile of MI patients in different groups.

	Non-diabetic ($n=73$)	Pre-diabetic ($n=65$)	Diabetic ($n=62$)
Troponin I (ng/mL)	1.06 ± 0.48	1.28 ± 0.62	2.52 ± 0.69$^{*,\#}$
CKMB (U/L)	117.03 ± 77.67	185.96 ± 78.37*	195.67 ± 83.21*
HbA1C (%)	5.01 ± 0.27	6.07 ± 0.21*	8.46 ± 1.23$^{*,\#}$
Fasting glycaemia (mg/dL)	81.35 ± 13.07	112.52 ± 9.06*	159.14 ± 20.79$^{*,\#}$
Post prandial glycaemia (mg/dL)	124.50 ± 10.06	171.76 ± 15.70*	271.36 ± 48.22$^{*,\#}$
Total cholesterol (mg/dL)	172.64 ± 37.26	170.70 ± 31.55	218.36 ± 45.31$^{*,\#}$
LDL cholesterol (mg/dL)	113.18 ± 35.97	109.42 ± 29.16	142.45 ± 43.33$^{*,\#}$
HDL cholesterol (mg/dL)	36.03 ± 6.43	34.64 ± 4.31	34.55 ± 6.62
Triglycerides (mg/dL)	133.82 ± 54.49	151.18 ± 50.15	158.55 ± 42.63

Data presented are mean ± SD; # depicts comparison with Pre-diabetic group, * depicts comparison with non-diabetic group; $^{*}P < 0.05$; $^{\#}P < 0.05$.