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Prevalence of impaired fasting glucose and impaired glucose tolerance in non-diabetic patients with Coronary Artery Disease

Nihar Ranjan Mohanty [1], Bhagyashree Panda [2*]

1. Department of General Medicine, KIMS Hospital, Bhubaneswar
2. Department of General Medicine, SCB Medical College, Cuttack

Correspondence: Nihar Ranjan Mohanty, Department of Medicine, KIMS hospital, Bhubaneswar, Odisha, India. Email: drnihar123@yahoo.com; Tel: +9437326539

Abstract

Background: Coronary artery disease (CAD) is one of the most common morbidities associated with diabetes mellitus. Impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) are precursors to diabetes and major risk factors for atherosclerosis. The study aimed to evaluate the prevalence of IFG and IGT in nondiabetic patients with CAD.

Methods: The study was performed on 100 non-diabetic patients with CAD and 50 healthy age- and sex-matched controls. Data were collected via detailed medical history taking, clinical examination, routine blood chemistry tests, fasting blood sugar test, 2-hour post-prandial blood sugar test, lipid profile, electrocardiogram, 2D-echocardiogram, and carotid Doppler.

Results: Dyslipidemia was more prevalent among the patients. The mean carotid intima–media thickness was higher in the patients. Overall, IFG was found in 9 (15%) cases and IGT was found in 13 (22%) cases. The co-existence of IFG and IGT was detected in 3 (5%) cases. Abnormal glucose regulation was found in 42% of patients.

Conclusion: The findings indicate the need for early screening and management of prediabetes for the prevention of further progression to diabetes.

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Highlights:

What is current knowledge?

Impaired fasting glucose (IFG) and glucose tolerance (IGT) are precursors to diabetes and major risk factors for coronary artery disease (CAD).

What is new here?

Abnormal glucose regulation is common in nondiabetic patients with CAD. The findings indicate that IGT and to a lesser extent IFG are associated with abnormal cardiovascular conditions.

Introduction

Coronary artery disease (CAD) is the most common form of heart disease worldwide (1). Some modifiable risk factors include hypertension, diabetes mellitus (DM), smoking, obesity, and hyperlipidemia. Non-modifiable risk factors are age, gender, family history, and genetic predisposition (2, 4). The most important and common risk factor for CAD is DM (2). Impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) are precursors to DM and intermediary steps between normoglycemia and hyperglycemia. Currently, there are 374 million people with IFG and IGT, and the number of these individuals is projected to reach 548 million by the year 2045 (3). In India, 25.2 million people have IGT and the number is estimated to increase to 37.5 million by 2045 (3). Sometimes, myocardial infarction is the initial presentation in people with IGT or overt diabetes (3). The micro- or macrovascular complications of DM may begin earlier in the prediabetes state (4,5). Decreased levels of high-density lipoprotein (HDL)-cholesterol and increased levels of low-density lipoprotein (LDL) and triglyceride (TG) are frequently observed among prediabetic individuals, which increases the risk of cardiovascular disease (6). Indo heart survey on latent abnormal glucose regulation reported that 50.28% of CAD patients in India are non-diabetic (7). This study aimed to assess the prevalence of IFG and IGT as well as other cardiovascular risk factors in non-diabetic patients with CAD. Although previous studies have investigated the prevalence of prediabetes in CAD patients (7-9), no study has been done in eastern India, which is of poor socioeconomic status, precluding the common belief that abnormal glucose regulation is more prevalent in an affluent society.

Methods

This was a cross-sectional study conducted at the Department of Medicine and Cardiology of SCB Medical College Hospital. After taking ethical clearance from the Institutional Ethics Committee, all CAD patients admitted to the Department of Medicine or Cardiology without any history of DM were enrolled. Overall, 100 patients were enrolled as cases, and 50 patients aged 40 to 70 years without DM and CAD were enrolled as controls. Subjects in the study groups were matched for age, gender, and risk factors. Data were collected via detailed medical history taking, clinical examination, routine blood chemistry tests, fasting blood sugar (FBS) test, 2-hour post-prandial blood sugar (PPBS) test, lipid profile, electrocardiogram (ECG), 2D-echocardiogram, and carotid Doppler.

Inclusion criteria included confirmed diagnosis of CAD by observing A) clinical features including chest pain/discomfort, breathlessness, syncope, nausea, and vomiting; B) ECG features including STEMI-ST elevation, unstable angina, and non-Q wave/NSTEMI -ST depression, transient ST elevation, and T inversion; C) stable angina-stress ECG showing more than 1mm ST depression and duration > 0.08 s; D) biochemical markers creatine kinase-myocardial band, troponin I, and troponin T. Patients with DM, cerebrovascular accident, peripheral vascular disease, or on steroid or anticancer drugs were excluded.

Written informed consent was taken from all participants. Carotid artery ultrasound was done using ACUSON 128×P/10 machine with a 7.5MHz linear superficial array probe in B-mode.

Statistical analysis was done using GraphPad InStat 3. Data were described using descriptive statistics after confirming the normal distribution of data. Data were compared using the t-test at a significance of 0.05. Correlation between various lipid fractions, age, waist circumference, body mass index (BMI), and intima–media thickness (IMT) was assessed using the Pearson correlation coefficient.

Results

Among 100 patients, 88 (88%) were male, and 12 (12%) were female. Of 50 individuals in the control group, 44 (88%) were male and 6 (12%) were female. Most patients were in the 55-64 years age group. The mean age of patients and

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controls was 59±9.32 and 47.88±13.98 years, respectively. The mean BMI level was 23.18±3.96 kg/m2 in the patients and 21.67±3.67 kg/m2 in the controls. Impaired glucose regulation was found in 42% of patients. In addition, FBS and 2hr PPBS were significantly higher in CAD patients compared with the controls (p<0.05) Table 1.

Table 1: Clinical and metabolic risk factors in the study groups

Risk factors	Controls (n=50)	Patients (n=100)	Unpaired t-test (*p*-value)
Age (years)	47.88±13.98	59±9.32	<0.0001
Male: Female	26:4	53:7	
Smoking	05	28	
Alcohol	09	05	
Hypertension	09	12	
BMI (kg/m2)	21.67±3.67	23.18±3.96	0.107
Waist circumference (cm)	81±8.69	82.71±8.40	0.848
FBS (mg %)	86.4±10.86	98.26±13.99	0.0003
2 hour-PPBS (mg %)	124.6±18.46	135.73±18.53	0.014
Total cholesterol (mg %)	146.48±27.30	174±38.58	0.002
Triglycerides (mg %)	125.44±39.40	126±40.14	0.915
Very-LDL-C (mg %)	26.1±9.6	34.64±9.54	0.003
LDL-C (mg %)	92.04±24.03	103±33.19	0.147
HDL-C (mg %)	43±7.08	42±8.18	0.507

The mean carotid IMT was 0.703±0.105 in the case group and 0.611±0.130 in the control group Table 2.

Table 2: Comparison of carotid IMT between the study groups

IMT(mm)	Control(n=50)	Case(n=100)	Unpaired t-test (*p*-value)
Carotid	0.611±0.130	0.703±0.105	0.001

As shown in table 3, IFG was found in 15 (15%) subjects, IGT was found in 22 (22%) subjects, and co-presence of IFG and IGT was found in 5 (5%) cases. The level of all lipid parameters was higher in patients compared with controls. Out of 28 patients with a history of smoking, IFG was found in 10 (35%) cases and IGT in 12 (42%) cases. Mean carotid IMT was highest in those with IFG and IGT Table 3.

Table 3: Comparison of risk factors between subjects with IFG and IGT alone or combined

Variables	IFG(n=15)	IGT(n=22)	IFG &IGT(n=5)	p-value
Age (years)	58.11±10.12	58.45±9.03	60±12	0.937
Male:Female	13:2	16:6	3:2	
Smoking	10	12	0	
Alcohol	2	0	0	
Hypertension	2	6	2	
BMI (kg/m2)	24.54±3.63	23.26±4.45	23.15±3.01	0.751
Waist circumference (cm)	82.41±8.4	84.36±7.86	85.66±6.02	0.936
FBS (mg %)	118.66±4.21	97.72±6.87	119.66±5.5	<0.0001
2hr PPBS (mg %)	133.44±8.01	162.45±9.41	157±12.12	<0.0001
Total cholesterol (mg %)	194.44±61.54	175.27±26.89	175±53.67	0.632
TG (mg %)	141.33±51.15	143.9±33.79	96±14	0.199
LDL-C (mg %)	109.44±54.67	99.81±28.7	116.33±41.62	0.790
Mean carotid IMT (mm)	0.671±0.088	0.69±0.07	0.76±0.20	0.176

As shown in Table 4, 2hr PPBS level had a positive correlation with age, waist circumference, and TG in both study groups.

Table 4: Correlation of 2hr PPBS with variables in the group

	Controls (n=50)		Patients (n=100)	
Variables	Correlation coefficient(r)	*p*-value	Correlation coefficient(r)	*p*-value
AGE (years)	0.257	0.214	0.062	0.635
Waist circumference (cm)	0.352	0.084	0.107	0.412
BMI (kg/m2)	0.356	0.080	-0.021	0.870
Total cholesterol (mg %)	-0.041	0.845	-0.063	0.631
TG (mg %)	0.012	0.952	0.253	0.05
LDL-C (mg %)	-0.150	0.474	0.029	0.820

Discussion

The present study was performed on 100 non-diabetic patients with CAD. When comparing different risk factors, it was found that smoking, hypertension, and alcohol consumption were more common among the patients compared with the control subjects. Mean BMI was higher in the patients (23.18±3.96) compared with the controls (21.67±3.67). The Indo heart survey (2008) reported similar findings regarding the increased BMI level in individuals with impaired glucose regulation (7).

The mean waist circumference was 82.71±8.40 cm in the patients and 81±8.69 cm in the controls. Another study also showed that individuals with impaired glucose regulation have an elevated waist circumference (8).

Among the biochemical parameters, FBS and 2hr PPBS were significantly higher among the patients. Similarly, dyslipidemia was more prevalent among the patients. However, the Indo Heart survey (2008) reported an increase only in TG among patients with abnormal glucose regulation (7). The China Heart survey reported an increase in lipid parameters in the form of increased TG and lowered HDL in subjects with abnormal glucose regulation compared with healthy controls (9).

The present study found IFG in 15% of the cases. In addition, IGT was detected in 22% of the cases, while both IFG and IGT were found in 5% of the cases. In total, abnormal glucose regulation was found in 42% of non-diabetic patients with CAD. The Indo heart survey on latent abnormal glucose regulation in nondiabetic patients with CAD reported impaired glucose regulation in 50.28% of the subjects. Similarly, the China Heart survey on 773 acutely admitted CAD patients reported impaired glucose regulation in 39% of the cases, which is similar to our findings (9).

In our study, abnormal glucose regulation was more prevalent among patients with a history of smoking, which is similar to the China Heart survey (9).

Waist circumference was highest in subjects with both IFG and IGT, which is in line with the results of previous study (8).

The mean carotid IMT was significantly higher among the patients and highest in those with both IFG and IGT. This is in contrast to some previous studies which found no association between the mean carotid IMT and IFG (7, 10). In our study, FBS and 2hr PPBS showed a positive correlation with age, waist circumference, BMI, and serum TG in all subjects. However, a statistically significant difference was found between the two groups in terms of 2hr PPBS and serum TG. Overall, BMI and waist circumference, as well as total cholesterol, very LDL, carotid IMT, and abnormal glucose regulation, were higher in the patients compared with the controls.

Conclusion

Abnormal glucose regulation is common in nondiabetic patients with CAD. The findings indicate that IGT and to a lesser extent IFG are associated with abnormal cardiovascular conditions. This provides further evidence for the increased cardiovascular risk associated with prediabetes. Thus, earlier diagnosis of abnormal glucose regulation will allow clinicians to employ more rigorous control of hyperglycemia, which ultimately leads to a better outcome. With the rising prevalence of CAD and the subsequent mortalities in the Indian population, it is vital to modify secondary preventive measures and pay more attention to glucometabolic abnormalities beyond DM.

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Ethical statement

Ethical clearance was obtained from the Institutional Ethics Committee and written informed consent was taken from all participants.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author contributions

MN & PB collected the data, analyzed, interpreted data, and drafted the manuscript. All authors read and approved the final manuscript.

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