

# Relationship of severity of coronary artery disease with fasting blood sugar and glycosylated hemoglobin



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## ABSTRACT

**Background:** Diabetes mellitus (DM) is one of the major risk factors for coronary artery disease (CAD). Accordingly, in this study, attempt is to be made to assess the association of severity of CAD by angiography with fasting blood sugar (FBS) and hemoglobin A1c (HbA1c). **Aims and Objectives:** To evaluate coronary angiographic abnormalities in patients of Diabetes. **Materials and Methods:** Six hundred adult patients of both sexes admitted in the department of cardiology, Nil Ratan Sircar Medical College and Hospital, Kolkata with ischemic heart disease from June 2018 to February 2020 underwent FBS and glycosylated Hb besides other routine tests. Coronary angiography done and the severity of CAD was assessed by SYNTAX SCORE was correlated. It is an observational, Cross-sectional hospital-based single center study. **Results:** Syntax scores were highest in the body mass index  $\geq 30$  kg/m<sup>2</sup> group (16.5). Patients with Syntax score  $\geq 33$  are found to have much higher values of HbA1c ( $6.8 \pm 1.3$ ) compared to those with Syntax score of  $\leq 22$  ( $6.4 \pm 1.8$ ). Fasting blood glucose level in Syntax score  $\geq 33$  group has been found to be significantly higher compared to the group of Syntax score  $\leq 22$ . **Conclusion:** Patients having DM and/or metabolic syndrome are found to have more severe form of CAD than those who don't have either of these.

**Key words:** Coronary angiography; Diabetes mellitus; SYNTAX SCORE

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## INTRODUCTION

Numerous prospective studies showed that all of the major cardiovascular risk factors such as smoking, hypertension and high serum cholesterol continue to act as independent contributors to cardiovascular disease in patients with diabetes. Clustering of various metabolic risk factors of metabolic syndrome (MS) occurs commonly in type 2 diabetes.<sup>1,2</sup>

Coronary artery disease (CAD) is a condition in which atherosclerotic plaques build up in the coronary arteries causing varying degrees of luminal obstruction.<sup>3</sup> CAD worldwide is largely driven by modifiable risk factors, such as smoking, lack of physical activity, and diets high

in fat and salt.<sup>4,5</sup> The INTERHEART study showed that smoking, hypertension, abdominal obesity, lack of physical inactivity, and a high-risk diet were responsible for a significant component of myocardial infarction risk. Elevated levels of blood pressure and hypercholesterolemia the leading causes of CAD; tobacco, obesity, and physical inactivity remain important contributors.

Hyperglycemia appears to accelerate atherogenesis, possibly by enhanced formation of glycosylated proteins and advanced glycation products and/or by increasing endothelial dysfunction.<sup>4</sup> These direct consequences of hyperglycemia probably contribute to the microvascular disease underlying nephropathy and retinopathy, and they may promote macrovascular disease as well.<sup>6,7</sup> Yoon et al.,

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showed strong correlation between MS and severity of CAD.<sup>8</sup>

South Asians are more prone to develop MS because of their high percentage of body fat, abdominal obesity, and insulin resistance. Most experts appear to believe that the increased cardiovascular risk seen in these subjects is probably due to the clustering of risk factors.<sup>9,10</sup> Many epidemiological and clinical studies have confirmed the association between MS and increased risk CAD, which is the leading cause of mortality worldwide. Morbidity and mortality from CAD are higher in patients with MS; therefore, early assessment of the risk of CAD in patients with MS is desirable because it could lead to improved patient or physician adherence to risk-reducing behaviors or interventions and improve clinical outcomes. There are reports in the literature on the association of inflammatory markers and insulin resistance with severity of disease. There are very few studies showing association of hemoglobin A1c (HbA1c) and fasting blood sugar (FBS) with the severity of CAD in India.

### Aims and objectives

To evaluate coronary angiography profile in patients of diabetes mellitus.

## MATERIALS AND METHODS

### Study area

Nil Ratan Sircar Medical College and Hospital, A.J.C. Bose Road, Kolkata – 700014. This study was pre-approved by the Institutional Ethics Committee for the final permission.

### Study population

Adult patients of both sexes admitted in the Department of Cardiology with presumed diagnosis of CAD who underwent coronary angiography (CAG) for diagnostic or therapeutic purpose.

### Study period

From June 2018 to February 2021.

### Sample size

Six hundred.

### Study design

Observational, cross-sectional, hospital-based, single center study.

### Parameters to be studied

1. Detailed clinical history and thorough clinical examination
2. Laboratory investigations such as lipid profile, blood sugar, HbA1c, cardiac enzymes, and serum creatinine

3. Imaging studies, for example., chest X-ray (CXR) and Echocardiography
4. CAG and SYNTAX score calculation.

### Inclusion criteria

Adult patients of suspected CAD who are undergoing CAG for any or diagnostic or therapeutic purpose.

### Exclusion criteria

1. Patients with previously diagnosed CAG abnormalities
2. Presence of severe renal, lung, and liver comorbidities.

## RESULTS

Average Syntax score was higher in the body mass index (BMI) <23 kg/m<sup>2</sup> group compared to 23–<25 kg/m<sup>2</sup>. This may be due to few very low syntax scores in this group, which resulted in the average score. Syntax scores were higher in the next two groups, being highest in the BMI ≥30 kg/m<sup>2</sup> group. Studies with a larger patient population are needed to further evaluate these findings.

Kruskal – Wallis test was used, the P-value found is 0.039, so HbA1C values are significantly different between these three groups. Patients with Syntax score ≥33 are found to have much higher values of HbA1c compared to those with Syntax score of ≤22. Higher HbA1c value is associated with more complex CAD. However, the difference between groups A and B as well as between B and C were not statistically significant (*post-hoc* Dunn's test).

Applying Kruskal – Wallis test, the P-value found is 0.0126, so FBS values are significantly different between these 3 groups.

Fasting blood glucose level in Syntax score ≥33 group (group A) was significantly higher compared to the group of Syntax score ≤22. Thus, higher FBS level is associated with more complex CAD (statistically significant by *post-hoc* Dunn's test).

Hypertensive patients constituting almost 37% study population had a Syntax score of 20.98±14.17 compared to non-hypertensives whose Syntax score was 14.09±9.63, having a highly significant P<0.0005. Hence, hypertensive patients presenting with chest pain are prone to have more complex CAD.

## DISCUSSION

The current study was conducted in the Department of Cardiology, N R S Medical College and Hospital, Kolkata from June 2018 to February 2021 and included patients presenting in the Cardiology emergency or OPD with

chest pain. The study included total of 600 patients. All the patients underwent CAG and the findings are divided according to the severity and complexity of disease based on Syntax score. Syntax score divided the study population into three categories:

- Low score  $\leq 2$
- Intermediate score 23–32 and
- High score  $\geq 33$ .

Out of the 600 patients, 420 (69.75%) had low Syntax score ( $\leq 22$ ), 115 (19.33%) had intermediate Syntax score (23–32) and 65 (10.92%) had high Syntax score of  $\geq 33$ . Average Syntax score was higher in the body mass index (BMI)  $< 23 \text{ kg/m}^2$  group compared to  $23\text{--}25 \text{ kg/m}^2$  (Table 1).

Median HbA1c value in group A is  $6.88 \pm 1.33$ , B is  $6.64 \pm 1.49$  and C is  $6.42 \pm 1.77$  and the p value found is 0.0392, so HbA1c values are significantly different between these three groups. Thus, higher HbA1c is associated with more severe and complex CAD (Table 2).

**Table 1: ABI and BMI relationship with syntax score**

BMI (kg/m <sup>2</sup> )	No. of patients	Average syntax score	Average ABI
<23	50	15.7	0.85
23–<25	77	12.9	0.94
25–<30	350	16.1	0.95
$\geq 30$	123	16.5	0.95

ABI: Ankle-brachial index, BMI: Body mass index

**Table 2: With HbA1C**

SYNTAX score	Group A $\geq 33$		Group B 23–32		Group C $\leq 22$	
	No (%)	HbA1C	No (%)	HbA1C	No (%)	HbA1C
	65 (10.9)	$6.8 \pm 1.3$	115 (19.3)	$6.6 \pm 1.5$	420 (69.7)	$6.4 \pm 1.8$

HbA1C: Hemoglobin A1c

**Table 3: Relationship of syntax score with FBS**

SYNTAX score	Group A $\geq 33$		Group B 23–32		Group C $\leq 22$	
	No (%)	FBS	No (%)	FBS	No (%)	FBS
	65 (10.9)	$167.5 \pm 80.9$	115 (19.3)	$134.3 \pm 70.8$	420 (69.7)	$133.7 \pm 96.1$

FBS: Fasting blood sugar

**Table 4: Relation between different risk factors and SYNTAX score**

Risk factor	Present		Absent		P-value
	No (%)	SYNTAX score	No (%)	SYNTAX score	
Hypertension	222 (36.9)	$20.98 \pm 14.17$	378 (73)	$14.09 \pm 9.6$	$< 0.0005^*$
Smoking	427 (71.4)	$17.00 \pm 11.65$	173 (28.5)	$14.80 \pm 11.9$	0.3106
Family h/o CAD	207 (34.45)	$18.27 \pm 12.71$	393 (65.5)	$15.79 \pm 11.5s$	0.2095

Mann Whitney's U test was used to check statistical significance

Patients with SS of  $\geq 33$  had a median FBS level of  $167.54 \pm 80.95 \text{ mg/dl}$ , SS of 23–32 had median FBS of  $134.30 \pm 70.83$ , and SS  $\leq 22$  had median FBS of  $133.73 \pm 96.11$  with a  $P=0.0126$  which is statistically significant. Thus, higher FBS is associated with more severe CAD (Table 3).

Relationship between various risk factors of CAD and Syntax score are being discussed in the following text (Table 4). 15% of the study population had both diabetes and MS, 18.33% had only diabetes, 13.33% had only MS without diabetes and the remaining 53.33% had none.

Approximately 37% of the study population had systemic hypertension and they had a median syntax score of  $20.98 \pm 14.17$  compared to  $14.09 \pm 9.63$  in non-hypertensive patients (73%) with a  $P < 0.0005$  which is highly significant statistically. This finding strongly indicates that hypertension is a strong risk factor for atherosclerotic CAD. This finding matches with the literature.

15% of the study population had combined diabetes mellitus (DM) and MS and this group had median syntax score of  $20.97 \pm 9.32$ . Patient group having only MS constituting 13.33% of patient pool had a median syntax score of  $21.21 \pm 14.94$  and those having only DM (18.33%) had median Syntax score of  $19.72 \pm 13.52$ . The group that had none of DM or MS (53.33%) had median syntax score of  $13.16 \pm 10.14$ . The difference among

these groups is statistically significant ( $<0.0001$ ). So, the presence of DM and/or MS in a patient presenting with angina is a strong risk factor for more severe and complex CAD.

Mahalle et al.,<sup>1</sup> studied association of MS with severity of CAD. It included 300 patients with known CAD above 25 years of age. Single vessel disease (SVD), double vessel disease (DVD), and triple vessel disease (TVD) were present in 22.3%, 25.3%, and 52.3% subjects, respectively. In a study from India by Sukhija et al., reported SVD in 11%, DVD in 27%, and TVD in 45% among 82 patients undergoing angiography. Rana et al.,<sup>2</sup> also reported more involvement of CAD in DM versus non-DM individuals (SVD [19% vs. 14%], DVD [9% vs. 7%], and TVD [9% vs. 5%] ( $P<0.0001$  for all)). Others have also observed similar findings. These results support the hypothesis of a greater severity of angiographic proven CAD in diabetic than in non-diabetic patients. Diabetics suffer from higher prevalence of diffuse and extensive coronary atherosclerosis.

Diabetic patients had a significantly smaller minimal lumen diameter in the infarct-related artery than non-diabetic patients. Reference segment diameters in all infarct-related arteries were also significantly smaller in diabetic than nondiabetic patients. de Sousa et al., studied “Comparison of CAG findings in diabetic and non-diabetic women with non-ST-segment-elevation acute coronary syndrome”<sup>(11)</sup> found that the diffuse pattern of atherosclerotic disease in diabetic patients. In GUSTO-I study, diabetic and non-diabetic patients exhibited similar percent diameter and percent area stenosis at early angiography. Diabetic patients had a significantly smaller minimal lumen diameter in the infarct-related artery than non-diabetic patients.

#### Limitations of the study

As the prevalence of coronary artery disease is quite high, higher number of patients would be better. Additional risk factors like dyslipidemia was not included. We did not separate acute coronary syndrome from stable ischemic heart disease.

#### CONCLUSION

This study has re-established the association of several risk factors with atherosclerotic CAD such as HbA1c and FBS. Patients having DM and/or MS are found to have more severe form of CAD than those who do not have either of these.

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**AS**- Concept preparation, coordination, implementation of study, statistical analysis, preparation of first manuscript; **MK**- Preparation of final manuscript, review of literature; **RKS**- Concept, supervision of study, final editing, discussion

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