Comparison of Extent of Coronary Artery Disease in Angiography of Diabetics and Non-Diabetics

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Abstract

Background- Type 2 diabetes mellitus is associated with an increased prevalence of atherosclerosis and coronary heart disease. This study was performed to determine the severity and extent of coronary artery disease in diabetics compared to non-diabetics.

Methods- Fifty type 2 diabetic patients and 50 sex- and age-matched non-diabetics, who were candidates for angiography to diagnose coronary artery disease, were enrolled in the study. Those patients with valvular heart disease, congenital heart disease and rhythm disturbances were excluded from the study. Selective angiography was performed, and a single experienced observer reported the angiograms and Gensini scores were calculated to determine the severity of the atherosclerosis.

Results- Sixty males and 40 females were included in the study, with a mean age of 57.3 ± 8.4 (Mean $\pm$ SD). Diabetic patients had higher Gensini scores than non-diabetics (51.44 ± 44.6 vs. 34.12 ± 29.9, $P<0.05$). Categorical staging of various types of coronary artery disease significantly differed in diabetic and non-diabetics ($P<0.05$), and multi-vessel CAD ($P<0.05$) was seen more often in diabetics. Moreover, mono-vessel CAD ($P<0.05$) was more common in non-diabetics, but normal coronary arteries did not significantly differ between the two groups. Hyperlipidemia and diabetes were associated with Gensini scores independently ($P=0.02$ and $P=0.04$, respectively), and a trend toward a positive association was seen between family history of coronary artery disease and Gensini score ($P=0.06$), but hypertension and cigarette smoking did not show any significant association. Left main coronary artery disease, disease of the proximal portion of left anterior descending artery, presence of occluded vessels, ejection fraction, left ventricular end diastolic pressure, and catheter-based systolic and diastolic blood pressure were not significantly different between diabetics and non-diabetics.

Conclusion- According to our study, diabetics may have more extensive coronary artery disease at presentation, hence care must be taken in the diagnosis and management of these patients, and it is better to maintain a lower threshold for performing noninvasive and sometimes invasive studies for the detection of coronary artery disease in diabetics (***Iranian Heart Journal 2006; 7 (4):37-42).***

People with diabetes have an increased prevalence of atherosclerosis and coronary artery disease (CHD) and experience higher mortality and morbidity after acute coronary syndrome and myocardial infarction (MI) than people without diabetes.

Diabetes has a dramatic impact on outcomes following unstable angina or MI.[1]
Malmberg and colleagues showed that diabetes significantly increased all-cause death and the incidence of new MI, stroke and heart failure during a 2-year mean follow-up

in patients who were hospitalized for unstable angina or non-Q-wave MI.[2] Diabetes also increases the risk of heart failure, and following the development of heart failure, diabetic patients have higher mortality and heart failure-related morbidity.[3] Traditional CHD risk factors such as hypertension, dyslipidemia, and obesity cluster in patients with impaired glucose tolerance or diabetes, but this clustering cannot account for all of the increased risk in these patients.[1] It is not clear which of these risk factors play a more important role in their contribution to the extent of coronary artery disease. This study was performed to determine the severity and extent of coronary artery disease in Iranian diabetic patients compared to non-diabetics.

Methods

Fifty type 2 diabetic patients, who were candidates for angiography for the diagnosis of coronary artery disease (CAD) were enrolled in the study. An individually matched (for age, sex) non-diabetic control subject was selected for each diabetic patient. Those patients with valvular heart disease, congenital heart disease and rhythm disturbances and those with significant thyroid, renal, or hepatic dysfunction according to routine laboratory screening were excluded from the study. Selective angiography was performed with Seldinger method (with Siemens angiographic set). Angiograms were reported by a single experienced observer.

The coronary arterial lesions seen by angiography were converted to a score by the standardized scoring system advocated by Gensini (Fig. 1).[4] This system involves both exponential quantification of site-specific severity and a disproportionate emphasis on disease in proximal segments.[5] The resulting score, which allowed the disease to be expressed as a continuous variable, was effectively utilized to see the correlations between the severity of coronary arterial

disease and individual risk factors/risk markers.

Ejection fractions were measured by means of angiography and echocardiography (with Toshiba Powervision 6000) for each patient. Other data (diabetes mellitus, hyperlipidemia and hypertension) were obtained through routine laboratory data, history taking and physical examination. Left ventricular end-diastolic pressures, systolic and diastolic pressures were measured directly from pressure waves by means of fluid-filled catheter that was attached to a pressure transducer in the catheterization laboratory.
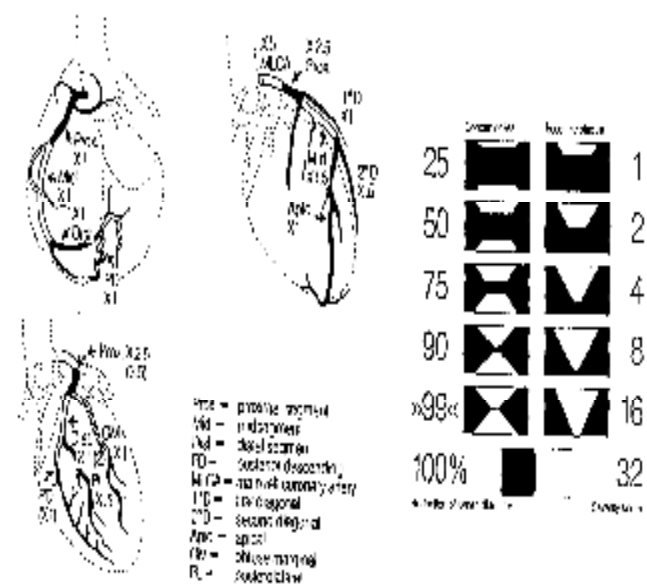

Fig. 1. Left panel, the principal vascular segments of (from left to right) the right coronary artery, the left anterior descending, and the circumflex. Each segment is followed by a multiplying factor such as X1, X2.5, and so on, depending on the functional significance of the area supplied by that segment. Right panel, roentgenographic appearance of concentric lesions and eccentric plaques. The right column in this panel indicates the relative severity of the obstruction progresses according to the indicated reduction of lumen diameter (the left column). (*From Gensini G G. A more meaningful scoring system for determining the severity of CHD. Am J Cardiol 1983; Feb 51(3):606).*

Statistical analyses
Data are given as mean ± SD. Analysis was performed with SPSS software. Pearson's chi-square and Fisher's exact tests were performed to assess associations between the

qualitative variables for the diabetic and non-diabetic groups. Quantitative variables (angiographic indices, ejection fractions, end-diastolic pressures, etc.) and discrete predictor variables were compared by independent samples Student's *t* tests when they had normal distribution and 2-independent sample non-parametric tests (Mann-Whitney), when they did not have a normal distribution. Associations between quantitative variables (Gensini score) and qualitative variables (diabetes mellitus, hyperlipidemia, hypertension, etc.) were tested by means of univariate analysis of variance. First, all the variables that appeared to have at least a moderate, although not necessarily a 'significant' association with the dependent variable ($P < 0.2$), were entered into the model and the best model was selected. Linear regression test was performed when appropriate. P values of less than 0.05 were assumed to be significant.

Results

Sixty males and 40 females were included in the study, with a mean age of 57.3 ± 8.4 years. Among the studied variables, age, ejection fraction, left ventricular end diastolic pressure, systolic blood pressure and diastolic blood pressure had a normal distribution. Linear regression test showed significant correlation between echocardiographic and angiographic measurement of ejection fraction (P<0.01, r =0.66).

Diabetic patients had higher mean Gensini scores than non-diabetics (51.44 ± 44.6 vs. 34.12 ± 29.9, P<0.05, Mann-Whitney). Selecting the best model of univariate analysis of variance for multiple risk factors showed that hyperlipidemia and diabetes were associated with higher Gensini scores separately (P=0.02 and P=0.04, respectively)

and a trend toward a positive association was seen between family history of coronary artery disease and Gensini score (P=0.06), but hypertension and cigarette smoking did not show any significant association (P=0.19 and P=0.28, respectively).

Among qualitative angiographic indices which were compared in diabetic and non-diabetic groups, left main coronary artery disease (P=0.34), disease of the proximal portion of left anterior descending artery (LAD) (P=0.68) and presence of occluded vessels (P=0.54) were not significantly different in diabetics and non-diabetics and specific vessels were not more occluded in diabetics compared with non-diabetics (left anterior descending artery [LAD] P=0.81, left circumflex artery [LCX] P=0.37, right coronary artery [RCA] P=0.13, diagonals P=0.3, obtuse marginal branches [OM] of LCX, P=0.5).

Categorical staging of various types of coronary artery disease (CAD) was significantly different in diabetics and non-diabetics (P<0.05), and multi-vessel CAD (P<0.05) was seen more often in diabetics and mono-vessel CAD (P<0.05) was more common in non-diabetics (Table I), but normal coronary arteries did not significantly differ in the two groups.

Both angiographically and echocardiographically measured ejection fractions did not differ significantly between diabetics and non-diabetics (angiographic ejection fraction: 52.2 ± 12 in diabetics vs. 51 ± 10.8 in non-diabetics, P=0.6, t-test). Also, left ventricular end- diastolic pressure (15.83 ± 8.3 in diabetics vs. 15.67 ± 8.3 in non-diabetics), catheter-based systolic blood pressure (144.9 ± 24.9 in diabetics vs. 139.4 ± 21.2 in non-diabetics) and diastolic blood pressure ($75.14.3 \pm 14.3$ in diabetics vs. 73.47 ± 14.3 in non-diabetics) did not differ significantly between the two groups.

Table I. Multiple types of coronary artery disease in diabetic and non-diabetic patients

Coronary artery disease type	Non-diabetics	Diabetics
Normal coronary arteries	8	6
Mono-vessel coronary artery disease	19	7
Two-vessel coronary artery disease	7	9
Multi-vessel and Three-vessel coronary artery disease	16	28

Diabetics did experience more myocardial infarction than non-diabetics (10 patients with diabetes and 16 patients without diabetes, P=0.17). Other risk factors in diabetics and non-diabetics are compared in Table II. Only hyperlipidemia had a significant relationship with diabetes (P=0.04). Cigarette smokers were more common among non-diabetics, but this was not statistically significant (P=0.17).

Table II. Other coronary artery risk factors in diabetics and non-diabetics

Risk factor	non-diabetics	diabetics	P-value
Hyperlipidemia	16	26	0.04
Hypertension	27	24	0.55
Cigarette smoking	16	10	0.17
Family history	8	8	1

Discussion

Gensini score involves both exponential quantification of site-specific severity and a disproportionate emphasis on disease in proximal segments.[5] The resulting scores allows the disease to be expressed as a continuous variable, so it could be utilized effectively to see the correlations between the severity of coronary arterial disease and individual risk factors/risk markers. In our study diabetics had higher Gensini scores than non-diabetics (P<0.05) and various types of coronary artery disease were different in diabetics and non-diabetics (Table I), (more 3-vessel and multi-vessel CAD in diabetics

and more mono-vessel CAD in non-diabetics). This finding is consistent with higher Gensini scores in diabetics and reconfirms that diabetics in our study had more extensive coronary artery disease. It seems that diabetes may have a significant and independent effect on the extent of coronary artery disease and this is why people with diabetes experience higher mortality and morbidity after acute coronary syndrome and myocardial infarction than people without diabetes, and diabetes has dramatic impact on outcomes following unstable angina or MI.

Krishnaswami and colleagues studied the coronary arterial lesions seen by angiography in 1666 consecutive male patients. Arterial lesions were converted to Gensini scores. On multiple regression analysis, significant correlations were found between CAD severity and LDL cholesterol, family history and total cholesterol after adjusting for other factors.[6]

In another study Krishnaswami et al. studied 516 Indian patients with diabetes mellitus who presented with chest pain and an equal number of matched controls without diabetes examined by selective coronary arteriography. Prevalence of CAD in diabetics with symptoms was 86.6%. This prevalence increased with age. Multi-vessel disease was more common in diabetics than in controls (p<0.01). In diabetic patients involvement of proximal and distal segments in the same vessel was more common (p<0.01). The Gensini scores were higher in diabetics (p<0.05), and the number of occluded segments in the coronary tree was higher in diabetics (p<0.01). No correlation could be established between severity of disease and age, body mass index or duration of diabetes. They concluded that diabetes affects the coronary arteries of Indian patients more adversely than those of non-diabetics.[7] Our results are somehow consistent with the results of their study, so it seems that diabetic patients have more extent of coronary artery disease.

Among qualitative angiographic indices in our study which were compared in diabetic and non-diabetic groups, left main coronary artery disease, disease of the proximal portion of left anterior descending artery (LAD) and presence of occluded vessels were not significantly different in diabetics and non-diabetics. These parameters have a very important impact on Gensini scores. These finding suggests that greater Gensini scores in our study group may be due to multiple plaques in a single vessel rather than more occluded vessels or involvement of left main or proximal LAD, which are more important sites of coronary artery disease.

In our study, hyperlipidemia and diabetes were associated with Gensini scores independently (P=0.02 and P=0.04, respectively), and a trend toward a positive association was seen between family history of coronary artery disease and Gensini score (P=0.06), but hypertension and cigarette smoking did not show any significant association with Gensini scores (P=0.19 and P=0.28, respectively). Traditional coronary artery risk factors such as hypertension, dyslipidemia, excess weight and obesity cluster in patients with impaired glucose tolerance or diabetes.[1] In our study, among other studied risk factors, only hyperlipidemia had a significant relationship with diabetes (P=0.04). Cigarette smokers were more common among non-diabetics, but this was not statistically significant (P=0.17). It is possible that some of the impact of diabetes on the extent of coronary artery disease is due to coexistence of other risk factors with diabetes.

Diabetics did not have more myocardial infarction, LV dysfunction and LV end-diastolic pressure than non-diabetics. This finding may be due to the pattern of case enrollment in our study. Ethically, we had to include only patients with a real indication for angiography, and low ejection fraction and previous myocardial infarction are among very important indications of angiography that were not too different between the two groups. Also, normal coronary arteries did not significantly differ in diabetics and non-diabetics, which confirms that indications for angiography were correct and similar in both groups.

Conclusion

People with diabetes have an increased prevalence of atherosclerosis and coronary artery disease (CHD) and experience higher mortality and morbidity after acute coronary syndrome and myocardial infarction (MI). According to our study, diabetics may have more extent of coronary artery disease at presentation, so care must be taken in diagnosis and management of these patients. It seems that it is better to maintain a lower threshold for performing non-invasive and sometimes invasive studies for the detection of coronary artery disease in diabetics.

We suggest that treatment, especially anti-lipid treatment, be more aggressive in diabetics, because of the coexistence of hyperlipidemia in diabetics and more extensive coronary artery disease in diabetics and hyperlipidemic patients.

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