Angiographic Comparison of Coronary Artery Disease in Arab Women with and without Type II Diabetes mellitus

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Key Words

Coronary artery disease • Diabetes mellitus •
Coronary angiography • Disease severity

Abstract

Objective: To compare angiographic features in women with and without type II diabetes mellitus. **Subjects and Methods:** One hundred and six consecutive women who underwent diagnostic coronary angiography in the Chest Diseases Hospital, Kuwait, were chosen for the study. Quantitative coronary angiography was performed and the angiographic features were assessed. **Results:** Eighty-two patients had coronary artery disease. Of these, 59 (72%) had type II diabetes mellitus and 23 (28%) were non-diabetics. Segmental disease involving the mid and distal left anterior descending artery was more common in diabetics than non-diabetics. Diabetics had a greater number of long lesions and more distal coronary artery disease. However, the caliber and suitability of the distal vessels for grafting was similar. **Conclusion:** Angiographic severity of coronary artery disease in this selective group of mostly Arab women was more in those with type II diabetes mellitus than non-diabetics. However, the distal luminal diameter was similar in both groups.

Introduction

Patients with diabetes mellitus (DM) are at high risk for cardiovascular mortality and morbidity. This high risk is related to increased incidence of myocardial infarction [1, 2], higher mortality in coronary ischemic events [3, 4] and higher overall risk of death from cardiovascular causes [1]. Even with revascularization procedures, diabetic patients have poorer long-term outcomes than non-diabetics.

Many explanations have been given for the worse prognosis in diabetic patients with coronary artery disease (CAD). Available data on the angiographic severity of CAD in diabetics compared to non-diabetics are conflicting and do not support the conclusion that diabetic patients have more severe CAD. Even among patients with DM there are differences between those with type I and type II [5, 6]. Also there are variations between the two sexes [6] and between various ethnic groups. All these factors need to be taken into consideration when severity of CAD is studied in patients with DM.

Therefore, this prospective study was planned to compare the angiographic severity of CAD between women with and without type II DM.

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1011-7571/02/0116-0063\$18.50/0

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Subjects and Methods

One hundred and six consecutive women patients undergoing routine diagnostic coronary angiography were prospectively enrolled in the study. Women more than 75 years of age, with unstable hemodynamics and on nitroglycerine infusion were excluded from the study.

Clinical Evaluation

Height (in m) and weight (in kg) were taken. Skinfold thickness (in mm) was measured one inch above the iliac crest using Accu-measure Caliper. Waist and hip measurements (in cm) were taken using a measuring tape at the level of the umbilicus and at the highest point of iliac crest, respectively. Body mass index (BMI) was calculated by dividing the weight in kg with the square of the height measured in m. Thus, $BMI = \text{kg/m}^2$.

Angiography

Angiography was performed by the percutaneous femoral approach using standard angiographic techniques. Left-ventricular angiography was done in the right anterior oblique view. Selective left and right coronary angiography was done in multiple views including craniocaudal angulations. Siemens Quantitative Coronary Angiography (QCA) Ancor System Version 2.3 was used to record images in a digital format.

Right anterior oblique projection was used for left ventricular ejection fraction analysis as well as for coronary segmental analysis. For analyzing coronary artery lesions, care was taken to avoid foreshortening and overlap. Optimum quality end-diastolic frame was chosen and analyzed.

Left main, proximal and mid segments of the left anterior descending artery (LAD), proximal segment of circumflex coronary artery (Cx) and proximal and mid segments of the right coronary artery (RCA) were analyzed as proximal segments. More distal vessel segments of graftable size such as distal LAD, diagonal branch of LAD, obtuse marginal branch of Cx, distal RCA, posterior descending and posterolateral branches of RCA and ramus intermedius (when present) were analyzed as distal segments. Coronary artery luminal diameter narrowing of $\geq 50\%$ was taken as significant. Diameter narrowing of $< 50\%$ was considered as O vessel disease.

For the purpose of analysis, distal LAD, main diagonal branch, main obtuse marginal or intermedius branch were taken as three distal segments. In the case of RCA, the segments beyond mid RCA were collectively taken as the fourth distal segment.

Distal Quality and Lesion Severity Scoring

Quality of the distal vessel with regard to suitability for grafting was graded as poor, fair or good (with scores of 1, 2, or 3, respectively). The scores from all the graftable segments were added and then divided by the number of segments to obtain the distal quality score of a particular patient.

Lesion severity scores was designed to combine the significance of % diameter narrowing and the length of a particular stenotic lesion to get a single score which reflects the severity of the atherosclerotic burden on account of any single lesion. A lesion with $< 50\%$ diameter narrowing was given a score of 1 and $> 50\%$ lesion was given a score of 2. Similarly, short, moderately long and long lesions were given a score of 1, 2 or 3, respectively. Diameter score multiplied by length score was taken as the severity score of a lesion. Severity of scores from all the coronary lesions were added to obtain the lesion severity

score in a patient. This is a new scoring system which we have devised and it is being used for the first time.

Statistical Analysis

Data were entered and analyzed using the SPSS statistical package Window version 8. χ^2 test was used to test the difference between proportions. Mean values were compared using Student's t test. $p \leq 0.05$ was considered statistically significant.

Results

Clinical Characteristics

Of the 106 women studied, 82 (77%) had CAD. Of the 82 patients with CAD, 59 (72%) had type II diabetes mellitus (DM) and the remaining 23 (28%) were non-diabetics. The women with CAD were mostly Kuwaiti (60/82; 73.2%) and they were from Arab ethnic background from the Middle East (74/82; 90.2%). Comparison of the clinical features in these groups is given in table 1. The mean age in those with DM was 57.34 years (± 7.8) while those of non-diabetics was 51.96 years (± 11.53). The BMI was high in both the groups being 31.39 kg/m^2 (± 6.94) in those with DM and 29.13 kg/m^2 (± 5.56) in those without. Systolic blood pressure was higher in those with DM (157 mm Hg (± 22.88)) than those without DM (141.17 mm Hg (± 25.08)) ($p = 0.006$). Similarly, pulse pressure was wider in those with DM (72.05 mm Hg (± 22.66)) than those without (63.51 mm Hg (± 23.71)) ($p = 0.07$).

Angiography

Left-ventricular end-diastolic volume index was 86.71 ml/m^2 (± 21.68) in those with DM and 76.68 ml/m^2 (± 14.16) in those without. The difference was statistically significant ($p = 0.048$) (table 2). Similarly, the left-ventricular end-systolic volume index was also higher in the diabetic than the non-diabetic group (35.63 ml/m^2 (± 16.96) and 26.27 ml/m^2 (± 6.03), respectively). Left-ventricular ejection fraction was 56.7% (± 8.85) in the diabetic group compared to 63.67% (± 4.1) in those without DM ($p = 0.003$). The number of coronary vessels involved was similar in both groups.

Coronary Artery Segments

Table 3 shows the type of coronary artery segment involvement in both groups. Mid and proximal LAD segments were the most frequently involved segments in the DM patients, the involvement being 71.2 and 57.6%, respectively. Proximal LAD was the most frequently involved segment in those without DM (52.2%). Segmental disease involving the mid and distal LAD and distal

Table 1. Characteristics of women with and without DM

	Type II DM women	Non-DM women	p value
n (%)	59 (72)	23 (28)	
Age, years	57.34 ± 7.8	51.96 ± 11.53	
BMI, kg/m ²	31.39 ± 6.94	29.13 ± 5.56	NS
SFT, mm	21.64 ± 8.34	18.91 ± 7.82	NS
W/H ratio	1.0 ± 0.058	0.98 ± 0.058	NS
Systolic BP	157 ± 22.88	141.17 ± 25.08	0.006
Diastolic BP	73.95 ± 11.16	72.74 ± 7.22	NS
Pulse pressure	72.05 ± 22.66	63.51 ± 23.71	0.07

DM = Diabetes mellitus; BMI = body mass index; SFT = skin fold thickness; W/H ratio = waist/hip ratio; BP = blood pressure.

segments of the RCA was more common in those with DM than non-diabetics. There was no difference in the involvement of the other segments. Important aspects of these results are shown in figure 1.

Severity of Coronary Artery Disease

Table 4 shows the severity of CAD in the type II DM compared to those without DM. Those with DM had a greater number of coronary segments involved in LAD than non-diabetics (mean of 4.44 in diabetics compared to 3.13 in non-diabetics; $p = 0.02$). The diabetics also had a greater number of long lesions (>20 mm) than non-diabetics (1.49 vs. 0.83; $p = 0.057$). Score for lesion severity (7.14 vs. 4.48; $p = 0.011$) as well as distal coronary segment involvement (1.39 vs. 0.7; $p = 0.011$) were greater in diabetics (fig. 2). However, the quality of distal vessel for bypass grafting was similar in both groups (2.419 vs. 2.507).

Discussion

The main finding of this study was that the patients with DM had more distal involvement of coronary arteries, diffuse and severe disease than the non-diabetics. However, the overall distal quality of the vessels with regard to suitability for bypass grafting was similar in both groups.

The higher systolic blood pressure and wider pulse pressure (table 1) seen in the DM group may be a reflection of the presence of more extensive atherosclerosis of the aorta as compared to the non-diabetics. The reason for higher LVEDVI and LVESVI along with a lower ejection

Table 2. Angiographic features

Angiographic feature	Type II DM women	Non-DM women	p value
LVEDVI, ml/m ²	86.71 ± 21.68	76.68 ± 14.16	0.048
LVESVI, ml/m ²	35.63 ± 16.96	26.27 ± 6.03	0.001
LVEF, %	56.7 ± 8.85	63.67 ± 4.1	0.003
3 VD, n (%)	12/59 (20.4)	2/23 (8.7)	NS
2 VD, n (%)	11/59 (18.6)	3/23 (13.0)	NS
1 VD, n (%)	25/59 (42.4)	10/23 (43.5)	NS
OVD, n (%)	11/59 (18.6)	8/23 (34.8)	NS

DM = Diabetes mellitus; LVEDVI = left-ventricular end-diastolic volume index; LVESVI = left-ventricular end-systolic volume index; LVEF = left-ventricular ejection fraction; VD = vessel disease.

Table 3. Angiogram: coronary segments involved

Vessel segment	Number (%) with ≥ 50% stenosis		p value
	with DM	without DM	
LEFT MAIN	6/59 (10.2)	1/23 (4.3)	NS
LAD-Px	34/59 (57.6)	12/23 (52.2)	NS
LAD-Md	42/59 (71.2)	10/23 (43.5)	0.019
LAD-DI	25/58 (43.1)	2/23 (8.7)	0.010
Diagonal-main	24/57 (42.1)	6/23 (26.1)	NS
Cx-Px	24/59 (40.7)	5/23 (21.7)	NS
OM-main	21/59 (35.6)	8/23 (34.8)	NS
Im	4/27 (14.8)	2/17 (11.8)	NS
RCA-Px	22/59 (37.3)	10/23 (43.5)	NS
RCA-Md	27/59 (45.8)	6/23 (26.1)	NS
RCA-more DI	17/59 (28.8)	2/22 (9.1)	0.05

LAD = Left anterior descending; Cx = circumflex; RCA = right coronary artery; Im = intermedius branch; Px = proximal; Md = mid; DI = distal.

fraction (table 2) in those with DM is not very clear. This may be related to more extensive myocardial damage in myocardial infarction or presence of small vessel disease.

Though there was no significant difference in the number of coronary arteries involved, there was more involvement of the mid and distal segments of the LAD and the distal segments of the RCA in the DM group (table 3; fig. 1). Data shown in table 4 also indicate that women with DM had more diseased distal segments than those without DM (1.39 vs. 0.7).

Diabetic women also were shown to have more disease burden as shown in table 4 and figure 2. Women in the

Fig. 1. Coronary segment involved in angiogram. Series 1: Women with diabetes. Series 2: Women without diabetes. Segment involved: 1 = Left anterior descending – proximal ($p = \text{n.s.}$); 2 = left anterior descending – mid ($p = 0.019$); 3 = left anterior descending – distal ($p = 0.010$); 4 = circumflex – proximal ($p = \text{n.s.}$); 5 = right coronary – distal ($p = 0.05$).

Table 4. Severity of coronary artery lesions

Segments	Women with DM (mean)	Women without DM (mean)	p value
Total disease segments	4.44	3.13	0.020
Long (>20 mm) lesions	1.49	0.83	0.057
Moderate-length (10–20 mm) lesions	1.14	0.91	NS
Short (<10 mm) lesions	1.32	1.09	NS
Disease distal segments	1.39	0.7	0.011
Distal quality score	2.419	2.507	NS
Lesion severity score	7.14	4.48	0.011

DM group had a greater number of diseased segments (4.44 vs. 3.13), more long lesions (1.49 vs. 0.83) and a higher lesion severity score (7.14 vs. 4.48) than non-diabetics. In spite of more distal involvement, the distal segment was suitable for grafting as seen from comparable distal quality score between the groups (2.419 vs. 2.507).

It is well known that patients with DM have a higher prevalence of CAD compared to the non-diabetics. Also the prognosis for CAD is worse in those with DM [1–4]. Patients with DM have a higher risk for myocardial infarction, mortality with coronary ischemic events and overall risk of both from cardiovascular causes than non-diabetics. Even after revascularization procedures, diabetic patients fare worse than non-diabetics [7–13]. The reasons

for the excess risk of CAD and the worse prognosis with CAD in those with DM are not yet fully understood.

Though there are many explanations given for the poorer outcome in diabetics, there is paucity of data on the angiographic severity of CAD. Autopsy studies done by Waller et al. [14] found no difference in the severity of CAD between diabetics and non-diabetics. However, Vigorita et al. [15] found that patients with ‘adult onset’ DM had more severe and more diffuse coronary atherosclerosis than age- and sex-matched non-diabetic controls. There are very few angiographic studies which used QCA for analysis. Conflicting results have also been obtained when semi-quantitative visual interpretation was done on the angiographic studies. Hamby et al. [16] found more

Fig. 2. Comparison of severity of coronary artery lesions. Series 1: Women with diabetes. Series 2: Women with diabetes. Category 1 = Total number of diseased segments ($p = 0.02$); category 2 = number of long lesions ($p = 0.057$); category 3 = number of diseased distal segments ($p = 0.011$); category 4 = lesion severity score ($p = 0.011$).

three-vessel CAD and less one-vessel CAD in patients with impaired glucose tolerance or non-insulin-dependent DM compared with those having normal glucose tolerance and no family history of DM [16]. Another study found higher scores in diabetics than in non-diabetic patients [17]. Studies using the CASS registry data have shown modest association between history of diabetes and extent and severity of CAD [18]. More elaborate analysis of angiographic severity of CAD have been requested by Pajunen et al. [5, 6] from Finland who have used QCA and expressed severity of disease using various indices such as atheroma burden index and global extent index. Another distinguishing feature of their studies is the fact

that patients with type I and type II diabetes were studied separately. They found that women with type I DM had more severe, extensive and distal type of CAD than individually matched control subjects. In the case of patients with type II DM, there was similarity between the angiographic characteristics of CAD between non-insulin-dependent DM patients matched with non-diabetic patients for sex, age and body mass index.

Further insight into coronary artery disease in diabetics needs more specific studies involving large numbers of patients and giving due consideration to the type of diabetes, sex and ethnic background.

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