Interventional
Cardiology

Sensitivity and specificity of gensini and friesinger score among pre-and postmenopausal women with acute coronary syndrome: A hospital based study in Bangladesh

Abstract

Aim: Gensini score and friesinger score are an effective tool used to evaluate the severity of Coronary Artery Disease (CAD). The risk of coronary artery disease in women after menopause sharply rises in contrast to that of women before menopause because of hormonal protection against atherosclerosis. Post-menopausal women presented with more severe Coronary Artery Disease (CAD) along with multiple comorbidity. However, there are limited data describing the sensitivity and specificity of gensini and friesinger score between pre- and postmenopausal women with Acute Coronary Syndrome (ACS). This study aimed to assess the sensitivity and specificity of Gensini and Friesinger score between pre-and postmenopausal women with ACS.

Methods: In this cross sectional observational study a total of 140 female patients with acute coronary syndrome were enrolled. They were divided in Group-I (premenopausal) and Group-II (postmenopausal) on the basis of the state of menopause. The clinical data and coronary angiographic characteristics severity by Gensini and Friesinger score were compared between the premenopausal and postmenopausal ACS groups and then sensitivity and specificity were analyzed.

Results: Mean age of the premenopausal ACS patients was 41.53 ± 5.45 years and 57.23 ± 7.45 years in postmenopausal ACS patients which was statistically significant (p=0.001). Normal coronary angiogram and single vessel disease were more prevalent in premenopausal group (31.4% *vs.* 17.1%; p=0.04 and 31.4% *vs.* 15.7%; p=0.002) and triple vessel disease in postmenopausal group (48.6% *vs.* 20%; p=0.001). The mean Gensini score was higher in postmenopausal group than premenopausal group (56.1 ± 43.4 *vs.* 33.5 ± 36.9; p=0.001). High to intermediate Friesinger score (11-15) was found significantly higher in postmenopausal group than premenopausal group (2.9% *vs.* 1.4%; 72.9% *vs.* 50%; p=0.003). Sensitivity and specificity of Gensini and Friesinger score were (95.9 *vs.* 97.3); (73.7 *vs.* 64.2).

Conclusion: Normal coronary angiogram and single vessel disease were more prevalent in premenopausal group and triple vessel disease in postmenopausal group. Regarding the Severity assessment by Gensini score and Friesinger score revealed, Friesinger score was more sensitive but Gensini score was more specific.

Keywords: Acute coronary syndrome • Coronary angiographic severity • Friesinger score • Premenopausal • postmenopausal women

Ayesha Siddika*, Fazila-Tun-Nesa Malik, Mir Nesaruddin Ahmed, Nahidul Hasan, Nazir Ahmed, Mohammad Badiuzzaman, Dhiman Banik, Mir Ishraquzzaman, Md. Shamim Chowdhury, Md. Kalimuddin

Department of Cardiology, National Heart Foundation Hospital and Research Institute, Dhaka, Bangladesh

*Author for correspondence:
Ayesha Siddika, Department of cardiology, National Heart Foundation Hospital and Research Institute, Dhaka, Bangladesh, E-mail: ayeshasiddika835@gmail.com

Introduction

Coronary Artery Disease (CAD) refers to heart disease caused by myocardial ischemia

and hypoxia due to coronary artery stenosis or occlusion. It is the most common type of organ disease caused by atherosclerosis, and it is also the most common clinical Cardiovascular (CV) disease [1].

Menopause is a normal biological event that occurs in every women during their late 40s or early 50s and marked by end of menustrual period. During menopause, womens oestrogen levels become approximately one third of that during her premenopausal years. With the changes in the production of female hormones after menopause, the risk of ischemic heart diseases and Cerebrovascular Accident(CVA) are increased which are the main causes of morbidity and mortality in women of both developed and developing countries [2,3].

Currently, there are a variety of scoring systems used for quantitative analysis of coronary artery lesions and Gensini scoring is more commonly used in clinical practice. Gensini score fully considers the number, location, and degree of stenosis of coronary artery lesions, which is a more scientific evaluation standard of coronary artery lesions [4]. At the same time, this scoring system has also been widely used in related studies on the clinical outcomes of CAD. At present, a number of studies have confirmed that the Gensini score can predict the risk of Major Adverse Cardiovascular and Cerebrovascular Events (MACCEs) in patients with different types of CAD [5,6], and evaluate the severity of coronary artery lesions combined with certain biochemical indicators [7-9].

However, due to the low incidence of CAD in premenopausal women, research on this particular population has not been sufficient [10]. The purpose of this study was to assess the sensitivity and specificity of Gensini and Friesinger score between pre- and postmenopausal women with ACS.

Materials and Methods

This observational cross-sectional study was performed at a medical teaching hospital and research institute in central Bangladesh. The study subject was enrolled after obtaining institutional ethical clearance (The ethical committee of National heart foundation hospital and research Institute-Post Graduate Research ref no. N.H.F.H. and R.I 4-14/7/Ad/04 dated 28th December 2021) and written informed consent from all study participants. Pre- and postmenopausal women with ACS whom underwent coronary angiogram admitted in the department of cardiology of National Heart Foundation Hospital and Research Institute, Dhaka, Bangladesh between December, 2021 to November 2022 were included in this study. Associated valvular heart diseases, congenital heart diseases, cardiomyopathy, extremely severe concomitant diseases (severe dementia, advanced malignancy) and unwilling to participate in the study were excluded from this study.

Postmenopause was defined as a lack of menustrual bleeding for 12

months or a history of hysterectomy [11]. Pre-menopause women had not experienced menopause and oophorectomy [10].

ACS was diagnosed in patient consistent with compatible clinical presentation and further confirmation by ECG and cardiac biomarker. Complete coronary angiographic profile, Friesinger score and Gensini score were recorded and then sensitivity and specificity were analyzed.

Gensini score is a widely used angiographic scoring system for quantifying the severity of CAD, and was first described in 1975 [4]. It considers the geometrical severity of the lesion, cumulative effects of multiple obstruction and significance of affected myocardium. It is based on consideration of 3 main parameters for each coronary lesion: Severity score, region multiplying factor and collateral adjustment factor. First, a non-linear score is assigned to each lesion according to the reduction of lumen diameter. A multiplier is then applied to the lesions depending on the functional significance of the area supplied by that segment. The final score is the sum of the lesion scores. So, Gensini Score Calculation: Severity score X the segment location multiplying factor X Collateral adjustment factor. In particular, a lesion is defined as significant when it causes ≥ 1% reduction in luminal diameter by visual assessment. The relative severity of the lesion is indicated using a score of 1 for 1%-25% obstruction and doubling that number as the severity of obstructions progresses with each step diameter reduction. For example, reductions of 25%, 50%, 75%, 90%, 99%, and complete occlusion are given Gensini scores of 1, 2, 4, 8, 16, and 32, respectively. Furthermore, the Gensini score is weighed according to the usual blood flow to the left ventricle in each vessel or vessel segment, with distinction between right and left dominant coronary system. A multiplying factor is applied to each lesion score based upon its location in the coronary tree, depending on the functional significance of the area supplied by that segment. If a segment is totally occluded or 99% stenosed and receiving collaterals, a collateral adjustment factor is used, and the adjustment is reduced by the extent of disease in the vessel that is the source of collaterals shown in the Figure S1. The final GS is the sum of all the lesion scores [4,12].

Statistical analysis

The sample size was calculated using Gpower 3.1.9.4 version where the mean difference between two independent means (two groups) was applied taking effect size was 0.50, alpha error as 0.05 and power as 80% with location ratio as 1. The total sample size was 140. Data entry was done on Statistical Package for Social Science (SPSS) program, version 22. All statistical analysis was performed using the SPSS program, version 22. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. Comparison of mean (continuous variables) was done by Student's t-test. Association between categorical variables

was assessed by Chi-Square test. Correlation analyses was done by Pearson Correlation Coefficient for continuous variables. The significance of the result as determined in 95% confidence interval and a p-value<0.05 was considered to be statistically significant. Sensitivity, specificity, positive and negative predictive value were analyzed.

Results

A total of 140 diagnosed case of ACS pre- and postmenopausal patients who underwent coronary angiogram were included in this study. Patients were categorized into two groups according to menopausal status. Group-I comprised premenopausal women with ACS and Group-II compromised postmenopausal women with ACS. The mean age of the Group-I patient was 41.53 ± 5.45 years and for Group-II patient was 57.23 ± 7.45 years shown in the Figure 1.
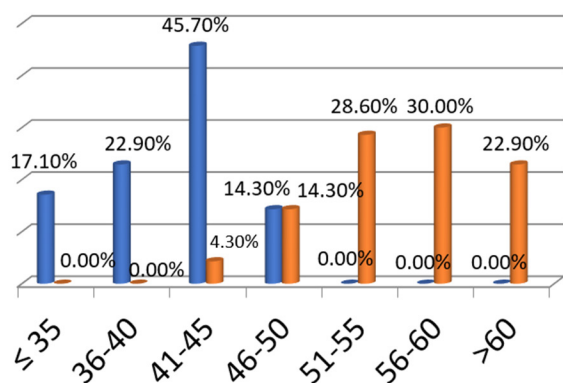
Figure 1: Age distribution of the study populations (n=140). **Note:** (■) Group-I; (■) Group-II.

Severity of coronary artery disease in the study patients by number of coronary artery involvement shown in Table 1. In Group-I, single vessel disease was 31.4% (22), double vessel disease was 17.1% (12) and triple vessel disease 20% (14). In Group-II, single vessel disease was 15.7% (11), double vessel disease 18.6% (13) and triple vessel disease 48.6% (34). Single vessel disease was more prevalent in premenopausal women (p<0.002) and triple vessel disease in postmenopausal women (<0.001). Normal vessel also significant and more prevalent in premenopausal women.

Table 1: Severity of coronary artery disease in the study populations by number of coronary artery involvement (n=140).

Number of involved vessels	Group I (n=70)	Group II (n=70)	p value*
None	22(31.4)	12(17.1)	0.049
SVD	22(31.4)	11(15.7)	0.002
DVD	12(17.1)	13(18.6)	0.825
TVD	14(20.0)	34(48.6)	0.001
Total	70(100.0)	70(100.0)	

Note: Chi-square test was done to measure the level of significance.

Among the study population, percentage of lesion in RCA, normal was found 43.6% (24) patients in Group-I and 11.1% (7) patients in Group-II. <70% lesions were 29% (9) patients in Group-I and 32.1% (18) patients in Group-II. 70-99% lesions were found 64.5% (20) patients in Group-I and 53.6% (30) patients in Group-II. Total occlusion (100%) lesion was found 6.5% (2) patients in Group-I and 14.3% (8) patients in Group-II.

Regarding the percentage of lesion in LCX, normal was found 47.2% (25) patients in Group-I and 21.0% (11) patients in Group-II. <70% lesions were found in 36.7% (11) patients in Group-I and 13.6% (6) patients in Group-II respectively. However, 70-99% lesion were found 63.3% (19) patients in Group-I and 79.5% (35) patients in Group-II. Total occlusion (100%) in LCX was only found 6.8% (3) patients in Group-II.

Regarding the percentage of lesion in LAD, normal were 39.7% (23) patients in Group-I and 15.5% (9) patients in Group-II. <70% lesions were found in 29.7% (11) patients in Group-I and 19.0% (11) patients in Group-II. 70-99% lesions were found in 64.9% (24) patients in Group-I and 77.6% (45) patients in Group-II. Total occulusion (100%) was found 5.4% (2) patients in Group-I and 3.4% (2) patients in Group-II respectively.

Regarding the percentage of lesion in LMCA, 81.4% (57) patients in Group-I and 84.3% (59) patients in Group-II were found normal. <50% lesions were 5.7% (4) patients in Group-I and 7.1% (5) patients in Group-II. ≥ 50% lesions were 12.9% (9) patients in Group-I and 8.6% (6) patients in Group-II shown in the Table 2.

Table 2: Severity of coronary artery disease of the study patients by percentage of coronary artery lesion (n=140).

Site of coronary artery lesion	Group I (n=70)	Group II (n=70)	p value
RCA			
Normal	24(43.6)	7(11.1)	0.001
<70%	9(29.0)	18(32.1)	0.117
70-99%	20(64.5)	30(53.6)	0.217
100%	2(6.5)	8(14.3)	0.007
LCX			
Normal	25(47.2)	11(21.0)	0.006
<70%	11(36.7)	6(13.6)	0.187
70-99%	19(63.3)	35(79.5)	0.002
100%	0(0.0)	3(6.8)	0.79
LAD			
Normal	23(39.7)	9(15.5)	0.004
<70%	11(29.7)	11(19.0)	0.776
70-99%	24(64.9)	45(77.6)	0.002
100%	2(5.4)	2(3.4)	0.911
LMCA			
Normal	57(81.4)	59(84.3)	0.654

<50%	4(5.7)	5(7.1)	0.654
≥ 50%	9(12.9)	6(8.6)	0.73
Note: Chi-square test was done to measure the level of significance.			

Among the respondents (Table 3), >32 Gensini score was found in 80 (72.1%) and ≤ 32 found in 31 (27.9%) in both group of patient.

Table 3: Association of the patients according to Gensini score with the number of vessels involved.

Gensini score	Number of vessels involved		Total
	Double/Triple vessel	Normal/Single vessel	
>32	70(95.9)	10(26.3)	80(72.1)
≤ 32	3(4.1)	28(73.7)	31(27.9)
Total	73(100.0)	38(100.0)	111(100.0)
Note: Figure within parenthesis indicates in percentage.			

Among the study population (Table 4), Intermediate and high Friesinger score was found in 95 (67.9%) and normal and low found in 45 (32.1%) in both group of patient.

Table 4: Association of the patients according to Friesinger score with the number of vessels involved.

Friesinger score	Number of vessels involved		Total
	Double/Triple vessel	Normal/Single vessel	
Intermediate/ High	71(97.3)	24(35.8)	95(67.9)
Normal/Low	2(2.7)	43(64.2)	45(32.1)
Total	73(100.0)	67(100.0)	140(100.0)
Note: Figure within parenthesis indicates in percentage.			

Among the respondents (Table 5), Sensitivity was more in Friesinger score in comparison to Gensini score (97.3 *vs.* 95.9). But specificity was more in Gensini score in comparison to Friesinger score (73.7 *vs.* 64.2). positive and negative predictive value of both Gensini score and Friesinger score were (87.5 *vs.* 74.7); (90.3 *vs.* 95.6).

Table 5: Validity test for Gensini score and Friesinger score with the number of vessels involved.

Validity test	Gensini score	Friesinger score
Sensitivity	95.9(90.0-98.9)	97.3(90.9-99.5)
Specificity	73.7(62.3-79.4)	64.2(57.3-66.6)
PPV	87.5(82.1-90.2)	74.7(69.9-76.5)
NPV	90.3(76.4-97.3)	95.6(85.3-99.2)
Accuracy	88.3(80.5-92.2)	81.4(74.8-83.8)

Discussion

In this study, mean age of Group-I patient was 41.53 ± 5.45 years and for Group-II patient was 57.23 ± 7.45 years. Most of the patients of Group-I belonged to 41-45 years of age. Most of the patients of Group-II belonged to 56-60 year of age which matched with study done by Ahmed, et al., [3], and they found mean age 41.6 ± 3.8 *vs.* 56.0 ± 7.2 in their study.

Premenopausal women have significant more normal coronary angiogram and SVD. This normal coronary angiogram may be due to higher incidence of microvascular dysfunction in premenopausal women than. TVD was significantly more common in postmenopausal women due to DM, increase age and more AMI and which matched with study done by Ahmed, et al., [3], they also found that in premenopausal women single vessel disease was more frequent (24% *vs.* 52%) and in postmenopausal women triple vessels disease (12% *vs.* 40%, p<0.05). This finding were similar to our study.

Distribution of site of coronary artery lesion in Group-I and Group-II revealed involvement of left anterior descending artery then right coronary artery followed by left circumflex artery were commonly found. left main coronary artery involvement was more common in Group-I compared to Group-II.

Involvement of right coronary artery and left anterior descending artery between two groups is statistically highly significant (p<0.001).

In Group-I proximal LAD involvement was more common. In Group-II along with proximal LAD, proximal LCX and proximal and mid RCA involvement were also common. At present there is no authoritative statement about why LAD disease occurred more often in the premenopausal women. Taking the anatomical structure of the left anterior descending artery into account, it was more active, and the left ventricle needs to consume more oxygen and nutrients. The anterior descending artery is more easily involved as it is the main blood supply of the left ventricle and it supports large areas of the ventricle.

Lesion distribution analysis showed by the study done by Ahmed, et al. 3 that more proximal Left Anterior Descending artery (LAD) lesion in the premenopausal group 56%. Followed by RCA (36%) and LCX (30%). This finding is similar to this study as most common lesion in premenopausal women was LAD, followed by LCX and RCA respectively. Similar finding also found in the study conducted by Ke-fei, et al., [13], involvement of LAD, LCX and RCA were 50.4%, 39.1% and 40.7% respectively.

Severity assessment by gensini score of the study patients revealed gensini score in Group-I patients was 33.5 ± 36.9 and 56.1 ± 43.4 in Group-II patient and this difference is highly statistically significant (p<0.001). The Gensini score and vessel scores of patients were much lower, which meant the lesions were confined mostly to single or double blood vessel.

Severity assessment by Friesinger score of the study patients revealed normal score (0) in Group-I patients was (34.3% *vs.*

10%) and intermediate score (5-10) in Group-II patient was (80.0% *vs.* 54.2%) and this difference is highly statistically significant (p<0.005). Ahmed, et al. [3], analyzed 100 pre-and postmenopausal women with ACS and showed that low Friesinger score were more common in premenopausal women (40% *vs.* 16%) and Higher score more common in postmenopausal women (6% *vs.* 32%). This results matched with our study findings.

Sensitivity was more in Friesinger score in comparison to Gensini score (97.3 *vs.* 95.9). But specificity was more in Gensini score in comparison to Friesinger score (73.7 *vs.* 64.2). positive and negative predictive value of both Gensini score and Friesinger score were (87.5 *vs.* 74.7); (90.3 *vs.* 95.6).

Limitations of the study

- The study was conducted at a public hospital in Dhaka city and the respondents of the research work were self-selected purposively, it cannot be assumed that this sample could be representative of the entire population of Bangladesh. It may differ in different socio-demographic or cultural situation.

- Women with ACS who underwent CAG were included in the study. This may inadequately reflect the angiographic profile of the women.

- Grouping of the patient was done on the basis of menstrual history which may be not adequate.

Conclusion

This study reflects that premenopausal period on the time when the risk of acute coronary syndrome is low but not as uncommon. Coronary angiographic findings in premenopausal women revealed less severe lesion, single vessel and most commonly involved LAD and low Friesinger score in compared to postmenopausal women. Regarding the Severity assessment by Gensini score and Friesinger score revealed, Friesinger score was more sensitive but Gensini score was more specific. Large scale community based study should be carried out for more information, Social awareness regarding primary and secondary prevention, early diagnosis and treatment are the key for reduction of morbidity, mortality and burden of CAD.

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