ORIGINAL ARTICLES

Study of Coronary Collaterals in Patients with Stable Angina

JAHANARA ARZU, FAZLUR RAHMAN, K.M.H.S. SIRAJUL HAQUE, MD. ABU SIDDIQUE, MD. KHAIRUL ANAM, MD. MUKHLESUR RAHMAN, MD. KHURSHED AHMED, S.M. MUSTAFA ZAMAN, ANISUL AWAL, BIKASH SUBEDI, QUAZI ARIF AHMED, NEENA ISLAM, MOHAMMAD SALMAN, MD. ASHRAF UDDIN SULTAN, NILUFAR FATEMA

Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka

Address for correspondence: Dr. Jahanara Arzu, Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka. E-mail : drjarzu@yahoo.com

Abstract

Background: Coronary collateral circulation is an alternative source of blood supply to the myocardium in coronary atherosclerotic disease. They provide adequate flow to the major epicardial branches of the coronary artery. Indicator of cardiac ischemia like stable angina pectoris may determine the presence of coronary collateral circulation. Methods and results: In this prospective observational cross sectional study, 150 patients with stable angina pectoris with or without MI (myocardial infarction) and or coronary intervention were enrolled. Presence of coronary collaterals in coronary angiogram was defined as Rentrop grade ≥ 1. Patients were divided into two groups. Group A patients having Rentrop grade 0 and Group B patients are with collateral circulation, having Rentrop grade 1-3. Patients are compared in these groups. Total (63%) patients with stable angina were in Group B with coronary collateral circulation and only (37%) patients with stable angina pectoris were in Group A without collaterals. Conclusions: The incidence of development of coronary collaterals was significantly higher in patients with stable angina pectoris.

Introduction:

Collateral vessels are the networks of small anastomotic branches interconnect the major coronary arteries. They preserve myocardial perfusion in coronary atherosclerotic disease.[1] So the other name of coronary collateral is natural bypass. Coronary artery disease is the leading cause of death in the world. But 20-30% of patients with severe coronary atherosclerosis are not suitable for percutaneous coronary intervention or coronary artery bypass grafting.[2] The coronary collateral flow was significantly lower in UAP compared with SAP. The poor collateral flow might play an important role of iscemic attack in patients with UAP.[3] Angina pectoris was significantly higher in patients with well developed collaterals in comparison to poorly developed ones.[4,5] Coronary collateral circulation is more in patients who presents with angina pectoris on exertion, during emotion, history of myocardial infarction and previous coronary intervention.[6] Patients with post – MI angina had more coronary collateral vessels as compared to those without angina.[7]

Methods:

Patient selection

This prospective observational cross sectional study was carried out in department of Cardiology, BSMMU from January 2007 to December 2008. A total of 150 patients with stable angina pectoris with or without MI (myocardial infarction) and or coronary intervention were enrolled undergoing CAG and PCI were included in the study. Patients having normal coronary artery and or coronary artery lesion < 70% (in case of Left main artery < 50%) in angiogram were excluded from the study.

Assessment of Coronary Angiographic findings

Coronary angiogram was done by percutaneous femoral arterial catheterization. Cardiac catheterization was done in the Cardiac Catheterization Laboratories of Department of Cardiology, BSMMU. Six (6) standard angiographic views of left coronary artery were taken and three (3) standard views were taken for right coronary artery. Significant coronary artery disease (CAD) was analyzed in four major coronary arteries - i.e. Left main if ≥ 50% stenosis or other epicardial arteries (left anterior descending artery, left circumflex artery and right coronary artery) if ≥ 70% stenosis. Lesions in diagonal and septal branch were considered under left anterior descending artery and lesions in ramus intermedius and obtuse marginal were considered under left circumflex artery.

The presence of coronary collaterals on each base line coronary angiogram was defined and visually assessed

with Rentrop's classification (grade 0-3). Coronary collateral presence was defined as Rentrop's grade ≥ 1.[8]

Comparison
Patients were divided into two groups. Group A patients having Rentrop grade 0 and Group B patients are with collateral circulation, having Rentrop grade 1-3. Patients having stable angina with or without MI, previous coronary interventions are compared in these groups. We tried to find out whether there is any correlation between stable angina pectoris and coronary collateral circulation.

Statistical Analysis
Statistical analysis was conducted using SPSS 11.5 for windows software. Categorical data were expressed as frequencies and corresponding percentages. Parametric data were expressed in mean ± SD. Parametric data were evaluated by independent sample "t" test and categorical data were evaluated by Chi-square test as needed. Level of significance for all analytical test were set at 0.05 and p value d"0.05 is considered significant.

Results:
As I mentioned before based on Rentrop grading the study subjects were divided into two groups. One is Group-A without collaterals (comprised of 55 patients) and Group-B with collaterals (consisted of 95 patients).

Table I compares the risk factors between the groups. Of the 6 risk factors shown in the table hypertension was observed to be significantly higher in Group-A (77.3%) than that in Group-B (58.3%) (p = 0.033). The low physical activity was also significantly prevalent in the former group (84.1%) than that in the latter group (63.1%) (p = 0.040). The other risk factors like diabetes mellitus, dyslipidaemia, current smoker and family history CHD were almost identically distributed between groups (p > 0.05).

Table-I
Comparison of risk factors between two groups

Risk factors	Coronary collateral circulation		p-value
	Group-A (n = 55)	Group-B (n = 95)	
Diabetes mellitus	19(34.1%)	33(34.5%)	0.961
Hypertension	42(77.3%)	55(58.3%)	0.033
Dyslipidemia	14(25.2%)	25(26.2%)	0.884
Current smoker	21(38.6%)	49(51.8%)	0.157
Family history CHD	11(20.5%)	19(20.5%)	0.997
Low Physical activity	46(84.1%)	60(63.1%)	0.040

Data were analysed using Chi-square (χ^2) Test.

* Figures in the parentheses denoted corresponding percentage.

Table II shows that stable angina pectoris, angina pectoris on exertion, stable angina with previous myocardial infraction and previous PTCA or CABG were significantly higher in Group-B than those in Group-A (p < 0.001, p < 0.001, p < 0.001 and p = 0.048 respectively). The mean duration of AP (angina pectoris) until index CAG or PTCA was also staggeringly higher in Group-B than that in Group-A (40.8 ± 25.8 vs. 13.1 ± 17.4, p < 0.001). The mean duration since MI (myocardial infarction) until index CAG or PTCA was also much higher in the former group than that in the later group (39.6 ± 32.9 vs. 11.6 ± 23.0, p = 0.003). The incidence of multi vessel coronary disease was significantly higher in Group-B (66.7%) than that in Group-A (40.9%) (p = 0.005).

Table II
Distribution of components cardiac ischemic score between groups

Components	Coronary collateral circulation		p-value
	Group-A (n = 55)	Group-B (n = 95)	
Stable angina pectoris	55(37%)	95(63%)	<0.001
Angina pectoris on exertion	42(77.3%)	90(94%)	<0.001
Stable angina with previous myocardial infraction#	17(27.3%)	43(72%)	<0.001
Stable angina with previous PTCA or CABG#	00	8(8.3%)	0.048
Duration of AP until index CAG or PTCA (months) *	13.1±17.4	40.8±25.8	<0.001
Duration since MI until index CAG or PTCA (months) *	11.9±23.0	39.6±32.9	0.003
Multi vessel coronary disease#	22(40.9%)	63(66.7%)	0.005

Data were analysed using c^2 Test; Figures in the parentheses denote corresponding %.
* Data were analysed using Student's t-Test and were presented as Mean ± SD.

Total (63%) of the patients with stable angina exhibiting presence of coronary collaterals (Group-B), 8% had experience of past coronary intervention, 12.2% non-cardiac surgery and 4.8% transient ischemic attack (TIA). In Group-A 37% with stable angina showed 13.6% had past history of non-cardiac surgery. The presence of stable angina pectoris was significantly higher in patients with coronary collaterals than that in patients without coronary collaterals (p < 0.001) (Table III).

Table III

Comparison of previous conditions between study populations

Previous conditions	Coronary collateral circulation		p-value
	Group-A (n = 55)	Group-B (n = 95)	
Stable angina pectoris	55(37%)	95(63%)	<0.001
Coronary intervention	00	8(8.3%)	0.048
Non-cardiac surgery	7(13.6%)	11(12.2%)	0.817
TIA or stroke	00	4(4.8%)	0.181

Data were analysed using Chi-square (χ^2) Test.

* Figure in the parentheses denoted corresponding percentage

Angiogram showed that about one-third (32.1%) of the patients of Group-B had SVD, 36.2% DVD and 31% TVD, while 61.4% of Group-A had SVD, 32% DVD and 6.8% TVD. The patients of Group-B encountered significantly higher TVD than those of Group-A (p = 0.001) (Table IV).

Table IV

Comparison of extent of disease between groups

Extent of disease	Coronary collateral circulation		p-value
	Group-A (n = 55)	Group-B (n = 95)	
SVD	34(61.4%)	30(32.1%)	
DVD	18(32%)	34(36.2%)	
TVD	4(6.8%)	29(31.0%)	0.001

Data were analysed using Chi-square (χ^2) Test.

Discussion

This study was done in selected group of patients based on their presentation of coronary artery disease. Total 128 patients having ≥70% lesion at least one coronary artery were selected for this study. They are divided into two groups. Group-A (55 patients) was without coronary collateral vessels and Group-B (95 patients) was with angiographically visible collateral circulation

In this study the mean age of both groups were 51.9±9.4 years and 53.7±8.9 years respectively. Majority of the study population of Group-A and Group-B were male.

The incidence of stable angina pectoris, angina pectoris on exertion, stable angina with previous myocardial infraction and or previous PTCA or CABG were significantly higher in Group-B with coronary collateral circulation than those in Group-A without coronary collaterals (p < 0.001, p < 0.001, p < 0.001 and p = 0.048 respectively) in this study.

In nearly two-third (63%) of the patients with stable angina shows coronary collateral circulation (Group B), whereas only (37%) patients were in Group A (without collateral).

At the time of angiogram, about (72%) stable angina patients with history of MI were in Group-B and 27.3% were in Group-A respectively. There were not any patient with previous coronary intervention in Group-A and 8.3% were in Group-B.

This data is consistent with different studies carried out elsewhere. The incidence of stable angina pectoris was significantly higher in patients with well developed collaterals than in those with poorly developed collaterals (21% vs. 12%; P = 0.01).[4]

Koerselman et al. (2005)[6] studied 244 patients and found coronary collaterals in 80.9% patients with angina pectoris on exertion versus 66% without collaterals. About half (50.5%) of the patients with collaterals had previous MI and 38.6% with collateral vs. 28.7% without in AP (angina pectoris) during emotions.

Reported prevalence of patients having angina with old myocardial infarction in collateral present versus absent was 94% versus 25% by Fukai et al.[9], and was 80% vs 20% by Chowdhury et al. [7]

Presence of coronary collateral vessels at the onset of myocardial infarction with history of angina is associated with limitation of infarct area and improved ventricular function.[10, 11, 12]

In the global population the left ventricular ejection fraction was higher and the duration of preceding angina pectoris was longer in the subgroups with a well developed collateral circulation.[13]

In this study the mean duration of AP (angina pectoris) until index CAG or PTCA was also staggeringly higher in Group-B than that in Group-A (40.8 ± 25.8 vs. 13.1 ± 17.4, p < 0.001). The mean duration since MI (myocardial infarction) until index CAG or PTCA was also much higher in the former group than that in the later group (39.6 ± 32.9 vs. 11.6 ± 23.0, p = 0.003).

In a previous study patients with longer duration of previous angina pectoris (11 vs 0.1 months; p less than 0.002) had more collateral circulation than without collateral (18 patients). A longer duration of previous angina pectoris probably allows collateral development before coronary occlusion in 1-vessel coronary artery disease, thereby limiting myocardial damage. [14]

In a previous study collateral circulation was more in post-MI angina patients compared to collateral absent was 89.5% vs 10.5%.[7]

One previous study showed that 52% patients with angina pectoris had good coronary collateral circulation and only 30% patients were without collaterals.[15]

The degree of collateral filling on angiography has been related to angina pectoris and the extent of previous myocardial infarction in patients with coronary artery disease.[16]

These various results from abroad, here and the one in this study show that stable angina pectoris is an important predictor for the coronary collateral circulation.

Conclusion

Different indicators of cardiac ischemic burden can determine the presence of coronary collateral circulation. Among them stable angina is common to estimate the burden of cardiac ischemia in a patient. Accordingly we found that stable angina pectoris was associated with the presence of coronary collaterals, even if severity of coronary artery disease was taken into account and which will be helpful for the treatment of patients at home and abroad. So, stable angina pectoris can determine the presence of coronary collateral circulation.

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