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Coronary Sinus Filling Time in Patients with Angina and Normal Coronary Angiography in Zagazig University Hospitals

Mohammad Elsayed Mohammad Ibrahim, Tarek Ahmed Naguib, Tamer M Mostafa, Hisham Samir Roshdy
Cardiology Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt.
***Corresponding author:** Mohammad Elsayed Mohammad Ibrahim, **Mobile**: (002) 010 07912660,
E-mail: dr.mohamed.hadhoud.2020@gmail.com

ABSTRACT

Background: Dysfunction of the coronary microcirculation may be one of the factors responsible for persistent anginal symptoms. Noninvasive as well as invasive modes for assessing microcirculation have yielded inconsistent results. **Aim of work:** To determine the usefulness of coronary sinus filling time (CSFT) for assessment of microcirculatory transit time in the coronary circulation.

Subjects and methods: A case-control study carried out in the Cardiology Department, Zagazig University Hospital on 57 patients divided into three groups: Group A included diabetics with angina, Group B included non-diabetics with angina, and Group C included control group. All patients were subjected to complete history taking, general examination and local cardiac examination. 12 Lead ECG, stress ECG (treadmill test), transthoracic echocardiography and coronary angiography were done.

Results: regarding CSFT in group A the mean was 5.247 ± 0.562, in group B the mean was 4.635 ± 0.224 sec and in group C the mean was 3.295 ± 0.525 sec. There were significant difference between group A and control group ($P < 0.001$), between group B and control group ($P < 0.001$) and between group A and group B ($P < 0.001$). There were statistically significant relation between prolongation of coronary sinus filling time and presence of comorbid hypertension ($P < 0.001$), dyslipidemia ($P < 0.05$), Family History of CAD ($P < 0.001$) and obesity ($P < 0.05$).

Conclusion: The coronary sinus filling time is a useful method for assessment of microcirculatory transit time in the coronary circulation. The prolongation of coronary sinus filling time is significantly associated with the presence of diabetes mellitus.

Keywords: CSFT, Coronary, Angiography, Cardiology.

INTRODUCTION

Normal epicardial coronary arteries are found in 20% of all diagnostic angiograms done for persons with chest pain. A heterogeneous group of patients with typical angina, a positive exercise stress test, intact epicardial coronaries without a proof of epicardial coronary artery spasm either clinically or angiographically represent Syndrome X [1].

One of the causes of recurrent anginal problems and inappropriate stress tests could be a problem with the coronary circulation. The prognosis for these cases may not be as good as initial cohort research shows. There have been findings that indicate a higher risk of cardiovascular events and cardiac mortality in cases that have a positive stress test [2].

The Women Ischemic Symptom Evaluation (WISE) trial found that persistent signs are linked to a rise in the incidence of cardiac problems, leading to the recommendation that those patients must do vascular function testing and continuous risk factor assessment [3]. Noninvasive and invasive methods for measuring microcirculation have shown mixed results, and there is currently no clear procedure for coronary microcirculation evaluation [4]. The aim of the present study was to determinate the usefulness of coronary sinus filling time (CSFT) for assessment of microcirculatory transit time in the coronary circulation.

SUBJECTS AND METHODS

A case-control study carried out in the Cardiology Department, Zagazig University Hospital on 57 patients divided into three groups: Group A included diabetics with angina, Group B included non-diabetics with angina and Group C included control group.

Inclusion criteria: Patients with typical angina with risk factors, normal ECG, positive stress ECG, and apparently normal coronaries.

Exclusion criteria: Patients with abnormal coronaries on angiography, current or prior cardiovascular events or presence of any cardiac diseases other than permitted in control group. The control group consisted of patients referred for preoperative coronary angiography for mitral valve replacement surgery not including patients with moderate to severe pulmonary hypertension, more than mild tricuspid regurge and left ventricular hypertrophy. The control group should have no significant epicardial coronary abnormality in coronary angiography.

All patients were subjected to complete history taking, general examination and local cardiac examination. 12 Lead ECG, stress ECG (treadmill test), transthoracic echocardiography and coronary angiography were done. Coronary angiogram was done with Philips Allura Xper FD20 at a rate of 15 frames/s. Left coronary artery injection was taken with

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7 mL contrast at 2 mL/s rate by the ACIST Injection system.

CSFT in seconds = (last frame count - first frame count /15)

Ethical approval:

Written informed consent was obtained from all participants after clear explanation of the study. the study was approved by the Research Ethical Committee, Faculty of Medicine, Zagazig University (Institutional Research Board IRB). The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

Data were analyzed using IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA) and NCSS 11 for windows (NCSS LCC., Kaysville, UT, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were used: Independent sample t- test of significance, chi-square (X2) test of significance, Pearson correlation coefficient and ANOVA test. P value ≤ 0.05 was considered significant.

RESULTS

The mean age in group A was 49.53 ± 7.74 years, in group B was 53.5 ± 7.35 years, and in group C was 53 ± 6.77 years without significant difference among the three groups (P > 0.05). Group A had 11 males (57.9%), group B had 10 males (52.6%), and group C had 9 males (47.4%), without significant difference among the three groups (P > 0.05) as shown in table (1).

Table (1): Comparison between the studied groups regarding demographic data

Parameter	Groups			Test	
	Diabetic patients with angina group	Non-diabetic patients with angina group	Healthy control group	χ^2/F	P
	N=19	N=19	N=19		
Gender:					
Male	11 (57.9)	10 (52.6)	9 (47.4)	0.422	0.810
Female	8 (42.1)	9 (47.4)	10 (52.6)		
Age (year):					
Mean ± SD	49.53 ± 7.74	53.5 ± 7.35	53 ± 6.77	1.553	0.221
Range	39 – 65	40 – 67	45 – 68		
P	8 (42.1)	9 (47.4)	10 (52.6)	0.422	0.810

There were statistically significant differences between group A and control group regarding risk factors; smoking (P < 0.05), hypertension (P < 0.05), dyslipidemia (P < 0.05), obesity (P < 0.05) and family history of coronary artery disease (P < 0.05). There were statistically significant differences between group B and control group regarding risk factors; smoking (P < 0.05), hypertension (P < 0.05), dyslipidemia (P < 0.05), obesity (P < 0.05) and family history of coronary artery disease(P < 0.05) (Table 2).

Table (2) Comparison between the studied groups regarding risk factors and comorbidities

Parameter	Groups			Test	
	Diabetic patients with angina group	Non-diabetic patients with angina group	Healthy control group	χ^2	p
	N=19	N=19	N=19		
Smoking:	10 (52.6)	10 (52.6)	3 (16.8)	7.143	0.04*
P	P_1 >0.999	P_2 0.017*	P_3 0.017*		
Hypertension:	6 (31.6)	5 (26.3)	0 (0)	6.984	0.03*
P	P_1 0.721	P_2 0.046*	P_3 0.019*		
Dyslipidemia:	6 (31.6)	8 (42.1)	0 (0)	9.847	0.005*
P	P_1 0.101	P_2 0.003*	P_3 0.019*		
Family History of CAD	6 (31.6)	5 (26.3)	0 (0)	6.984	0.03*
P	P_1 0.721	P_2 0.046*	P_3 0.019*		
Obesity	10 (52.6)	10 (52.6)	3 (16.8)	7.143	0.04*
P	P_1 >0.999	P_2 0.017*	P_3 0.017*		

There was a statistically significant difference between group A and control group regarding CSFT; in group A, the mean was 5.247 ± 0.562 sec and in group C the mean was 3.295 ± 0.525 sec (P< 0.001). There was a statistically significant difference between group B and control group regarding CSFT; in group B, the mean was 4.635 ± 0.224 sec and in group C the mean was 3.295 ± 0.525 (P< 0.001) as shown in table (3) & figure (1).

Table (3): Comparison between the studied groups regarding coronary sinus filling time:

Parameter	Groups			Test	
	Diabetic patients with angina group	Non-diabetic patients with angina group	Healthy control group	F	p
	N=19	N=19	N=19		
CSFT :(sec) Mean ± SD	5.247 ± 0.562	4.635 ± 0.224	3.295 ± 0.525	61.529	< 0.001**
LSD	P_1 < 0.001**	P_2 < 0.001**	P_3 < 0.001**		

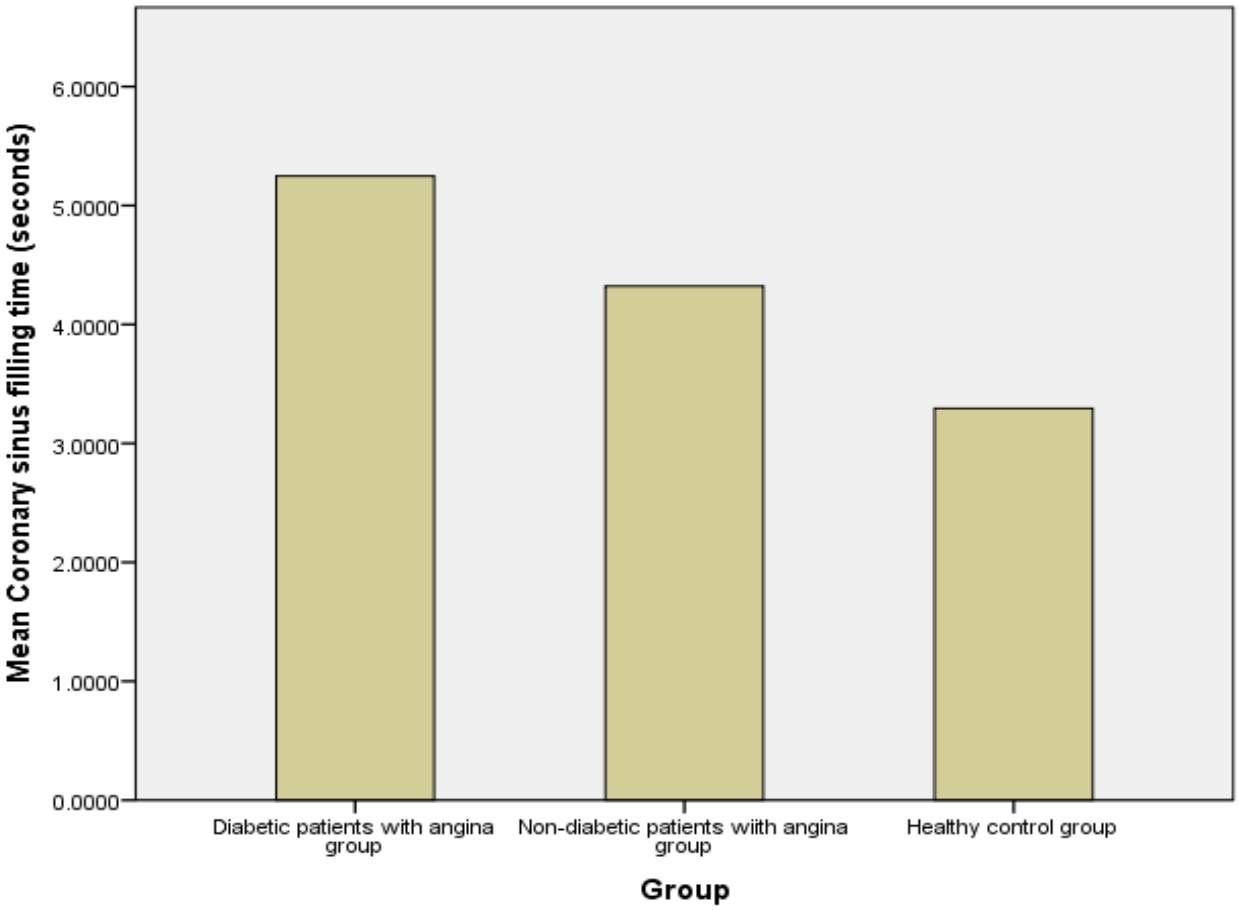

Figure (1): Simple bar chart showing coronary sinus filling time among the studied groups

There was statistically significant relation between prolongation of coronary sinus filling time and presence of comorbid hypertension (P < 0.001), dyslipidemia (P < 0.05), family history of CAD (P < 0.001) and obesity (P < 0.05). There was non-significant relation between either gender or smoking and prolongation of coronary sinus filling time (P > 0.05) as shown in table (4).

Table (4): Relation between presence of gender, risk factors and coronary sinus filling parameters

	CSFT		
	Mean±SD	t	p
Gender: Male	4.24±0.955	0.346	0.731
Smoking:	4.57±0.931	-1.85	0.069
Hypertension	5.2±0.697	-3.91	<0.001**
Dyslipidemia	4.8 ± 0.79	-2.38	0.021*
Family History of CAD	5.2±0.697	-3.91	<0.001**
Obesity	4.7±0.73	-2.41	0.023*

DISCUSSION

Anginal pain, a positive exercise stress test, healthy coronaries on angiogram, and absence of signs of coronary artery spasm are all features of cardiac syndrome X. In those patients, myocardial ischemia has been identified as one of the causes of chronic anginal pain. Microvascular dysfunction in the coronary arteries has been reported as the reason of myocardial ischemia [5].

Patients with angina and healthy coronaries have a longer coronary sinus filling time (CSFT), which can be considered an indicator of coronary microvascular efficiency. However, no research has been done on the prognostic value of CSFT [6].

In the present study we assessed the prognostic significance of CSFT in predicting cardiovascular events on follow up. The aim of our study was to determinate the usefulness of coronary sinus filling time (CSFT) for assessment of microcirculatory transit time in the coronary circulation and to assess the difference in (CSFT) in diabetic and non-diabetic patients.

CSFT is defined as the time needed for the contrast material to cross the epicardial coronary artery to the coronary microvasculature and enter the coronary sinus root estimated in seconds. The discrepancy between the frame count of maximal left anterior descending artery (LAD) system opacification at first diagonal (D1)/first septal (S1) and the beginning of opacification of coronary sinus origin was used to calculate CSFT [7].

In our study, we analyzed the demographic data of the studied patients. The studied patients included 57 patients in which 30 were males and 27 were females. We found that there were a statistically non-significant difference between the studied groups regarding age or gender. In a similar study conducted by **Haridasan and colleagues** [6], there were 41 patients in angina group and 16 in control group. Among the angina group 68.8% were females as against 81.8% in the control group. 87.8% (n ¼ 36) had typical angina**.**

Our findings revealed that there were a statistically significant difference between the studied groups regarding smoking, hypertension, dyslipidemia, obesity and family history of coronary artery disease, on comparing each two individual groups, the difference is significant between control group and each of the other two groups. In the same line, smoking and a higher HbA1c level were found to be associated with angina and the production of layered plaque as reported by **Okamoto and colleagues** [8]**.** Male sex and smoking are recognized risk factors for intravascular thrombosis, and diabetes mellitus is also linked to a higher rate of the same problem**.** During our study, we found that there was statistically significant difference between the studied groups regarding CSFT. On comparing each two individual groups, the difference was significant between each two individual groups (the highest value was in DM patients with angina followed by non-DM with angina then control group). **Haridasan and colleagues** [6] only used CSFT because the drainage characteristics of the coronary sinus, rather than those of the coronary microcirculation, determine coronary sinus emptying time and velocity. They redefined CSFT as the discrepancy in frame counts among maximum LAD opacification and the start of coronary sinus origin filling

We also found during our study that there was a statistically significant relation between presence of comorbid hypertension, dyslipidemia, obesity or family history of coronary artery disease (CAD) and coronary sinus filling time. CSFT was significantly higher in hypertensive patients and patients with dyslipidemia, obesity or family history of coronary artery disease. On the other hand, there was non-significant association between CSFT and either gender or smoking. Contrary to our findings, **Haridasan and colleagues** [6] investigated a relation among CSFT and smoking in their study. In addition, they discovered a statistically significant relationship between coronary sinus filling time and diabetes mellitus, hypertension, dyslipidemia, and a family history of CAD, which is consistent with our findings**.**

CONCLUSION

We concluded that measuring coronary sinus filling time is a good way to measure microcirculatory transit time in the coronary circulatory system. We also concluded that the length of time it takes for the coronary sinuses to fill is linked to the existence of diabetes mellitus.

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