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Short Communication

Echocardiographic Study of the Coronary Sinus in the Indeterminate Form of Chagas Disease

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Abstract

Introduction: We investigated the occurrence of coronary sinus abnormalities in the indeterminate form of Chagas disease (CD). **Methods:** Differences between the maximum and minimum diameters of the coronary sinus (Δ%) on echocardiography were evaluated in individuals with the indeterminate form of CD (n=14) and those without (n=16) CD. The association of the difference with abnormalities detected by echocardiography and myocardial scintigraphy was assessed. **Results:** The mean Δ% values did not differ significantly between the groups. There was no correlation of the measurements with echocardiographic and myocardial scintigraphy findings. **Conclusions:** The coronary sinus evaluation revealed no differences between the groups.

Keywords: Coronary sinus. Echocardiography. Indeterminate form of Chagas disease.

The coronary sinus (CS) receives most of the cardiac venous blood[1]. It is composed of layers of endocardium, myocardium and epicardium, a conduction branch, and a node with cells similar to those of the sinus node. This indicates that the CS has a structure similar to that of the atrial chamber and is not a vein, as traditionally recognized[2].

The cardiac involvement in Chagas disease (CD) is caused by a direct invasion of the myocardial cells by *Trypanosoma cruzi*; the invasion is minimal in the indeterminate form of the disease. Since the CS is composed of myocardial cells, we aimed to study if it could develop structural and functional changes in the indeterminate form of CD. From a pathological point of view, no previous study has evaluated the CS in CD[3,4].

The indeterminate form of CD is defined by the absence of clinical, radiological, and electrocardiographic manifestations of cardiac or gastrointestinal involvement[10]. When subjected to advanced cardiovascular tests, minor abnormalities might be detected in these patients. A study of the coronary venous circulation in the indeterminate form of CD provides information that might improve the understanding of this disease.

Based on these observations, the aim of this study was to compare the maximum and minimum diameters of the CS, determine the differences in these diameters (Δ%) in individuals with and without Chagas infection, and analyze the association between the differences and the abnormalities detected by echocardiography and myocardial scintigraphy.

We studied the variation in CS diameters to evaluate the coronary venous circulation indirectly. We analyzed the anterior and posterior segments of the CS by a Doppler study of the left ventricle (LV) diastolic function and the tricuspid valve, respectively. The correlation with scintigraphy findings was important to detect any myocardial perfusion changes.

We studied individuals without and with Chagas infection confirmed by two different serological methods: IFI IgG, ELISA (immunoenzymatic assay) or HAI (indirect hemagglutination). All participants underwent transthoracic echocardiography according to the parameters defined by the American Society of Echocardiography[5], including measurement of the maximum (>) and minimum (<) transverse diameters (Ø) of the CS. The difference between the diameters (Δ%) was calculated using the following equation: (Δ%) = [(> Ø CS – < Ø CS) / > Ø CS] x 100, where > Ø CS and < Ø CS represent the mean value of the greatest and smallest diameters of the coronary sinus, respectively. We obtained the < Ø CS measurements at the beginning of the QRS complex and the > Ø CS measurements during the ventricular contraction. The images were obtained in M-mode from the apical two-chamber view. We also

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analyzed the association of the CS parameters with other echocardiographic data and findings of myocardial perfusion scintigraphy using technetium sestamibi (99mTc).

All procedures were performed in accordance with the Declaration of Helsinki. The study was approved by the Human Research Ethics Committee of the Health Sciences School at University of Brasília (CEP/FS-UnB) and all participants signed the informed consent form.

Data of categorical variables were compared using the chi-square test, while Fisher's exact test was used in cases with expected values < 5. To verify the differences in the CS maximum and minimum diameters, and the differences in these diameters (Δ%) between the two groups, we compared the mean values between the groups using Student's t test. The analyses of correlation between continuous quantitative variables were performed using Spearman's correlation coefficient.

The variable Δ% followed a normal distribution in the population, as assessed by the non-parametric Kolmogorov-Smirnov and Shapiro-Wilk tests, and was analyzed by Student's t test and Spearman's test. The distribution of the median Δ% values in the population of patients with and without abnormal scintigraphy was compared using the Mann-Whitney test. Statistical analyses were performed using the software IBM SPSS Statistics 21.

We enrolled young patients with a mean age of 35.3 (7.3) years, (**Table 1**) at the indeterminate stage of CD. We collected information from two groups: Group 1, including 14 participants with Chagas infection, and Group 2, including 16 participants without Chagas infection. Both groups were compared with respect to the anthropometric data, age, and gender (**Table 1**).

The mean values of Δ%, < Ø CS, and > Ø CS did not differ significantly between the groups (p-value = 0.55, 0.46 and 0.90, respectively). The proportion of patients with Chagas infection showing abnormalities on scintigraphy was not significantly different from the proportion of patients without Chagas infection with abnormalities on scintigraphy (p-value = 0.15). The median Δ% value in patients with scintigraphy abnormalities (62.96 %) and the median Δ% value in patients with normal scintigraphy (48.81 %) was also not significantly different (p-value = 0.20).

The proportion of patients with mitral regurgitation was comparable between the groups with and without Chagas infection (p-value = 0.05) (**Table 2**). Spearman's linear correlation coefficients (r) and their respective p-values between Δ% and diastolic dysfunction measurements in Group 1 were as follows: mitral E/A (r = 0.04; p-value = 0.87), mitral EF (r = -0.22; p-value = 0.44), septal E'/A' (r = 0.05; p-value = 0.84), and lateral E'/A' (r = 0.16; p-value = 0.56). The corresponding values in Group 2 were: mitral E/A (r = -0.25; p-value = 0.33), mitral EF (r = 0.13; p-value = 0.61), septal E'/A' (r = 0.15; p-value = 0.57), and lateral E'/A' (r = -0.10; p-value = 0.68). These results indicate no significant correlation between Δ% and measures of diastolic dysfunction in both groups (**Table 3**).

Spearman´s (r) linear correlation coefficients and their respective p-values between Δ% and the tricuspid Doppler measurements in Group 1 were: A wave (r = -0.03; p-value = 0.91), E/A ratio (r = -0.08; p-value = 0.78), S wave (r = 0.08; p-value = 0.78), E wave (r = -0.17; p-value = 0.54). In Group 2 the corresponding values were: A wave (r = -0.13; p-value = 0.60), E/A ratio (r = -0.21; p-value = 0.42), S wave (r = -0.09; p-value = 0.72), E wave (r = -0.02; p-value = 0.93). These results indicate no significant correlation between Δ% and the tricuspid Doppler measurements in both groups (**Table 3**).

Microvascular disorders are among the main pathophysiological mechanisms of Chagas cardiopathy. There could be a possible involvement of the CS, because changes in its contractility could have an impact on the coronary circulation, including on small vessels.

Furthermore, patients with Chagas cardiopathy present perfusion changes without obstruction of the coronary arteries[6] and a greater involvement of the areas supplied by the two arteries[7], i.e., the apex and postero-lateral wall of the LV. The regions supplied by the two arteries drain almost entirely into the CS. Thus, a failure in venous drainage from the CS could have a retrograde repercussion to the entire coronary venous circulation, causing changes in myocardial perfusion and consequently LV diastolic dysfunction, which is seen in the initial stage of Chagas cardiopathy[8].

To evaluate the CS in CD, we started with the indeterminate form of CD. To study the right ventricle (RV), which is involved

TABLE 1: Anthropometric measurements, age, and gender of the participants in both groups.

Characteristics*	Group 1 (n = 14)	Group 2 (n = 16)	P-value**
Weight	75.6 (19.1)	73.8 (12.6)	0.76
Height	166.8 (9.0)	171.0 (8.7)	0.20
Body Surface	1.8 (0.2)	1.9 (0.2)	0.78
BMI	27.0 (5.7)	25.2 (3.6)	0.30
Age	35.3 (7.3)	31.3 (7.2)	0.14
Gender (male)	6 (42.86)	7 (43.75)	0.96

*Quantitative variables are expressed as mean (standard deviation) and categorical variables are expressed as frequency (%). **Student's *t* test was utilized for numerical variables and Chi-square test was used for categorical variables. **BMI:** Body mass index.

TABLE 2: Coronary sinus, myocardial scintigraphy, and mitral regurgitation measurements.

Characteristics*	Group 1 (n = 14)	Group 2 (n = 16)	P-value**
Δ%	51.47 (8.41)	49.51 (9.58)	0.55
< Ø CS	4.24 (1.05)	4.54 (1.13)	0.46
> Ø CS	8.92 (2.44)	9.02 (1.63)	0.90
Scintigraphy (abnormal)	4 (28.57)	1 (6.25)	0.15
M.R. (positive)	2 (14.29)	8 (50.00)	0.05

*: Quantitative variables are expressed as mean (standard deviation) and categorical variables are expressed as frequency (%). ****:** Student's *t* test was used for numerical variables and Fisher's exact test was used for categorical variables. **Δ%:** Difference between the maximum and minimum transverse diameters of the coronary sinus; **> Ø CS:** Maximum transverse diameters of the coronary sinus; **< Ø CS:** Minimum transverse diameters of the coronary sinus; **M.R.:** Mitral regurgitation.

TABLE 3: Correlation between Δ% and variables estimating the diastolic dysfunction and tricuspid Doppler in the participants in both groups.

Variable	Correlation Coefficient*	P-value
	Diastolic Dysfunction – Group 1	
Mitral E/A	0.046	0.87
Mitral EF	-0.220	0.44
Septal E'/A'	0.059	0.84
Lateral E'/A'	0.169	0.56
	Tricuspid Doppler – Group 1	
A wave	-0.033	0.91
E/A ratio	-0.081	0.78
S wave	0.081	0.78
E wave	-0.178	0.54
	Diastolic Dysfunction – Group 2	
Mitral E/A	-0.259	0.33
Mitral EF	0.135	0.61
Septal E'/A'	-0.153	0.57
Lateral E'/A'	-0.109	0.68
	Tricuspid Doppler – Group 2	
A wave	-0.138	0.60
E/A ratio	-0.215	0.42
S wave	-0.097	0.72
E wave	-0.021	0.93

*Spearman's correlation coefficient.

very early and frequently in CD[9], we evaluated the tricuspid annulus under Doppler, and to evaluate the LV, we assessed the diastolic function.

Thus, considering the LV as a segment proximal to the CS, and RV as the distal segment, we assessed the coronary venous circulation indirectly in the indeterminate form of CD and found no abnormalities in the segments located proximally or distally to the CS (diastolic dysfunction or tricuspid abnormalities on Doppler).

In conclusion, no changes on Doppler echocardiography were found in the CS of patients with the indeterminate form of CD. Further studies on patients with Chagas cardiopathy should be conducted to investigate the CS in the context of chronic Chagas cardiopathy.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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