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Assessment of left ventricle systolic and diastolic functions in schizophrenia patients

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ABSTRACT

The objective of the study was to scrutinize in detail the changes that occur in left ventricle (LV) systolic and diastolic functions using echocardiography in patients with at least 5 years of history and 40 healthy volunteers matching the patients in age and gender, who were enrolled in a cross-sectional study. All cases were examined with Tei Index, an index that could assess LV systolic and diastolic functions in conjuction, and with LV ejection fraction (LVEF) that assesses systolic function. In addition, Mitral E and A wave velocities, Isovolemic relaxation time (IVRT), Tissue Doppler Em (peak early motion) and Am (peak after motion) waves, which evaluate diastolic functions were measured. Tei Index was calculated as 0.61 ± 0.19 in the patient group, and as 0.39 ± 0.10 in the control group and the difference was statistically significant ($p < 0.001$). LVEF was measured as $58\% \pm 5$ in the patient group, and as $62\% \pm 3$ in the control group and the difference was statistically significant ($p < 0.001$). Also the IVRT values were significantly different between the tissue Doppler Em and Em/Am ratio among the groups ($p < 0.001$). Echocardiographic myocardial performance, LV systolic and diastolic functions in schizophrenia patients was found to be worse than those of the control group.

1. Introduction

The risk of cardiovascular disease is higher in schizophrenia patients when compared to general population. Several factors including genetic predisposition, increased smoking rate, unbalanced nutrition and malnutrition, a sedentary lifestyle and increased alcohol and substance use could play a role in this finding (Brown et al., 1999; Schulz et al., 2015). Also, possible adverse effects in the cardiovascular system that develop due to the use of certain antipsychotic drugs could result in the increase of morbidity and morbidity prevalence rates induced by cardiovascular factors. Average life expectancy of an individual diagnosed with schizophrenia is approximately ten years lower than the general population and the relative risk of death due to cardiovascular disease increases 33% in these patients (Jeste et al., 1996).

There is limited number of data available in the literature on whether heart failure develops in schizophrenia patients (Unsal et al., 2013; Chow et al., 2014). The authors were not able to find a detailed study in the literature that scrutinized systolic and diastolic heart failure in schizophrenia patients using the echocardiographic method. The objective of this study was to scrutinize in detail the changes that occur in left ventricle systolic and diastolic functions by echocardiography in patients, who were monitored after diagnosis of schizophrenia, when compared to the control group.

2. Materials and methodology

In this prospective study, forty patients receiving treatment in our psychiatric clinic as inpatients or outpatients, and diagnosed with schizophrenia for at least 5 years based on DSM-IV-TR (APA, 2000) and conforming to the study criteria were included. The control group included 40 healthy volunteers within the same age range and gender demographics as the patient group. Patients with known ischemic coronary diseases, heart failure, long-term uncontrolled hypertension, history of myocardia and infective endocarditis were excluded from the study. Cases with alcohol and substance use histories, except smokers, were also excluded from the study.

2.1. SCID-1 Clinical Interview Index

Axis 1 psychiatric diagnosis of the patients was identified using SCID-1 index. SCID-1 is a clinical interview scale designed for major DSM-IV Axis 1 disorders in 1997 by American Psychiatric

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Association (First et al., 1997).

In addition to this scale, a survey form aimed to collect socio-demographic and clinical data, which was developed by the authors in accordance with the clinical experience and the information gathered from the reviewed resources based on the objectives of this study, was utilized. Socio-demographic information such as age, gender, marital status, educational background, profession, domicile, income level, and family structure were recorded using this form.

2.2. Echocardiography

Echocardiography plays an important role in diagnosis and follow-up of most heart diseases (Sagie et al., 1993). Echocardiography is a reliable, non-invasive, reproducible, relatively non-expensive examination technique that could establish a final diagnosis for heart diseases. It could measure the dimensions of cardiac cavities and the blood pumping force of the heart using harmless sound waves and the condition of cardiac valves and furthermore, the movements of cardiac walls could be evaluated using this method. Tissue Doppler echocardiography is a pretty recent and popular echocardiographic technique. Although it is not commonly used in routine clinical practice, it could be used for assessment of global or regional, systolic and diastolic functions of the ventricles. The same cardiologist, who was not aware of the groups, conducted an echocardiographic assessment of all groups in the study. Transthoracic echocardiography was conducted on the cases using a 2.5 MHz transducer with GE-Vivid 7 Pro GE-Vingmed (Ultrasound AS, Horten, Norway) equipment at left lateral decubitus position (Schiller et al., 1989). M-mod measurements were taken using parasternal window; two-dimensional and Doppler echocardiographic assessments were made using parasternal and apical windows. All values were given as the mean of the three consecutive cycles conducted. Left ventricle diastole end diameter, left ventricle systole end diameter, interventricular septum and rear wall thicknesses were measured. Ejection fraction was calculated using the modified Simpson method (Feigenbaum et al., 2005). Left ventricle filling parameters were assessed from the ends of mitral leaflets in apical quadrilocular image, and peak early (E) and after (A) diastolic flow velocities were measured. E/A ratio was calculated by the division of E wave by the A wave value. Where the E/A ratio was below 1, it was considered as flipped. Isovolemic Relaxation Time (IVRT) was accepted as the duration between the closure of the aortic valve and the beginning of the flow into mitral interior; Isovolemic Contraction Time (IVCT) was accepted as the time that passes between the closure of the mitral valve and the opening of the aortic valve; Ejection Time (ET) was considered as the period between the beginning of the flow in left ventricle exit way and until its end. Left ventricle Tei index was calculated using the formula: (IVRT+IVCT)/ET (Tei et al., 1997). Tissue Doppler assessment was conducted on apical quadrilocular image. Tissue Doppler imaging was applied by placing pulse wave Doppler at the region where posterior mitral valve clings to the left ventricle free wall and the region where the mitral anterior leaflet clings to the septum. Peak systolic motion (Sm), peak early motion (Em), and peak after motion (Am) wave values were also measured. Each parameter was measured in at least 3 cycles and mean figures were utilized.

2.3. Statistical method

Analysis of collected data was conducted using SPSS 22.0 software (Chicago, IL, USA). Quantitative data were presented as mean ± standard deviation and the qualitative data were given as percentages. The normal distribution of the variables was evaluated with Kolmogorov-Smirnov test. Parametric data were analyzed using independent *t* test and nonparametric data were analyzed with Mann-Whitney *U* test. Chi-square test was used to compare categorical variables. The results were evaluated at $p < 0.05$ significance level and $p < 0.01$ advanced significance level.

3. Results

The data obtained from 80 cases, out of which 40 were schizophrenia patients and 40 were control group, were compared in the study. There were 22 males and 18 females in the patient group; in the control group, there were 21 male and 10 female cases. There were no differences in mean age, gender, and body mass index values between the groups. Socio-demographic characteristics of the patient and control groups are presented in Table 1. Mean disease duration was 16.89 ± 7.2, while mean disease onset age was found as 20.78 ± 6.7. Evaluation of the medicine used by the patients recently demonstrated that 6 used quetiapine, 8 used olanzapine, 3 used risperidone, 6 used clozapine, 2 used aripiprazole, 2 used amisulpride, 1 used haloperidol, 4 used risperidone+quetiapine, 2 used quetiapine+paliperidone palmitate, 2 used risperidone+olanzapine, 1 used risperidone + clozapine, and 2 used amilsulpride+risperidone for treatment.

Tei index was calculated as 0.61 ± 0.19 in the patient group and as 0.39 ± 0.10 in the control group. An advanced significant statistical difference was found between the groups ($p < 0.001$). Mean feft ventricle ejection fraction (LVEF) was measured as 58% ± 5 in the patient group. LVEF was 62% ± 3 in average in the control group. LVEF ratio was found very statistically significantly low in the patient group when compared to the control group ($p < 0.001$). The number of cases with flipped or less than 1 mitral E/A wave ratio, one of the indicators of diastolic early stage disorder, was 18 (45%) in the patient group, while there was only

Table 1
Comparison of socio-demographical and clinical characteristics of patient and control groups.

		Patient group n:40	Control group n:40	p
Age Year (min ± std)		38.5 ± 12.8	35.7 ± 9.8	NS[a]
Gender male n (%)		22 (%55)	21 (%53)	NS[b]
Marital Status	Married n	11	29	
	Bachelor n	24	11	
	Divorced n	5	–	
Education	Illiterate n	3	1	
	Primary-Secondary n	31	16	
	College n	6	23	
Residence Central n (%)		28 (%70)	37 (%93)	0.042[b]
Smoking n (%)		23 (%58)	22 (%55)	NS[b]
Psychiatric disorder in family		24	–	
Diabetes n		2	–	NS[b]
Hypertension n		3	–	NS[b]
Employed n		9	29	0.038[b]
Body mass index		28.2 ± 6	26.3 ± 5	NS[c]
Heart rate (beats per minute)		76 ± 17	74 ± 15	NS[a]
Systolic Blood Pressure (mmHg)		121 ± 14	118 ± 12	NS[c]
Diastolic Blood Pressure (mmHg)		77 ± 10	75 ± 9	NS[a]

[a] p values were established using Mann-whitney *u* test.
[b] P values were established using Chi-square test.
[c] P values were established using independent test.