

ORIGINAL ARTICLE

Pulsed and Tissue Doppler-derived Myocardial Performance (Tei) Indices in Fetuses with Maternal Antibodies to Intracellular Ribonucleoproteins

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ABSTRACT

Background: This study aimed to compare the normal fetuses and the fetuses of the women with positive anti-SSA/Ro and anti-SS/La antibodies in terms of the changes in pulsed Doppler (PD) and tissue Doppler imaging (TDI)-derived myocardial performance (Tei) indices.

Materials and Methods: In This cross sectional study, we investigated 11 fetuses with anti-SSA/Ro and anti-SS/La-positive mothers (case group) and compared with 48 normal fetuses (control group). The mean gestational ages in the case and control groups were 25.0±5.5 and 27.5±6.5 weeks, respectively (P=0.310). Furthermore, the mean maternal ages were 26.0±3.5 and 27.0±4.5 years in the case and control groups, respectively (P=0.292). In addition, PD and TDI Tei indices of the mitral and tricuspid valves were measured in both study groups.

Results: The mean PD Tei indices of the mitral valve in the case and control groups were 0.51±0.11 and 0.59±0.05, respectively (P=0.586). Regarding the tricuspid valve, the mean PD Tei indices were 0.53±0.12 and 0.53±0.12 in the case and control groups, respectively (P=0.876). In addition, the mean TDI-derived Tei indices of the mitral and tricuspid valves in the case and control groups were 0.58±0.05 versus 0.55±0.09 (P=0.321) and 0.56±0.05 versus 0.55±0.08 (P=0.861), respectively.

Conclusion: According to the results of this study, there were no statistically significant differences between the two groups in terms of the PD and TDI Tei indices of the mitral or tricuspid valves. In other words, these indices did not trigger any global dysfunction in the fetuses of the women with positive anti-SSA/Ro and anti-SSB/La antibodies. Therefore, PD or TDI Tei indices of the right or left side of the heart could not be suitable indicators of early fetal cardiac involvement in fetuses with no evidence of carditis.

Key Words: Antinuclear antibodies, Anti-SSA/Ro antibodies, Anti-SSB/La antibodies, Congenital heart block, Myocardial performance index, Pulsed doppler ultrasonography, Tissue doppler

➤ How to cite this paper:

Soltani M, Amoozgar H. Pulsed and Tissue Doppler-derived Myocardial Performance (Tei) Indices in Fetuses with Maternal Antibodies to Intracellular Ribonucleoproteins. Journal Of Iranian Clinical Research. 2015; 1(1): 33-37.

INTRODUCTION

Complete heart block (CHB) is considered as the most severe complication of transplacental passage of anti-SSA/Ro and anti-SSB/La antibodies, which could appear in the neonates or fetuses with structurally normal hearts. CHB affects 2% of fetuses with maternal positive anti-SSA/Ro and anti-SSB/La antibodies, while neonatal lupus accounts for 90-95% of all neonatal CHB cases [1].

Myocardial performance index, also known as "Tei" index, is a well-known indicator of global heart function in normal fetuses, as well as sick neonates [2-9]. Tie index is the sum of

isovolumic contraction time (ICT) and isovolumic relaxation time (IRT), divided by ejection time (ET) [9].

In the present study, we aimed to compare the pulsed Doppler (PD) and tissue Doppler imaging (TDI)-derived Tei indices of the right and left ventricles in fetuses with no evidence of carditis and heart block, who had positive maternal anti-SSA/Ro and anti-SSB/La antibodies. In order to determine the ability of these indices to detect an undisclosed myocardial dysfunction, we also investigated normal fetuses in the control group.

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MATERIALS AND METHODS

This bi-group cross sectional study was conducted in a health care center affiliated to the Shiraz University of Medical Sciences, Shiraz, Iran in 2014.

Study Population

In this study, we enrolled 59 asymptomatic pregnant women and divided them to two groups based on the study measures. The case group consisted of 11 subjects with positive anti-SSA/Ro and anti-SSB/La antibodies as detected by enzyme-linked immunosorbent assay, and the control group included other 48 normal fetuses.

The gestational age (GA) of the subjects was calculated via ultrasonography, based on the last menstrual period of the mothers and was not statistically significant between the groups.

Echocardiographic Data

Two-dimensional and PD echocardiography were performed using a General Electric Vivid 3 echocardiography apparatus (General Electric Vivid 3 Vingmed, Horten, Norway), a 3-MHz probe, and pulsed tissue Doppler software. All the echocardiographic assessments were conducted by the same pediatric cardiologist in order to minimize errors.

Initially, the PD sample volume was positioned at the tips of the mitral and tricuspid leaflets in the four-chamber view in order to record the inflow velocities. We attempted to simultaneously record the inflow and outflow velocities in the same strip; however, in case this was not plausible, the right and left ventricular inflow and outflow velocities were recorded separately. Therefore, the tissue Doppler of mitral and tricuspid lateral walls was performed in the four-chamber view with no angle correction.

In order to determine IRT, ICT, and ET, all the strips were saved and evaluated off-line using a digital clipper. Eventually, the Tei indices were calculated as $(ICT + IRT)/ET$, and at least three consecutive cardiac beats were obtained.

Statistical Analysis

The obtained data from the PD and TDI of the right and left ventricles were analyzed using the Mann-Whitney U test through SPSS version 15. All data were presented as mean and standard deviation. P-value less than 0.05 was considered statistically significant.

Ethical considerations

The study protocol was approved by the Ethics Committee of the university. Written

informed consent was obtained from all the subjects.

RESULTS

In total, 59 fetuses within the age range of 16-38 weeks were evaluated in this study (mean age: 27.5 ± 6.5 weeks). The mean age and mean GA of the case group were 26.0 ± 3.5 years and 25.0 ± 5.5 weeks, respectively. Regarding the control group, the mean age and mean GA were 27.0 ± 4.5 years and 27.5 ± 6.5 weeks, respectively. The subjects' mean PD- and TDI-derived time intervals in the mitral and tricuspid valves and the significance of the differences are illustrated in tables 1 and 2.

DISCUSSION

The findings of the current study, demonstrated that PD and TDI Tei parameters of the right or left ventricles could not be appropriate indicators of early cardiac involvement in fetuses with no evidence of carditis.

Even though, dermal manifestations are highly prevalent in neonatal lupus, CHB is regarded as the most severe complication of the disease [1]. Fetuses of either gender whose mothers have anti-SSA/Ro and anti-SSB/La antibodies are equally susceptible to CHB [10]. These antibodies play a significant pathophysiological role in CHB [11].

According to the literature, CHB frequently develops during the GA of 18-24 weeks. On the other hand, the findings of Logar et al. were indicative of a higher prevalence of myocarditis and conduction disorders among the adults with systemic lupus erythematosus. Their findings emphasized the fact that such defects are associated with the presence of anti-SSA/Ro antibody [12].

Moreover, there are several studies indicating a significant relationship between prolonged mean corrected QT interval, ventricular dysrhythmia, and positive anti-SSA/Ro antibody [13-16]. For instance, Mahmoud et al. reported the TDI findings of the left ventricular diastolic dysfunction in the patients with systemic lupus erythematosus [17].

The CHB is considered as a leading cause of mortality and morbidity during the fetal and neonatal periods, particularly within the first 12 hours of birth. Therefore, the timely echocardiographic follow-up of the neonates should be mandatory in health care centers [18]. In this regard, several researchers have recommended to perform serial echocar-

Table 1. Mean pulsed Doppler and tissue Doppler imaging data for mitral and tricuspid valves in the case and control groups

	Control group (Mean±SD)	Positive maternal antibodies (Mean±SD)	P-value
Age (years)	27.0±4.5	26.0±3.5	0.292
Gestational age (weeks)	27.5±6.5	25.0±5.5	0.310
Pulsed Doppler across mitral valve			
ET (ms)	150±26	154±24	0.413
ICT (ms)	34±7	37±10	0.520
IRT (ms)	51±5	41±6	0.227
Pulsed Doppler across tricuspid valve			
ET (ms)	147±20	154±27	0.612
ICT (ms)	32±5	35±4	0.231
IRT (ms)	43±6	45±7	0.436
Tissue Doppler imaging of mitral valve			
ET (ms)	153±31	146±19	0.633
ICT (ms)	36±5	36±3	0.619
IRT (ms)	46±7	49±8	0.169
Tissue Doppler imaging of tricuspid valve			
ET (ms)	153±26	147±23	0.405
ICT (ms)	36±5	35±4	0.815
IRT (ms)	46±6	47±7	0.977

ET: Ejection time, ICT: Isovolumic contraction time, IRT: Isovolumic relaxation time

Table 2. Pulsed and tissue Doppler imaging derived Tei indices for mitral and tricuspid valves in the case and control groups

Measured variables	Control group (Mean±SD)	Positive maternal antibodies (Mean±SD)	P-value
Mitral pulsed Doppler	0.59±0.05	0.51±0.11	0.586
Tricuspid pulsed Doppler	0.52±0.08	0.53±0.12	0.876
Mitral tissue Doppler imaging	0.55±0.09	0.58±0.05	0.321
Tricuspid tissue Doppler imaging	0.55±0.08	0.56±0.05	0.861

diographic evaluations at least every two weeks, starting from the 16th week of gestation [19, 20].

Therefore, the detection of anti-SSA/Ro and anti-SSB/La antibodies in the maternal serum might act as a suitable indicator of fetal CHB. Nevertheless, according to a study, there is no correlation between the anti-SSA/Ro antibody titers and the presentation of neonatal lupus [21]. In addition, the frequent measurement of anti-SSA/Ro and anti-SSB/La antibodies are not widely considered as appropriate predictors for neonatal and fetal CHB [22].

In the current study, the obtained values for PD and TDI Tei indices of the fetuses with anti-SSA/Ro- and SSB/La-positive mothers were comparable with those of the tissue Doppler imaging indices of normal fetal cardiac systolic and diastolic functions as well as the Tei indices of normal fetal cardiac function [4].

The Tei index was first introduced to evaluate the global systolic and diastolic myocardial

function, independent of the fetal load, heart rate, and ventricular geometry [23, 24]. According to the literature, this index could be affected by different factors [25-27]; however, TDI-derived Tei index overcomes this potential limitation through measuring the tissue variations. As a result, it is less likely to be influenced by the changes of loading conditions, heart rate, and geometry [28].

In a study conducted by Duanet al., a significant correlation was reported between PD- and TDI-derived Tei indices in the right side of the fetal heart [29]. Nonetheless, Acharya et al. indicated no such correlation between these indices in the right or left ventricles of the fetal heart [29].

Despite the incompatibilities between the studies attempting to verify the correlation between PD and TDI indices, the Tei index is deemed as a suitable approach to assess the systolic and diastolic cardiac function of both

healthy and ill fetuses and neonates [2-9].

In a study carried out by Ichizuka et al., the PD-derived Tei index was noticeably higher in the fetuses with twin to twin transfusion syndrome, large-for-gestational-age fetuses, neonates of diabetic mothers, and fetuses with hydrops fetalis, compared to the control group.

Consequently, this index was considered as a proper indicator of the myocardial performance in these fetuses, as well as the early detection of other fetal cardiac defects [6]. Additionally, several other studies are indicative of significant variations in the Tei index of fetuses with intrauterine growth restriction, hypoplastic left heart syndrome, and critical aortic stenosis [3, 7].

In the current study, we compared the right and left ventricular PD-and TDI-derived Tei indices of the fetuses with anti-SSA/Ro and anti-SSB/La-positive mothers and those of normal fetuses. According to our findings, there were no statistically significant differences between the IRT, ICT, ET, and the Tei indices of the two groups. Furthermore, the obtained Tei index values in the fetuses with anti-SSA/Ro- and anti-SSB/La-positive mothers were similar to those reported earlier for normal fetuses [2, 4].

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CONCLUSION

As the findings of the present study indicated, PD and TDI Tei indices of the right or left ventricles could not be suitable indicators of early cardiac involvement in fetuses with no evidence of carditis. Moreover, these indices are not able to differentiate between the normal fetuses and those with anti-SSA/Ro- or anti-SSB/La-positive mothers.

ACKNOWLEDGEMENTS

Hereby, we extend our deepest gratitude to K. Shashok, the author aid in the Eastern Mediterranean Journal, for editing the manuscript. We would also like to thank M. Gholami, working at the Clinical Research and Development Center of Namazi Hospital, for assisting us in this research project. The financial support for the present study was provided by the Vice Chancellor of Research affiliated to the Shiraz University of Medical Sciences.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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