

Assessment of ventricular functions with tissue Doppler echocardiography in children with asthma



Ozdemir O.¹, Ceylan Y.², Razi C.H.³, Ceylan O.⁴, Andiran N.²

¹ Department of Pediatric Cardiology; ² Department of Pediatrics; ³ Department of Pediatric Allergy, Kecioren Training and Research Hospital, Ankara, Turkey; ⁴ Department of Pediatric Cardiology, Dr. Sami Ulus Gynecology, Children's Health and Diseases Training and Research Hospital, Ankara, Turkey

Introduction and objective

Asthma, which is the most common chronic illness among children, is a chronic inflammatory disorder of the airways. In the patients with asthma, pulmonary hypertension develops due to recurrent hypoxia and chronic inflammation, leading to right heart enlargement with ventricular hypertrophy. Patients with severe asthma can experience cor pulmonale later in life, but little is known about right ventricular function early in the disease.

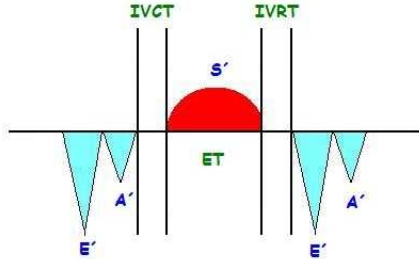
Our study aimed to investigate subclinical ventricular dysfunction by using conventional and tissue Doppler echocardiography in asthmatic children without any cardiovascular symptoms.

Methods

We studied 51 pediatric patients with asthma and 46 age- and sex-matched healthy children. All subjects were examined on conventional echocardiography and tissue Doppler echocardiography (TDE) with myocardial performance index, and 51 patients with asthma had pulmonary function tests on spirometry. Cardiac time intervals are shown in Figure.

The collected data were analyzed using the SPSS version 16.0. Kolmogorov-Smirnov test was used to assess the normality of distribution. Data are expressed as mean \pm standard deviation, and $p < 0.05$ was considered significant. Student's *t*-test and Pearson's correlation analysis were used.

Figure



Results

Demographic characteristics, conventional echocardiographic parameters, and TDE results of the asthmatic patients and healthy children are shown in Table 1, Table 2, and Table 3, respectively.

The results of correlation are given in Table 4.

Table 1	Asthmatic patients (n = 51)	Healthy children (n = 46)	p-value
Male/Female	34/17	33/13	0.59
Age (years)	10.4 \pm 2.2	10.9 \pm 2.4	0.77
Body height (cm)	142.6 \pm 13.4	138.8 \pm 16.2	0.06
Body weight (kg)	40.6 \pm 12.6	30.6 \pm 13.5	0.54
Heart rate (beat/min)	90.6 \pm 7.7	91.0 \pm 12.5	0.84
Respiratory rate (/min)	18.2 \pm 2.2	19.2 \pm 2.2	0.93
Systolic BP (mmHg)	104.7 \pm 9.6	100.3 \pm 11.8	0.12
Diastolic BP (mmHg)	69.4 \pm 8.2	62.8 \pm 8.9	0.39

Table 3	Asthmatic patients (n = 51)	Healthy children (n = 46)	p-value
Tricuspid annulus			
E' (cm/s)	16.4 \pm 1.8	13.2 \pm 2.3	0.01
A' (cm/s)	5.7 \pm 1.4	8.2 \pm 2.0	0.01
E'/A'	3.2 \pm 0.7	1.6 \pm 0.5	0.01
S' (cm/s)	10.1 \pm 2.0	9.9 \pm 1.7	0.10
IVRT (ms)	67.7 \pm 10.2	46.2 \pm 8.7	0.01
IMPI (%)	48.1 \pm 7.0	42.0 \pm 5.7	0.01
Mitral annulus			
E' (cm/s)	15.9 \pm 3.4	15.4 \pm 3.4	0.51
A' (cm/s)	5.9 \pm 1.2	6.2 \pm 2.1	0.45
E'/A'	2.7 \pm 0.7	2.6 \pm 0.6	0.89
S' (cm/s)	7.3 \pm 1.6	6.9 \pm 1.7	0.24

Table 2	Asthmatic patients (n = 51)	Healthy children (n = 46)	p-value
FS (%)	39.4 \pm 3.1	40.2 \pm 4.1	0.29
RV wall thickness (mm)	4.7 \pm 1.5	3.6 \pm 0.4	0.01
RV diameter (mm)	23.8 \pm 3.6	24.9 \pm 3.4	0.11
Mitral E (cm/s)	77.1 \pm 14.9	77.3 \pm 15.4	0.97
Mitral A (cm/s)	54.6 \pm 8.8	52.2 \pm 14.9	0.81
Mitral E/A	1.4 \pm 0.1	1.5 \pm 0.2	0.09
Mitral DT (ms)	138.5 \pm 33.9	129.1 \pm 25.4	0.22
Tricuspid E (cm/s)	107.6 \pm 16.0	102.4 \pm 19.5	0.15
Tricuspid A (cm/s)	62.8 \pm 12.2	59.3 \pm 20.2	0.31
Tricuspid E/A	1.7 \pm 0.4	1.8 \pm 0.4	0.26
Tricuspid DT (ms)	155.6 \pm 44.0	140.5 \pm 46.7	0.11

Table 4	RV wall thickness	Tricuspid E/A	IVRT	IMPI
PEF	r = 0.04 p = 0.97	r = -0.38 p = 0.01	r = 0.04 p = 0.77	r = 0.06 p = 0.86
FEV1	r = 0.08 p = 0.56	r = 0.08 p = 0.57	r = 0.14 p = 0.31	r = 0.10 p = 0.47
FVC	r = 0.14 p = 0.30	r = 0.11 p = 0.43	r = 0.07 p = 0.61	r = 0.02 p = 0.86
FEV1/FVC	r = 0.06 p = 0.64	r = 0.02 p = 0.87	r = 0.06 p = 0.67	r = 0.06 p = 0.67

Discussion

Authors conclude that asthma affects right ventricular diastolic function in children with asthma because exaggerated respiratory efforts can increase intrathoracic pressure. But, assessment of ventricular functions using TDE in asthmatic children is very limited in published reports; therefore, the present study is an observational one.

This study showed that although the clinical and conventional echocardiographic findings of asthmatic children were apparently normal except right ventricular wall thickness, examination of TDE demonstrated subclinical right ventricular dysfunction, which is negatively correlated with the peak expiratory flow.

These findings signify the diagnostic value of TDE in early detection and monitoring of such deleterious effects among asthmatic patients. There is a need for further observational studies on TDE to demonstrate right ventricular function in children with asthma.

References

- Global Initiative for Asthma (GINA) Report. Global Strategy for Asthma Management and Prevention, 2011. Available from: <http://www.ginasthma.org/>
- Han MK, McLaughlin VV, Cramer GJ, Martinez FJ (2007) Pulmonary diseases and the heart. *Circulation* 116:2992-3005
- Healy F, Hanna BD, Zirmar R (2010) Clinical practice. The impact of lung disease on the heart and cardiac disease on the lungs. *Eur J Pediatr* 169:1-6
- Uyan AP, Uyan C, Ozyurek H (2003) Assessment of right ventricular diastolic filling parameters by Doppler echocardiography. *Pediatr Int* 45:263-267
- Coghlan JG, Daver J (2007) How should we assess right ventricular function in 2008? *Eur Heart J Suppl* 9 (suppl 1):H22-H28
- Nikulin NP, White R (2004) Application of tissue Doppler imaging in cardiology. *Cardiology* 101:170-184
- Shedden SA (2010) Right ventricular function in children with bronchial asthma: a tissue Doppler echocardiographic study. *Pediatr Cardiol* 31:1098-1015
- Zaybet C, Yalcin Y, Erdem A, Polat TB, Aktuglu-Zaybek AC, Bayoglu V, Aldemir C, Celikci A (2007) Tissue Doppler echocardiographic assessment of cardiac function in children with bronchial asthma. *Pediatr Int* 49:911-917
- Lai WW, Geva T, Shinnall GS, Frommelt PC, Humes RA, Brook MM, Pignatelli RH, Rychik J, Task Force of the Pediatric Council of the American Society of Echocardiography; Pediatric Council of the American Society of Echocardiography (2006) Guidelines and standards for performance of a pediatric echocardiogram: a report from the Task Force of the Pediatric Council of the American Society of Echocardiography. *J Am Soc Echocardiogr* 19:1413-1430
- Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA, Picard MH, Roman MJ, Seward J, Shanewise JS, Solomon SD, Spencer KT, Sutton MS, Stewart WJ, Chamber Quantification Writing Group; American Society of Echocardiography's Guidelines and Standards Committee; European Association of Echocardiography (2005) Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. *J Am Soc Echocardiogr* 18:1440-1463
- Quilford MA, Otto CM, Stockard M, Waggoner A, Zoghbi WA; Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography (2002) Recommendations for quantification of Doppler echocardiography: a report from the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography. *J Am Soc Echocardiogr* 15:167-184
- Yu CM, Lin H, Ho PC, Yang H (2003) Assessment of left and right ventricular systolic and diastolic synchronicity in normal subjects by tissue Doppler echocardiography and the effects of age and heart rate. *Echocardiography* 20:19-27
- Corrales M, Taziro A, Ieva R, Brunetti ND, Di Biase M (2011) Time intervals and myocardial performance index by tissue Doppler imaging. *Intern Emerg Med* 6:393-402