

CLINICAL STUDY

Doppler-derived myocardial performance index in healthy children

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Abstract: The myocardial performance index (MPI) is a simple quantitative, non-geometric index of ventricular function and is readily applicable for evaluation of the right and left ventricle function. The aim of the study was to assess normal MPI values in healthy children. We studied 38 healthy children from 3 to 18 years of age. The normal values of both, the left ventricular and right ventricular MPI were $0,32 \pm 0,07$ and $0,27 \pm 0,09$, respectively. Measurement of the MPI is non-invasive and easily obtainable and does not prolong the time required for examination. It is independent from ventricular geometry, blood pressure, heart rate and it appears to be of great prognostic value in many different clinical settings (Tab. 2, Fig. 1, Ref. 14). Full Text in free PDF www.bmj.sk.

Key words: myocardial performance index, Tei index, Doppler.

The development of 2-dimensional (2-D) echocardiography has raised new expectations and hopes for improving the accuracy of echocardiography in quantitating left ventricular (LV) function. The myocardial function is determined by preload, afterload, contractility, heart rate and rhythm. The myocardial performance index (MPI) is a simple quantitative, non geometric index of ventricular function and is readily applicable for evaluation of the right and left ventricle functions (1, 2). The aim of the study was to assess the normal MPI values in healthy children.

Methods

We studied 38 healthy children from 3 to 18 years of age. The study has been approved by the Ethical Committee of the Martin Faculty Hospital. The inclusion criteria were as follows: no presence of structural cardiovascular diseases, weight appropriate for age and height, no presence of somatic or mental disorders. The measurements were done using the GE Vingmed (System five performance) Doppler pulsed echocardiograph. The MPI (Tei index) is calculated from a ratio of time intervals ($a-b/b$) derived with the aid of pulsed Doppler echocardiography (Fig. 1). Locating the sample volume at the tips of the mitral valve leaflets, in the apical 4-chamber view, enables the measurement of a , which is the time interval between the end and the start of transmitral flow. The sample volume is then relocated to the left ventricular

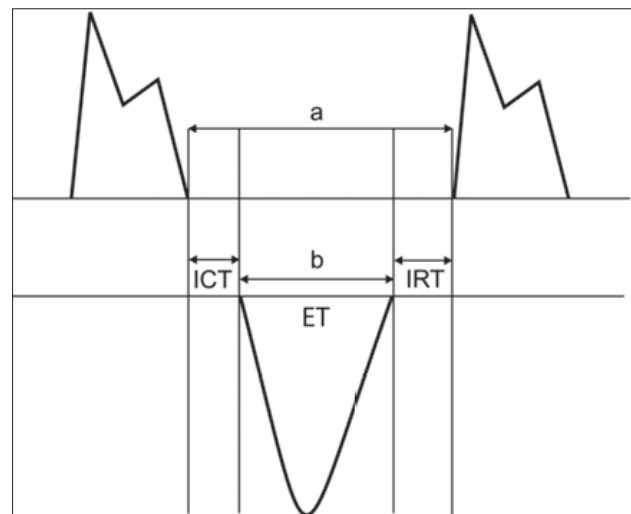


Fig. 1. The MPI index ($ICT+IRT/ET$) is derived as $(a - b / b)$. ICT = isovolumic contraction time, IRT = isovolumic relaxation time, ET = ejection time.

(LV) outflow tract, just below the aortic valve (apical 5-chamber view) for the measurement of b , the LV ejection time. The interval a includes the isovolumic contraction time (IVCT), the ejection time (ET) and the isovolumic relaxation time (IVRT), and MPI may also be expressed by the formula $IVCT+IVRT/ET$ (1). The results were expressed as mean and standard deviation.

Results

In our study the normal values of both, the left ventricular (LV) and right ventricular (RV) MPI were 0.32 ± 0.07 and $0.27 \pm$

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Tab. 1. Echocardiographic measurements.

Measurement	Mean ± SD
EDV [ml]	64.3±33.2
ESV [ml]	25.1±1.2
SV [ml]	40.8±30.8
LVIDs [cm]	2.5±0.7
LVIDd [cm]	3.8±0.9
RV MPI	0.27±0.09
LV MPI	0.32±0.07

SD = Standard deviation, EDV = End diastolic volume, ESV = End systolic volume, LVIDs = Left ventricular internal diameter systolic, LVIDd = left ventricular internal diameter diastolic, RV MPI = Right ventricular myocardial performance index, LV MPI = Left ventricular myocardial performance index

Tab. 2. Comparison of MPI in a healthy children.

Study	Number of Patients	RV MPI	LV MPI
Kim WH et al (10)	26	–	0.38±0.04
Eidem BW et al (11)	152	–	0.35±0.03
Djuradin K et al (5)	75	–	0.37±0.05
Williams RV et al (12)	30	–	0.32±0.1
Bruch C et al (13)	35	–	0.39±0.31
Ishi M et al (14)	150	0.28±0.04	–
Tei C et al (4)	37	0.24±0.04	–
Borzonee M et al (8)	108	0.25±0.09	0.36±0.11
Jurko Jr et al	38	0.27±0.09	0.32±0.07

RV MPI = Right ventricular myocardial performance index, LV MPI = Left ventricular myocardial performance index

0.09 respectively. Echocardiographic data are summarized in Table 1.

Discussion

We determined normal values for left ventricular and right ventricular MPI in healthy children from 3 to 18 years of age (Tab. 1). There was only one previous study that assessed both, LV and RV myocardial performance indexes in the same group of children. Our values are consistent with those found in other studies (Tab. 2).

There are many limitations in using the classical echocardiographic indexes for the estimation of systolic and diastolic LV function (1).

MPI was published for the first time in 1995 as an evaluation of left ventricular systolic and diastolic function in combination (2). It has proven to be a reliable method for the evaluation of LV systolic and diastolic performance, with clear advantages over older indexes and prognostic values in many kind of heart diseases (1).

MPI measures the ratio of isovolumic time intervals to ventricular ejection time. It is a simple quantitative non geometric index of ventricular function (3). Since the results obtained from the Tei-index (MPI) correspond to those of invasive methods, it may be preferable over the available invasive techniques (4).

MPI for children < 3 years is significantly bigger (0.40 ± 0.09) than for those aged between 3 and 18 (0.33 ± 0.22). The age-dependent changes in the index may reflect changes during the maturation of the myocardial characteristics of the LV in neonates and children (1).

In patients with dilated cardiomyopathy, the MPI was found to reflect the severity of LV dysfunction and has proven to be an independent prognostic factor for mortality, similar to the ejection fraction (5). It seems, that MPI might be a useful prognostic factor for cardiac rejection in post-transplant pediatric patients (6).

In patients with an acute myocardial infarction, the MPI was found to be significantly higher, than in healthy controls (0.705 ± 0.023 versus 0.455 ± 0.023). The MPI showed significant predictive value in relation to the severity of coronary artery disease (7).

No significant differences in the left and right MPI have been seen between patients with left-to-right shunt lesions and control subjects. MPI is a quantitative measure of ventricular function that appears to be relatively independent of changes in preload (3).

Our study presents LV and RV MPI in healthy children. The MPI (Tei-index) is a simple, sensitive and accurate tool for the quantitative assessment of functions of the RV and LV. Measurement of the MPI is non-invasive and easily obtainable and it does not significantly prolong the time required for examination. It is independent from ventricular geometry, blood pressure, heart rate and it appears to be of great prognostic value in many different clinical settings (1). It could be considered as an important measurement in a comprehensive hemodynamic study, especially in patients with abnormal ventricular geometry (8, 9).

References

1. Lakoumentas JA, Panou FK, Kotseroglou VK, Aggeli KI, Harbis PK. The Tei index of myocardial performance: applications in cardiology. *Hellenic J Cardiol* 2005; 46 (1): 52–58.
2. Tei C, Ling LH, Hodge DO, et al. New index of combined systolic and diastolic myocardial performance: a simple and reproducible measure of cardiac function – a study in normals and dilated cardiomyopathy. *J Cardiol* 1995; 26 (6): 357–366.
3. Baysal T, Oran B, Dogan M, Cimen D, Karaaslan S. The myocardial performance index in children with isolated left-to-right shunt lesions. *Anadolu Kardiyol Derg* 2005; 5 (2): 108–111
4. Tei C, Nishimura RA, Seward JB, Tajik AJ. Non invasive doppler-derived myocardial performance index: correlation with simultaneous measurements of cardiac catheterization measurements. *J Am Soc Echocardiogr* 1997; 10 (2): 169–178.
5. Durjadin K, Tei C, Yeo T, Hodge D, Rossi A, Seward J. Prognostic value of a Doppler index combining systolic and diastolic performance in idiopathic dilated cardiomyopathy. *Am J Cardiol* 1998; 82 (9): 1071–1076.
6. Mooradian S, Goldberg C, Crowley D, Ludomirsky A. Evaluation of a noninvasive index of global ventricular function to predict rejection after pediatric cardiac transplantation. *Am J Cardiol* 2000; 86 (3): 358–360.

- 7. Nearchou NS, Tsakiris AK, Stathacopoulos DN, Loutsidis KE, Skoufas PD.** A new Doppler index combining systolic and diastolic myocardial performance. Behavior and significance of this index during hospitalization of patients with acute myocardial infarction. *Hell J Cardiol* 1999; 40 (6): 486–496.
- 8. Berzoe M, Kheirandish Z.** Doppler-derived myocardial performance index in healthy children in Shiraz. *Iran J Med Sci* 2004; 29 (2): 85–89.
- 9. Schusterova I, Saligova J, Potocnakova L, Kuchta M, Riecan sky I.** Impact of obesity and overweight on left ventricle mass, systolic and diastolic function in children and adolescents. *Circulation* 2008; 118 (12): e417
- 10. Kim WH, Otsuji Y, Seward JB, Tei C.** Estimation of left ventricular function in right ventricular volume and pressure overload. Detection of early left ventricular dysfunction by Tei-index. *Jpn Heart J* 1999; 40 (2): 145–154.
- 11. Eidem BW, Tei C, Leary PW, et al.** Nongeometric quantitative assessment of right and left ventricular function: myocardial performance index in normal children and patients with Ebstein anomaly. *J Am Soc Echocardiogr* 1998; 11 (9): 849–856
- 12. Williams RV, Ritter S, Tani LY, et al.** Quantitative assessment of ventricular function in children with single ventricles using the doppler myocardial performance index. *Am J Cardiol* 2000; 86 (10): 1106–1110.
- 13. Bruch C, Schermund A, Martin D, et al.** Tei-index in patients with mild-to-moderate congestive heart failure. *Eur Heart J* 2000; 21 (22): 1888–1895.
- 14. Ishi M, Tei C, Tsutsumi T, et al.** Quantitation of global right ventricular function in children with normal heart and congenital heart disease: a right ventricular myocardial performance index. *Pediatr Cardiol* 2000; 21 (5): 416–421.

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