P-wave dispersion and P-wave duration in children with stable asthma bronchiale

Stabil astımlı çocuklarda P dalga dispersiyonu ve P dalga süresi

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ABSTRACT

Objective: P-wave dispersion is associated with inhomogeneous and discontinuous propagation of sinus impulses. The aim of this present study was to investigate the impact of P-wave dispersion in children with stable asthma.

Methods: In this cross-sectional study, the study group consisted of 20 children (12 boys, 8 girls) with stable asthma and mean age of 7.7 ± 2.0 years. During the study, these patients were treated with low dose inhaled corticosteroids for at least six months. Control group consisted of 20 healthy children matched by same sex and age population. Age, weight, height, echocardiographic values, P-wave maximum duration and P-wave dispersion were compared between asthmatic and healthy children. P - wave duration was calculated in 12-leads of the surface electrocardiography. The difference between P maximum and P minimum durations was defined as P - wave dispersion. The obtained results were compared by independent samples t test and Mann-Whitney U test. Correlations for P- wave dispersion were calculated using Pearson test.

Results: P-wave maximum duration is slightly increased in patients with stable asthma (0.092 ± 0.017 ms) as compared with healthy controls (0.083 ± 0.011 ms) (p=0.07). We found significant correlation between P-wave dispersion and age (r=0.40, p=0.01), weight (r=0.41, p=0.008) and height (r=0.41, p=0.008).

Conclusion: P-wave maximum duration is slightly increased and P- wave dispersion is correlated with age, weight and height in children with stable asthma. *(Anadolu Kardiyol Derg 2009; 9: 118-22)*

Key words: Asthma bronchiale, children, P-wave dispersion, P- wave duration

ÖZET

Amaç: P dalga dispersiyonu, sinus uyarılarının homojen ve sürekli olmayan yayılımı ile ilişkilidir. Bu çalışmanın amacı stabil astım tanılı çocuklarda P dalga dispersiyonun etkisini araştırmaktır.

Yöntemler: Bu enine-kesitsel örneklemli çalışmada, çalışma grubu, stabil astım tanılı, yaş ortalaması 7.7±2.0 yaş olan 20 çocuktan (12 erkek, 8 kız) oluşmaktaydı. Çalışma boyunca bu hastaların profilaktik, düşük doz inhale kortikosteroid tedavilerine devam edildi. Çalışma grubunu oluşturan çocuklar, en az altı aydır inhale kortikosteroid kullanıyorlardı. Kontrol grubu ise aynı yaş ve cinsiyetteki 20 sağlıklı çocuktan oluşmaktaydı. Astım tanılı çocuklarla sağlıklı çocuklar; yaş, kilo, boy, ekokardiyografik parametreler, P dalgasının maksimum süresi ve P dalga dispersiyonu yönünden karşılaştırıldı. P dalga süreleri 12 derivasyonlu yüzeyel elektrokardiyogramdan hesaplandı. Verilerin istatistiksel analizi bağımsız örneklem t testi ve Mann-Whitney U testi ile yapıldı, P dalga dispersiyonunun korelasyonları için Pearson testi kullanıldı.

Bulgular: Stabil astımlı çocuklarda P dalgasının maksimum süresi (0.092±0.017 ms), kontrol grubundakilere (0.083±0.011 ms) göre hafifçe artmış olarak bulundu (p=0.07). Ayrıca, P dalga dispersiyonu ile yaş (p=0.01; r=0.40), kilo (p=0.008; r=0.41) ve boy (p=0.008; r=0.41) arasında da belirgin korelasyon saptandı.

Sonuç: P dalga maksimum süresi, astımlı çocuklarda sağlıklı çocuklardan daha yüksekti. P dalga dispersiyonu yaş, kilo ve boy ile korelasyon göstermektedir. *(Anadolu Kardiyol Derg 2009; 9: 188-22)*

Anahtar kelimeler: Astım, çocuk, P dalga maksimum süresi, P dalga dispersiyonu

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The work was presented at the congress – Europaediatrics, 14-17 June, 2008, İstanbul, Turkey

Introduction

P - wave axis reflects the atrial orientation in the thorax. P - wave dispersion (PwD) is defined as the difference between maximum and minimum P - wave duration (PD). P - wave duration and PwD are important to determine the velocity of atrial impulse propagation (1, 2). P - wave dispersion could reflect left atrial enlargement, velocity of atrial impulse propagation and altered conduction because of its relation to the nonhomogenous and interrupted conduction of sinusal impulses both intra and interatrially (1- 4). P - wave duration and PwD have been reported to be influenced by the autonomic tone which induces changes in atrial size and the velocity of impulse propagation (1, 2). P - wave alterations were shown in adults having obstructive lung disease (5, 6). But, there are a few studies in the pediatric patients examining the relationship between P - wave and pulmonary function (6, 7, 8). P - wave duration and PwD could be altered by relation of atria and diaphragm. Hyperinflation of the lung and high airway resistance could create some changes in cardiac activity. The right ventricular functions are influenced by pulmonary diseases (6, 9-11). As a most common chronic obstructive pulmonary disease in childhood, asthma affects pulmonary arterial pressure and systolic-diastolic activity of right ventricle (7).

In severe bronchial asthma, reversible electrocardiographic (ECG) abnormalities are not rare. The abnormalities could be sinus tachycardia, right axis deviation, atrial enlargement and right bundle branch block and, therefore, severity of ECG signs is correlated with the degree of airway obstruction. These alterations could depend on adrenergic stimulation, hyperventilation, hyperinflation and severity of asthma (5).

The aim of this study was to answer the question if there were any disturbances in ECG parameters of PD and PWD in asthmatic children as compared with healthy controls.

Methods

Study Population

Twenty children with mild persistent asthma (12 boys and 8 girls) were included in this cross-sectional study. Control group consisted of 20 healthy children matched by same sex and age population

Children who were diagnosed with mild persistent asthma according to the GINA (Global Initiative for Asthma) report guidelines were eligible for our study (12).

The inclusion criteria were: 1) to be between 5 - 12 years of age; 2) to have controlled asthma; 3) to have been using low doses of inhaled corticosteroids (ICS) for at least the previous 6 months.

Exclusion criteria were : 1) to have been using high doses of ICS or oral corticosteroids in the previous 6 months; 2) to have had an acute asthmatic attack 3) to have another pulmonary or cardiac disease.

All of the children were following up in the department of asthma and allergic diseases. They were evaluated clinically according to the NAEPP (National Asthma Education and Prevention Program) Report 3 (13). Weight and height of all subjects were recorded and body surface area was calculated. A detailed history was taken and systemic physical examination was done for each child to exclude acute asthmatic exacerbation and another pulmonary pathology before attending to the study. Those who had the history of cardiovascular and any other systemic disorders were excluded from the study. All children were using low dose ICS. In the study group, patients were defined as having persistent asthma, receiving ICS in the form of budesonide 200-400 µg bid. During this study, children were treated with low dose inhaled corticosteroids with a spacer device.

This study conformed to the principles of in the Declaration of Helsinki. Signed written consent with full information was obtained from all parents before participation in our study.

Measurement of P - wave duration and dispersion

P - wave duration was calculated in all 12 leads of the surface ECG which were simultaneously recorded. All recordings were performed in the same quiet room during spontaneous breathing, following 10 minutes of adjustment in the supine position. P - wave duration measurements were obtained manually by two of the investigators using calipers and magnifying lens for accurate definition of the electrocardiogram deflection as defined in previous study (1, 2). The onset of the P - wave was defined as the point of the first visible upward departure of the trace from the bottom of the baseline. The return to the baseline of the bottom of the trace in wave was considered to be the end of the P - wave. P - wave maximum duration in any of the 12- lead surface ECGs was calculated and used as a marker of prolonged atrial conduction time. The difference between P - wave maximum and P - wave minimum durations was defined as PwD.

Echocardiographic evaluation

All children underwent M-mode echocardiography and Doppler evaluation at rest, in supine position. Echocardiography was performed with an Vivid 3, GE, 3S MHz sector transducers. Measurements were obtained according with recommendations proposed by the American Society of Echocardiography (14-16). The left ventricular end-systolic diameters, left ventricular end-diastolic diameters, interventricular septum thickness, left ventricular posterior wall thickness, aortic diameter, left atrial diameter, right atrial diameter and left ventricular ejection fraction were measured with M-mode and two dimensional echocardiography using the parasternal long-axis view. None of the subjects had more than trivial regurgitation detectable by color-flow Doppler. The following pulsed Doppler parameters were measured in each subject: Mitral and tricuspid peak early diastolic (E) velocity, peak late diastolic (A) velocity, aortic velocity and pulmonary velocity.

Statistical analysis

Statistical analysis was performed with SPSS for Windows version 12.0 (SPSS Inc., Chicago, IL, USA). All the values are expressed as mean±standard deviation and median (min-max) values. One sample Kolmogorov-Smirnov test was performed to determine the normal distribution of data of statistical analysis. $p<0.05$ indicates that distribution is not normal. The obtained

results were assessed accordingly using independent samples t test and Mann-Whitney U test. Correlations for P - wave dispersion were calculated using Pearson test. P<0.05 was considered significant.

Results

There were no significant differences in age, weight, height, P - wave minimum duration, P - wave dispersion, heart rate and echocardiographic parameters between the study and control groups (Table 1). The P - wave maximum duration was slightly increased in patients with stable asthma as compared with healthy controls (p=0.07) (Fig. 1, Table 1). We found significant correlation between PwD and age (r=0.40, p=0.01), weight (r=0.41, p=0.008), and height (r=0.41, p=0.008).

Discussion

We investigated P - wave maximum duration and PwD in children with stable asthma in comparison with those of age and gender matched healthy controls. It was shown that children with stable asthma had slightly higher P - wave maximum duration than healthy controls in our study.

Asthma, which is a chronic inflammatory disease of airways, is the most common chronic pulmonary disease in childhood. Asthma increasing right ventricular afterload affects pulmonary arterial pressure and systolic-diastolic activity of right ventricle indirectly (7). Hyperinflation of the lung and high airway resistance could create some changes in cardiac activity. But, little is known about the presence of electrical abnormalities in children, especially with asthma, who inhaled drugs including corticosteroids. P - wave dispersion is a non-invasive method for assessment of atrial depolarization within the myocardial tissue.

P - waves represent atrial depolarization signals and the maximum duration of P - wave corresponds to the duration of

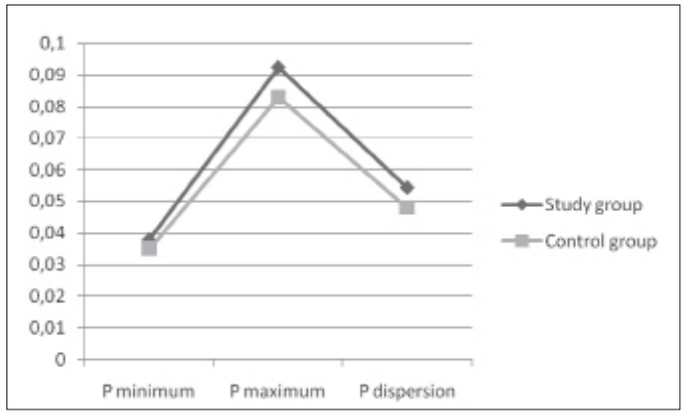

Figure 1. P wave durations and dispersion in studied groups

Table 1. Demographic, hemodynamic and electrocardiographic parameters of studied groups

Variables	Study Group	Control Group	p*
Age, years	7.7±2.04	8.57±1.53	0.13
Weight, kg	27.92±9.87	28.30±6.17	0.88
Height, cm	124.65±14.04	130.85±8.43	0.09
Minimum P - wave duration, ms	0.038±0.007 (0.02 - 0.06)	0.035±0.010 (0.02 - 0.06)	0.372
Maximum P - wave duration, ms	0.092±0.017 (0.06-0.12)	0.083±0.011 (0.06-0.10)	0.07
P-wave dispersion, ms	0.054±0.016 (0.03-0.08)	0.048±0.009 (0.04-0.06)	0.244
Hearth Rate, beats/min	92.15±11.86	91.10±11.35	0.77
Ejection fraction, %	71.5±3.64	69.55±6.08	0.22
Interventricular septum thickness, mm	7.81±1.08	8.85±0.43	0.22
Left ventricular posterior wall thickness, mm	8.20±0.71	8.42±0.67	0.14
Right atrium diameter, cm	18.80±2.26	20.20±2.50	0.07
Left atrium diameter, cm	24.98±2.54	26.35±3.06	0.13
Mitral E velocity, m/s	1.14±0.13	1.17±0.15	0.59
Mitral A velocity, m/s	0.61±0.15	0.66±0.12	0.27
Tricuspid E velocity, m/s	0.87±0.76	0.87±0.05	0.80
Tricuspid A velocity, m/s	0.64±0.09	0.64±0.08	0.88
Aortic root, mm	19.21±2.26	19.87±2.29	0.36
Aortic velocity, m/s	1.14±0.10	1.19±0.08	0.15
Pulmonary velocity, m/s	0.96±0.11	0.99±0.15	0.42

Data are represented as mean±SD and median (min-max) values

*Independent samples t test and Mann Whitney U test

the atrial activation. Stretching of the atria due to pressure and/or volume load, electrolyte imbalance or increase in sympathetic activity are the main causes that increase PwD. P - wave duration reflects the activation of atrial muscle and may depend primarily upon the mass of tissue excited. P - wave duration and PwD could be affected by age due to decreasing in heart rate and increasing in weight and size of heart are seen in higher age (9, 11, 14). In our study, the correlations between PD and age, weight, height were determined.

Inhaled corticosteroids are used for persistent asthma to prevent recurrence of exacerbations and to speed recovery. Long-term ICS therapy suppresses the inflammation and decreases hyperinflation of lung, but does not alter the progression and severity of the disease in children (13). Asthma is a highly variable chronic inflammation disease, with alternative day-to-day pulmonary effects despite ICS therapy. Our patients were taking low doses of inhaled ICS, but they did not need any beta-agonists at last months, because they could alter the results due to cardiac effects. We wondered whether cardiac functions were altered and there was an increased risk for atrial fibrillation in children with controlled asthma. These patients could be at risk even if they have few day-to-day effects of asthma.

It has been reported that changes in the cardiac chamber dimensions and pressure might influence P - wave duration (17). When the left ventricle compliance decreases (or the left ventricle stiffness increases) in congestive heart failure, the left atrial pressure increases to maintain adequate filling, and the increased atrial wall tension leads to chamber dilatation. This causes a change in the geometry of the atrium and interatrial conduction. Larrazet et al (6) compared right and left isovolumic ventricular relaxation time intervals in patients with controlled hypertension without left ventricular hypertrophy, hypertrophic cardiomyopathy, and cor pulmonale by means of a single-pulsed Doppler method. They demonstrated that right and left isovolumic ventricular relaxation time intervals lengthening in patients with hypertrophic cardiomyopathy and cor pulmonale suggests interdependence of both ventricles through the septum (6). In atrial septal defect, valvular pulmonary stenosis or chronic obstructive pulmonary disease, the right atrial pressure increases, and the right atrium stretches and becomes more enlarged (18-21). Evidences of diastolic right and left ventricular dysfunctions have been reported by echocardiographic studies in asthmatic patients. Uyan et al (8) pointed out that diastolic filling parameters of right ventricle were getting better after treatment in children with asthma (the mean age was 8.6 ± 2.69 years and mean period of symptoms were 56.4±35.8 months). In our study, the age of subjects were between 6 and 12. We could not determine any differences of echocardiographic parameters among these groups.

Study limitations

There are some limitations in this study. Our study was conducted with a small group. Therefore, the evaluation was performed with this limited number of the subjects. We believe that new multicenter studies must be organized to describe atrial effects of antiasthmatic drugs in children. We could not find out the high-resolution computer software program for evaluation of ECG results in this study. On echocardiographic examination of cases, no pathological regurgitations of mitral, tricuspid, aortic and pulmonary valves were detected. Therefore, the estimated pulmonary arterial systolic pressures calculated via tricuspid regurgitation according to Bernoulli equality have not been mentioned.

Conclusions

Our study demonstrated that atrial conduction might be altered and dispersion of atrial impulse propagation, as documented by P-wave analysis, depends on age, height and weight of children with stable bronchial asthma.

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