

PRACE ORYGINALNE • ORIGINAL PAPERS

Analysis of the spirometry performed on asthmatic children and teenagers coming from rural communities, during the rehabilitation therapy

Analiza spirometrii wykonanej w czasie turnusu rehabilitacyjnego u dzieci i młodzieży z rozpoznaniem astmy, pochodzących ze środowisk wiejskich

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A – Study Design, B – Data Collection, C – Statistical Analysis, D – Data Interpretation, E – Manuscript Preparation, F – Literature Search, G – Funds Collection

Summary Background. According to the WHO, 300 million people around the world suffer from asthma. Spirometry is one of the most common methods in asthma diagnostics and treatment control. The FVC, FEV₁, FEV₁/FVC ratio are the basic parameters used to properly interpret lung function.

Objectives. The objective of this study was to compare the state of respiratory function of children from rural communities with diagnosed chronic mild or moderate asthma.

Material and methods. Authors studied 35 subjects at the age of 10 to 15, with diagnosed asthma. Control group was statistically similar group of 35 healthy subjects. All patients were tested with Lungtest500 spirometer. Results were compared with the standards and statistically analysed.

Results. Results of spirometry in all cases in both study and control group, were in the range of laboratory standards. Results of statistical analysis showed no significant difference between the groups in parameters: FEV₁, FVC EX, FVC IN, PEF, MEF75, MEF50, VC, FEV₁/FVC. Significantly lower results ($p < 0.05$) of study group was observed in Tiffeneau index and MEF 25.

Conclusions. Results of treated patients with diagnosed asthma indicated the reinstatement of right respiration function and are the evidence of the efficiency of performed treatment. The statistically significant difference in parameter FEV₁/VC indicated the high sensitiveness of this parameter and it suggested its high usefulness in asthma diagnostics.

Key words: asthma, spirometry, Tiffeneau index, GINA, children.

Streszczenie Wstęp. Według danych WHO około 300 mln ludzi choruje na astmę oskrzelową. Spirometria jest jedną z najczęściej stosowanych metod diagnostycznych do rozpoznania i kontroli astmy. Wskaźniki FVC, FEV₁, FEV₁/FVC są podstawowymi parametrami używanymi do oceny funkcji dróg oddechowych.

Cel pracy. Porównanie stanu dróg oddechowych dzieci pochodzących z środowisk wiejskich, z rozpoznaną łagodną i umiarkowaną astmą.

Materiały i metody. Autorzy przeanalizowali 35 badanych w wieku 10 do 15 lat ze zdiagnozowaną astmą. Grupa kontrolna była statystycznie podobną grupą 35 osób. Wszyscy pacjenci zostali przebadani spirometrem Lungtest500. Wyniki porównano z danymi standardowymi i przeanalizowano statystycznie.

Wyniki. Wyniki spirometrii we wszystkich przypadkach mieściły się w granicach normy. Wyniki analizy statystycznej nie wykazały istotnej różnicy między badanymi grupami.

Wnioski. Wyniki pacjentów ze zdiagnozowaną i leczoną astmą wskazują na przywrócenie prawidłowej funkcji płuc i są dowodem efektywnego leczenia. Statystycznie znaczące różnice w wartości FEV₁/VC wskazują na dużą dokładność tego parametru i jego znaczenie w diagnostyce astmy.

Słowa kluczowe: astma, spirometria, indeks Tiffeneau, GINA, dzieci.

Background

According to the WHO – about 300 million people around the world suffer from asthma and this number is going to increase in the future [1]. The incidence of asthma in Polish children is almost 8–9%, which gives about 708 000 children [2, 3]. The disease is characterized by changeable narrowing of air passages. It is called “bronchi obstruction” and it is evoked by inflammation of mucosa and remodeling. These processes are a result of recruitment of inflammatory cells and various mediators and cytokines activity [4]. Chronic inflammation and hyperreactivity of the bronchi cause many symptoms in patients. They involve wheez-

ing breath, cough, dyspnoea, sensation of compressing in thorax. Symptoms can appear and vanish, but the inflammation is permanent. Basic risk factors for asthma are genetic and environmental. Environmental factors are connected with atopy and exposure to allergens of house dust mite, pollen of plants and animals fur. Other risk factors are smoking, respiratory tract infections, low birth weight, air pollution, poor diet. Children population is not engaged in occupational activity, therefore occupational factors haven't affected their respiratory tract [5]. There are many methods used to diagnose asthma. High variability of symptoms of the disease often delays the process of diagnosing [6]. Spirometry allows for assessing the lung function. The FVC

(forced vital capacity), FEV_1 (forced expiratory volume in the first second), FEV_1/FVC ratio are the basic parameters used to properly interpret lung function. The most important parameter in obstruction is FEV_1/FVC . The typical spirometry parameters are: normal FVC, decreased FEV_1 and FEV_1/FVC . According to the reports of GINA (Global Initiative for Asthma), the FEV_1 parameter before starting treatment is very important to define the stage of asthma severity [4]. Asthma suspicion appears, when FEV_1 parameter in a child is lower than 85%. Spirometry is not only helpful with diagnosis but also in the treatment control. Inhaled glucocorticoids, usually in combination with long-acting β -mimetics, are the most often used medicines in asthma therapy. Trigger factors must be identified and patient should be educated about avoiding them and about the treatment plan. This plan depends on the stage of severity of asthma. Every stage should be treated with different set of medicine. Treatment standards are determined by GINA and BTS (British Thoracic Society).

Objectives

The aim of this study was to compare the state of respiratory function of children from rural communities with diagnosed chronic mild or moderate asthma, who were treated in pulmonary office with group of healthy children.

Material and methods

Authors examined 35 subjects, 27 female and 8 male. Their age ranged from 10 to 15. All children came from rural communities from different areas of Poland. They all suf-

fered from mild or medium stage of asthma and were treated in specialist clinics according to GINA. Research was done during the 3-week rehabilitation therapy in sanatorium in Szklarska Poręba. Spirometric tests were performed as a part of examination qualifying children for therapeutic procedures. Control group also comprised 35 subjects from rural communities at the same age and sex as study group. Spirometry was performed, using Lungtest500 Spirometer. Subjects with asthma were instructed to withhold their bronchodilator medications for at least twelve hours before the examination. Following parameters were analysed: FEV_1 , FVC expiratory and inspiratory, Peek Expiratory Flow (PEF), Mid-expiratory Flow (MEF) 75, 50 and 25, FEV_1/FVC ratio and Tiffeneau index. Data were expressed as a percentage of predicted values, using prediction equations based on age, sex and height.

Statistical analysis was done using STATISTICA v10. The normality of distribution of all parameters was checked by Shapiro-Wilk test. Parametric indicators (FEV_1 , FVC EX, FVC IN, PEF, MEF75, MEF50, MEF25, VC) were compared with a *t*-Student test and those non-parametric (FEV_1/FVC , FEV_1/VC) with a Mann-Whitney test.

Results

Results of spirometry in all cases, both in study and control group, were in the range of laboratory standards. Results of statistical analysis are shown in Table 1. There was no significant difference between the groups in parameters: FEV_1 , FVC EX, FVC IN, PEF, MEF75, MEF50, VC, FEV_1/FVC . Significantly lower results ($p < 0.05$) of study group was observed in Tiffeneau index (Fig. 1) and MEF 25 (Fig. 2).

Table 1. Results of statistical analysis of parameters: FEV_1 , FVC EX, FVC IN, PEF, MEF75, MEF50, MEF25, VC, FEV_1/FVC , FEV_1/VC . Statistically lower results of study group were observed in MEF25 and FEV_1/VC . Data were analyzed as percentages of predicted values

	FEV_1 (%)	FVC EX (%)	FVC IN (%)	PEF (%)	MEF75 (%)	MEF50 (%)	MEF25 (%)	VC (%)	FEV_1/FVC (%)	FEV_1/VC (%)
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Study group <i>n</i> = 35	95.82 \pm 12.77	93.58 \pm 9.70	92.24 \pm 10.58	84.82 \pm 18.77	92.23 \pm 20.39	100.34 \pm 28.05	108.70 \pm 36.01	92.63 \pm 9.72	101.81 \pm 9.90	101.93 \pm 12.08
Control group <i>n</i> = 35	101.18 \pm 13.26	94.97 \pm 10.50	94.27 \pm 11.19	83.47 \pm 17.38	91.91 \pm 19.36	105.86 \pm 19.63	126.61 \pm 27.00	93.29 \pm 10.97	105.35 \pm 7.00	107.11 \pm 7.40
<i>p</i>	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	< 0.05	> 0.05	> 0.05	< 0.05

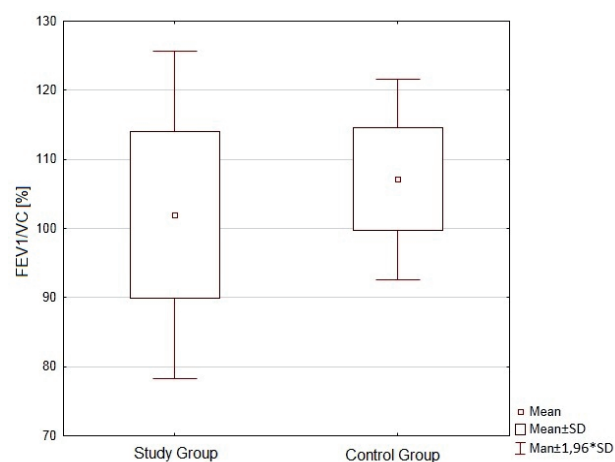


Figure 1. Difference of FEV_1/VC between study and control group. Results of study group were significantly lower. Data are shown as percentages of predicted values

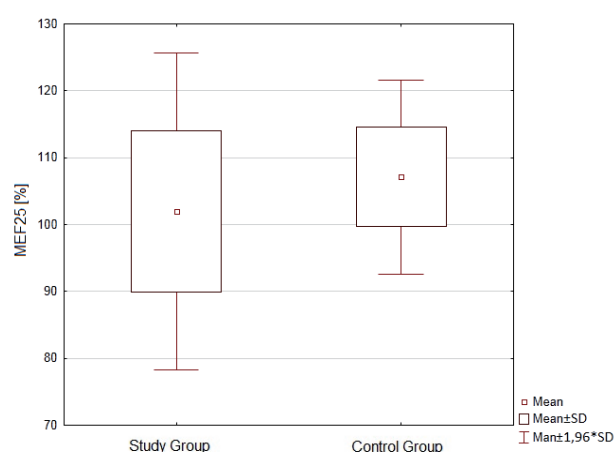


Figure 2. Difference of MEF25 between study and control group. Results of study group were significantly lower. Data are shown as percentages of predicted values

Discussion

Results of spirometry of asthmatic children, which was in the range of laboratory standards, indicated the reinstatement of right respiration function. It is additionally confirmed by no significant difference comparing to control group in parameters: FEV₁, FVC EX, FVC IN, PEF, MEF75, MEF50, VC, FEV₁/FVC. It suggests that properly treated asthmatic children can reach the same efficiency of respiratory system as healthy children. It also confirms that GINA standards for treatment bring good effect in asthma therapy. MEF25 is a parameter with a great variability. Very low results of MEF25 can indicate inflammation of small bronchioles, but making any assumption on small difference ($p = 0.02$) in case of this indicator could be improper. The statistically significant difference between groups in Tiffeneau index indicates the high sensitiveness of this parameter. It shows changes in

respiratory tract in asthmatic children even if they are in the range of laboratory standards and other spirometry parameters are similar for both groups. This sensitiveness suggests high usefulness of this parameter in asthma diagnosis.

Conclusions

Results of this study revealed that GINA standards, followed by Polish physicians, give great improvement of respiration function with no signs of obturation in spirometry. It is a very impressive outcome, considering that all children in this study came from rural communities, which suggested difficult access to specialist care. The statistically significant difference between examined groups in Tiffeneau index, even in the range of laboratory standards, indicates the high sensitiveness of this parameter and suggested its usefulness in asthma diagnosis.

References

1. Balińska-Miśkiewicz W. Diagnostyka i leczenie astmy oskrzelowej osób dorosłych. *Farm Pol* 2009; 11: 793.
2. Maciejewska B, Milanowski J. Znaczenie badań spirometrycznych w diagnostyce i monitorowaniu leczenia astmy. *Zdr Publ* 2011; 2: 186–190.
3. Fal A, Muszyńska A, Felińczak A, i wsp. Epidemiologia chorób alergicznych we Wrocławiu – wyniki badania ECAP. *Fam Med Prim Care Rev* 2009; 3: 352–354.
4. Grzelewska-Rzymowska I, Mikołajczyk J, Kroczyńska-Bednarek J. Astma w badaniach spirometrycznych. *Pediatr Med Rodz* 2010; 1: 8–14.
5. Złotkowska R, Skiba M. Ocena stanu układu oddechowego w populacji nastolatków uczęszczających do gimnazjów. *Med Prakt* 2005; 3: 241–247.
6. Chazan R. Rozpoznawanie i postępowanie w astmie w 2012 roku. *Pneumon Alergol Pol* 2012; 80: 375–382.

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Received: 28.02.2013

Revised: 25.03.2013

Accepted: 10.04.2013