ORIGINAL ARTICLE

Pulmonary Function of Patients with Juvenile Diabetes Mellitus

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ABSTRACT In this study, respiratory functions were applied on 20 patients (10 boys and 10 girls) with juvenile diabetes mellitus and 20 healthy subjects (10 boys and 10 girls) followed up for 2.5 (SD 1.2) years on the average. Vital capacity (VC), maximal voluntary ventilation (MVV), forced volume in 1 second (FEV1) and mean forced expiratory flow during the middle half of the FVC (FEF 25-75) parameters were evaluated. No significant difference was observed in the ages, heights and weights of diabetic and healthy children. A statistically significant decrease was observed in the VC (1.90, SD 0.13) and FEV1 (1.62, SD 0.54) parameters in diabetic boys and MVV (42.10, SD 5.16) and FEV1 (1.55, SD 0.43) parameters of diabetic girls when compared with those of the control group. These results suggested a restrictive process in patients with juvenile diabetes mellitus. **[Paediatr Indones 1996; 36:155-159]**

Various endocrine diseases manifest some important respiratory symptoms and signs. One of the most important endocrine diseases presenting an increasing risk in the development of pulmonary disorders is juvenile diabetes mellitus (JDM). Pulmo- nary disorders developing in children with diabetes mellitus dependent particularly on insulin are attributed to reduced pulmonary volume.[1] In this study, the pulmonary functions of children with JDM have been investigated and changes in the pulmonary volume likely causes examined.

Methods

This study covers 20 patients with JDM and 20 controls followed up for 2.5 (SD 1.2)

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years at the Department of Pediatrics, Faculty of Medicine, Cumhuriyet University, Sivas, Turkey. The mean age of girls with JDM was 13.0 (SD 2.53) years and that of boys with JDM 12.0 (SD 1.78) years. The mean duration of JDM in patients ranged from 2 to 5 years.

Glycosylated hemoglobin (HbA1c) levels were measured as described by Flückiger and Winterhatter in each child at least 4 times/year.[2] The mean HbA1c value was found to be 8.5 (SD 0.8)% (n=4.9 to 6.3%)[3] in all the children with JDM. Pulmonary functions tests of patients with JDM and controls were determined, using Minato Autospiro AS 600 VC, MVV, FEV1, FEF25-75 parameters were evaluated. All cases were subjected to pre and post maneuvers for three times in all parameters and the best test result obtained was evaluated.[4]

Results

The mean ages, heights and weights of 20 children with JDM and 20 controls are shown in Table 1. No significant difference ($p>0.05$; student-t test) was found in the mean ages, heights and weights of boys and girls in the patient and control groups.

Table 1. Mean ages, heights and weights of patients with JDM and the control group

Patients	Age-years Mean (SD)	Height-cm Mean (SD)	Weight - kg Mean (SD)
Girls with JDM	13.00 (2.53)	143.00 (8.67)	36.50 (4.23)
Boys with JDM	12.00 (1.78)	134.50 (7.55)	33.16 (3.18)
Controls (Girls)	11.87 (1.64)	140.37 (14.24)	39.62 (14.78)
Controls (Boys)	13.00 (1.58)	137.20 (7.98)	36.20 (2.86)

Findings obtained and comparative analysis from the pulmonary function tests applied on the patients with JDM and the control group are shown in Table 2. Decreases in VC and FEV1 in boys with JDM and in MVV and FEV1 in girls with JDM were found to be statistically significant when compared with those of the control group ($p<0.05$).

Discussion

JDM is one of the most frequently observed endocrine disorders and the pulmonary dysfunction it causes is still under discussion. Only a limited number of investigations on this subject has been reported. The cause of respiratory findings in these investigations have been attributed to different etiologies.[1] In a spirometric study made

Table 2. Pulmonary function tests of patients with JDM and the control group

Pulmonary Functions	BOYS		GIRLS	
	Controls	JDM	Controls	JDM
VC; mean (SD)	2.22 (0.28)	1.90 (0.13)	2.22 (0.60)	1.77 (0.65)
MVV; mean (SD)	56.55 (8.54)	50.60 (5.36)	55.96 (10.73)	42.10 (5.16)
FEV1; mean (SD)	2.25 (0.27)	1.62 (0.54)	2.31 (0.48)	1.55 (0.43)
FEF25-75; mean (SD)	2.23 (0.39)	2.19 (0.47)	2.85 (0.93)	2.11 (0.39)

on 11 patient with JDM in 1976 a decrease in the total pulmonary capacity was determined and this state was attributed to the decrease in the pulmonary elastic resistance.[5] While no pulmonary dysfunction was determined in another investigation made on 20 patients with JDM in 1977, Oulhen et al in 1983 observed no abnormality in the ventilator mechanics of 74 patient with JDM but determined a decrease in the carbon monoxide transfer at the alveolar capillary level.[6,7]

In investigations made on rats streptozotocin - induced diabetes mellitus, several ultrastructural alterations confirming pulmonary abnormality have been determined. These changes were observed to be particularly in the granular pneumocytes at the interalveolar septum, nonciliated bronchial epithelial cells and the elastin and collagen fibers of the alveolar septum.[8] Although these alterations may probably result from the direct toxic effect of streptozotocin, Kida et al. claimed that lack of insulin may be responsible and the autopsy results of patients with JDM confirmed this argument.[9]

Limited mobility in the small joints of patients with JDM has been reported.[10] Recent reports support the view that limited joint mobility (LJM) in patients with JDM is the most important cause in the decrease of lung volume.[11,12] Investigations on this subject were initiated by Grgic et al. for the first time in 1976 and further studies were noted by 1981. According to Grgic et al, the development of LJM in patients with JDM depends on the diabetic period. While the LJM prevalence in patients with JDM not exceeding 4.5 years is 7%, that the patients affected for more than 4.5 years reaches 30%.[13,14] In Ducic et al. applied spiroplethysomography on 22 of 108 children with JDM and determined LJM in 50.9% of these patients. While Ducic et al. determined no LJM in patients with JDM diagnosis for less than 2 years, they reported the LJM ratio to be 89.3% in patients with JDM suffering for more than 10 years. They stressed that the LJM development is related with the period of diabetes. In the same study, they determined a marked decrease in VC in patients with JDM.[10]

In this study the significant decrease in VC and FEV1 in male patients with JDM

and that in MVV and FEV1 in female patients with JDM may, as indicated by Primhak et al. and Ducic et al. be attributed to restrictive events.[10,15] Primhak et al. carried out spirometric investigations on 88 children with JDM and determined the FVC to be significantly low compared to that of the control group. They made longitudinal studies on 27 of 88 children with JDM and followed them up for 4 years and observed that the FVC showed no progressive change with age. According to them, the tendency of decrease in the pulmonary volume in cases with JDM is not related with the metabolic effect of the disease but results from a single acute attack which does not progress in the lung development or a genetic factor upsetting the collagenous structure.[15]

In conclusion, it may be said that the determination of a significant decrease in VC, FEV1 and MVV values in this spirometric study made on 20 patients and 20 controls as compared to that of the control group indicates a decrease in the pulmonary volume in JDM and may be in such cases be attributed to a restrictive cause.

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