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Spirometry Findings Following Treatment with Oral and Inhalant Corticosteroids in Mild to Moderate Asthma Exacerbation in Children

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Abstract

Introduction

Asthma exacerbation is common in children. Treatment with Oral corticosteroids (OCS) and inhaled corticosteroids are suggested for asthma exacerbation. It is shown that inhaled corticosteroids has similar outcome in reducing asthma symptoms compared to OCS. But few studies have evaluated the pulmonary function changes in these two treatments. In this study, we evaluated the changes in pulmonary function tests in children with mild-to-moderate asthma exacerbation receiving oral prednisolone and inhaled Budesonide.

Methods and Materials

Forty-four children with mild-to-moderate asthma exacerbation were randomly assigned to receive oral prednisolone (2 mg/kg) or Budesonide spray (2 puffs every 12 hours, each puff contains 200 microgram Budesonide) using a spacer for one week. The first dose of the treatment was given in the emergency department. Children were followed for seven days and spirometry findings before and after treatment were evaluated.

Results

There was no significant difference between pulmonary function tests before and after treatment between groups. Children receiving oral prednisolone had significantly more improvement in Peak expiratory flow (PEF) ($p=0.01$). There was significant improvement in all respiratory parameters after treatment in both groups ($p<0.05$), but PEF had no significant change after treatment s in inhaled Budesonide group ($p=0.63$).

Conclusion

Both inhaled Budesonide and oral prednisolone significantly improved respiratory function in children with mild-to-moderate asthma exacerbation. As there was no significant difference between groups in Pulmonary function tests (PFT) findings and due to the low systemic effects of inhaled budesonide compared to oral prednisolone, this treatment seems to be more appropriate in mild to moderate exacerbations**.**

***Key words*:** Asthma exacerbation, Inhaled budesonide, Prednisolone, Pulmonary function test.

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Introduction

Asthma is a chronic inflammatory disease of the airways which has the highest Emergency department (ED) visits in childhood due to its exacerbation (1,2). Asthma exacerbations are usually treated with bronchodilators and anti-inflammatory corticosteroids. The standard treatment for acute exacerbation is inhaled rapid-acting β2 agonist (3,4).
The use of Oral corticosteroids (OCS) is considered in cases with failed response to short-acting β-agonist therapy (1,4). Treatment with systemic corticosteroids is associated with decreased rates of admission (5,6), reduces hospital length of stay (7), improved pulmonary index scores (8,9).

Besides these beneficiary effects of OCS, there is decreased acceptance and compliance to drug after discharge from emergency department due to possible side effects (10-12). Inhaled corticosteroids are introduced as possible alternative treatment in these patients. The protective effect of inhaled corticosteroids on acute asthma exacerbations in a pediatric asthma population has been shown recently (13).

Although some studies have shown better results for OCS compared to Inhaled corticosteroids (ICS) in severe asthma exacerbation (14,15), the results in mild-to-moderate exacerbation were different (16-19). Different types of ICS including fluticasone and Budesonide are used in this regard. In our previous study, we compared the efficacy of inhaled fluticasone compared to oral prednisolone and observed similar improvement in asthma symptoms, but better respiratory function in children treated with inhaled fluticasone (20).

most studies have evaluated the effect of inhaled fluticasone, and few studied inhaled Budesonide results. In this study, we aim to evaluate the changes in pulmonary function tests in children with mild-to-moderate asthma exacerbation receiving oral prednisolone and inhaled Budesonide.

Methods and Materials

Forty-four children with mild-to-moderate acute asthma exacerbation visiting emergency department, Tabriz Children's Hospital, Iran between May 2012 to January 2014 were included in this randomized clinical trial. Children between 5-14 years old with a documented diagnosis of asthma for ≥6 months, with mild-to-moderate acute asthma exacerbation with baseline Forced expiratory volume in 1 second (FEV1) 50% to 79% predicted were included. Children were excluded if they had persistent vomiting, airway instability, treatment with oral corticosteroids within 7 days, coexistent heart, liver, kidney and chronic pulmonary diseases, cardiopulmonary/neuromuscular disease, and severe exacerbation requiring intensive care or mechanical ventilation or previous treatment in the intensive care unit for asthma. We also excluded patients with any contraindications to use salbutamol. The study has been approved by the ethical committee of Tabriz University of Medical Sciences and informed consents obtained from all the patients, controls and their parents before including in the study.

In the emergency department both groups received O2 therapy and salbutamol 2 puff each 20 minutes until the symptoms are controlled. Patients were randomly assigned to two treatment groups using randlist software. First group was treated with salbutamol spray (2 puffs every four hours for 48 hours, each puff contains 100 micro grams of the drug) using an spacer plus oral prednisolone (2 milligrams per each

kilograms of body weight for one week). Second group was treated with salbutamol spray (2 puffs every four hours for 48 hours) plus budesonide spray (2 puffs every 12 hours, for one week, each puff contains 200 micrograms of the drug) using an spacer.

The first dose of the treatment (oral prednisolone or fluticasone spray) was given in the emergency department. Spirometry was performed on day one and seven to evaluate forced expiratory volume in one second (FEV1), Forced vital capacity (FVC), FEV1/FVC and Forced expiratory flow (FEF) 25-75%. Children with persistent symptoms during study were referred either to our emergency department or to their physicians for assessment.

Statistical analyses were performed using the Statistical Package for Social Sciences, version 17.0 (SPSS, Chicago, Illinois). Quantitative data were presented as mean ± standard deviation (SD), while qualitative data were demonstrated as frequency and percent (%). The categorical parameters were compared by chi-square test, and the continuous variables were compared by independent t- test. Findings before and after treatment in each group were compared using paired samples T-test. A p- value of <0.05 was considered statistically significant.

Results

In this study, 44 children with mild to moderate asthma exacerbation were evaluated in 2 groups receiving oral prednisolone (n=30) and budesonide inhaler (n=14). Baseline findings between groups are shown in (Table.1). There was no significant difference between groups in baseline findings.

Pulmonary function test (PFT) before and 7 days after treatment, as well as percent of PFT changes in each variable are demonstrated in (Table.2). There was no significant difference between PFT findings before and after treatment between groups. However, children receiving oral prednisolone had significantly more improvement in the peak expiratory flow (PEF).

Comparing the findings before and after in each group, there was significant improvement in all parameters in both groups ($p<0.05$), but PEF had no significant change after treatment compared to before treatment values in inhaled budesonide group ($p=0.63$).

Table 1: Baseline findings between groups

Variables	Oral prednisolone (Mean±SD)	Budesonide inhaler (Mean±SD)	P value
Age (years)	7.73±2.30	7.14±2.10	0.42
Gender	26 (86.7%)	12 (85.7%)	0.93
Rhinitis	2 (6.7%)	2 (14.3%)	0.58
Sinusitis	10 (33.3%)	3 (21.4%)	0.42
Gastroesophageal reflux disease	0	2 (14.3%)	0.09
Passive smoker	4 (13.3%)	3 (21.4%)	0.69

NS: Not significant.

Table 2: Changes in pulmonary function tests during follow-up period

Variables		Oral prednisolone (Mean±SD)	Inhaled fluticasone (Mean±SD)	p value
FEV1	Before	88.06±18.81	70.78±24.29	0.28
	Day 7	104.36±12.62	107.85±18.18	0.46
	%change	25.48±7.25	45.47±14.04	0.16
FVC	Before	86.16±17.57	88.92±20.52	0.64
	Day 7	104.00±12.94	106.42±16.84	0.6
	%change	26.74±6.76	26.10±9.40	0.95
FEV1/FVC	Before	99.83±9.14	103.21±5.32	0.2
	Day 7	109.66±14.22	108.00±2.66	0.66
	%Change	10.80±3.44	4.95±1.86	0.26
FEF	Before	95.66±35.41	92.42±22.14	0.75
	Day 7	106.96±13.13	115.57±15.42	0.06
	%Change	26.91±8.91	36.08±14.32	0.57
PEF	Before	89.96±34.61	107.78±39.90	0.13
	Day 7	125.53±39.94	109.28±32.07	0.19
	%Change	53.87±11.68	6.89±5.90	0.01*
PFM	Before	136.00±34.79	123.57±23.90	0.24
	Day 7	174.66±51.97	152.14±29.91	0.14
	%Change	27.92±19.94	24.28±14.60	0.54

Discussion

It is known that OCS could significantly alleviate the symptoms of acute asthma exacerbations (21,22). It is also observed that ICS could show comparable results to OCS in treatment of acute asthma exacerbation in ED (18, 23-25). Most previous studies have evaluated the outcome and improvement in asthma symptoms after treatment with OCS and ICS and few have considered the changes in PFT.

Pulmonary function testing allows an objective assessment of the degree of bronchial obstruction in asthma (including reversibility and variability), contributing to the diagnosis, treatment, and prognosis of the disease (3). Spirometry is an essential objective method used in diagnosing asthmatic children and is recommended to follow spirometry in order to monitor asthma control after therapy initiation (26). It is shown that low Forced expiratory flow 25–75% (FEF25-75%) and low FEV1/FVC

are significantly associated with steroid use, asthma exacerbations and asthma severity, as compared to children with normal spirometry (27).

In this study, we evaluated the spirometry findings following treatment with budesonide inhaler and OCS in mild to moderate asthma exacerbation in ED. WE observed that in both group all PFT parameters except PEF in budesonide inhaler group had significantly improved during one week treatment after asthma exacerbation. Comparing the PFT parameters changes there was no significant difference between two treatments, but a significant improvement in PEF in OCA group compared to budesonide inhaler group.

Edmonds et al. (28) in a review of 11 studies observed that patients who received ICS compared to placebo showed significant improvements in PEF and FEV1. However, there was heterogeneity in results regarding ICS and OCS administration. Different inhaled corticosteroids are evaluated in this regard. One study comparing fluticasone with OCS showed better outcomes (including improvements in FEV1) when patients received systemic steroid therapy (14). Unlike these findings, in our previous study we observed that spirometry parameters especially FEV1, FVC and FEF significantly improve after one week in children receiving inhaled fluticasone compared to oral prednisolone (20). Similar results are reported in the literature (29,30).

Several studies have evaluated the effect of budesonide compared to OCS in improving PFT in children and adults. Similar to our findings, Morice nad colleagues (31) and Nana et al. (32) in their study on asthma exacerbation in adults and Volovitz et al. (33) on their study in children showed significant improvement in FEV1 and PEF in both groups with no difference between groups. Nuhoglu and colleagues (18) also reported no statistically significant difference between the budesonide and OCS groups with respect to the increase in lung function test measurements (FEV1, FEV1/FVC, FEF). However, Matthews and colleagues (34) in the study of 46 hospitalized children with severe asthma exacerbations observed FEV1 was significantly increased from baseline in the budesonide group but not the prednisolone group.

It is important to achieve better PFT following asthma exacerbation. All these studies are indicative of beneficiary effect of inhaled budesonide in improving PFT better or comparable to OCS use. While there are low compliance to OCS use and possible side effects in long term use, The use of inhaled budesonide could be recommended for treatment of mild-to-moderate asthma exacerbation in children.

There are some limitations for this study. Although this was a randomized clinical trial, there was a small sample size. We only evaluated the short term effects of ICS and OCS on PFT and these findings could not completely expanded to the long term effects.

Conclusion

In conclusion, both inhaled Budesonide and oral prednisolone significantly improved respiratory function in children with mild-to-moderate asthma exacerbation. As there was no significant difference between groups in PFT findings and due to the low systemic effects of inhaled budesonide compared to oral prednisolone, this treatment seems to be more appropriate in mild to moderate exacerbations.

Conflict of interests: None

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