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CLINICAL TRIAL PAPER

Reversibility after inhaling salbutamol in different body postures in asthmatic children: A pilot study

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Pediatric asthma;
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Summary
Rationale: Pulmonary medication is mostly delivered in the form of medical aerosols to minimize systemic side effects. A major drawback of inhaled medication is that the majority of inhaled particles impacts in the oropharynx at the sharp bend of the airway. Stretching the airway by a forward leaning body posture with the neck extended ("sniffing position") may improve pulmonary deposition and clinical effects.
Methods: 41 asthmatic children who were planned for standard reversibility testing at the pulmonary function lab, alternately inhaled 200 μgr salbutamol with an Autohaler® in the standard or in the forward leaning body posture. Forced Expiratory Volume in 1 s (FEV_1), Forced Vital Capacity (FVC), Peak Expiratory Flow (PEF), Mean Expiratory Flow at 25% of vital capacity (MEF_{25}) and Mean Expiratory Flow at 75% of vital capacity (MEF_{75}) were analysed.
Results: The children in the forward leaning body posture group showed a significantly higher mean FEV_1 reversibility than the control group after inhalation of 200 μgr salbutamol (10.2% versus 4.1%, $p = 0.019$). Additionally, mean MEF_{75} was significantly more reversible in the forward leaning body posture group versus the standard body posture group (32.2% resp. 8.9%, $p = 0.013$).
Conclusion: This pilot study showed a higher reversibility of FEV_1 and MEF_{75} after inhaling salbutamol in a forward leaning body posture compared to the standard body posture in

Abbreviations: BAI, Breath Actuated Inhaler.

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asthmatic children. This suggests that pulmonary effects of salbutamol can be improved by inhaling in a forward leaning body posture with the neck extended. This effect is possibly due to a higher pulmonary deposition of salbutamol and should be confirmed in a randomized controlled trial.

Introduction

Inhaled bronchodilators are recommended as rescue medication for all children with asthma [1]. Deposition of inhaled medication in the upper airway can compromise deposition at the target area. This upper airway deposition is caused by the sharp angle between the pharynx and trachea [2,3]. In asthmatic children the loss of inhaled medication may even be greater as the upper airway is smaller and has a different geometry. Even with optimal inhalation via a breath actuated inhaler (BAI) 50—60% of the dose of beclomethasone diproprionate impacted in the oropharynx in children under the age of 12, as measured in a radio-labelling study [4]. In daily practice the inhalation technique is frequently less optimal leading to an even higher loss of medication [5].

Brandao et al. showed that inhaling nebulised bronchodilators in a forward leaning body posture during an asthma exacerbation in asthmatic young adults, led to a faster recovery of lung function compared to the conventional body posture [6]. They suggested that this could be caused by a higher pulmonary deposition of the nebulised medication in the forward leaning posture.

We hypothesized that stretching the bend in the upper airway during inhalation could improve the effect of salbutamol on lung function.

The aim of this study was to compare the reversibility of lung function in asthmatic children after a dose of 200 μgr salbutamol that was inhaled either in the forward leaning body posture with the neck extended, or in the standard body posture.

Materials and methods

Patients

Clinically stable patients aged 6 till 16 years old, with pediatrician diagnosed mild to moderate asthma, who underwent a planned spirometry in Medisch Spectrum Twente, Enschede from May to August 2013, participated in this prospective pilot study. Children were not allowed to use long acting bronchodilators 24 h before testing, or short acting bronchodilators 8 h before testing.

The medical ethical committee reviewed our study protocol and declared that our study did not meet the criteria necessary for an assessment by a medical ethical committee according to the Dutch law, because the children were not subjected to procedures deviating from the normal procedures. All children and parents received verbal information and their participation was voluntarily.

Pulmonary function measurements

Spirometry was performed by standard pulmonary function tests before and after the administration of 200 μgr salbutamol, administered with an Autohaler®. All pulmonary function measurements — Forced Expiratory Volume in 1 s (FEV_1), Forced Vital Capacity (FVC), Peak Expiratory Flow (PEF), Mean Expiratory Flow at 25% of vital capacity (MEF_{25}) and Mean Expiratory Flow at 75% of vital capacity (MEF_{75}) — were performed in the same standard upright body posture. Percentage of predicted baseline FEV_1 was measured with the aid of the Koopman formulas [7]. Reversibility was calculated as follows: (value after salbutamol — value at baseline)/value at baseline [8]. All spirometry measurements consisted of duplicated full flow volume loops, using standard ERS protocol [9]. The best values for all variables were used for analysis. Visual incentives such as blowing out candles or knocking down bowling pins were used to optimize spirometric effort.

Inhalation technique

Patients inhaled alternately in the standard upright body posture described on the standardized checklists designed by the Dutch Asthma Foundation [10] or in the alternative body posture: a forward leaning body posture with the neck extended (Fig. 1).

The inhaled medication was administered to all children by the same investigator who did not perform the pulmonary function measurements. The pulmonary function technician was not blinded to the body posture during inhalation.

Sample size calculation

No sample size calculation was performed, because this study was deemed a pilot study. This study was conducted between May 2013 and August 2013 (12 weeks). Results were analysed after the inclusion of 41 children.

Statistical analyses

Data was expressed as mean values ± standard deviation (SD), and 95% Confidence Intervals (95CI), where appropriate, for normally distributed data, as median (Inter Quartile Range; IQR 25th—75th) for not normally distributed data or as numbers with corresponding percentages if nominal or ordinal. Continuous variables were visualised with histograms. When applicable, between-group comparison of continuous, normally distributed data was