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Determination of parameters related to nasal inspiratory pressures in children utilizing valved-holding chambers (valved spacers)

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Summary

Objective: The administration of medication by the nasal route using valved spacers, may be an alternative for the concomitant treatment of allergic rhinitis and asthma. The aim of this study was to determine if children are capable, in using a spacer and face mask, of opening the inspiratory valve using only nasal inhalation.
Methods: Prospective cross-sectional. The study included 85 children aged 4–9 years. Four types of valved spacers connected to a digital vacuum manometer were evaluated. The patients were prompted to inhale through their nose and the pressure reached in the first curve, maximal peak and time between the start of the inspiratory action and the first effective inspiration (opening of the valve) were determined. The results were compared with factors such as age, weight, BMI, gender, and presence of rhinitis or asthma.
Results: In two of the spacers, the valve opened in 98.8% of the tests with nasal inspiration only. The spacer ACE® holding chamber showed initial and maximal inspiratory pressures that were significantly greater than with the others ($p < 0.001$). No correlation was observed between the parameters examined for each spacer and the patient variables considered.
Conclusion: The results suggest that children 4–9 years old are able to open the spacer valve with only nasal inspiration. The spacer ACE® holding chamber was shown to be significantly more effective than the others tested. Studies that demonstrate that air inspired nasally reaches the lungs effectively are

Abbreviations: SPSS, Statistical Package for the Social Sciences.

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necessary so that this airway can be utilized for the administration of therapeutic agents.

1. Introduction

In the last decades, the global view of the pathogenesis of respiratory allergy changed significantly. The association between allergic rhinitis and asthma (upper and lower airways) has been investigated by clinical and epidemiological studies. A great deal of evidence has been published on the rate of allergic rhinitis accompanied by asthma and on the role of upper airway infections in the exacerbation of pulmonary diseases [1—13]. These relationships are particularly evident in children [4,5,14]. It has been demonstrated that the comorbidity rate between these two entities reaches 75% [5,15]. Bronchial hypereactivity is a common finding in patients with rhinitis [16,17], and allergic rhinitis is a separate risk factor for subsequent asthma [15,18]. Therefore, it is of utmost importance to establish an individualized therapeutic plan based on the severity of the clinical presentation of the two diseases. The combined treatment of allergic rhinitis and asthma results in better control of both and lower incidence of adverse effects related to the use of medications [19,20].

Recently, the administration of medications by the nasal route through the use of valved spacers has been an alternative for the simultaneous treatment of the two diseases, based on the principle that nasal inhalation is effective in making the medication available to the lungs [20]. The aim of this study was to determine if children have the capacity, with the use of spacer and mask, to produce an inspiratory pressure capable of opening the valve located between the mask and the reservoir of different types of valved spacers.

2. Methods

During the period of May to June of 2008, a prospective cross-sectional study was conducted, which included children in the age group of 4—9 years old, who were waiting for doctor visits in the outpatient Clinic for Pediatric Specialties at the Hospital da Criança Santo Antônio (Complexo Hospitalar Santa Casa de Porto Alegre, RS, Brazil).

The sampling process was by convenience, in accordance with the agreement of the children and parents/guardians collaborating with the study, on days selected for evaluation.

Excluded from the study were patients showing acute respiratory complaints and patients with neuromuscular disease or special needs. The presence of fever or other clinical conditions that could compromise the capacity of the child to concentrate was also a reason for exclusion.

Once identified, the patients with established eligibility criteria were taken, along with their parents or guardians, to a private room where information about the procedure was given. At this time, signed informed consent was obtained. The same investigator conducted all the examinations. The study protocol was approved by the Committee of Ethics in Research of the Federal University of Health Sciences of Porto Alegre (UFCSPA), registered under the project number 677/08.

Four types of valved spacers were evaluated, all of small volume and commercially available for the treatment of asthma. The devices were numbered 1—4: ACE® holding chamber (1), AlergoChamber/Elefantair® (2), Flumax Baby® (3) and LuftChamber® (4). The order in which the evaluations were performed for the different spacers was randomized. All the spacers were connected to a V1.27-MVD 300® digital vacuum manometer (Global Med, Porto Alegre, Brazil), placed inside a chamber with an exit 0.5 cm beyond the inspiratory valve of the system. This apparatus allowed the determination of pressure difference (cm H_2O) generated by the inspiratory force inside the chamber of the spacer for each inspiratory cycle. To determine the nasal inspiratory pressure, this system was connected to a face mask. When the patient breathes in, there is a flow of air through the system and the manometer measures the variation in pressure inside the chamber. During the testing, no aerosol inhaler was utilized for giving medication. The patient simply carried out the task of inspiration in between the face and spacer.

All the patients performed the test with the four spacers, where they were prompted to inhale deeply only through their nose, keeping their mouth closed. The pressure reached in the first effective inspiration (determined by the opening of the spacer valve), the time between the start of the inspiratory action and the opening of the spacer valve and maximal peak inspiratory pressure obtained in 15 s of the test were recorded. At the end of each scheduled collection of data (approximately 6 or 7 children evaluated), the spacers were