Allergology International 65 (2016) 253–258

Contents lists available at ScienceDirect

Allergology International

journal homepage: http://www.elsevier.com/locate/alit

Original article

Right middle lobe atelectasis in children with asthma and prognostic factors

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ARTICLE INFO

Article history:
Received 12 August 2015
Received in revised form
8 December 2015
Accepted 9 December 2015
Available online 22 January 2016

Keywords:
Asthma control
Atelectasis
Complication
Pediatrics
Prevention

Abbreviations:
RML, right middle lobe; FEV_1, forced expiratory volume in 1 s; C-ACT, Childhood Asthma Control Test; OR, odds ratio; CI, confidence interval; ICS, inhaled corticosteroids; LABA, long-acting beta agonists

ABSTRACT

Background: Although right middle lobe (RML)-atelectasis of the lungs is a common complication of asthma, the relevant data is limited. The aim of this study is to define the characteristics of RML atelectasis in asthma during childhood.
Methods: Children with asthma who had recently developed RML atelectasis were included; anti-inflammatory medications, clarithromycin, and inhaled salbutamol were prescribed, chest-physiotherapy (starting on the sixth day) was applied. Patients were reevaluated on the sixth, fourteenth, thirtieth, and ninetieth days, chest X-rays were taken if the atelectasis had not resolved at the time of the previous visit.
Results: Twenty-seven patients (6.8 (4.8–8.3) years, 48.1% male) with RML atelectasis were included. Symptoms started 15 (7–30) days before admission. The thickness of the atelectasis was 11.8 ± 5.8 mm; FEV_1% was 75.9 ± 14.2 and Childhood Asthma Control Test scores were 11.8 ± 5.6 at the time of admission. The atelectasis had been resolved by the sixth (n = 3), fourteenth (n = 9), thirtieth (n = 10), and ninetieth days (n = 3). The treatment response of the patients whose atelectasis resolved in fourteen days was better on the sixth-day (atelectasis thickness: 4.7 ± 1.7 vs. 11.9 ± 7.3 mm, p = 0.021) compared to those whose atelectasis resolved later. Nearly half (54.5%) of the patients whose atelectasis had resolved by fourteen days were using controller medications at the time of admission. However, only two patients (13.3%) were on controller treatment in the latter group (p = 0.032). Regression analysis didn't reveal any prognostic factors for the early resolution of atelectasis.
Conclusions: Early diagnosis and treatment of RML atelectasis prevents complications. Patients who had early resolution of atelectasis had already been on anti-inflammatory medications, and responded better to aggressive treatment within the first week.

Introduction

Atelectasis is defined as the incomplete expansion of the lung parenchyma, leading to alveolar hypoxia and pulmonary vasoconstriction to prevent ventilation-perfusion mismatching. Children, especially younger children, are more prone to develop atelectasis due to smaller and more collapsible airways, more pliant chest walls, and inefficient collateral ventilation through intra-alveolar and bronchiole-alveolar pores.[1] This predisposition is especially notable in patients not only with lung diseases[2,3] (e.g., pneumonia, asthma, or cystic fibrosis) but also with systemic diseases[4] (e.g. neuromuscular diseases).

Although segmental or lobar collapse of the lungs is a common complication of asthma, data about its exact incidence is limited. The incidence has been recorded in 1.62 percent of the general population of children with asthma[2] and 11 percent and 36 percent of populations of children with non-hypoxemic and hypoxemic asthma exacerbations, respectively.[5] While right middle lobe (RML) atelectasis is typically seen, sometimes the lingula is involved.[6] The presence of bronchial inflammation that produces cellular debris, mucus plugs, and edema contributes to the development of atelectasis in asthma.

RML atelectasis can resolve spontaneously, but in some cases the region undergoes atelectasis after acute exacerbation prevents the lobe from re-expanding; in these cases the lobe remains

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Peer review under responsibility of Japanese Society of Allergology.

http://dx.doi.org/10.1016/j.alit.2015.12.002

collapsed. Recurrent infections/inflammations and obstruction of the involved lobe may lead to parenchymal damage and bronchiectasis.[7] Prompt diagnosis and treatment is mandatory for a better pulmonary outcome. The term 'RML syndrome' is used if the RML atelectasis is persistent (with a duration longer than one month) and/or recurrent (≥2 episodes).[7,8] Although there have been some studies on RML syndrome, little is known about RML atelectasis regarding its response to treatment and the recovery from RML syndrome in childhood asthma. Our aim in this follow-up study was to identify the characteristics and prognostic factors of RML atelectasis in asthma during childhood.

Methods

Study population

In this prospective study, children between the ages of 3–18 years with an initial diagnosis of asthma who had developed RML atelectasis during follow-up (Fig. 1) were enrolled from the outpatient allergy clinic of the Ankara Education and Research Hospital. The initial diagnosis of asthma was established if there had been a history of respiratory symptoms, such as intermittent wheezing, shortness of breath, coughing, and/or reversible expiratory airflow limitation, defined by at least a twelve percent improvement in forced expiratory volume in 1 s (FEV1) following bronchodilator administration.[9] As part of a routine clinical practice, before making an initial diagnosis of asthma the patients who participated in this study had been evaluated for the other etiologies of recurrent respiratory symptoms with other diagnostic tools including chest X-rays and none of them had been found to have any structural pulmonary abnormalities at that time. In this study the chest X-rays revealing atelectasis during follow-up had been required either due to symptoms where we suspected uncontrolled asthma or due to the existence of an exacerbation. In that case, the diagnosis of RML atelectasis was based on radiologic findings, more apparent in the lateral view of a chest X-ray as a wedge-shaped, increased density between the minor and major fissures, with the apex at the hilum and the base towards the pleura[10] (Fig. 1). Patients were excluded from the study if they had severe, predefined chronic illnesses other than asthma, including cystic fibrosis, primary ciliary dyskinesia, chest wall defects.

A survey was administered to each participant regarding demographic characteristics (age, gender, family history for atopic diseases, and smoke exposure), asthma control parameters (asthma exacerbations, package of salbutamol consumption, and hospitalizations due to asthma within the last year), and symptomatology of the most recent episode (the onset of symptoms before admission, and the frequency of daytime and nighttime symptoms within the last month).

The children and their parents also filled in the Turkish-language version of the Childhood Asthma Control Test (C-ACT).[11] The C-ACT is a self-administered questionnaire with seven items that assesses asthma symptoms during the day and night, the effects of asthma on daily life, and the use of rescue medications in the preceding four weeks.[12] A C-ACT score of 19 or lower indicated inadequately controlled asthma.[11] Asthma severity was assessed according to the type of controller medications used by the patients, such as inhaled corticosteroids and/or montelukast at the enrollment visit.[9]

Study measurements

Spirometry using the ZAN100 spirometry system (nSpire Health, Longmont, Colorado, USA), complete blood cell count, and immunoglobulin E measurements (Uni-Cap; Pharmacia, Kalamazoo, Michigan, USA) were done with standard procedures. Skin prick testing (Stallergenes; Antony, France) with twenty-four aeroallergens, including house dust mites; cockroaches; grass, weed, and tree pollens; molds; and cat and dog dander was performed with positive and negative controls. Reactions with an induration of 3 mm or greater than that of the negative control was considered positive, and children with at least one positive test were diagnosed as atopic.

In cases where RML atelectasis was diagnosed during the initial visit, therapy was planned as systemic methylprednisolone (2 mg/kg/day, for five days), clarithromycin for probable underlying infection (20 mg/kg/day, for ten days) and inhaled salbutamol as needed. On the sixth day of treatment, chest physiotherapy[13] was started and continued until the improvement of atelectasis. For the purpose of chest physiotherapy[13] the patients and their parents were advised to perform percussion and vibration techniques and the exercises of deep breathing and coughing about which they were educated. The medications of the ones who had been already on regular controller treatment was stepped up according to the allowed medications and doses implicated according to age in current GINA guidelines.[9] For the ones newly starting to the regular treatment (either montelukast or low dose inhaled corticosteroids) the controller medication was chosen according to the patient's age and using capability and started after discussion with the parents of the patients and the patient him/herself. The prescriptions were also given age appropriately in accordance with the GINA guidelines.[9]

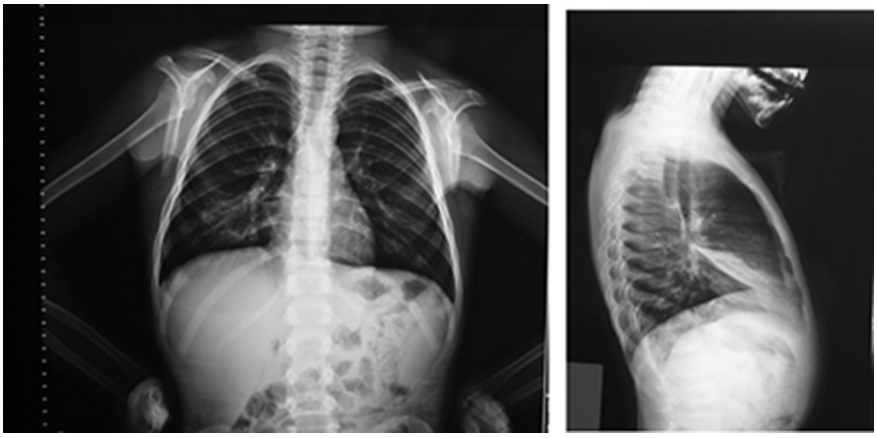

Fig. 1. Posteroanterior and lateral radiographs of five-year-old child with atelectasis of right middle lobe.