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How Often is Chest Radiography Ordered for Patients with Pediatric Asthma?

Serap Özmen, İlknur Bostancı, Emine Dibek Mısırlıoğlu

Department of Pediatric Allergy and Immunology, University of Health Sciences Dr. Sami Ulus Maternity and Children Research and Training Hospital, Ankara, Turkey

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Abstract

Objective: Although many children with asthma can be diagnosed clinically, chest radiographs are routinely requested in asthma attacks. The aim of this study is to determine how often chest radiographs are requested and the factors affecting these requests in pediatric patients with asthma.

Methods: This cross-sectional study was performed by studying the electronic radiographic records of pediatric patients with asthma who were referred to our Pediatric Allergy and Immunology Department over a six-month period. A questionnaire was designed to obtain further information from the parents of the patients.

Results: The records of 100 children with bronchial asthma, aged 21 to 192 months, were evaluated. The average number of chest radiographs was 3.9±3.8 (between 1-30). Fifty-one percent of the children underwent three or more chest radiographs. There was a positive correlation between the number of chest X-rays before asthma diagnosis and the frequency of antibiotic usage (r=0.222, p=0.026). An inverse correlation was found between the number of chest radiographs and the patients' ages and the age at which asthma was diagnosed (r=–0.335, p=0.001; r=–0.211, p=0.035, respectively). In contrast, there was a positive correlation between the number of chest X-rays and the number of hospital admissions (r=0.205, p=0.040). A positive correlation between the frequency of antibiotic usage and the annual number of hospital admissions was determined (r=0.428, p=0.000). Furthermore, a positive correlation between the frequency of antibiotic usage and the frequency of asthma attacks was observed (r=0.292, p=0.003).

Conclusion: The results of our study show that the use of chest radiographs is high in cases of childhood asthma, especially in younger children.

Keywords: Asthma, asthma attack, chest radiography, chest x-ray, childhood

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Corresponding Author
Serap Özmen
E-mail: serapeldem@gmail.com

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INTRODUCTION

Asthma is the most common chronic disease in childhood, with a prevalence of 10% to 30% (1). Its management is guided by clinical symptoms, physiological measurements, and response to therapy. Chest radiographs are commonly, even routinely, requested in asthma exacerbations (2, 3). However, there is no clear-cut evidence as to whether routine chest X-rays are necessary in all asthmatic patients or whether they are valuable in the management of acute asthma attacks (4). Chest radiographs are usually recommended at the first presentation of asthma. In the initial evaluation of children with acute asthma attacks, chest radiographs are only necessary if focal signs are present in mild and moderate episodes. In addition, a chest radiograph is necessary in the case of severe or life-threatening episodes that do not respond to initial therapy or if there is any suspicion of pneumothorax (5).

The aim of this study is to determine how often chest radiographs are requested for pediatric asthmatic patients and the factors that affect these requests.

METHODS

This cross-sectional study was performed over a six-month period in the Pediatric Allergy Outpatient Clinic of a tertiary hospital. Patients were randomly assigned to our clinic according to their application order. One hundred asthmatic children diagnosed according to the Global Initiative for Asthma (GINA) report were included in this study (6). Patients with systemic diseases such as bronchiectasis, cystic fibrosis, immune deficiency, and gastroesophageal reflux disease that can affect the number of chest x-rays obtained were excluded from the study. The questionnaire was completed by the researchers during a face-to-face interview and by examining hospital electronic records over the previous four years. The questionnaire consisted of questions regarding the socio-demographic characteristics of the patients, the number of requested chest radiographs, the frequency of asthma attacks, and the patients' antibiotic usage. In addition, we used the hospital electronic records from the previous four years as a radiographic data source. Local Ethical Committee approval was obtained for the study, and the parents gave their informed consent.

Statistical Analyses

Statistical analyses were performed with the Statistical Package for the Social Sciences statistical software program (Version 10.0, SPSS Inc.; Chicago, IL, USA). While discrete variables were given as numbers and percentages, continuous variables were given as means ± standard deviations. The chi-square test was used to compare discrete variables of the two different groups independently from each other, and the Mann-Whitney U test was used to compare continuous variables. $p<0.05$ was considered as significant. Correlations were performed using the Spearman correlation.

RESULTS

The records of 100 children with bronchial asthma, aged 21 to 192 months, were evaluated. The data concerning the patients' socio-demographic status and their numbers of chest radiographs are shown in Table 1 and Table 2, respectively.

The percentage of patients who underwent three and more chest radiographs was found to be 51. Only 15 (15%) patients had no chest radiographs before being diagnosed with asthma; 37 (37%) had no chest radiographs after diagnosis of asthma. Thirty-four (34%) patients had only one chest radiograph before being diagnosed with asthma; 28 (28%) patients had one chest radiograph after being diagnosed with asthma. The median of the annual quantity of antibiotic usage was found to be 4 (between 0–25). Nine patients had not used antibiotics in the previous year.

Table 3 shows the factors affecting the number of chest radiographs. We found negative correlations between the number of chest radiographs and the patients' age and the age at which they were diagnosed with asthma; we found positive correlations between the number of chest radiographs and hospital admission. In addition, there was a positive correlation between the number of chest X-rays before diagnosis and the frequency of antibiotic usage ($r=0.222$, $p=0.026$). We found positive correlations between antibiotic usage and the annual number of hospital admissions and the number of asthma attacks ($r=0.428$, $p=0.000$; $r=0.292$, $p=0.003$, respectively). The correlation between the frequency of antibiotic usage annually and the duration of patient follow-up was found to be negative ($r=-0.198$, $p=0.048$).

Table 1. Socio-demographic characteristics of the asthmatic patients

Characteristics	
Age (months)	
Mean±SD	84.6±34.6
Minimum-maximum	21-192
Median	84
Gender	
Male (%)	62
Passive smoking (%)	30
Atopy (%)	48
Age of asthma diagnosis (months)	
Mean±SD	47.8±31.1
Minimum-maximum	6 -192
Median	48
Duration of follow-up for asthma (months)	
Mean±SD	35.2±27.8
Minimum-maximum	1-120
Median	36
Average annual number of hospital admissions	
Minimum-maximum	1-20
Median	4

SD: Standard deviation

Table 2. Number of chest radiographs in asthmatic patients

Characteristic	Mean±SD	Minimum-maximum	Median	p
Number of chest radiographs of the patients	3.9+3.8	1-30	3	
Number of chest radiographs				0.002
Children younger than five years	6.3+6.1	1 – 30	4.5	
Children older than five years	3.3+2.7	1-16	2	
Number of chest radiographs				0.015
Before asthma diagnosis	2.3+2.5	0-15	2	
After asthma diagnosis	1.5+2.4	0-20	1	
Number of chest radiographs				0.020
Exposure to passive smoking	5.8+5.6		4.5	
No exposure to passive smoking	3.1±2.4		2	
Number of chest radiographs				0.108
Atopic	4.2±3.2		2	
Not atopic	3.6±4.5		3	

SD: Standard deviation

Table 3. Factors affecting the number of chest radiographs in asthmatic patients

	r	p
Patient's age	-0.335	0.001
Age at asthma diagnosis	-0.211	0.035
Hospital admission	0.205	0.040

DISCUSSION

In this study, we present certain facts and issues pertaining to chest radiographs in pediatric patients with asthma to draw physicians' attention to the unnecessary use of chest radiographs in the management of asthmatic children. Recently, studies have emphasized the need to reduce the number of unnecessary chest x-rays in children with asthma (7, 8). Chest radiographs do not contribute significantly to the management of asthma attacks unless pneumothorax, pneumomediastinum, or pneumonia are present (9). There are also concerns regarding the cost effectiveness, potential radiation hazards, and associated risks of antibiotic therapy of chest x-rays (10).

In our study, we determined that the average number of chest radiographs requested per asthmatic pediatric patient was 3.9. The upper limit for the number of chest radiographs was found to be 30 for 1 patient. Of all our patients, 51% received three or more chest X-rays**.** In fact, chest radiography is not suitable for every asthmatic patient. In asthma follow-up, it has limited benefit. Sung et al. (9) stated that in the diagnosis and management of asthma, chest radiographs are not useful and are used largely to exclude other conditions that may imitate or complicate asthma. In another study, Hederos et al. (4) showed that chest X-rays were not required when determining asthma in 60 preschool children. Therefore, as physicians, we should request radiographic examinations only when they will contribute to the management of an asthmatic patient; we should also consider that for ordinary asthma attacks, chest x-rays may be of no value. Radiographic examinations may be useful only if the diagnosis of asthma is in doubt on initial presentation; in this case, x-rays may exclude other causes of wheezing, such as foreign body aspiration, pneumonia, congestive heart failure, vascular anomalies, and enlarged lymph nodes (11).

In our study, the number of chest radiographs was found to be higher in younger children than in older children; the number was also higher in children diagnosed at a younger age than in children diagnosed at an older age. There was a significant negative correlation between the number of chest radiographs and the age of the patient. Moreover, the correlation between the number of chest radiographs and the age of asthma diagnosis was found to be positive. These results may arise from the difficulties of evaluating the lung sounds of younger children and from fear of failing to diagnose pneumonia. In addition, during initial episodes of wheezing in preschool-aged children, chest x-rays may be very useful for excluding other non-asthmatic disorders. As recurrent wheezing is seen as a common symptom, it may be difficult to diagnose asthma in children five years or younger (6). Severe viral infection-induced wheezing episodes may necessitate radiological evaluation at emergency departments. This may be another reason for the high rates of chest X-rays in patients under five years of age. In our study, when we compared the number of chest radiographs before and after the diagnosis of asthma, the number of chest radiographs was found to be significantly decreased after asthma diagnosis. The correlation between the frequency of annual antibiotic usage and the duration of patients' follow-up was found to be negative. Following asthma diagnoses, the frequency of antibiotic usage was found to decrease.

In addition, we found that patients who were subject to passive smoking had more chest radiographs than patients who were not. It is known that exposure to passive smoking is a significant respiratory tract irritant in children. Consequently, this exposure may trigger asthma attacks, which may lead to an increase in chest X-rays.

Moreover, there was a positive correlation between the number of chest X-rays and the number of annual hospital admissions. We observed that the frequency of antibiotic usage increased parallel to increases in the numbers of asthma attacks and hospital admissions. This issue would appear to be linked to excessive use of antibiotics due to over-diagnosis of pneumonia on chest x-rays in asthmatic children. In asthma attacks, chest radiographs generally reveal radiographic signs of air trapping. Furthermore, peribronchiolar inflammatory changes are observed in chronic asthma. In some cases, atelectasis may also be observed (12-17). All these radiographic findings may lead to unnecessary prescription of antibiotics. In contrast, in a recent study, the factors associated with pneumonia in children with asthma exacerbation were determined to be age of five years or older and presenting with fever and hypoxemia. The authors suggested that chest radiography should not be requested routinely to detect pneumonia in children experiencing asthma attacks (18).

Another issue in our study was that almost every child patient who visited our hospital with respiratory system symptoms was required to undergo chest radiography. The more x-rays are taken, the higher the cost. Also, when physicians request chest radiographs, they should consider the possible long-term negative effects of radiation on child patients (19). Therefore, in the pediatric population, protection from radiation is of great importance.

The limitations of our study are its retrospective nature, referral bias due to using patients referred to a single clinic, and the relative recall accuracy of the parents.

CONCLUSION

In conclusion, the results of our study imply that chest radiographs are frequently used in cases of childhood asthma, especially in children under the age of five years. Therefore, we would like to emphasize that physicians should only recommend radiographic examinations when chest radiographs will contribute to the management of asthmatic patients.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of University of Health Sciences Dr. Sami Ulus Children Children's Health and Diseases Training and Research Hospital.

Informed Consent: Verbal informed consent was obtained from patient's parents who participated in this study.

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