

Original Article

Usefulness of chest radiographs in the management of acute asthma in adult asthmatics in a developing country

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Abstract. Chest radiographs are widely available, even in most hospitals in developing countries, and can detect a variety of lung pathologies. When adults are admitted to hospital with acute asthma, chest radiographs are often obtained. Studies on the usefulness of chest radiographs in acute asthma have shown varying results. This study aimed at evaluating the usefulness of chest radiographs in the management of acute asthma in adult asthmatics in a developing country. Plain chest radiographs performed within 24 hours of admission in 115 consecutive adult asthmatic patients (asthma defined by Asthma Education and Prevention programme NIH-1997) admitted to National Hospital of Sri Lanka were reviewed prospectively for one year. The relationship between radiographic findings and clinical findings and leucocyte count were evaluated. Significance was calculated using Fisher exact test. Among 115 participants there were 56 males and 59 females, with mean age of 47.77 years. Chest radiographs were abnormal in 40.9%, the abnormalities including hyperinflation (8.7%), consolidation (15.7%), segmental/greater atelectasis (5.2%), pneumomediastinum (0.9%), features of obstructive lung disease (6.1%), solitary lung nodule (0.9%), and pulmonary edema (3.5%). There was no significant association of abnormal radiographs with leucocytosis ($p=0.322$), elevated body temperature ($p=3.109$), and high pulse rate ($p=0.157$). The incidence of abnormalities on admission chest radiographs in patients with acute asthma was high, though immediate management was influenced in only less than half of the patients with abnormal radiographs. Chest radiographic abnormalities had no significant association with elevated blood leukocyte count, body temperature, and pulse rate. Using clinical criteria to identify those requiring chest radiographs within the first 24 hours in adults admitted with acute asthma may improve the cost effectiveness of chest radiographs without compromising patient care.

Keywords: Acute asthma, chest radiograph, developing country

Introduction

Patients with acute severe asthma require hospital admission for immediate management, as inadequate treatment may lead to respiratory failure, coma and death [1] with up to 8% mortality in admissions to intensive care [2]. Exacerbations of asthma may be triggered by underlying pulmonary pathology [3], with one study reporting 37% with respiratory tract infection [4]. Rate of relapse varies from 7-15% and depends on the aggressiveness of the treatment given [2].

Chest radiographs are widely available, even in most hospitals in developing countries, and can detect a variety of lung pathologies, thus when an adult is admitted to hospital for acute asthma, chest radiographs are often obtained.

Chest radiographs may reveal expected findings in asthma, including hyperinflation and prominent perihilar markings, which do not require specific management [5], or more sinister pathologies such as consolidation,

pneumothorax, pulmonary edema, pulmonary tuberculosis and lung collapse which necessitate additional specific management in addition to the standard treatment for asthma [5, 9].

Studies on the usefulness of chest radiographs in acute asthma have shown varying results, with some authors recommending admission chest radiographs be obtained for all patients hospitalized with acute asthma [6, 10], whereas other studies suggesting that routine admission chest radiographs are unnecessary [11]. Several studies of chest radiographs in adults have reported that the results of chest radiographs influenced treatment in only 1 to 5 percent of patients [11, 12].

Obtaining unnecessary chest radiographs is costly and exposes the patients to radiation. In addition, facilities such as additional labor and transportation of patient or X-ray machine are required to obtain a radiograph. It is therefore useful to know how important chest radiography is in the management of acute asthma. We reviewed the usefulness

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of admission chest radiographs on the management of 115 adult patients with acute asthma, in a tertiary care hospital in Sri Lanka.

Materials and Methods

The study was conducted in two medical wards admitting males and females at the National Hospital of Sri Lanka over a period of one year. One hundred and fifteen consecutive adult patients over the age of 12 years, admitted to the wards with acute asthma (asthma defined by Asthma Education and Prevention programme NIH-2007)[13] were recruited for the study. All patients were managed as for acute asthma, using the standard protocol.

Plain chest radiographs (posteroanterior) were performed within 24 hours of admission in all patients. If abnormalities were detected in the chest radiographs, patients were treated accordingly. All chest radiographs were reported by the same consultant radiologist. All patients had oral temperature and pulse rate measured, and white blood count evaluated as a standard procedure on admission.

Approval for study was obtained by the ethics review committee of the National Hospital Sri Lanka. Informed consent was obtained from the patients or immediate family member, to participate in the study. Women who were pregnant and patients not wishing to undergo a chest radiograph were excluded from study.

The relationship between radiographic findings, clinical parameters and leucocyte count were evaluated using SPSS version 20 (SPSS Chicago, IL). Data were analyzed using mean, standard deviation, and percentages for descriptive statistics and Fisher's Exact Test for comparison of groups. $p < 0.05$ was considered statistically significant.

Results

One hundred and fifteen consecutive patients (56 males, 59 females), with acute asthma were recruited. The mean age was 47.77 (SD \pm 1.78) years (range 13-86 years). Most patients [$n=78$ (67.8%)] had chest radiographs that were compatible with uncomplicated asthma, which included normal chest radiographs in 68 (59.1%) and chest radiographs with hyperinflation in 10 (8.7%). Thirty-seven radiographs (32.2%) were interpreted as positive; in which the radiographic findings were not necessarily seen routinely in uncomplicated asthma, and included consolidation, atelectasis, pneumomediastinum, features of obstructive lung disease, solitary lung nodule and pulmonary edema (Table 1).

There was no significant relationship between abnormal radiographs with consolidation and leucocytosis ($p=0.322$), elevated temperature ($p=3.109$), or high pulse rate ($p=0.157$) (Table 2).

All patients with radiographic evidence of consolidation were commenced on antibiotics addition to bronchodilators and steroids. The patients with pulmonary edema were treated accordingly. The pneumomediastinum resolved with conservative management.

The patient with the solitary nodule was directed for further investigation in the surgical unit. There were no mortalities in the study group.

TABLE 1
CHEST RADIOGRAPH FINDINGS IN 115
PATIENTS

Chest radiograph findings	No.	Percent
Normal	68	59.1
Hyperinflation	10	8.7
Consolidation	18	15.7
Segmental/greater atelectasis	6	5.2
Pneumomediastinum	1	0.9
Features of obstructive lung disease	7	6.1
Solitary lung nodule	1	0.9
Pulmonary edema	4	3.5
Total	115	100

Discussion:

Abnormal chest radiographs were detected 40.9% cases, which higher than that reported in other studies: 14% (Dalton, 1991), 23% (Ismail et al, 1994), 25% (Aronson et al, 1989) and 34% (White et al, 1991) [5, 6, 8, 11]. However, only 32.3% were interpreted as positive; in which the radiographic findings were not necessarily seen routinely in uncomplicated asthma. The higher rate of abnormal chest radiographs in this study could be attributed to patient behavior in urban Sri Lanka, as many patients with asthma opt to seek treatment from widely available private practitioners, and present to government hospitals only when the disease is severe or unresponsive to treatment. Furthermore only patients who are unresponsive to treatment offered at the emergency treatment units in government hospitals are admitted to the wards, which implies that severe disease or complicated asthma was more likely to be included in this study population. This is supported in a study by Aaronson et al, 1989, in which chest radiograph abnormalities were reported only among patients with complicated asthma, with no abnormal chest radiographs detected in patients with uncomplicated asthma [11]. The much higher rates of abnormal chest radiographs reported in older studies, eg. 72% by Rebeck (1970) may be attributed to inadequate outpatient care and poor social circumstances at those times, which could have contributed to the higher mortality rates caused by asthma prior to late 1980s [14, 15].

The abnormalities detected in the chest radiographs in this study are comparable other published data [6, 14, 16] : Number of patients with pneumonia (15.7%) was similar to published data reporting 16-20% of patients [14]. The incidence of pneumomediastinum and solitary lung nodule

TABLE 2
COMPARISON BETWEEN CHEST RADIOGRAPH FINDINGS WITH WHITE BLOOD CELL COUNT,
ORAL TEMPERATURE AND PULSE RATE IN ADULTS WITH ACUTE ASTHMA

X-ray findings	White blood cell count $\times 10^9/L$		Temperature (F^0)		Pulse rate/minute	
	$\leq 12\ 000$	$> 12\ 000$	Normal *	Elevated	< 100	> 100
Without consolidation	71	26	92	5	89	8
With consolidation	12	6	15	3	16	2
Total	83	32	107	8	105	10
Significance Fisher's exact test	p=0.322		p=3.109		p=0.157	

is comparable with other series [14, 16]. In these patients, chest radiographs were essential in the diagnosis.

One reason for the variation in radiographic findings could be the selection criteria in different studies. White et al, 1991 included patients who failed to respond to a 12 hour course of bronchodilator therapy in the emergency ward [6], and Aronson et al, 1989 reported his findings in patients with complicated asthma [11]. Another could be the classification of normal and abnormal chest radiographs, where hyperinflation and increased perihilar markings may or may not be considered as abnormal.

It was interesting to note that there was no relationship between the presence of consolidation in the chest radiograph with the leucocyte count, oral temperature or pulse rate. Lack of correlation of radiographic focal opacities with white cell count or body temperature has been reported by White et al, 1991 [6]. It has been reported that only a minority of patients admitted with acute asthma with recent respiratory tract infection had fever or leucocytosis [4]. It is also possible that treated respiratory tract infection or pneumonia may have resulted in the presence of consolidation the radiographs with normal white cell count and temperature, as the resolution of a consolidation on chest radiograph lags behind clinical resolution [17]. This could have resulted in over-treatment of such patients with antibiotics, when they had only radiographic evidence of consolidation.

Multiple abnormalities may be present in the lungs of patients with asthma, mostly related to bronchial destruction, i.e. reversible abnormalities such as mucoid impactions, acinar pattern, and lobar collapse and irreversible abnormalities including bronchiectasis, bronchial wall-thickening, sequellar line shadows, and emphysema [18]. Such expected abnormalities were found in 37% of chest radiographs and 71.9% of CT scans in patients with chronic asthma [18]. Thus it is likely that routine chest radiographs may pick up radiographic findings that may not require any treatment.

Chest radiographs within the first 24 hours of admission are useful for acute asthma management. However, in the current study which identified a high rate of abnormalities by routine admission chest radiography in patients with

acute asthma, only a minority appears to have lead to the diagnosis of unsuspected but clinically important disease. Gentile et al, 2003 have shown that devising protocols for identifying patients requiring chest radiography in patients admitted with asthma to emergency department, significantly reduced the request for chest radiographs without compromising patient care [19].

In conclusion, it may be appropriate to perform chest radiographs in selected groups of patients admitted to hospital with acute asthma, so that a higher yield of underlying respiratory pathologies requiring treatment is obtained, while reducing the cost of patient management which is burdening the developing countries.

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Conflict of Interest

The authors declare that they have no competing interests and no financial support.

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