

Why do asthmatic children need referral to an emergency room?

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Asthmatic attacks continue to be a major cause of referral to the emergency room (ER), despite currently available effective treatments. We have prospectively evaluated 100 consecutive children who were referred to the ER with acute asthma and were followed by their primary physicians. Only 46% were able to recognize acute attacks, and 26% had the knowledge and skills for self-management. The prophylactic therapy recommended was usually appropriate, but the compliance was poor and mean serum theophylline levels (STL) was 6.8 µg/ml, with subtherapeutic values (<10 µg/ml) in 44 (88%). We studied an additional group of 50 consecutive children who were on a routine follow-up in the hospital asthma clinic. All were examined periodically and were instructed on the disease. The compliance of these children was much better and STL were within the therapeutic range in 73%, significantly higher than in the ER patients ($p < 0.001$). Their need for ER treatment or hospitalization was much lower than the former group. Poor compliance is a major factor causing referral of asthmatic children to ER, and careful education can improve patient compliance with reduced referral and subsequent hospitalization.

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Bronchial asthma is one of the most common chronic diseases in childhood (1–3). According to the National Institutes of Health Statistics, 5% of all children under the age of 15 years suffer from the disease (4), and in children aged 10–14 years, its prevalence can reach 12.1% (1).

Considerable progress has been achieved regarding the treatment of asthma. Methylxanthines, cromolyn sodium and inhaled corticosteroids or sympathomimetics were proven to be beneficial in the prevention and treatment of acute attacks (5). Nevertheless, in spite of these currently available effective treatments, acute asthma attacks are still one of the most frequent causes of referral to emergency room (ER). Between 4 and 19% of all ER visits have been reported to be related to asthmatic attacks, necessitating over 130, 000 admissions annually in the USA (6).

Treatment of asthma in an ER is an inappropriate, cumbersome and expensive way to treat this widespread disorder. Factors that may contribute to treatment failure and need for referral to ER may include inappropriate preventive recommendations by the physician, non-compliance by the patient, failure to recognize and poor selfmanage-

ment skills of acute attacks, and lack of education and understanding of the nature of the disease.

The present prospective study was undertaken in order to assess the importance of these and other possible factors on the treatment failure and the need to refer asthmatic children to ER.

Patients and methods

One hundred consecutive children, referred to the pediatric ER of Beilinson Medical Center, Petah Tiqva, Israel, due to acute asthma attack, over a 14-month period (starting January 1986), were enrolled in this study. Inclusion criteria were: age of 2–14 years, previous diagnosis of asthma and a history of at least two acute attacks during the preceding six months. Patients with evidence of infection or temperature over 38°C were excluded. The subjects in the study group had a mean age of 7.3 years and consisted of 71 males and 29 females. These patients were mainly managed in prepaid health insurance (Sick Fund) public clinics by their primary physicians.

A questionnaire was filled during the interview of each patient and his parents. It included de-

Table 1. Characteristics of study population

	Emergency Room (ER) Group	Hospital Clinic (HAC) Group	p
Number	100	50	
Mean age (yrs)	7.3	6.5	NS
Boys:Girls	71:29	36:14	NS
Mean duration of asthma (yrs)	4.5	3.6	NS

tailed information concerning the severity and duration of asthma, the treatment prescribed by the physicians, including dose and recommended frequency, the medications actually taken by the patient, the education and the knowledge regarding asthma and its management, the ability to recognize acute attacks and the knowledge on their management. In all patients who received theophylline (TH) preparations, serum levels were determined during the acute attack in duplicate by fluorescent polarization immunoassay (TDS, Abbott Irving, Texas, USA).

In order to evaluate the possible impact of more formal and careful education programs on the patient compliance, cooperation and morbidity, we also studied 50 consecutive patients on a routine follow-up visit in our hospital asthma clinic (HAC). They included 36 males and 14 females with a mean age of 6.5 years. During routine visits, the patients and parents were interviewed as detailed for the ER group, and serum theophylline levels (STL) were obtained, when applicable.

Both groups had similar demographic and socioeconomic status. All patients had complete pre-paid health insurance, enabling free visits to the primary physician, hospital clinics and ER. The practice of telephone contact for advice on home management of asthmatic attacks is uncommon in patients treated at any of these settings.

Chi-square and student t-test were used for statistical analysis.

Results

The ER group patients had a history of bronchial asthma for a mean period of 4.5 years with a mean of 2.8 acute attacks during the preceding two months (Table 1). During the study period, in 13 of the children the treatment given in the ER was not sufficiently effective and they were hospitalized. In the HAC patients, an asthmatic history was reported for a mean period of 3.9 years. These 50 children experienced a total of 21 asthma attacks during the two months preceding the study, necessitating referral to the ER in only 6 episodes, with no hospitalizations.

Table 2. Education and knowledge of asthma of the emergency room (ER) and hospital asthma clinic (HAC) patients (% of patients)

	ER N=100	HAC N=50
Education		
Individual	50	98
Lecture	2	42*
Total	52	98
Knowledge		
Recognition of acute attack	46	96
Appropriate management	26	82

*In addition to individual instruction.

Education and knowledge of asthma

Only half of the parents from the ER group had received some explanation and education concerning the disease (Table 2). The explanation was given by their physician who was usually preoccupied and busy. Two parents had heard a lecture on asthma. Nearly all the parents of the HAC patients were extensively instructed and educated according to a routine schedule which also included a lecture on childhood asthma. When questioned about the ability to recognize acute asthma episodes, a positive answer was obtained from less than half of the parents of the ER group, and only one quarter knew how to manage the acute episode (Table 2). On the other hand, most of the parents in the HAC group reported having the knowledge to recognize acute episodes and skills for management.

Prescribed treatment

Preventive treatment was prescribed to 72 (82%) patients of the ER and to 39 (78%) of the HAC subjects. Many patients (72% and 48% in the ER and HAC groups, respectively) were treated by TH, mostly slow-release preparations.

The instructions given by the physicians concerning the treatments were usually correct. Only

Table 3. Compliance as recorded by the patients' parents

	No. of patients	Drugs used as prescribed	
		Dose No. (%)	Frequency No. (%)
Emergency room group	82	34 (41)*	20 (25)**
Educated	51	22 (43)	13 (25)
Non-educated	31	12 (39)	7 (22)
Hospital asthma clinic (all educated)	24	22 (92)*	22 (92)**

*p < 0.001. **p < 0.001.

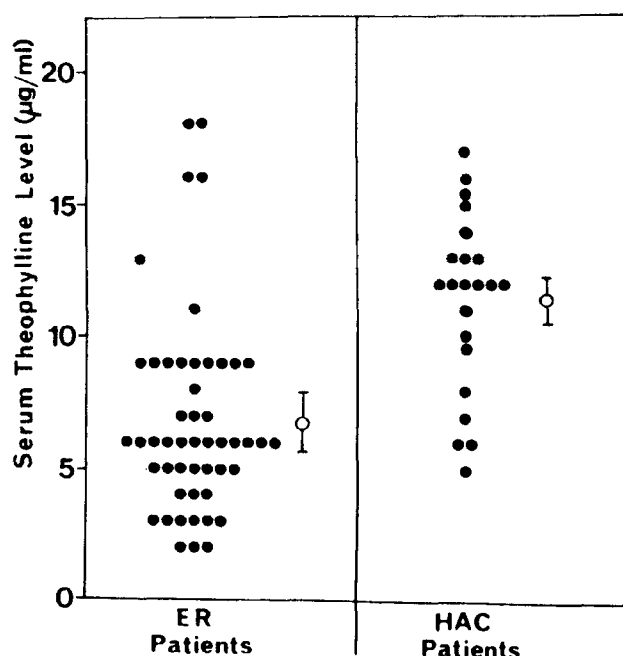


Fig. 1. Serum theophylline levels of the emergency room (ER) and hospital asthma clinic (HAC) patients. The dot and the line represent $M \pm SEM$ of the determinations. The difference between the two groups was highly significant ($p < 0.001$).

in 16% of the ER patients was the TH dose prescribed lower than usually recommended (<16 mg/kg/day, not based on serum levels). In 3% the recommended frequency was inappropriate.

Compliance

According to the parents' records, the drugs were used in the correct dose and frequency in 41% and 25% of the ER subjects, respectively (Table 3). There were no significant differences between the educated and non-educated patients. The age also did not correlate with the compliance. The reported compliance of the HAC patients was 92% (Table 3), significantly higher than the ER group ($p < 0.001$).

Objective evaluation of the compliance according to the STL was undertaken in all the patients who took TH preparations. The results are summarized in the Figure. The mean STL of the ER group was $6.8 \mu\text{g/ml}$. Levels in the recommended therapeutic range ($10\text{--}20 \mu\text{g/ml}$) were found in only 12% of the patients. No correlation was found between the age and STL ($r = 0.19$, $p = \text{NS}$). The non-educated patients showed the lowest mean STL, none of them being higher than $6 \mu\text{g/ml}$. In the educated patients, the mean STL was somewhat higher ($6.9 \mu\text{g/ml}$), but in the majority of the patients levels were still below the therapeutic range.

The mean STL of the HAC patients was $11.4 \mu\text{g/ml}$ (Fig. 1), significantly higher than the ER

patients ($p < 0.001$). However, in 27% of these patients STL were still below the usually accepted therapeutic levels ($10\text{--}20 \mu\text{g/ml}$).

Fourteen children of the ER patients used oral inhalation therapy. Poor inhalation technique was noted in 7 (50%) of them. On the other hand, all the children of the HAC group to whom inhalation therapy was prescribed, were well trained.

Discussion

Childhood asthma can be controlled and managed on an ambulatory basis. However, despite the significant advances in the treatment of this disease (5), recurrent attacks are still a frequent cause of absence from school, referral to the ER, and even hospitalization (6).

Although the two studied groups were not entirely comparable because the patients were evaluated at different stages of the disease, the ER group during an acute asthma attack and the HAC group on a routine visit to the clinic, they were comparable regarding age, sex, socioeconomic background and mean duration of asthma. There was insufficient data for comparison of the severity of the disease. However, it is reasonable to assume that those referred to the special hospital clinic suffered from a more severe form of asthma than those managed mainly by their primary physicians. In any case, the findings of poor compliance and improper skills of self-management of the ER group stand by themselves.

Fewer asthmatic attacks during the two months preceding the study were experienced by the patients in the HAC group as compared to those in the ER group. Most of these exacerbations were successfully treated at home, resulting in less referrals to the ER. None of the patients from the HAC group required hospitalization.

The major finding of this study is the poor compliance of the ER patients, as reported by the parents and confirmed by the subtherapeutic serum TH concentrations. Poor compliance caused most referrals to ER. Inadequate compliance of asthmatic children has been noted before (7–13). Eney et al. found subtherapeutic STC in only 11% of chronically treated asthmatic children (7). In pediatric patients referred to the ER with acute asthma, subtherapeutic STC was evident in 71% to 98% of the subjects (9, 11).

Non-compliance has also been recognized as a major cause of treatment failure in other chronic disorders (14). The reason for non-compliance is complex and multifactorial. Glanz et al. stressed that the "usual habit of compliance" was one of the most important issues (10), although physician-

patient (parent) communication has been found to be of crucial significance (9, 11).

Education is usually accepted as affecting compliance, but its contribution to asthma is equivocal and not well proven (6, 13, 15, 16). The present results show that although more than 50% of our ER patients had received some education from their physicians, compliance was poor and the STC was subtherapeutic in the majority of cases. On the other hand, the compliance of the patients followed at HAC appeared to be more satisfactory. It seems, therefore, that the care and education as usually given in a primary care clinic setting, by physicians who are usually busy and preoccupied, does not appear to have a prominent influence on compliance. Careful education together with repeated instruction, accompanied by periodic follow-up and supervision, as provided in special asthma clinics, seems to contribute more significantly to improving compliance. Similar conclusions were also reported by Wood et al (11), who found that patients cared for in the special allergy clinic setting were more likely to comply. Hilton et al. have evaluated the effect of two patient education programs for asthma (13). They observed that only "maximum intervention", a program which included recurrent explanations, a booklet and an audiocassette lecture, had any lasting effect. "Limited intervention" only was of no value. Prolonged behavioral intervention was also shown to affect compliance (12, 17).

In addition to its effect on compliance, proper education facilitates early recognition of acute asthmatic episodes, with skilled self-management (6, 13, 15). Conway and Littlewood studied in-hospital treatment of asthmatic children and concluded that in 70% of cases appropriate treatment at home could have prevented the need to reach a hospital (18). The knowledge of timely administration and skilled use of inhalation therapy with β -agonists usually control acute exacerbations and prevent the need for referral to the ER (15, 19).

In conclusion, most of the children who needed ER referral for an acute asthmatic attack were found in this study to have subtherapeutic STC, most probably as a result of poor compliance. In addition, the majority of the parents of these patients were not able to recognize and manage an acute asthmatic attack. Appropriate education in asthma and suitable management by physicians skilled in this treatment, preferably in a specialized clinic, including careful supervision and follow-up, may lead to improved care and compliance and

minimize the need for referral to the ER and subsequent hospitalization.

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