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Original Contributions

PREDICTING HOSPITALIZATION IN CHILDREN WITH ACUTE ASTHMA

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☐ **Abstract—Background: Acute asthma is one of the most common medical emergencies in children. Appropriate assessment/treatment and early identification of factors that predict hospitalization are critical for the effective utilization of emergency services. Objective: To identify risk factors that predict hospitalization and to compare the concordance of the Modified Pulmonary Index Score (MPIS) with the Global Initiative for Asthma (GINA) guideline criteria in terms of attack severity. Methods: The study population was composed of children aged 5–18 years who presented to the Emergency Departments (ED) of the tertiary reference centers of the country within a period of 3 months. Patients were evaluated at the initial presentation and the 1st and 4th hours. Results: Of the 304 patients (median age: 8.0 years [interquartile range: 6.5–9.7]), 51.3% and 19.4% required oral corticosteroids (OCS) and hospitalization, respectively. Attack severity and MPIS were found as predicting factors for hospitalization, but none of the demographic characteristics collected predicted OCS use or hospitalization. Hospitalization status at the 1st hour with moderate/severe attack severity showed a sensitivity of 44.1%, specificity of 82.9%, positive predictive value of 38.2%, and negative predictive value of 86.0%; for MPIS ≥ 5, these values were 42.4%, 85.3%, 41.0%, and 86.0%, respectively. Concordance in prediction of hospitalization between the MPIS and the GINA guideline was found to be moderate at the 1st hour ($\kappa = 0.577$). Conclusion: Attack severity is a predictive factor for hospitalization in children with acute asthma. Determining attack severity with MPIS and a cut-off value ≥ 5 at the 1st hour may help physicians in EDs. Having fewer variables and the ability to calculate a numeric value with MPIS makes it an easy and useful tool in clinical practice.** © 2013 Elsevier Inc.

☐ **Keywords—acute asthma; Emergency Department; GINA; hospitalization; modified pulmonary index score**

INTRODUCTION

Acute asthma in children is one of the most common reasons for Emergency Department (ED) visits. Despite advances in our understanding and treatment of asthma, about 500,000 emergency cases are hospitalized annually

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due to complaints of asthma (1). However, rates of readmission to the ED and hospitalization vary between centers, reflecting the variability in medical practice and assessment methods, which can result in inappropriate hospitalization and discharge of patients (2–6).

Measurements such as lung function tests and oxygen saturation are recommended for objective assessment of attack severity. However, spirometer and peak flow meter testing cannot be performed in children in most cases due to age-related factors, unavailability of devices, and lack of a well-trained medical staff (7). Hence, findings from physical examinations play the most critical role in the physician's decision.

A standardized approach to asthma attacks in children and the use of reminder cards outlining treatment protocols may result in better utilization of emergency services. These approaches may also facilitate appropriate assessment of attack severity, perhaps even providing a decrease in the hospitalization rates (8). In recent years, guidelines and several scoring systems have been recommended in assessing the severity of asthma attacks (9–16). However, in studies that evaluated approaches to asthma attacks, it was reported that compliance with guidelines is not at the desired level, and that hospitalization rates in different hospitals are diverse (17,18). The Modified Pulmonary Index Score (MPIS) is one of the newly developed scoring systems that utilizes parameters commonly used in clinical practice and ascribes a numeric value to the clinical condition (19). Therefore, it increases the awareness of physicians regarding the need for early hospitalization and ensures the application of similar treatment procedures among physicians. MPIS is also the first pediatric clinical asthma score that is reproducible among different groups of health care professionals (physicians, nurses, respiratory technicians). The Global Initiative for Asthma (GINA) guideline, which is commonly used worldwide, is identical with our national asthma guideline and is used in asthma management by the majority of physicians in daily practice (15). In the present study, we aimed to identify the risk factors that predict hospitalization in children with acute asthma and to compare the effectiveness of MPIS with the standardized method of the GINA guideline.

MATERIALS AND METHODS

The biggest referral center in Turkey designed and announced the study, and 12 tertiary centers from different regions of the country agreed to participate. In these centers, the patients are first attended by a pediatrician and then consulted to a pediatric allergist. Children aged 5–18 years who presented to the ED with acute asthma were included in the study. Acute asthma was defined as an increase in symptoms, such as cough, wheezing, shortness of breath or chest tightness, and β_2-agonist use (15). Patients with pneumonia, chronic pulmonary diseases, and chronic cardiac diseases were excluded. The study was approved by the Local Ethics Committee, and informed consent was obtained from both patients and their parents.

Data Collection

At initial presentation, data including age, gender, follow-up duration, age at asthma diagnosis, medications used for long-term treatment, aeroallergen sensitization, atopy history of parents/siblings, attack-triggering factors, and fatal asthma risk factors were collected. Vital signs, oxygen saturation, accessory muscle use, retractions, inspiratory/expiratory rate, wheezing, and dyspnea were measured and evaluated initially and then reassessed at the 1st and 4th hours.

Treatment of Asthma Attacks and Hospitalization Criteria

For treatment, no standard mandatory approaches were recommended to the centers, but suggestions were made to utilize the GINA guideline treatment approach, because the Turkish guideline is identical. All centers declared that they were currently using and would continue to use the recommendations according to the GINA guideline in their treatments.

Thus, the physicians had treated the patients according to GINA guideline's "management of asthma exacerbations" protocol. If there was no immediate response to inhaled β2-agonist therapy, or attack severity was severe, or the patient recently took oral corticosteroid; systemic corticosteroids were administered. Four hours after the initiation of therapy, patients with persistent tachypnea, moderate or severe attack, and those who had no raised oxygen saturation ($SaO_2 < 95$) were hospitalized.

Determination of the Severity of Asthma Attacks

Severity of asthma attacks was evaluated three times: at initial presentation to the ED and at the 1st and 4th hours of treatment. The GINA guideline and MPIS were used in patient evaluations. The MPIS uses six variables—respiratory rate, heart rate, inspiratory-to-expiratory flow ratio, accessory muscle use, degree of wheezing, and oxygen saturation on room air—with each variable given a score between 0 and 3, depending on its presence or severity (19). Twelve variables are used in the GINA guideline, and the severity of attacks is classified into four groups as mild, moderate, severe, or respiratory failure (15). In the GINA guideline, it is noted that the presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.

Statistical Methods

Statistical analyses were performed using SPSS software version 15 (IBM, Armonk, NY). Descriptive features of patients included in the study were analyzed, and features of discharged and hospitalized patients were compared (chi-squared, Mann-Whitney *U*, Student's *t*-test). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) at initial presentation and the 1st hour were determined in predicting hospitalization in patients with moderate/severe attack according to the GINA guideline and with an MPIS ≥ 3, which were measured at the same time. Concordance between the GINA guideline and MPIS in predicting hospitalization was investigated using the Cohen's kappa (κ) statistic. A p-value of < 0.05 was considered to show a statistically significant result.

RESULTS

During a 3-month interval, a total of 304 patients from 12 centers were enrolled into the study. The median age of the patients was 8.0 (6.5–9.7) years (median [25–75% range]), and 60.9% (n = 185) were male. The most common complaints were exercise-induced cough or dyspnea (63.3%), nocturnal cough (60.5%), wheezing (60%), and dry coughing (59%). Among all patients, 66.7% were diagnosed with mild intermittent or mild persistent asthma, with 61.4% using prophylactic asthma medication. Three of every five acute asthmatics (60.2%) reported having fatal asthma risk factors. Of these patients, an emergency care visit for asthma in the past year (50.7%) and history of non-compliance with an asthma medication plan (26.2%) were reported most commonly (Table 1).

Severity of Attacks, Treatment Results, and Hospitalization

At initial presentation, mild, moderate and severe attack incidences according to GINA guideline were determined in 40.5%, 48.7%, and 10.9% of patients, respectively. After treatment, incidence of mild attack rose to 77.3% at the 1st hour and to 83.1% at the 4th hour. Median MPIS values were 5.0 (4.0–7.0) at initial presentation, and decreased to 2.0 (0.0–4.0) and 0.0 (0.0–2.0) at the 1st and 4th hours, respectively (Figure 1).

Systemic steroids were administered cumulatively to 30.9%, 49.3%, and 51.3% of the patients at initial presentation, and the 1st and 4th hours, respectively. The MPIS values of the patients who received steroids at initial presentation (n = 96) or at the 1st hour (n = 56) were higher than the patients who were not administered steroids (n = 148); however, no difference was found in the 4th hour MPIS values across the groups (Table 2).

After 4 h of treatment, 19.4% (n = 59) of the patients were hospitalized. None of these patients required admission to the intensive care unit (ICU). No significant differences were found in age, gender, asthma severity, atopy, use of prophylactic medication, and presence of fatal asthma risk factors between the discharged and hospitalized patients. However, there was a statistically significant difference between the initial and 1st hour assessments with MPIS and the GINA guideline (attack severity) (Table 3).

Table 1. Descriptive Characteristics of the Patients

Male (%)	60.7
Age, years	8.0 (6.5–8.7)*
Complaints (%)	
Exercise-induced cough/dyspnea	63.3
Nocturnal cough	60.5
Wheezing	60.0
Cough	59.0
Dyspnea	56.2
Sneeze	53.7
Nasal draining	52.4
Nasal obstruction	50.7
Prophylactic asthma medication (%)	61.4
Prophylactic asthma medication distribution (%)	
ICS	33.6
LTRA	9.2
ICS+LTRA	12.2
ICS+LABA	3.9
ICS+LTRA+LABA	2.5
Asthma severity (GINA guideline) (%)	
Mild intermittent	22.8
Mild persistent	46.1
Moderate persistent	29.0
Severe persistent	2.1
Attack severity at initial presentation (GINA guideline) (%)	
Mild	40.5
Moderate	48.7
Severe	10.9
MPIS at initial presentation	4.0 (3.0–6.0)*
Attack risk factors (%)	
Nonadherence to treatment	68.2
Upper respiratory tract infections	49.0
Smoke exposure	35.5
Heavy exercise	25.8
Exposure to fume or strong odor	24.7
Exposure to allergens	22.8
Fatal asthma risk factors (%)	
History of ED visit/hospitalization in the past year	50.7
History of noncompliance with an asthma medication plan	26.2
Over-dependent on rapid-acting inhaled β2-agonists (especially $\geq$ 1 canister of salbutamol [or equivalent] monthly)	12.4
Currently using or have recently stopped using oral glucocorticoids	4.4
History of near-fatal asthma requiring intubation and mechanical ventilation	3.4

ICS = inhaled corticosteroid; LTRA = leukotriene receptor antagonist; LABA = long-acting beta agonist; GINA = Global Initiative for Asthma; MPIS = Modified Pulmonary Index Score; ED = Emergency Department.
* Median (interquartile range).

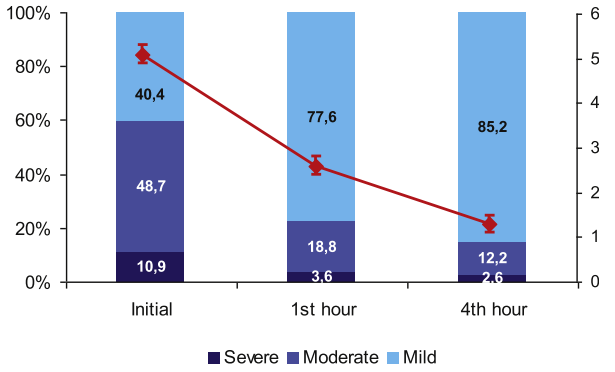

Figure 1. Attack severities and Modified Pulmonary Index Score values of the patients at initial presentation and 1st and 4th hours.

Receiver Operating Characteristic Curve Analysis for MPIS in Predicting Hospitalization

Taking into account the MPIS values at initial presentation and the 1st hour, a receiver operating characteristic curve analysis was performed to determine a cut-off MPIS value in predicting hospitalization. The highest sum of sensitivity and specificity was found to be ≥ 7 at initial presentation and ≥ 5 at the 1st hour (Table 4).

Risk Factors of Hospitalization

Logistic regression analysis was performed on factors including age, gender, asthma severity, presence of fatal asthma risk factors, not using prophylactic medication, initial and 1st-hour attack severity (according to GINA guideline), and MPIS cut-off values. In univariate analysis, having moderate/severe attack severity and an MPIS value equal to or higher than the cut-off were found as risk factors. When multivariate analysis was performed, only the 1st-hour attack severity was found as a risk factor according to the GINA guideline, but MPIS was found as a risk factor at both initial presentation and the 1st hour. Fatal asthma risk factors and non-use of prophylactic medication were not found as risk factors (data not shown).

Table 2. MPIS of Steroid-administered and Non-steroid-administered Patients at Initial Presentation and 1st and 4th Hours

MPIS	Steroid-administered Patients at Initial Presentation (n = 94)	Non-steroid-Administered Patients by the 4th Hour of Treatment (n = 148)	*p*-Value
Initial	6 (4–8)*	4 (3–5)*	<0.001
1st hour	2 (0–5)*	2 (0–3)*	<0.001
4th hour	0 (0–2.25)*	0 (0–2)*	0.859
MPIS	Steroid-administered Patients at 1st Hour (n = 56)		
Initial	5 (4–6)*	4 (3–5)*	0.034
1st hour	3 (2–4)*	2 (0–3)*	<0.001
4th hour	0 (0–1)*	0 (0–2)*	0.389

MPIS = Modified Pulmonary Index Score.
* Median (interquartile range).

Table 3. Descriptive Characteristics of Discharged and Hospitalized Patients

	Discharged (n = 245)	Hospitalized (n = 59)	*p*-Value
Gender (male)	60.0	64.4	0.534
Age, years	8.0 (6.6–9.7)*	6.7 (5.9–9.9)*	0.085
MPIS initial	4.0 (3.0–6.0)*	5.0 (4.0–8.0)*	<0.001
MPIS 1st hour	2.0 (0.0–4.0)*	3.5 (0.8–5.3)*	0.005
MPIS 4th hour	0.0 (0.0–1.0)*	2.0 (0.0–6.3)*	<0.001
Asthma severity			0.097
Mild	71.3	58.7	
Moderate + severe	28.7	41.3	
Prophylactic asthma medication	60.4	59.3	0.878
Presence of fatal asthma risk factor	61.3	62.1	0.908
Attack severity (initial)			<0.001
Mild	43.3	28.8	
Moderate	49.8	44.1	
Severe	6.9	27.1	
Attack severity (1st hour)			<0.001
Mild	82.4	55.9	
Moderate	15.1	33.9	
Severe	2.0	10.2	

MPIS = Modified Pulmonary Index Score.
* Median (interquartile range).

Predicting Hospitalization

Sensitivities of descriptive characteristics, presence of fatal asthma risk factors, and not using a prophylactic drug were < 50%. In addition, sensitivities of male gender and requirement for systemic steroid administration by the 1st hour ranged between 50% and 65% in predicting hospitalization. At initial presentation, the sensitivity, specificity, PPV, and NPV of a determined moderate/severe asthma severity in predicting hospitalization were 71.2%, 43.3%, 23.2%, and 86.2%, respectively, and at the 1st hour, these values were 44.1%, 82.9%, 38.2%, and 86.0%, respectively. In addition, the highest value of the sum of sensitivity and specificity of the MPIS was found to be ≥ 7 at initial presentation and ≥ 5 at the 1st hour. The PPVs and NPVs were 35.1–85.9% and 41.0–86.0% at initial presentation and the 1st hour evaluation, respectively.

Concordance

At initial presentation, if the MPIS was ≥ 7, 94.8% of patients were classified as having a moderate/severe attack according to the GINA guideline, whereas in contrast, if the MPIS was < 7, 52.4% of the patients were evaluated

Table 4. Sensitivity, Specificity, PPV, and NPV of MPIS and GINA Guideline in Predicting Hospitalization

	Sensitivity	Specificity	PPV	NPV	Sensitivity + Specificity
MPIS initial					
MPI ≥ 5	71.2	50.6	25.8	87.9	121.8
MPI ≥ 6	50.8	65.7	26.3	84.7	116.6
MPI ≥ 7	45.8	79.6	35.1	85.9	125.4
MPI ≥ 8	32.2	88.6	40.4	84.4	120.8
MPI ≥ 9	22.0	93.5	44.8	83.3	115.5
MPI ≥ 10	15.3	96.7	52.9	82.6	112.0
MPIS 1st hour					
MPI ≥ 3	55.9	57.1	23.9	84.3	113.1
MPI ≥ 4	49.2	74.7	31.9	85.9	123.8
MPI ≥ 5	42.4	85.3	41.0	86.0	127.7
MPI ≥ 6	23.7	91.4	40.0	83.3	115.2
MPI ≥ 7	20.3	95.1	50.0	83.2	115.4
Moderate/severe attack (according to GINA guideline)					
Initial	71.2	43.3	23.2	86.2	114.5
1st hour	44.1	82.9	38.2	86.0	127.0

PPV = positive predictive value; NPV = negative predictive value; MPIS = Modified Pulmonary Index Score; GINA = Global Initiative for Asthma.

as having a mild attack. At the 1st hour, if the MPIS was ≥ 5, 70.5% of patients were assessed as having a moderate/severe attack, whereas if the MPIS was < 5, 89.7% of patients were assessed as having a mild attack. As a consequence, there was a fair level of agreement between the MPIS and the GINA guideline at the initial presentation ($\kappa = 0.367$). Even though the 1st-hour results are better than those at the initial presentation, results yielded a moderate level of agreement between the two assessment systems ($\kappa = 0.577$).

DISCUSSION

In this study, we concluded that the majority of pediatric patients presenting to EDs with acute asthma had benefited from treatment administered in the 1st hour; however, 19.4% of all patients required hospitalization after treatment at the 4th hour. Sensitivities and specificities of moderate/severe attack severity according to the GINA guideline and MPIS ≥ 5 in predicting hospitalization at the 1st hour were found to be 44.1%, 82.9%, and 42.4%, 85.3%, respectively. Despite these similar results, the concordance of the MPIS and the GINA guideline was found to be moderate.

Short-acting bronchodilators and systemic steroids are the mainstay treatments of asthma exacerbations, and most of our patients responded well to this management, as documented by the increase in MPIS and decrease in attack severity. However, the factors regarding when to admit in EDs is not clear. In 2003, Wilson et al. reported that the decision to admit or discharge can be made after 1 h of treatment because delaying the decision yielded no explicit benefit (20). In the same study, the peak bronchodilator effect was seen after the 1st hour of treatment, and according to post hoc statistical analysis, the 1-h decision was the most valuable. Colacone et al. demonstrated that approximately 90% of patients achieve maximal bronchodilatation after three doses of albuterol (21). In an Australian study, 720 patients with acute asthma were evaluated, and it was found that assessment of attack severity after 1 h of treatment is better than the initial assessment in predicting the need for hospitalization (22). The study of Schuh et al., in which baseline clinical parameters were not found to be associated with hospitalization, also supports these results (23). In our study, a substantial portion of the patients (about 60%) responded well to treatment administered within the 1st hour. At the initial evaluation, about half of the patients considered to be severe were hospitalized, none of the patients required ICU admission, and 75% of severe attack patients were not severe at the 4th hour. These results confirm the recommendation of conducting a pre-assessment at the 1st hour to decide on hospitalization. In fact, in busy EDs, making the disposition decision after 1–2 h of treatment will facilitate patient flow, prevent unnecessary hospitalizations, and increase both patient and parent satisfaction.

In previous studies, hospitalization rates have been reported to be higher in male than female children. Schatz et al. reported that these increased rates are the result of differences in prevalence, not the reflection of severity or management (24). In contrast with that study, some of the same authors found no significant differences in hospitalization rates between boys and girls when adjusting for asthma prevalence (25). In our study, boys presented more frequently in the ED than did girls, in accordance with other studies; however, we did not determine any difference in hospitalization rates between boys and girls.

Using anti-inflammatory medication as a maintenance treatment in asthma management has been recommended

in the guidelines for many years. A study conducted in Sweden demonstrated that anti-inflammatory treatment with inhaled corticosteroids was a major reason for the decrease in hospitalizations in children aged 2–18 years (26). Accordingly, studies from Norway and Finland observed that an increase in the use of anti-inflammatory treatment is associated with a decrease in hospitalization for asthma (27,28). In contrast, our current study did not demonstrate any significance between discharged and hospitalized patients in terms of using anti-inflammatory medication (Table 2). The reason for this difference is not clear, but may be explained by the effect of inherent severity of the disease or inadequate treatment.

In previous studies, investigators have tried to illuminate the predicting factors for hospitalization. In 1994, Geelhoed et al. found pulse oximetry to be a predictive factor in poor outcomes and reported that children presenting with $SpO_2 < 91\%$ had a 92% likelihood of admission to the hospital (29). In a study of 278 children older than 12 months, Keogh et al. found that an oxygen saturation value < 92%, an asthma score ≥ 6, previous hospitalization in the ICU, and an hourly need of bronchodilator after steroid administration significantly predicted the need for a treatment time of more than 12 h (30). In contrast to those studies, we found that oxygen saturation alone was not a predictive factor in hospitalization, which supports the results of the study by Keahey et al. (31).

In a multi-center prospective study, Pollack et al. reported that increases in the pulmonary index score, independent of other factors, increased the risk of hospitalization as much as 1.3-fold (32). Similarly, in a prospective study by Kerem et al., it was demonstrated that only clinical parameters predicted hospitalization, and the most effective variable among clinical score variables was the severity of dyspnea (33). In their study, it was reported that the most important tool was careful clinical evaluation. In Canada, Schuh et al. evaluated 120 pediatric patients with severe asthma attacks; having an attack score ≥ 6 in the 2nd hour and a forced expiratory volume in 1 s ≤ 30% were found to be associated with hospitalization (80% and 86%, respectively) (23).

In 1997, Rodrigo and Rodrigo developed a predictive scoring index consisting of peak expiratory flow (PEF) variation and PEF (% predicted) and accessory muscle use at 30 min for asthmatic patients who present to the ED (34). An index score > 4 demonstrated a sensitivity of 0.86, specificity of 0.96, PPV of 0.75, and NPV of 0.98.

In our study, the *attack severity* at the 1st hour that was determined according to GINA guideline criteria and MPIS was found to be a predictive factor in hospitalization due to asthma. Because there is no single variable in children to determine attack severity, many attempts have been made to develop scoring systems for assessing the degree of severity. These scoring systems consist of a number of clinical signs and facilitate determination of the severity when spirometry cannot be performed. One of these scoring systems used in asthma attacks in children is the MPIS (19). It has been suggested to be a highly reproducible and valid indicator of the severity of illness in children. Each individual component of the score index can be determined easily in clinical practice, making the score useful in assessing the severity.

In our study, we found that an MPIS ≥ 5 at the 1st hour had a sensitivity and PPV of 42.4% and 41%, respectively, whereas the sensitivity and PPV of moderate/severe attack severity according to the GINA guideline were found to be 44.2% and 38.2%, respectively. Predictive values in our study were not as high as in recent studies (23,29,30,34). Approximately 60% of the patients determined as moderate/severe at the 1st hour were discharged, whereas 14% of the mild attack patients were hospitalized. Similarly, Keogh et al. showed in their study that 18% of the patients with mild attack severity at the 1st hour required hospitalization (30). In addition, the ability of the MPIS and the GINA guideline to predict discharge was better than the ability to predict hospitalization. This may be the result of the high variability in clinical practice, or even inaccurate implementations by physicians, though our current study does not address the reasons.

We determined that a decrease in attack severity and MPIS within the 1st hour of treatment in those that were administered steroids was significantly greater than in those that were not. Benefits from the treatment during this period may be due to the dominance of bronchospasm in attacks initially or from not taking bronchodilator treatment at home at the onset of the attacks as recommended. Furthermore, systemic steroid treatment was administered to 49.3% of the patients in the 1st hour, and the difference in attack severity between the steroid-administered and non-steroid-administered groups disappeared after 4 h of treatment. This result emphasizes that the effects of systemic steroids can be detected even after 3–4 h of treatment. Administration of steroids during this period may have provided recovery in the clinical status of our patients and decreased the hospitalizations at the 4th hour.

An important result from our study is that we found great similarity between the results of the GINA guideline criteria and the MPIS. According to the GINA guideline, 38.2% of moderate/severe attack patients and 41% of the patients with MPI ≥ 5 had been hospitalized. Based on this result, MPIS can be recommended in assessing pediatric patients who present to EDs. The calculation of a numerical value and the use of fewer variables as compared with the GINA guideline make the MPIS assessment

more simple and useful. The concordance of the MPIS and the GINA guideline was found to be moderate; however, this may reflect the subjective parameters that exist more commonly in the GINA guideline.

Although peak expiratory flow rate (PEFR) measurement is recommended in the guidelines, it is rarely performed in clinical practice in children with acute asthma. This is due to several reasons, including lack of familiarity with the technique, severity of airflow obstruction, and its dependence on effort, together with the unavailability of personal best values, limiting its use. Because our aim was to determine predictive factors in hospitalization and to assess the clinical scoring system, the PEFR measurement was not performed in our study.

Limitations

This study may have some potential limitations. Because EDs participating in the study were tertiary medical centers, all of them accept individual admittance in addition to referrals; thus, the results may not be generalized to the entire population. Detailed information about symptom duration was not obtained from the patients. Moreover, early-period outcomes (the first 2 weeks after the attack) of the patients are not known. In further studies including this information, as well as variables predicting hospitalization or discharge and their efficiency, should be studied in a more detailed manner. However, the multi-center nature of the study, inclusion of a large number of patients, and pertinence to daily clinical practice are the positive characteristics of this trial.

CONCLUSION

In this study, we demonstrated that the large majority of asthma attacks in children are mild and moderate and that most attack symptoms can be relieved with the use of effective doses of bronchodilators; therefore, assessment regarding the decision of hospitalization should not be made at the initial presentation. Attack severity as determined with MPIS and the GINA guideline was found to be a predictive factor for hospitalization. Ultimately, MPIS may help physicians in clinical decision-making for hospitalization of patients with acute asthma. A cut-off value $\geq$ 5 at the 1st hour can be used confidently in determining those patients with a higher risk for hospitalization.

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ARTICLE SUMMARY

1. Why is this topic important?

Acute asthma is one of the most common medical emergencies in children. Effective management improves the quality of life while decreasing the cost of treatment.

2. What does this study attempt to show?

We attempted to show the risk factors predicting hospitalization and compared the concordance of Modified Pulmonary Index Score (MPIS) with Global Initiative for Asthma (GINA) guideline criteria.

3. What are the key findings?

GINA guideline is commonly used worldwide and consists of 12 variables in determining attack severity. MPIS is also a useful tool in clinical practice in terms of using fewer variables and having a numeric value. Attack severity and MPIS were found as predicting factors for hospitalization. Concordance in predicting hospitalization between MPIS and GINA guideline was found to be moderate at the 1st hour.

4. How is patient care impacted?

To prevent unnecessary hospitalizations, the decision to hospitalize a patient should be made at the 1st hour assessment instead of at the initial presentation. MPIS may help physicians in clinical decision-making for hospitalization in patients with acute asthma. Prediction powers of GINA and MPIS are similar in acute asthma for hospitalization.