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Predictive Factors of PICU Admission for Asthmatic Children Hospitalized in Tabriz Children's Hospital

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Abstract: Although, deaths due to asthma usually happen out of the hospital, but high risk children may be identified upon their previous medical history before admission toPediatric Intensive Care Unit (PICU). Patients who do not respond considerably to primary treatments in emergency department must be transferred to PICU for close observation, monitoring and further treatment. According to burden of asthma and its fatality if not be classified or treated properly, the early recognition of high-risk asthmatic children who must be admitted to PICU and to avoid unnecessary admissions, play a significant role in management of asthma, therefore we planned this study to identify predictive factors of PICU admission for asthmatic children. This comparative (analytical) and cross-sectional study on 70 asthmatic children (40 patients admitted to ward and 30 patients to PICU) carried out to determine epidemiologic and clinical factors, laboratory and radiologic findings and treatments in 2 groups of patients, who admitted to PICU versus respiratory ward. Statistical tests including t-test and Chi-square were used to analyze and compare results between these groups. This study revealed some statistically significant difference in presenting clinical signs such as Cyanosis ($p = 0.0001$), Tachypnea ($p = 0.04$) and Tachycardia ($p = 0.01$) between 2 groups of patients, who admitted to PICU versus respiratory ward. Besides, there were some meaningful differences in their laboratory findings, including lower PaO_2 ($p = 0.03$) and higher $PaCO_2$ ($p = 0.02$) in patients admitted to PICU than who admitted to ward. Previous positive history of PICU admission and/or inappropriate medical treatment was more common in PICU admitted patients than ward admitted group. We concluded that cyanosis, rapid respiratory and pulse rates, low PaO_2, high $PaCO_2$, previous positive history of PICU admission and inappropriate medical treatment, all prepare an asthmatic patient to need PICU readmission.

Key words: Asthma, pediatric intensive care unit, PICU

INTRODUCTION

Asthma is one of the most common chronic disease of childhood and a major cause of hospitalization in this age group. Asthma together with infections is responsible for 50% of all hospital admissions in children between 1 and 4 years of age and 33% of that in the age group of 5-9 years (Liu *et al*., 2004; Bloomberg *et al*., 2003).

Despite of increasing knowledge about pathophysiologic background of asthma and improvements in its management, the most recent statistical findings revealed that prevalence of asthma and hospitalization due to its severe exacerbations and related mortality and morbidity, all are increasing worldwide during recent years (Paret *et al*., 1998).

Although, mortality cases of asthma often occur out of hospitals, but high risk asthmatic children may be detected according to their past history of treatment for asthma and admission to Pediatric Intensive Care unit (PICU).

All asthmatic patients who do not show considerable improvement in Emergency Room must be admitted to PICU for close observation and aggressive treatment. Hypoxia, Dehydration, Acidosis and hypokalemia make these patients susceptible to cardiac dysrhythmia and cardio-respiratory arrest (Phipps and Garrard, 2003). The major causes of increased mortality rate of asthma are misdiagnosis, underestimation of disease severity, delayed referral and mismanagement. Therefore, early diagnosis of high risk children for immediate PICU

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admission and refrain from admission of the low risk cases to PICU, play a significant role in the management of asthma.

This study designed to uncover major predicative factors necessitating early PICU admission, which must be considered in asthmatic children.

MATERIALS AND METHODS

In a cross-sectional analytic study on 70 children who had been admitted to Tabriz Children's Hospital because of asthma attack, the patients were divided into two groups upon their admission place PICU versus pulmonology ward. Needed data including Epidemiologic factors like age, gender, season at which attack was happened, residence area and so on; clinical manifestations such as Cyanosis, expiratory wheezing, respiratory rate, heart rate, etc; radiological findings on chest roentgenograms; laboratory data on Arterial Blood Gas analysis (ABG) and previous clinical findings and pas medical history of asthma status and its management if there was any, all were collected for every patient and analyzed by t-test and chi-square test.

Inclusion criteria were diagnosis of Asthma upon history, physical examination and chest radiogram findings and also admission to Pulmonology ward or PICU of Tabriz Children's Hospital, from March 2003-September 2005.

Exclusion criteria were disruption of therapeutic plans due to arbitrary decision of parents to leave the hospital and take their child home and presence of a chronic Underlying disorder other than asthma, such as Congenital heart disease, renal failure, pulmonary hypertension and so on.

In evaluation of past medical history of patients, if previous maintenance drug therapy for prevention of asthma was compatible with guidelines of Global Initiative for Asthma, it has been considered as appropriate previous treatment and otherwise, inappropriate (Global Initiative for Asthma, 2000).

RESULTS AND DISCUSSION

Comparison of 2 groups of patients, 30 cases who admitted to PICU versus 40 patients, admitted to pulmonology ward, resulted in findings that summarized in Table 1 and 2.

As shown in Table 2, only 2 from all studied factors in past medical history of patients reveal a statistically meaningful difference between 2 groups, they are appropriateness of previous maintenance therapy and positive history of previous PICU admission. It has been also mentioned that, central cyanosis, heart rate and respiratory rate make a significant difference between 2 groups. Besides, ABG test, that were taken on arrival of Patients to Emergency Room, showed that PaO_2 is significantly lower and PaCO2 higher in patients admitted to PICU.

Our study showed that epidemiologic factors plays no role in determination of severity of asthmatic attacks and can not be used as an indicator for any need to PICU admission in exacerbation of asthma.

In similar studies, researchers have found a meaningful correlation between socio-economic class of patient's family or their race and frequency of asthma exacerbations that resulted in hospitalization of children, for example. Chen *et al.* (2003) showed that lack of self-confidence in parents for caring their asthmatic child and their belief that they can not control the disease, besides various family problems and their disturbed emotional environment all together, resulted in increased frequency of child hospitalization due to asthma.

Another study, carried out by Winkelstein *et al.* (2000) showed that in some families with lower income, children even in young ages, are usually responsible for taking their own medications and accomplishing therapeutic plans. This information may explain how socio-economic level of family can affect admission risk of asthmatic child and even overall disease process, but this may not be true among Iranian population (Bloomberg *et al.*, 2003; Chen *et al.*, 2003; Winkestein *et al.*, 2000).

Our study showed that some findings in past medical history of patients, such as previous admission to PICU due to asthma and inappropriate maintenance therapy

Table 1: Epidemiologic factors in two groups, of patients, admitted to PICU versus pulmonology ward*

	Admission place		
Factors	PICU (30 patients) (%)	Pulmonology ward (40 patients) (%)	Total (%)
Previous disease type			
Intermittent Asthma	11(36.7)	20(50)	31(44.3)
Persistent Asthma	19(63.3)	20(50)	39(55.7)
Season (When acute exacerbation presented)			
Spring	12(40)	15(37.5)	27(38.6)
Summer	6(20)	3(7.5)	9(12.8)
Autumn	8(26.7)	9(22.5)	17(24.3)
Winter	4(13.3)	13(32.5)	17(24.3)
Age (Years)			
<2	17(56.6)	15(37.5)	32(45.7)
2-4	8(26.6)	15(37.5)	23(32.9)
>4	5(16.6)	10(25)	15(21.4)
Gender			
Male	20(66.6)	33(82.5)	53(75.7)
Female	10(33.3)	7(17.5)	17(24.3)

*Despite of some percentage differences, there is no statistically meaningful difference between above mentioned parameters (p = Not Significant)

Table 2: Comparison of History, physical findings and results of arterial blood gas analysis (ABG); in two groups of patients, admitted to PICU versus pulmonology ward

Factors	Admission place: PICU (30 patients)	Admission place: Pulmonology ward (40 patients)	p-value
History			
Previous treatment			
Appropriate	8(26.7%)	25(62.5%)	0.002
Inappropriate	22(73.3%)	15(37.5%)	
Previous admission to:			
PICU	3(10%)	0(0%)	0.04
Pulmonology ward	11(36.7%)	17(42.5%)	NS
Frequency of exacerbations in one recent year			
2 or Less	11(36.7%)	24(60%)	NS
More than 2	8(26.7%)	11(27.5%)	NS
Physical findings			
Average respiratory rate (breath/minute)	56.5±10.2	49.5±12.5	0.04
Average heart rate (beat/minute)	143±29.8	124±23.2	0.01
Expiratory wheezing			
+	30(100%)	37(92.5%)	NS
-	0(0%)	3(7.5%)	NS
Accessory muscle use			
+	30(100%)	25(62.5%)	NS
-	0(0%)	15(37.5%)	NS
Central cyanosis			
+	18(60%)	0	<0.0001
-	12(40%)	40 (100%)	
Results of arterial blood gas bnalysis			
HCO_3^- (mEq L^{-1})	18.46±6.31	19.46 ±5.35	NS
$PaCO_2$ (Torr)	43± 21	33.94±12.67	0.02
SaO_2 (%)	83.78±12.78	82.02±11.47	NS
PaO_2 (Torr)	47.07±9.5	49.57±13.02	0.03

NS = Not Significant

have a meaningful correlation with further need to PICU admission whenever an exacerbation happens; this is similar to results of other's studies. For example, Warman *et al.* (1999) revealed that among urban children admitted to hospitals because of asthma that had a previous history of repeated hospitalizations due to same reason, often had not followed national health organization's guidelines for asthma management before admission. Adams *et al.* (2001) showed that asthmatic children under regular treatment with inhaled anti-inflammatory drugs (corticosteroids) have a lower risk for admission due to asthma (Warman *et al.*, 1999; Adams *et al.*, 2001; Blais *et al.*, 1998; Childhood Asthma Management Program Research Group, 2000).

Our study showed that among clinical findings of acute exacerbation of asthma, presence of central cyanosis, tachycardia and tachypnea are reliable predictive factors for indication of PICU admission; indeed all above mentioned factors are indicators of severity during an asthmatic attack (Liu *et al.*, 2004; Paret *et al.*, 1998; Phipps and Garrard, 2003; Kercsmar and Asthma, 1998). Other factors that could be relied on to predict the patient's need to PICU admission even at the onset of an asthmatic attack, are low PaO_2 and/or high $PaCO_2$ in an early ABG analysis, which showed significant difference between two groups in our study, this result is similar to Kercsmar's idea (Kercsmar and Asthma, 1998).

Besides, it must be mentioned that increased PaCO2 in spite of tachypnea can be resulted from shallow breathing, diminished tidal volume and progression of disease process into respiratory exhaustion.

CONCLUSION

Findings of this study can be used in evaluation of every acute exacerbation of asthma and prediction of patients' need for PICU admission, to prevent any time wasting which may be crucial to effective treatment and early restoration of patient's health. On the other hand, determination of those patients who can be treated in general ward, may prevent unjustified engagement of PICU facilities.

It is also possible to employ findings of this study to designate guidelines for admission of Asthmatic patients to general ward or PICU and other needed interventions for their management.

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