



Validity of acute severe asthma criteria in asthmatic patients presenting to the emergency department in Medina Hospitals, Saudi Arabia

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General Note

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ABSTRACT

Introduction: Bronchial asthma estimated to affect about 15% of the population, Asthmatic episodes can be traumatic given the affected person's trachea constriction hence limiting the amount of air entering the respiratory system. Patient history is key in

diagnosing acute severe asthma which includes frequency of visit to the ER, adherence to medication, smoking condition, allergen and irritant exposure and upper respiratory tract infection. An episode of acute severe asthma is considered a medical emergency. Medication given to a patient during an episode of acute severe asthma attack should be done so as soon as possible as some of the medication takes between 6-12 hours before becoming effective. *Aim of the study:* The aim of this study is to identify the number of asthmatic cases that fit the criteria of acute severe asthma and to verify the applicability of these criteria on asthmatic patients presenting to the emergency department of different hospitals in Medina, Saudi Arabia. *Materials and Methods:* This study was a prospective descriptive design, where a convenience sample of 50 patients was collected from patients with average age 43.9 ± 13.7 years. The study was conducted between May 2019 and October 2019, using a data collection sheet to register patient's data. Patients were met at the emergency departments of different governmental hospitals situated in Medina, Saudi Arabia. All patients were subjected to careful history taking and careful clinical examination with stress on heart rate, respiratory rate, O₂ saturation by pulse oximetry, Peak expiratory flow rate measurement as well as laboratory testing were done to all patients. Confidentiality of the information was maintained and the data were analyzed using SPSS version 21. *Results:* Thirty out of 50 patients (60.0%) had met the criteria for acute severe asthma based on PEF (33% - 50%) while 40% did not meet the criteria for acute severe asthma and considered as having moderate asthma. The most commonly known precipitating factor of asthma was allergens (62%) and about 76% of them were non adherent to bronchodilator inhaler. The mean PEF was $45.5\% \pm 9.98$ whereas the mean oxygen saturation level was $90.9\% \pm 2.78$. We also found that PEF was the sole independent significant factor of acute severe asthma based on the regression model (OR=1.224, $p < 0.001$). *Conclusion:* 40% of asthmatic patients presented to the emergency departments did not meet the criteria for acute severe asthma and considered as having moderate asthma. During asthma exacerbations, inabilities to talk in full sentence and decrease in PEF are considered as red flag signs of acute severe asthma.

Keywords: Acute Severe Asthma, Emergency Department, PEF, Oxygen saturation

1. INTRODUCTION

Asthma is one of the most common chronic respiratory diseases that affect both children and adults (Subbarao et al., (2009). According to World Health Organization (WHO), 235 million people are suffering from asthma worldwide (Horaib et al., 2018). In the US, there was an increase of the percentage of people with asthma by 15% according to the Centre for Disease Control and Prevention (CDC National Asthma Control Program, 2013). Approximately 10% of the world's population is suffering currently from asthma, 5% of which is classified as severe disease (Dennis et al., 2011). In Saudi Arabia, more than 2 million Saudis are asthmatic patients (Horaib et al., 2018).

Acute severe asthma is defined as an asthma exacerbation that is unresponsive to the conventional treatment with bronchodilators and steroids, leading to potentially fatal complication such as respiratory failure (Khawaja et al., 2014; Papisir et al., 2009). It is a medical emergency that requires immediate recognition and treatment. Asthma exacerbations are more common in females than in males, and females are twice as likely as males to be hospitalized for asthma (Krishnan et al., 2006). Studies showed that each year, 2 million of patients who presented to emergency department, 15 million of patients presented to outpatient clinics and 500,000 of hospitalized patients are seeking help for acute severe asthma (Dougherty & Fahy, 2009). In emergency department, 70-80% of patients who treated optimally will show clear improvements within two hours (McFadden, 2003). It is considered to be a public health problem worldwide. It has been observed that low and lower-middle income countries carry higher rates of mortality (The Global Asthma, 2011).

Patients who experienced one asthma exacerbation are at high risk of developing other exacerbations as it is considered to be a potent risk factor of exacerbation recurrence (Horaib et al., 2018). The rate of relapses depends on how aggressively patients are managed and varies between 7-15% (McFadden, 2003). Respiratory viruses considered to be the most common cause of asthma exacerbations especially rhinoviruses infections (Grissell et al., 2005). Furthermore, intrinsic factors such as anti-viral type I interferons (IFN- α and IFN- β) deficiency may play a role. Other extrinsic factors that contribute to exacerbate asthma include: smoking, non-compliance to medications, psychosocial factors and other co-morbidities such as obesity, gastroesophageal reflux disease and rhinosinusitis (Dougherty & Fahy, 2009). Hence, failure to recognise the severity and delay in treatment may lead to high rates of morbidity and mortality (Khawaja et al., 2014). There is risk for developing serious and often fatal complications in these patients such as: pneumo-pericardium, pneumo-mediastinum, electrolyte and metabolic disturbances, cardiac arrhythmias, and even myocardial infarction (MI) and anoxic brain injury (Afessa et al., 2001; Papisir et al., 2002). An exacerbation (attack) of asthma is experienced as a worsening of asthma symptoms with breathlessness and cough (often worse at night). In acute severe asthma, breathlessness may be so severe that it is impossible to speak more than a few words (inability to complete sentences). On

examination, the respiratory rate may be elevated (more than 25 breaths per minute), and the heart rate may be rapid (110 beats per minute or faster). Reduced oxygen saturation levels (but above 92%) are often encountered. Examination of the lungs with a stethoscope may reveal reduced air entry and/or widespread wheeze. The peak expiratory flow can be measured at the bedside; in acute severe asthma the flow is less than 50% a person's normal or predicted flow (British Thoracic Society and Scottish Intercollegiate Guidelines Network, 2014). The present study endeavours at investigating the applicability of criteria of acute severe asthma in all asthmatic patients admitted to the emergency department.

Aim of the Study

The main aim of this study is to identify the number of asthmatic cases that fit the criteria of acute severe asthma and to verify the applicability of these criteria on asthmatic patients presenting to the emergency department of different hospitals in Medina, Saudi Arabia.

2. RESEARCH METHODOLOGY

This study was a prospective descriptive study. The study was conducted between May 2019 and October 2019, using a data collection sheet to register patient's data. Patients were met at the emergency departments of different governmental hospitals situated in Medina, Saudi Arabia. The study's inclusion criteria were that all patients aged 12 years old or older present at an emergency department with an acute asthma exacerbation. Patients younger than 12 years of age were not considered. Convenience sampling approach where patients were approached with an electronic decoder to record their data and criteria of acute severe asthma in a specified data collection sheet. The final sample consisted of 50 patients. Outcome measures were clinical data with stress on heart rate, respiratory rate, O₂ saturation by pulse oximetry; laboratory investigations, peak flow meter reading and data storage in excel sheets. Confidentiality of the information collected was maintained as information was only shared among researchers for this particular study. Each patient's information was stored in a file to enable reference with the laboratory report. Patients were informed about the purpose of the study and an oral consent was taken and confidentiality ensured.

Ethical approval

The study was ethically approved by Taibah University Scientific Research Ethical Committee on 20/10/2019 (IRB00010413)

Statistical Analysis

Quantitative data are presented using mean \pm Standard deviation (SD) or median with interquartile range if appropriate. Qualitative data are presented using counts and proportions (%). For the association between the severity of asthma among demographic and clinical characteristics of asthmatic patients presented at Emergency Department, we used Fischer Exact test or Mann U Whitney test whenever appropriate. Normality tests were conducted using Shapiro-Wilk test, p-value <0.05 was considered as skewed data. A p-value of <0.05 (two sided) was used to indicate statistical significance. All data analyses were performed using the statistical package for social sciences, version 21 (SPSS, Chicago, IL, USA).

3. RESULTS

As described in table 1, a total of 50 patients with acute severe asthma presenting to ED were recruited in this study. The mean age of the patients was 43.9 ± 13.7 years, with age ranging from 19 to 69 years, of whom majority were in the middle age group (46%) with more than a half of them were females (54%) and (46%) were males. Majority of them were non-smokers (64%). As regard to the history of ER visit per year, a high proportion of them (58%) had 3 – 5 times ER visits per year while 32% had 6 times or more ER visits per year.

Table 1 Socio demographic characteristics of asthmatic patients presenting to ED

Study variables	N (%) (No=50)
Age in years (mean \pm SD)	43.9 \pm 13.7
19 – 35	12 (24.0%)
36 – 50	23 (46.0%)
>50	15 (30.0%)
Gender	

Male	23 (46.0%)
Female	27 (54.0%)
Smoking Status	
Smoker	08 (16.0%)
Non-smoker	32 (64.0%)
Ex-smoker	10 (20.0%)
Occupation	
Employed	15 (30.0%)
Unemployed	12 (24.0%)
Housewife	18 (36.0%)
Student	05 (10.0%)
History of ER visit per year	
1 – 2 times	05 (10.0%)
3 – 5 times	29 (58.0%)
6 times or more	16 (32.0%)

ED: Emergency Department; ER: Emergency Room.

Table 2 showed (24%) of patients were adherent to bronchodilator inhaler while (76%) were non adherent. 74% of patients has inability to talk in full sentence. The most common precipitating factors of asthma were allergens in (62%) and upper respiratory tract infection in (38%). There were 40% of patients using accessory respiratory muscles whereas 20% were having pulsus paradoxus. The average respiratory rate of patients was 25.7 ± 2.94 , while the average heart rate was 111.5 ± 5.68 . With regards to Peak Exploratory Flow rate % (PEFR), it was 45.5 ± 9.98 whereas the mean oxygen saturation level was 90.9 ± 2.78 .

Table 2 Clinical characteristics of asthma patients presenting to ED

Parameters	N (%) (n=50)
Adherence to Bronchodilator inhaler	
Yes	12 (24.0%)
No	38 (76.0%)
Patient unable to talk in full sentence	
Yes	37 (74.0%)
No	13 (26.0%)
Precipitating factors	
Allergens	31 (62.0%)
URTI	19 (38.0%)
Use of accessory respiratory muscles	
Yes	20 (40.0%)
No	30 (60.0%)
Having pulsus paradox	
Yes	10 (20.0%)
No	40 (80.0%)
	Mean \pm SD
Respiratory rate (bpm)	25.7 ± 2.94
Heart rate (bpm)	111.5 ± 5.68
PEF (%)	45.5 ± 9.98
Oxygen saturation level %	90.9 ± 2.78

ED: Emergency Department; URTI: Upper Respiratory Tract Infection; PEF: Peak expiratory flow.

Figure 1 described the % of asthmatic patients presented to the emergency departments who did not meet the criteria for acute severe asthma according to PEFr measurement versus those who meet the criteria. Based on the results, 30 patients (60%) had met

the criteria for acute severe asthma (PEF=33% – 50%) while 20 patients (40%) did not meet the criteria and were classified as having moderate asthma.

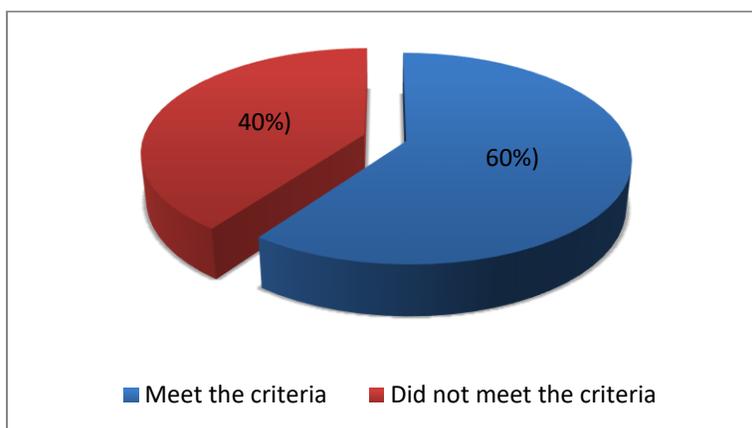


Figure 1 Asthmatic patients presented to the emergency departments who did not meet the criteria for acute severe asthma according to PEFr measurement versus those who meet the criteria

When measuring the association between socio demographic and clinical characteristics of Asthmatic patients presenting to ED, we found that, those unable to talk in full sentence are significantly more of having acute severe asthma (p-0.035). We also found out that, lower PEF rate are significantly more associated with acute severe asthma. On the other hand, age group in years (p-0.773), gender (p-0.774), smoking status (p-0.765), occupation (p-0.999), history of ER visit per year (p-0.763), use of bronchodilator inhaler (p-0.999), use of accessory respiratory muscles (p-0.769), precipitating factors (p-0.999), having pulsus paradoxicus (p-0.494), respiratory rate (p-0.424), heart rate (p-0.071) and oxygen saturation level (p-0.134) were not statistically significant with the severity of asthma (Table 3).

A multivariate regression analysis has been conducted at table 4 to predict the influence of acute severe asthma from the selected clinical characteristics of asthmatic patients. Based on the results, we predicted that as the PEF% decrease, the chance of having acute severe asthma will likely to increase (OR=1.224, p-<0.001). In contrast, we observed that unable to talk in full sentence have no significant effect with the acute severe asthma.

Table 3 Association between socio demographic and clinical characteristics among patients who meet the criteria for acute severe asthma versus those who did not meet the criteria

Factor	Severity of Asthma		P-value [§]
	Acute Severe	Moderate	
	N (%) (n=30)	N (%) (n=20)	
Qualitative variables ^a			
Age group			0.773
≤45 years	14 (46.7%)	08 (40.0%)	
>45 years	16 (53.3%)	12 (60.0%)	
Gender			0.774
Male	13 (43.3%)	10 (50.0%)	
Female	17 (56.7%)	10 (50.0%)	
Smoking Status			0.765
Smoker/Ex-smoker	10 (33.3%)	08 (40.0%)	
Non-smoker	20 (66.7%)	12 (60.0%)	
Occupation			0.999
Employed	12 (40.0%)	08 (40.0%)	
Unemployed	18 (60.0%)	12 (60.0%)	
History of ER visit per year			0.763
≤5 times	21 (70.0%)	13 (65.0%)	

>5 times	09 (30.0%)	07 (35.0%)	
Use of Bronchodilator inhaler			
Yes	07 (23.3%)	05 (25.0%)	0.999
No	23 (76.7%)	15 (75.0%)	
Unable to talk in full sentence			
Yes	19 (63.3%)	18 (90.0%)	0.035 **
No	11 (36.7%)	02 (10.0%)	
Precipitating factors			
Allergens	19 (63.3%)	12 (60.0%)	0.999
URTI	11 (36.7%)	08 (40.0%)	
Use of accessory respiratory muscles			
Yes	13 (43.3%)	07 (35.0%)	0.769
No	17 (56.7%)	13 (65.0%)	
Having pulsus paradox			
Yes	05 (16.7%)	05 (25.0%)	0.494
No	25 (83.3%)	15 (75.0%)	
Quantitative variables ^b	Mean ± SD	Mean ± SD	
Respiratory rate (bpm)	25.9 ± 2.49	25.2 ± 3.54	0.424
Heart rate (bpm)	112.9 ± 4.75	109.3 ± 6.39	0.071
PEF (%)	40.0 ± 3.90	53.8 ± 10.7	<0.001 **
Oxygen Saturation level (%)	90.4 ± 2.82	91.7 ± 2.57	0.134

ED: Emergency Department; URTI: Upper Respiratory Tract Infection; PEF: Peak expiratory flow.

^a P-value has been calculated using Fischer Exact Test.

^b P-value has been calculated using Mann Whitney U test.

** Significant at p<0.05 level.

Table 4 Multivariate regression analysis to predict the effect of acute severe asthma from the selected clinical characteristics of patients presenting at ED

Factor	Odd Ratio	95% CI	P-value
Unable to talk in full sentence			
Yes	Ref		0.099
No	5.724	0.721 – 45.408	
PEF (%)	1.224	1.103 – 1.359	<0.001 **

ED: Emergency Department; URTI: Upper Respiratory Tract Infection; PEF: Peak expiratory flow.

** Significant at p<0.05 level.

4. DISCUSSION

Severe asthma exacerbations are events that need immediate attention for both patients and physician to avoid any life-threatening circumstances. This requires a frequent visit to Emergency Department (ED) or an asthma-related hospitalization for the necessary treatment (Puranik et al., 2017). In fact, acute severe asthma is considered a medical emergency that “requires immediate recognition and treatment” (Shah & Saltoun, 2012). This is partly due to the fact that clinical intervention brought in later may not benefit a patient for a minimum of 6-12 hours, hence the need for urgency of the treatment (Gallegos-Solórzano et al., 2010). It is reported that more than half of the acute asthma attacks are due to upper respiratory tract infections (Nicholson et al., 1993). The present study sought to determine the number of asthmatic cases that fit the criteria of acute severe asthma presenting to the ED of different hospital in Medina, Saudi Arabia. According to the British guideline for the management of acute severe asthma using specific criteria of Peak Exploratory Flow (33% - 50%) (British Thoracic Society, 2003), in this study thirty out of 50 patients (60%) presented with acute severe asthma at ED had met the criteria for acute severe asthma based on PEF (33% - 50%) while 40% did not

meet the criteria for acute severe asthma and considered as having moderate asthma. Up to our knowledge, no study in Saudi Arabia that validate the criteria of acute severe asthma in patients presenting to the emergency department in Medina Hospitals, Kang et al., (2018) published a study about "Risk factors of asthma exacerbation based on asthma severity: a nationwide population-based observational study in South Korea." Among 22,130 asthmatic patients, the prevalence of acute severe asthma was relatively low, with only 223 (1.05%) were classified as patients with severe asthma. On the other hand, in children, the prevalence of acute severe asthma was also low with 2.5% and 6.5% respectively which were reported by Dondi et al., (2017) and Edelu et al., (2016). Another published study in Denmark (Ye et al., 2008), accounted 26.75% of asthmatic children had an acute asthma exacerbation which was also lower than our study report.

It has been reported that exposure to allergens whether indoors or outdoors, can lead to poor asthma control and severe asthma exacerbation (Kanchong kittiphon et al., 2015). In our study, the most commonly known precipitating factors of acute severe asthma among patients presenting to ED was allergens (62%) followed by respiratory tract infection (38%). This has been corroborated by Refaat & Aref, (2014) where they documented that acute asthma reporting to ED had been triggered by weather changes (28.4%), followed by infections (26.6%) and exposure to allergens (21.3%). This had also been noted with asthmatic children, where researchers documented that the most common cause of acute asthma among children were the exposures to infections and allergic condition (Dondi et al., 2017). Asthma controller medications are necessary to reduce the severity and frequency of acute asthma exacerbation. In this study, adherence to asthma controller medication such as bronchodilator was moderately low (24%). This is consistent from the study published by Edelu et al., (2016) who reported that among 114 children presented with acute asthma exacerbation, 25% of them were on controller medications, mainly steroid and long-acting beta₂ agonist. This has been further corroborated in a study published by Dondi et al., (2017) who observed that among 603 patients with acute asthma; only 33% were in adherence to asthma controller medications which was also coincided with our study outcome.

In this study, we observed that those unable to talk in full sentence were more associated with acute severe asthma though when conducting regression model this did not differ significantly among the severity of the lung disease. Furthermore, we also observed that lower percentage of PEF was more associated with acute severe asthma and based on the regression model, we observed that for every decrease of the PEF percentage the likelihood of having acute severe asthma will be increased. This indicates that PEF was the sole independent significant factor of acute severe asthma. Airflow obstruction must be measured objectively when-ever possible, using either FEV₁ or peak expiratory flow. Peak expiratory flow is an integral component of the Canadian Triage and Acuity Scale, a reliable and valid complaint-based triage tool developed by Canadian emergency nurses and physicians to prioritize the severity of a patient's condition and the timing of care in the emergency department (Beveride, 1998; Canadian Association of Emergency Physicians, 2009). In one prospective study, more than 90% of patients presenting to the emergency department with acute asthma had valid spirometry measurements when the test was administered by trained personnel (El Sawy et al., 2018). Factors associated with the severity of asthma vary by region (Ye et al., 2008; Silverman et al., 2007; Kumar et al., 2018). For example, Ye et al., (2008) observed that factors associated with higher likelihood of experience with an acute asthma exacerbation includes; age, gender, region and asthma severity. In Egypt (Silverman et al., 2007), history of sudden onset of severe respiratory distress, chronic steroid-dependent asthma were the risk factors concomitant with severe asthma exacerbations among children attending at Alexandria University Children's Hospital while in India (Kumar et al., 2018), it has been reported that poor drug compliance, exposure to house dust, and smoke were the risk factors among children with acute severe asthma.

Limitation of the study

This study has limited sample size which does not accurately reflected the power of the study. In spite of this limitation, the outcome provided important insights about the prevalence and the risk factor of acute severe asthma among patients presenting to ED in Medina, Saudi Arabia.

5. CONCLUSION

40% of asthmatic patients presented to the emergency departments did not meet the criteria for acute severe asthma and considered as having moderate asthma. During asthma exacerbations, inability to talk in full sentence and decrease in PEF are considered as red flag signs of acute severe asthma.

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Conflicts of interest

Authors declare no conflicts of interest

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