American Journal of Emergency Medicine 33 (2015) 1583–1586

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Original Contribution

Assessment of acute asthma severity in the ED: are heart and respiratory rates relevant?☆,☆☆

Gustavo J. Rodrigo, MD [a,1], Hugo Neffen, MD [b,*]

[a] Departamento de Emergencia, Hospital Central de las Fuerzas Armadas, Av 8 de Octubre 3020, Montevideo 11300, Uruguay
[b] Unidad de Medicina Respiratoria, Hospital de Niños "O Allassia", Santa Fe, Argentina

ARTICLE INFO

Article history:
Received 6 May 2015
Received in revised form 11 June 2015
Accepted 13 June 2015

ABSTRACT

Background: Assessment of acute asthma severity in the emergency department (ED) determines the appropriate initial therapy. The aim of this study was to evaluate the usefulness of heart and respiratory rates as determinants of severity of asthma exacerbations.
Methods: It was a pooled analysis of individual patient data from different controlled clinical trials performed over a 9-year period. The sample was characterized by patients with a diagnosis of asthma, age 18 to 50 years, and a forced expiratory volume in the first second (FEV_1) or a peak expiratory flow less than or equal to 50% of predicted at ED presentation.
Results: One thousand one hundred ninety-two severe acute asthmatics (age 33.9 ± 10.3 years and FEV_1 = 27.4% ± 9.7%) were enrolled. Two-thirds of patients were categorized as having severe acute asthma (FEV_1, 31%-50% of predicted) and the remaining third as life-threatening asthma (FEV_1, ≤30% of predicted). There were no relationships between the intensity of airway obstruction as measured by the FEV_1 and the degree of tachycardia ($r = 0.05$, $P > .1$) or tachypnea ($r = 0.06$, $P > .1$). Only 22% and 19% of the patients, respectively, met the heart rate and respiratory rate requirements for acute severe asthma (≥120/min and ≥25/min, respectively). In contrast to FEV_1 and arterial oxygen saturation, baseline heart and respiratory rates did not predict admissions of patients at the end of treatment.
Conclusions: This pooled analysis suggests a poor performance of heart and respiratory rates as determinants of acute asthma severity in the ED.

1. Introduction

All patients with asthma are at risk for having exacerbations characterized by progressive increases in shortness of breath, cough, wheezing, chest tightness, along with a decrease in expiratory airflow [1,2]. The severity of exacerbations may range from mild to life threatening, and deterioration mostly progresses over hours, days, or weeks. Overall, the assessment of an asthma exacerbation in the emergency department (ED) constitutes a process with 2 different steps: firstly, a static assessment to determine the severity of attack and, secondly, a dynamic assessment to evaluate the response to treatment [1-6]. Regarding the first step, patients should be evaluated quickly because the severity of the exacerbation determines the appropriate initial therapy. Although spirometry is the primary determinant of severity, different symptoms and signs are additionally used to categorize asthma exacerbations. [7-9] Hence, asthma management guidelines include heart and respiratory rates as a part of the severity evaluation of acute exacerbations. For example, the Global Initiative for Asthma guidelines [7] establish that tachycardia (>120/min) and tachypnea (>30/min) are vital signs that characterized severe exacerbations. In a similar way, a heart rate greater than or equal to 110/min and a respiratory rate greater than or equal to 25/min are indicators of severe acute asthma according to the British guideline on the management of asthma [8]. However, these recommendations are poorly supported by scientific evidence and have rarely been verified in clinical practice.

The aim of this study was to evaluate the usefulness of heart and respiratory rates as determinants of severity of acute asthma in the ED setting, through a pooled analysis of individual patient data from a large cohort of acute asthmatic patients.

2. Methods

2.1. Study population

This was a pooled analysis of individual patient data from different controlled clinical trials performed over a 9-year period. Patients were adults with acute asthma who had attended the ED of a tertiary-care general hospital in Montevideo, Uruguay. The characteristics of the

☆ Author disclosures of conflicts of interest: Drs Rodrigo and Neffen have no financial or other potential conflicts of interest related with the objective of this research.
☆☆ Funding source: No sponsorship from institutions or pharmaceutical industry was provided to conduct this study.

* Corresponding author.
E-mail addresses: gustavo.javier.rodrigo@gmail.com (G.J. Rodrigo), hugoneffen@arnet.com.ar (H. Neffen).
[1] Tel.: +598 2708 2354; fax: +598 2900 6313.

http://dx.doi.org/10.1016/j.ajem.2015.06.022
0735-6757/

cohort and the selection criteria used are described in detail elsewhere [9-15]. Briefly, the following sample was quite homogeneous: (1) patients with a diagnosis of asthma according to the guidelines; (2) age 18 to 50 years; (3) a forced expiratory volume in the first second (FEV_1) or a peak expiratory flow (PEF) less than or equal to 50% of predicted at ED presentation; and (4) absence of history of chronic cough and cardiac, hepatic, renal, or other medical disease or pregnancy. All participants gave their informed written consent to participate, and each study was approved by its respective ethics committee.

2.2. Protocol

All patients were treated with albuterol, 4 puffs at 10-minute intervals (100 mg per actuation), delivered by a metered-dose inhaler and a spacer device (Volumatic; Allen & Hansburys, Greenford, United Kingdom). In 2 of the studies, patients received also ipratropium bromide [10,13]. In all studies, exacerbation treatment lasted 3 hours and also included the administration of systemic corticosteroids and O_2 if arterial oxygen saturation (Sao_2) decreased to less than 92%. Aminophylline was excluded in all studies. Patients from 3 of the studies also received inhaled corticosteroids added to albuterol [9,12,14]. At the end of protocol, patients were discharged from the ED according the following criteria: if accessory muscle use was abated, if wheezing was judged to be minimal or completely resolved, if patients were free of dyspnea, and if FEV_1 or PEF was greater than or equal to 60% of predicted.

2.3. Variables

The following variables were measured in each patient immediately before starting treatment and at 30-minute intervals for 3 hours after presentation to the ED: FEV_1, PEF, respiratory rate, heart rate, and oxygen saturation by pulse oximetry while breathing room air. Furthermore, an interviewer determined the duration of symptoms before presentation to the ED, age, sex, and body mass index of each patient.

2.4. Statistical methods

Mean values ± SD and 95% confidence intervals (CIs) were calculated for all continuous variables. Data were compared by 1-way or repeated-measures analysis of variance (ANOVA). χ^2 test with Yates correction or Fisher exact test was used for categorical variables. Finally, logistic regression was used to predict hospitalization from baseline variables. A P value of less than .05 using a 2-tailed test was taken as being of significance for all statistical tests. Data were analyzed with "IBM SPSS Statistics version 20 for Windows (SPSS Inc, Chicago, IL)".

3. Results

We found 1192 patients fulfilling the data set required for inclusion in the analysis (Table). The sample presents the typical features of severe acute asthma patients when they presented for care to an ED—on average, a mean age approximately equal to 30 years old, predominantly female, with a mean level of lung function (FEV_1 or PEF) around 30% of predicted, tachycardia, tachypnea, and a Sao_2 greater than or equal to 95%. Two-thirds of patients were categorized as having severe acute asthma (FEV_1, 31%-50% of predicted) and the remaining third as life-threatening asthma (FEV_1, ≤30% of predicted). At baseline, the univariate analysis showed that those patients with severe acute asthma were predominantly female, had a significantly longer duration of symptoms before the ED treatment, and, obviously, presented with significantly higher spirometric values, in comparison with life-threatening asthma patients (Table). On the contrary, both groups did not differ in heart and respiratory rates and Sao_2. Accordingly, there were no relationships between the intensity of airway obstruction as measured by FEV_1 and the degree of tachycardia ($r = 0.05$, $P > .1$) or tachypnea ($r = 0.06$, $P > .1$). Fig. 1 shows the baseline distribution of heart and respiratory rates in the sample of patients with acute asthma. They showed an average of 102.8 ± 17.1 beats per minute (range, 60-160) and 22.0 ± 4.9 breaths per minute (range, 12-36), respectively. Only 22% and 19% of the patients met the requirements for acute severe asthma (≥120/min and ≥25/min, respectively).

Table
Characteristics of all patients included stratified by severity of exacerbation (severe vs life threatening)

Measures	Total (n = 1192)	Severe acute asthma[b] (n = 748)	Life-threatening asthma[c] (n = 444)	Difference (95% CI)	*P*
At ED presentation					
Age, y[a]	33.9 (10.03)	33.7 (10.5)	34.3 (9.1)	0.6 (−0.5 to 1.7)	.31
Female, n (%)	780 (65.4)	436 (55.9)	344 (44.1)	−19.2 (−24.3 to 13.8)	.0001
BMI[a]	24.3 (4.8)	24.5 (4.5)	24.1 (4.9)	−0.4 (−0.9 to 0.1)	.20
Duration of symptoms before ED presentation, h[a]	30.9 (23.9)	32.3 (24.0)	28.5 (23.7)	−3.8 (−6.6 to −0.9)	.008
Heart rate/min[a]	102.8 (17.1)	102.8 (16.7)	102.8 (17.7)	0.0 (−2.0 to 2.0)	.99
Respiratory rate/min[a]	22.0 (4.9)	22.2 (5.3)	21.8 (4.4)	−0.4 (−0.9 to 0.1)	.49
PEF, % predicted[a]	33.1 (7.9)	38.0 (5.0)	24.8 (4.0)	−13.2 (−13.7 to −12.6)	.0001
PEF, L/min[a]	172.5 (48.4)	200.0 (36.1)	126.1 (25.9)	−73.9 (−77.7 to −70.0)	.0001
FEV_1, % predicted[a]	27.4 (9.7)	30.2 (9.2)	22.8 (8.7)	−7.4 (−8.4 to −6.3)	.0001
FEV_1, L[a]	0.8 (0.3)	1.0 (0.3)	0.6 (0.2)	−0.4 (−0.4 to −0.3)	.0001
Sao_2,[a]	95.4 (1.8)	95.4 (1.8)	95.6 (1.8)	0.2 (0.0 to 0.4)	.22
At the end of ED treatment					
PEF, % predicted[a]	64.5 (16.2)	67.6 (14.9)	59.3 (16.9)	−8.3 (−10.1 to −6.4)	.0001
Change from baseline in PEF, L/min[a]	157.3 (72.5)	151.3 (74.6)	168.7 (76.4)	17.4 (8.5 to 26.2)	.0001
FEV_1, % predicted[a]	59.8 (19.1)	61.2 (17.5)	57.6 (21.2)	−3.6 (−5.8 to −1.3)	.002
Change from baseline in FEV_1, L[a]	1.1 (1.2)	1.0 (1.3)	0.7 (0.9)	−0.3 (−0.1 to −0.4)	.001
Change from baseline in heart rate/min[a]	3.0 (2.3)	4.5 (3.1)	0.8 (0.5)	−3.7 (−3.9. to 3.4)	.0001
Change from baseline in respiratory rate/min[a]	−3.0 (2.5)	−3.2 (2.4)	−2.8 (2.3)	0.4 (0.0 to 0.7)	.01
Change from baseline in Sao_2[a]	1.2 (0.9)	0.7 (0.6)	1.8 (1.2)	1.1 (1.0 to 1.2)	.0001
Hospital admissions, n (%)	188 (15.8)	104 (13.9)	84 (18.9)	−5.0 (−7.0 to −9.0)	.02

Abbreviations: BMI, body mass index.
[a] Mean values ± (1 SD).
[b] Forced expiratory volume in the first second less than or equal to 50% to greater than 30% of predicted.
[c] Forced expiratory volume in the first second less than or equal to 30% of predicted.