Original Article

Clinical Characteristics Influencing the Asthmatic Crisis Intensity in Pediatrics

Características clínicas que influyen en la intensidad de la crisis asmática en pediatría

María Z. Cázares Ramos,[*] Diego H. Ramírez Leyva,[**] María Citlaly Ochoa,[***] Elizabeth Medina Valentón,[*] José M. Ornelas Aguirre.[****]

Summary

Objective: to determine the clinical characteristics that influence the asthmatic crisis intensity in pediatrics. **Methods:** analytical cross-sectional study. 148 patients who attended the Emergency Room for asthmatic crisis were studied. Severity was analyzed with the Wood Downes-Ferrés scale, and clinical and sociodemographic variables were measured as well. **Results**: the main symptoms were cough, wheezing and dyspnea. Seventy-one percent of the participants had no controller treatment and 78% presented an adequate nutritional status. A significant association was found between exposure to tobacco smoke and severity of asthmatic exacerbation. Patients exposed to tobacco smoke were ten times more at risk of presenting a moderate to severe crisis (OR = 10.1, p<0.001). **Conclusion:** this study allowed us to identify a low frequency of controller treatment, high exposure to tobacco smoke was a risk factor for the presence of moderate to severe crisis in the studied population.

Keywords: Asthma; Asthmatic Crisis; Smoking

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[*]Regional General Hospital No. 1, Mexican Institute of Social Security, Ciudad Obregon, Sonora, Mexico.
[**]Family Medicine Unit No. 40, Mexican Institute of Social Security, Ahome, Sinaloa, Mexico.
[***]Gynecology-Pediatrics Hospital No. 2, Mexican Institute of Social Security, Ahome, Sinaloa, Mexico.
[****]Medical Sciences Department, University of Sonora, Mexico.

Correspondence:
José Manuel Ornelas Aguirre
jmoapat@gmail.com

Resumen

Objetivo: determinar las características clínicas que influyen en la intensidad de la crisis asmática en pediatría. **Métodos:** estudio transversal analítico. Se estudiaron 148 pacientes que acudieron al servicio de urgencias por crisis asmática. Se analizó la gravedad del cuadro con la escala de Wood Downes-Ferrés y se midieron variables clínicas y sociodemográficas. **Resultados:** los principales síntomas fueron tos, sibilancias y disnea. El 71% de los participantes no tenían tratamiento de control y 78% presentó un estado nutricional adecuado. Se encontró asociación significativa entre la exposición al humo de tabaco y la gravedad de la exacerbación asmática. Los pacientes expuestos al humo de tabaco tenían diez veces más riesgo de presentar una crisis moderada a grave (RM = 10.1, p <0.001). **Conclusión:** este estudio permitió identificar una baja frecuencia de tratamiento de control, la alta exposición al humo de tabaco fue un factor de riesgo para la presencia de crisis moderada a grave en nuestra población.

Palabras clave: asma, crisis asmática, tabaquismo

Introduction

Asthmatic crisis is characterized by the occurrence of episodes of progressive or sudden shortness of breath, accompanied by dyspnea, cough or chest tightness, or a combination of both.[1] It is considered a heterogeneous disease involving predisposing factors for its development and triggering factors that activate the disease and can lead to a fatal outcome.[1,2] It is a frequent condition in the pediatric age group and the most common reason for hospitalization in children. Some studies in Europe and Latin America found that 71% of children with wheezing received emergency treatment and, of these, 27% required hospitalization.[3] On the other hand, patients diagnosed with asthma who go to the emergency room required hospital treatment in up to 9% of cases.[4] International studies document that asthma deaths occur before the person receives emergency medical care; in general, patients who die from this cause did not receive medical care in the previous year and did not use adequate controller treatment.[5,6]

Asthma attacks are one of the main reasons for admission to the emergency room, which has been related to poor adherence to treatment and exposure to triggering factors, some of the most frequent being viral infections, exposure to allergens, air pollution and tobacco smoke.[7] Some studies show a seasonal variation in asthma attacks; in Mexico their frequency increases after September and has been related to the beginning of the school year, the change of seasonal weather and the increase of viral infections.[8,9]

Patients who develop asthma with risk of death are those who required assisted mechanical ventilation, hospitalization or several visits to the emergency room in the last year; also chronic use of systemic steroids, in addition to those who do not receive inhaled steroids or with abuse of beta 2, fast-acting agonists and poor adherence to treatment.[10-12] There are no studies in our setting on the usual presentation of asthmatic crisis in children, nor studies that analyze the factors involved in its severity; therefore, the aim of this study was to determine the clinical characteristics that influence the asthmatic crisis intensity in a group of pediatric patients in northwestern Mexico.

Methods

An analytical cross-sectional study, after signing an informed consent form, was conducted from May to July 2020 in the pediatric emergency room of the Regional General Hospital No. 1 in Ciudad Obregon, Sonora, Mexico. Patients from 6 to 15 years of age with a diagnosis of asthma, who attended emergency medical consultation for asthmatic crisis were included; individuals with chronic lung disease other than asthma were excluded. A non-probabilistic sampling by consecutive cases was used, obtaining a final sample of 148 patients.

The variables were collected by pediatric residents and pediatricians assigned to the emergency room using a standardized data form; on admission, the research team recorded vital signs, including axillary temperature taken with a mercury thermometer, respiratory rate, heart rate, and pulse oximetry. Patients were weighed and measured to calculate body mass index (BMI) using the Quetelet formula (BMI= weight/height^2) and percentile according to the Center for Disease Control and Prevention (CDC) charts. Participants with a BMI equal to or above the 95th percentile were defined as obese; those with a percentile between 85 and 94 were defined as overweight; those with a BMI below the 5th percentile were defined as underweight; and those between the 5th and 84th percentile were defined as adequate weight. An asthmatic crisis was defined as an acute worsening of the baseline condition in a patient with asthma, characterized by wheezing, dyspnea, cough or sensation of chest tightness.

A questionnaire was used to record sociodemographic variables including age, residence, and exposure to tobacco smoke; and the included clinical varia-

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bles were cough, wheezing, dyspnea, chest tightness, fever, and pulse oximetry on admission. The severity of asthmatic exacerbation was classified based on the score obtained on the Wood Downes-Ferrés scale. Patients with a score from one to three were classified as mild exacerbation; four to seven, moderate; and greater than eight, severe.[12] Variables related to disease control were the use of controller therapy, use of rescue therapy and immunotherapy.

Quantitative variables were described as mean, median, standard deviation and interquartile range (IQR), according to the Kolmogorov-Smirnov normality test; qualitative variables were expressed as frequency and percentage. Analysis was performed with Pearson's χ^2 test to establish differences in dichotomous qualitative variables, and with the U Mann-Whitnney test for freely distributed quantitative variables. In the multivariate analysis, logistic regression was used to identify the variables that were associated with the severity of the asthmatic crisis (dichotomous), for which those associated variables were identified. The resulting variables ($p<0.200$) were included in a multivariate logistic regression. Of all the analyzed variables, those with higher p values were eliminated from the model and the logistic regression was performed again using the remaining variables. The results were expressed as odds ratios (OR), with 95% confidence intervals (95% CI). The robustness of the model was assessed on the basis of the area under the ROC curve and the model assumptions were tested by calculating residuals. Prior to this analysis, the assumptions of linearity, independence of errors and multicollinearity were tested. A $p< 0.05$ was determined as significant. SPSS v.20 was used for data analysis.

The study was approved by the Local Health Research and Ethics Committee of the Mexican Institute of Social Security (IMSS) in Ciudad Obregon, Mexico; registration number R-2020-2601-014.

Results

A total of 148 patients were studied, most of them men (68%). The median age was 10 years (4 IQR) and the average body mass index was 18.9 ± 3.2 kg/m2. 78% of the patients had an age-appropriate BMI. It was observed that 67% of the patients who attended the emergency room lived in urban areas, and 61% were exposed to tobacco smoke. Table 1 shows the baseline characteristics of the population.

In the clinical presentation of asthmatic exacerbation, the most frequent symptom found was cough (65%), followed by wheezing (62%) and dyspnea (37%). On admission to the emergency room, patients had mild to moderate asthmatic exacerbation in 82% of cases, see Table 2.

Table 1. Baseline Characteristics of Participants

Characteristic (n=148)	
Age[a]	10 (4.0)
BMI[b]	18.9 ± 3.2
	n (%)
Sex	
Women	47 (32)
Men	101 (68)
BMI	
Underweight	5 (4.0)
Normal weight	116 (78)
Overweight	18 (12)
Obesity	9 (6.0)
Tobacco exposure	
Yes	91 (61)
No	57 (39)
Population	
Rural	49 (33)
Urban	99 (67)

a= median (interquartile range), b= mean and standard deviation.

Table 2. Clinical Presentation of Asthmatic Crisis

Characteristic (n=148)	n (%)
Cough	
Yes	96 (65)
No	52 (35)
Wheezing	
Yes	92 (62)
No	56 (38)
Dyspnea	
Yes	55 (37)
No	93 (63)
Fever	
Yes	46 (31)
No	102 (69)
Chest tightness	
Yes	37 (25)
No	111 (75)
Severity	
Mild	53 (36)
Moderate	68 (46)
Severe	27 (18)
Treatment	
Controller	53 (36)
Rescue	65 (44)
Immunotherapy	19 (13)

Prior to admission to the emergency room, 36% of the patients used inhaled steroid therapy, 44% beta-2 agonists rescue treatment, 13% immunotherapy, and 7% had no treatment. A significant association was found between exposure to tobacco smoke and severity of asthmatic exacerbation. Patients exposed to tobacco smoke were 10 times more likely to have a moderate to severe crisis (OR = 10.1, p<0.001). The remaining variables associated with asthma severity are specified in Table 3.

Table 4 shows the multivariate model, for this analysis the severity of the asthmatic crisis was dichotomized into mild and moderate-severe. Among the variables included in the model were previous exposure to tobacco smoke, obesity, gender, rural/urban population, use of rescue and controller treatment. In the end, tobacco exposure was found to be the only risk factor for moderate to severe illness, this variable alone explained 38% of variability in severity (r2 Nagelkerke 0.38, p<0.001).

Table 3. Variables Associated with Asthma Severity

Severity				
Variable	**Moderate -Severe (n=95)**	**Mild (n=53)**	**OR (IC 95%)**	**p**
BMI[a]	18.6 (4.6)	17.7 (4.3)	--	0.39[b]
Sex[c]				
Women	32 (34)	15 (28)	1.2 (0.6 a 2.6)	0.50[d]
Men	63 (66)	38 (72)		
Tobacco exposure[c]				
Yes	76 (80)	15 (28)	10.1 (4.6 a 22.1)	<0.001[d]
No	19 (20)	38 (72)		
Controller treatment[d]				
No	67 (71)	28 (53)	2.1 (1.1 a 4.2)	0.03[d]
Yes	28 (29)	25 (47)		
Rescue treatment[c]				
No	50 (53)	33 (62)	0.6 (0.3 a 1.3)	0.25[d]
Yes	45 (47)	20 (38)		
Population[c]				
Rural	32 (34)	17 (32)	1.0 (0.5 a 2.2)	0.84[d]
Urban	63 (66)	36 (68)		
Immunotherapy[c]				
Yes	10 (11)	9 (17)	0.5 (0.2 a 1.5)	0.26[d]
No	85 (89)	44 (83)		

a= mean (standard deviation), b= Mann-Whitnney U, c= frequency (percentage), d= Pearson χ^2, OR= odds ratio, 95% CI= confidence interval 95%.

Table 4. Multivariate Model of Associated Factors with Asthma Severity

Multivariate analysis		
Model	**OR (95% IC)**	**p**
Tobacco exposure	11.5 (4.8 a 27.2)	0.001
Obesity	7.6 (0.7 a 73.9)	0.07
Sex	1.0 (0.4 a 2.7)	0.84
Rural population	0.5 (0.2 a 1.4)	0.26
Rescue treatment	0.7 (0.3 a 1.7)	0.48
Controller treatment	1.7 (0.7 a 4.0)	0.21

OR= odds ratio, 95% CI= confidence interval 95%.
All covariates were included as categorical

Discussion

The most important finding of this research was the low frequency of controller treatment and the high exposure to tobacco smoke in the population, these two factors combined allow asthma exacerbation and lack of control of the disease. The frequency of these two factors could be the result of the interaction of multiple variables, such as low socioeconomic level, insufficient understanding of treatment, persistence of misconceptions about the disease, lack of agreement with the prescribed treatment between physicians and parents, among others.[13]

Asthma attacks occur as a reaction to an external agent or poor adherence

to treatment and are a frequent reason for visiting the emergency room. Initial treatment includes repeated administration of short-acting bronchodilators, inhaled or systemic corticosteroids, and controlled administration of oxygen. Occasionally, airflow reversibility does not occur and adjuvant therapies such as magnesium sulfate, theophylline, noninvasive ventilation, high-flow cannulas or endotracheal intubation are required.[14]

The use of asthma control medications reduces the risk of emergency room visits and hospitalization between 30% to 50%.[15,16] The use of inhaled corticosteroids has also been shown to be inversely related to re-hospitalization. Kenyon et al.[17] demonstrated a reduction in re-hospitalization in children who used inhaled steroids for three months after discharge. In agreement with this study, a significant association (bivariate analysis) was demonstrated between the severity of the asthmatic crisis and the lack of use of controller treatment, for this reason, education to prevent re-hospitalization focused on this treatment plays an important role in the control of the disease.

It was observed that patients who are exposed to tobacco smoke more frequently develop moderate to severe asthmatic exacerbation; this is consistent with other national studies that identify tobacco as an important triggering factor for asthmatic crisis.[18,19] Exposure to tobacco smoke (especially at home) has health consequences such as elevated risk of sudden infant death syndrome, early development of cardiovascular disease, atopic dermatitis, increased susceptibility to respiratory infections, and childhood bronchial asthma, not to mention effects on quality of life and school performance.[20,21] Exposure to tobacco smoke is a modifiable risk factor and education focused on minimizing or inhibiting that exposure can alleviate the economic burden of bronchial asthma and other smoking-related diseases.

At the time of admission to the emergency room, 95 of the 148 patients had moderate to severe respiratory distress; this differs from Zambrano et al,[22] who observed that 52% of the children were admitted to the emergency room with mild asthmatic crisis, which was associated with better family education to early identify the clinical data, since rescue management was initiated at home, thus avoiding the development of a severe asthmatic crisis. In this sense, the present study agrees with Hinojos-Gallardo et al.[18] who found that most children with asthma crisis in a hospital in central Mexico presented a moderate to severe episode. These results suggest the need for new health promotion interventions that are specific to pediatric populations, thus improving the influence that primary caregivers have in the adequate management of the disease.

In Mexico, a study conducted in the Pediatric Emergency Room of the National Institute of Respiratory Diseases (INER) identified that 63% of patients with acute crisis had not previously received supportive anti-inflammatory treatment for their condition;[18] this coincides with what was observed in our population, in which 71% of patients did not use controller treatment and their management plan was based almost exclusively on the rescue of acute asthma crises; this result is also observed in many regions of the world and is consistent in patients with poor medical control.[13-15]

The studied population maintains a good nutritional status, according to BMI-for-age, which decreases the risk of presenting severe asthmatic exacerbation at the time of admission to the emergency room; due to airway inflammation,[23] obesity is a risk factor for the development of asthma that influences the control and severity of symptoms, some studies indicate a directly proportional relationship between the severity of the asthma attack and the BMI level;[24,25] other studies hypothesize that chronic inflammation and oxidative stress in obesity may be the link between these two entities. [26] This risk factor is modifiable and actions to reduce weight represent a priority intervention in asthma that can improve symptoms and increase quality of life, especially at an early age.[27]

The main strength of this study is that it is the first research of its kind in the northwestern region of Mexico and represents a starting point for a research on asthma crises in the Yaqui Valley of Sonora, Mexico. The study was conducted in a hospital located in the south of Sonora, between the Gulf of California and the Sierra Madre Occidental; it is a region with intense agricultural activity and multiple ecosystems that harbor a great diversity of flora and fauna; for this reason, allergic diseases are a frequent reason for consultation. The climate is hot and dry with sporadic summer rains,[28] relative humidity averages 45% with an annual rainfall of 450 mm.[29]

This study has several limitations, such as the fact that it was conducted in a single hospital center and that there is a possible selection bias due to the seasonal variation of asthma and recruitment in a short period of time. In addition, there are other variables that influence the intensity of the exacerbation such as lack of access to health care, lack of infrastructure, highly variable asthma control, use of rescue treatment prior

to admission to the emergency room, low educational level of the parents and variability in the time of evolution of the asthmatic crisis; limited results were due to these data were not collected.

Conclusions

Asthmatic crisis is one of the main reasons for consultation in the pediatric emergency room and is a public health problem. The patients who attended the emergency room presented moderate to severe respiratory distress, the main symptom was cough, most of them did not use controller medication, and a high percentage used beta-2 agonist medication as the only treatment. The main factor for the severity of asthmatic exacerbation was exposure to tobacco smoke, which is a modifiable factor to decrease the number of hospital admissions. Health education on asthma, smoking and, particularly, that focused on treatment to prevent crises, represents the greatest area of opportunity discovered in this study, which will allow opening and expanding new lines of research in our region.

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