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ORIGINAL ARTICLE

Assessment of fractional exhaled nitric oxide in children with acute exacerbation of asthma

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ABSTRACT:

Background: Exhaled nitric oxide (eNO) measurement is a valuable tool in the management of asthmatics. The present study was conducted to assess fractional exhaled nitric oxide in children with acute exacerbation of asthma. **Materials & Methods:**58 children with acute exacerbation of asthmaof both genders were selected. History was taken and a physical examination, and pulse oximetry was performed. The pulmonary score was used to determine the severity of acute asthma. The child had spirometry and FENO testing. **Results:** Out of 58 patients, males were 32 and females were 26.Family history showed asthma in 27 and nasal allergy, or eczema in 31 patients. Baseline asthma severity showed intermittent asthma in 8, mild persistent asthma in 24, moderate persistent asthma in 16 and severe persistent asthmain 10 patients. Atopy (skin prick testing) showed positive to at least one allergen in 19 and positive to more than one allergen in 39 patients. The difference was significant (P< 0.05). The mean FENO at enrolment (ppb), minimum FENO(ppb) and acute exacerbation(ppb) in intermittent asthma was 14.2, 5.7 and 11.8, in mild persistent was 15.6, 8.3, and 21.3, in moderate persistent was 14.7, 8.9 and 15.7, and in severe persistent was 20.5, 12.7, and 20.4 respectively. **Conclusion:** FeNO levels rise from their minimum follow-up levels after an acute exacerbation. Nevertheless, no suitable cutoff that could aid in the diagnosis of an acute exacerbation could be found.

Keywords: Asthma, eczema, Exhaled nitric oxide

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INTRODUCTION

Exhaled nitric oxide (eNO) measurement is a valuable tool in the management of asthmatics. Nitric oxide (NO) is a gas produced by various cells in the body, including epithelial cells in the airways, and it plays a role in regulating airway inflammation and smooth muscle tone. In asthma, eNO levels can be elevated due to increased inflammation in the airways.[1]

Elevated eNO levels can help in diagnosing asthma, especially in patients with symptoms suggestive of asthma but inconclusive spirometry results.eNO levels correlate with airway inflammation in asthma.[2] Regular monitoring of eNO levels can help assess the degree of inflammation in the airways and guide treatment decisions. Lowering eNO levels through treatment indicates reduced airway inflammation.Studies have suggested that changes in eNO levels can precede asthma exacerbations. Monitoring eNO levels may help predict impending exacerbations, allowing for early intervention and prevention.[3,4]

Currently, the only functions of FENO in asthma are the detection of eosinophilic airway inflammation, the tracking of airway inflammation, and the probability of response to steroids. While FENO has been investigated in acute exacerbations, its application has been restricted to response to corticosteroids, emergency department disposition, and measurement repeatability.[5,6]The present study was conducted to assess fractional exhaled nitric oxide in children with acute exacerbation of asthma.

MATERIALS & METHODS

The present study consisted of 58 children with acute exacerbation of asthmaof both genders. Parents gave their written consent to participate in the study.Acute exacerbation was defined as recent increase in asthma symptoms requiring hospital visit and treatment with salbutamol and/or steroids.

Data such as name, age, gender etc. was recorded. History was taken and a physical examination, and pulse oximetry was performed. The pulmonary score was used to determine the severity of acute asthma. The child had spirometry and FENO testing.Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Total- 58		
Gender	**Male**	**Female**
Number	32	26

Table I shows that out of 58 patients, males were 32 and females were 26.

Table II Baseline characteristics

Parameters	Variables	Number	P value
Family history	Asthma	27	0.81
	nasal allergy, or eczema	31	
Baseline asthma severity	Intermittent asthma	8	0.75
	Mild persistent asthma	24	
	Moderate persistent asthma	16	
	Severe persistent asthma	10	
Atopy (skin prick testing)	Positive to at least one allergen	19	0.02
	Positive to more than one allergen	39	

Family history showed asthma in 27 and nasal allergy, or eczema in 31 patients. Baseline asthma severity showed intermittent asthma in 8, mild persistent asthma in 24, moderate persistent asthma in 16 and severe persistent asthma in 10 patients. Atopy (skin prick testing) showed positive to at least one allergen in 19 and positive to more than one allergen in 39 patients. The difference was significant (P< 0.05).

Graph I Baseline characteristics

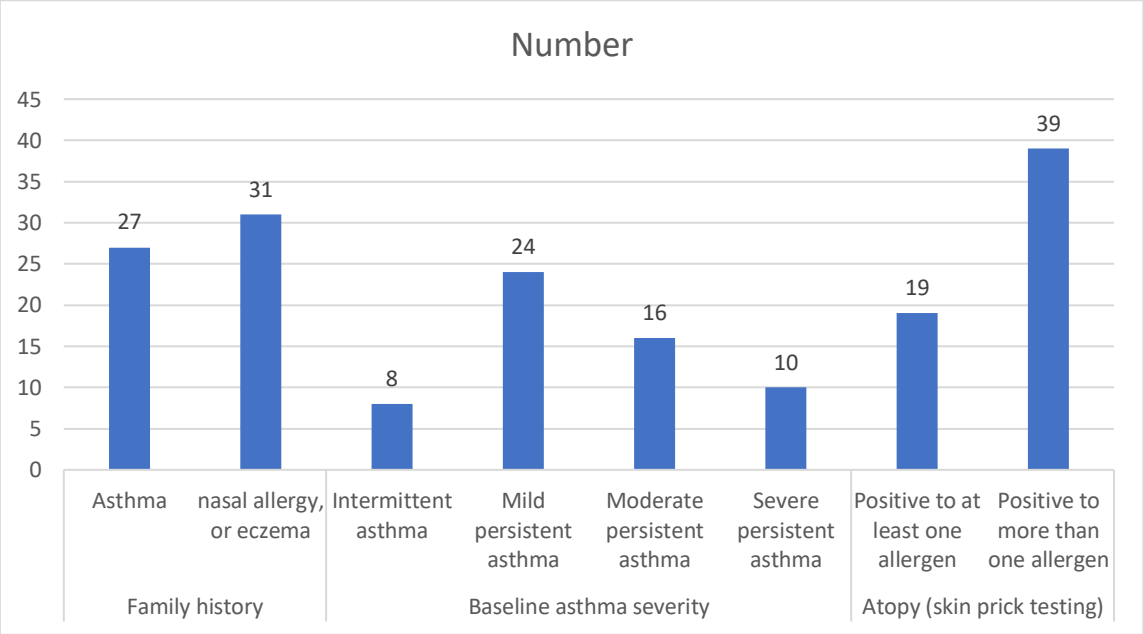

Table III Assessment of NIH asthma severity and FENO

Asthma severity	FENO at enrolment (ppb)	Minimum FENO (ppb)	Acute exacerbation (ppb)
Intermittent asthma	14.2	5.7	11.8
Mild persistent	15.6	8.3	21.3
Moderate persistent	14.7	8.9	15.7
Severe persistent	20.5	12.7	20.4
P value	0.85	0.02	0.81

Table III, graph I shows that mean FENO at enrolment (ppb), minimum FENO(ppb) and acute exacerbation(ppb) in intermittent asthma was 14.2, 5.7 and 11.8, in mild persistent was 15.6, 8.3, and 21.3, in moderate persistent was 14.7, 8.9 and 15.7, and in severe persistent was 20.5, 12.7, and 20.4 respectively.

DISCUSSION

eNO measurement can aid in determining the appropriate intensity of asthma treatment. High eNO levels may suggest the need for increased anti-inflammatory therapy, such as inhaled corticosteroids, while decreasing eNO levels may indicate successful treatment response.eNO monitoring allows for a more personalized approach to asthma management.[7] By tracking individual eNO levels over time, healthcare providers can tailor treatment plans to each patient's specific inflammatory profile.Persistent elevation of eNO levels despite treatment may indicate poor adherence to therapy. In such cases, healthcare providers can address adherence issues and provide additional support to improve treatment compliance.[8,9] We found that out of 58 patients, males were 32 and females were 26. Raj et al[10]determined whether fractional exhaled nitric oxide (FENO) has a utility as a diagnostic or predictive maker in acute exacerbations of asthma in children. Pulmonary function tests (PFT) and FENO were obtained at all visits. 243 asthmatic children were enrolled from

August 2009 to December 2011 [mean (SD) follow up - 434 (227) days]. FENO during acute exacerbations was not different from FENO during follow up; however, FENO was significantly higher than personal best FENO during follow up ($P < 0.0001$). FENO during acute exacerbation did not correlate with the severity of acute exacerbation (P=0.29). The receiver operating characteristics curve for FENO as a marker for acute exacerbation had an area under the curve of 0.59. Cut-off of 20 ppb had a poor sensitivity (44%) and specificity (68.7%) for acute exacerbation.

We found that family history showed asthma in 27 and nasal allergy, or eczema in 31 patients. Baseline asthma severity showed intermittent asthmain 8, mild persistent asthma in 24, moderate persistent asthma in 16 and severe persistent asthmain 10 patients. Atopy (skin prick testing) showed positive to at least one allergen in 19 and positive to more than one allergen in 39 patients. Baptist et al[11] in their study 35 adult ED patients with asthma completed the peak expiratory flow rate maneuver, forced expiratory volume in one second, and FE(NO) in triplicate. The coefficient of variation and the intraclass correlation coefficient were used to assess reproducibility. We looked into correlations between FE(NO), demographics, and conventional asthma measures. We examined the FE(NO) levels of patients who were discharged home and those who were hospitalized for additional care.Acceptable intraclass correlation coefficient and coefficient of variation values (0.98 and 9.42%, respectively) for reproducibility were shown by the FE(NO) measurements. The forced expiratory volume in one second and the peak expiratory flow rate were not as good as these figures. FE(NO) and conventional asthmatic variables did not correlate, however the duration of the asthma episode showed a tendency toward statistical significance (P =.08). The FE(NO)levels did not differ between those admitted and those discharged home (P = .53).

We observed that the mean FENO at enrolment (ppb), minimum FENO(ppb) and acute exacerbation(ppb) in intermittent asthma was 14.2, 5.7 and 11.8, in mild persistent was 15.6, 8.3, and 21.3, in moderate persistent was 14.7, 8.9 and 15.7, and in severe persistent was 20.5, 12.7, and 20.4 respectively.Jentzsch NS et al[12]assessed the difference in exhaled nitric oxide levels in atopic and nonatopic asthmatic patients treated with anti-inflammatory drugs, and to compare exhaled nitric oxide measurement with lung function tests. The patients were split into two groups: atopic ones (with positive skin tests) and nonatopic ones. The clinical and functional assessments and the measurement of exhaled nitric oxide were carried out concomitantly. There was a male predominance (62.5%), with an age range between 6 and 13 years (mean of 10.4 years) in 85% of the patients. Neither the symptoms associated with asthma ($p = 0.07$), allergic rhinitis ($p = 0.17$), food allergy ($p = 0.09$), necessity of systemic corticosteroids ($p = 0.10$), antileukotrienes ($p = 0.20$) and antihistamines ($p = 0.70$), nor the three parameters used to assess lung function (FEV1, FEV1/FVC and FEF25-75%, $p > 0.14$) were statistically significant. The frequency of eczema ($p < 0.005$) and exhaled nitric oxide levels ($p < 0.001$) were higher among atopic patients.

The limitation of the study is the small sample size.

CONCLUSION

Authors found that FeNO levels rise from their minimum follow-up levels after an acute exacerbation. Nevertheless, no suitable cutoff that could aid in the diagnosis of an acute exacerbation could be found.

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