Risk Factors, Clinical Features and Usefulness of PEFR in Asthmatic Children

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ABSTRACT

BACKGROUND

Asthma is a chronic inflammatory disorder of the airways characterized by an obstruction of airflow, which may be completely or partially reversed with or without specific therapy. We wanted to study the clinical features of bronchial asthma in children, determine the presence of risk factors among children with bronchial asthma, study the usefulness of PEFR in asthmatic children and observe its response to bronchodilator therapy.

METHODS

This is a hospital based observational study conducted among 86 children aged between 5 years and 15 years suffering from with bronchial asthma. Detailed history, clinical examination, investigations and the PEFR before and after salbutamol nebulization was recorded in symptomatic bronchial asthma children in 5-15 years of age group.

RESULTS

The incidence of bronchial asthma was more in children of more than 9 years of age. The male to female ratio was 1.38:1. Cough and breathlessness were the major presenting symptoms. The incidence of asthma was more in children of middle class comprising of 67%. The incidence was more in children living in urban areas when compared with children hailing from rural areas comprising of 62 and 24. The incidence was more in children born at term when compared with preterm children comprising of 76 and 10. The incidence was more in children delivered normally against LSCS comprising of 63 and 23. Bronchial asthma was seen in all the children irrespective of the feeding practices.

CONCLUSIONS

Bronchial asthma is a major respiratory disease in children which causes morbidity and prolonged treatment to control and prevent acute exacerbations. The incidence of bronchial asthma can be reduced by preventing major risk factors but, it may not be possible to completely prevent it.

KEYWORDS

Paediatric Asthma, Risk Factors, PEFR, Bronchodilator Therapy

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BACKGROUND

Asthma is a chronic inflammatory disorder of the airways characterized by an obstruction of airflow, which may be completely or partially reversed with or without specific therapy. Asthma is a common chronic disease of childhood and is the leading cause of childhood morbidity as measured by school absences, emergency department visits and hospitalizations.[1] WHO estimates that 235 million people currently suffer from asthma.[2] In India, there are currently more than 15 million people living with asthma.[3] A large multicentric study done in India, to estimate the prevalence of chronic respiratory diseases reported wide variations in the prevalence of bronchial asthma among different cities ranging from 0.37% in Secunderabad to 4.45% in Thiruvananthapuram (Kerala).[4] An estimated 1.9 disability adjusted life year are lost every year due to asthma per thousand children under 15 years of age in India.[5]

The proportion of Indian school children suffering from bronchial asthma has increased to more than double in the last 10 years.[6] The increase in prevalence of asthma in children may have serious implications in their adult life, as 40% of children with trivial wheeze and 70–90% of those with troublesome asthma continue to have symptoms in midadult life.[7] Children with asthma also have an increased risk of school absenteeism and hospitalizations when compared with unaffected children.[8] The risk of developing asthma depends on a variety of predisposing factors, both hereditary and environmental. Risk factors are: genetic predisposition (family history of atopy or asthma); perinatal factors (low birth weight, prematurity); exposure to a variety of allergens; upper respiratory tract infections; air pollution; tobacco smoke; diet and obesity.[9]

In children with asthma and other obstructive airway diseases, the expiration is prolonged, and lungs are over inflated leading to abnormalities in various lung volumes and capacities. Pulmonary function testing is an important tool in the diagnosis and management of Asthma, especially pulmonary function tests provide an objective and reproducible method to evaluate the disease and follow the response to therapy. In particular, PEFR measurement has gained worldwide acceptability as a method of recognition, assessment of severity and planning of therapy.[10] Asthma has been classified into 4 main categories based on the severity (mild intermittent, mild persistent, moderate persistent, and severe persistent) according to Global Initiative for Asthma (GINA) guidelines 2018.[11] Since asthma severity fluctuates over time and is influenced by many environmental trigger factors, an effort to reduce the modifiable risk factors would result in a reduction in the severity as well as overall prevalence of asthma. With proper evaluation of pulmonary function tests that can be used to monitor improvement, intervene early worsening and measure response to therapy.

We wanted to study the clinical features of bronchial asthma in children, determine the presence of risk factors among children with bronchial asthma, study the usefulness of PEFR in asthmatic children and observe its response to bronchodilator therapy.

METHODS

This is a hospital based observational study conducted among 86 children aged between 5 years and 15 years suffering from with bronchial asthma over a period of 2 Years.

Exclusion Criteria

1. Children < 5 years and children >15 years.
2. The patient with history of heart failure, abnormal chest radiography findings apart from hyper-inflated chest.
3. Children with life threatening asthma as defined by British Guidelines on Management of Asthma.
4. The patient with history of systemic disease influencing respiratory system.
5. The patient with history of major respiratory disease or thoracic surgery in the past.
6. Children with bronchiolitis.

Statistical Analysis

Detailed history, clinical examination, investigations and the PEFR before and after salbutamol nebulization was recorded in symptomatic bronchial asthma children between 5-15 years of age group. Data had been collected and entered in the Microsoft excel sheet. All analyses were done with IBM SPSS software Version 23.0. Descriptive statistics was done for analysis of the variables. Continuous variables were analysed by computing the means while categorical variables were analysed by computing frequencies. The means of PEFR before and after salbutamol nebulization were analysed by paired T test to find out the statistical significance. Value of $p < 0.05$ is considered as statistically significant.

RESULTS

Age Group	Frequency	%
5-6 years	10	12%
7-8 years	17	20%
9-10 years	26	30%
11-12 years	25	29%
13-15 years	8	9%
Total	86	100%

Table 1. Age Wise Distribution of Patients with Bronchial Asthma

Age wise distribution of bronchial asthma in children showed that the incidence was low below 9 years of age comprising of 32%. Maximum number of cases was reported above 9 years of age comprising of 59 cases (68%). It indicates that the incidence of bronchial asthma is more in children of more than 9 years. It also showed that the incidence of bronchial asthma is increasing with increase of age. Sex incidence of bronchial asthma, it was observed that 50 male children and 36 female children were found to have bronchial asthma comprising of 58% and 42% respectively.

It was observed that the incidence of asthma is more in male children. Analysis of symptomatology in patients with bronchial asthma, it was observed that cough was the commonest symptom comprising of 93% followed by breathlessness, wheeze, chest tightness and other symptoms comprising of 89%, 86%, 64% and 9% respectively. It showed cough and breathlessness are the major symptoms of bronchial asthma.

Evaluation of severity of bronchial asthma in children according to subjective assessment by following the guidelines of Expert Panel Report-3, it was observed that the incidence of intermittent asthma, mild asthma, moderate asthma and severe asthma comprising of 21 (24%), 28 (33%), 30 (35%) and 7 (8%) respectively. Analysis of incidence of bronchial asthma by considering the socio-economic factors by using Modified Kuppuswamy Scale[12] it was observed that the incidence was more in lower middle class and upper middle class comprising of 58 (67%) cases out of 86. 28 out of 86 cases were seen in children of lower class, upper lower class and upper class comprising of 33%. So, it is observed that the incidence of bronchial asthma is more in children of middle socio-economic status.

Analysis of the living conditions in children of bronchial asthma, it was found that the incidence was more in children hailing from urban areas comprising 62/86 (72%) against the children hailing from rural areas comprising of 24/86 (28%). So, it is the observation that the incidence of bronchial asthma is more in children of urban background for which a detailed study is required to know the exact cause for increased incidence. Analysis of relationship between bronchial asthma with gestational age, it was observed that the incidence of bronchial asthma is more in term children comprising of 88% as against 22% in preterm infants. So, there is no increased incidence of bronchial asthma in preterm infants. Analysis of mode of delivery in relation to incidence of bronchial asthma, it was found that the incidence was more in children born normally comprising of 63/86 (73%) as against the children born by LSCS with an incidence of 23/86 (27%). So significant number of children has developed bronchial asthma born by LSCS.

Sl. No.	Type of feeding	No. of Cases	%
1.	Exclusive breast feeding >6 months	23	27%
2.	Exclusive breast feeding <6 months	37	43%
3.	Artificial feeding	16	18%
4.	Both	10	12%

Table 2. Evaluation of Bronchial Asthma in Relation to Feeding Practices

Sl. No.	Triggering Factor	No. of Cases	%
1.	Allergens	52	60%
2.	Cold	45	52%
3.	Infections	42	49%
4.	Certain foods and preservatives	32	37%
5.	Exercise	22	26%
6.	No triggering factor	10	12%

Table 3. Analysis of Triggering Factors of Bronchial Asthma in Children

Analysis of influence of feeding in bronchial asthma showed that 23 cases (27%) were given exclusive breast milk for more than 6 months, 37/86 cases (43%) were given exclusive breast feeding for less than 6 months and only artificial feeding was given for 16 cases (18%). From the above analysis it was observed that there is no relationship of duration of breast feeding with incidence of bronchial asthma. From the above analysis it was observed that the allergens were the leading cause of bronchial asthma comprising of 60% followed by cold comprising of (52%), infections (49%), diet (37%), exercise (26%) and none in 12% of cases. So in all the cases studied, majority of children with bronchial asthma are having triggering factor for causing bronchial asthma. In some children, more than one risk factor was involved in causing bronchial asthma.

It was found that 45 cases (52%) were having seasonal incidence. Rest of 41 cases (48%) were not having any seasonal incidence so those patients were having attacks of bronchial asthma irrespective of seasons throughout the year. It was found that 46 patients were living in good surroundings, 21 patients were living in satisfactory surroundings and remaining 19 patients were living in poor surroundings. Out of 86 children, 67 patients were living in good and satisfactory living conditions. It indicates that the inflammatory conditions like auto immune disorders and asthma incidence increase when the infections are controlled as per "Hygiene hypothesis."[13]

From the above analysis, it was found pets were present in the house of 22 children and passive smoking was seen in 56 children. It indicates that passive smoking and presence of pets in house are definite predisposing factors for causing bronchial asthma. From the above analysis it was found that 28 children were having atopy and 24 children were having allergic rhinitis comprising of 33% and 28% respectively and rest of the children were not having any associated conditions.

Sl. No.	Family History	No. of Cases	%
1.	Only Parents	24	28%
2.	Only Grand parents	9	10%
3.	Only Siblings	12	14%
3.	Parents, siblings and grand parents	5	6%
4.	No family history	36	42%
	Total	86	100%

Table 4. Analysis of Family History of Bronchial Asthma

From the above analysis, it was found that 50 children out of 86 children were having the family history of bronchial asthma. Rest of the children were not having any family member suffering from bronchial asthma. So, bronchial asthma is not a genetic disorder but there is a familial tendency.

Sl. No.	Clinical Finding	No. of Cases	%
1.	Tachypnoea	86	100%
2.	Wheeze	86	100%
3.	Nasal flaring	30	35%
4.	Retractions	33	38%
5.	Crepitations	8	9%

Table 5. Analysis of Signs of Bronchial Asthma

On careful examination of the patient, it was found that all cases were having tachypnoea and wheeze. Rest of the patients were having nasal flaring in 30 cases, retractions in 33 cases and crepitations in 8 cases. All the children attending the paediatric ward evaluated by blood

examination, stool examination for any parasites and chest X ray.

Sl. No.	Laboratory Investigation	Normal	Abnormal
1.	Chest X Ray	49 (57%)	37 (43%)
2.	AEC	62 (72%)	24 (28%)
3.	Stool Microscopy	71 (83%)	15 (17%)

Table 6. Laboratory Evaluation of Bronchial Asthma

From the above analysis, it was observed out of 86 cases abnormal x-ray finding was observed in 37 cases in the form of hyper-inflated lung fields, depressed domes of diaphragm and increased intercostal spaces. Absolute eosinophil count was increased in 24 cases out of 86 cases comprising of 28%. Stool examination revealed presence of ova and cyst in 15 cases comprising of 17%. So, routine investigations are also important in evaluation of a case of bronchial asthma.

Sl. No.	Parameter	Mean	S.D.	Standard Error	p
1.	Pre PEFR	128.14	38.51	4.15	0.000
2.	Post PEFR	154.53	39.48	4.25	

Table 7. Analysis of Peak Expiratory Flow Rate Readings in Children of Bronchial Asthma

The peak expiratory flow rate was measured in all 86 children before and after administration of bronchodilator like salbutamol. It was observed that the mean PEFR with standard deviation before administration of bronchodilator was 128.14 ± 38.51 L/min and after administration of bronchodilator was 154.53 ± 39.48 L/min. Statistical analysis of measured PEFR before and after administration of bronchodilator was done by paired T test which had shown a highly significant P value of 0.000. The percentage of improvement of PEFR before and after administration of bronchodilator was 22.30% in asthmatic children.

DISCUSSION

This study was an observational study undertaken among children of 5 to 15 years of age who attended the out-patient department as well as those children admitted with symptoms and signs suggestive of bronchial asthma during a period of two years. All the children with asthma attending the out-patient department and admitted in the ward were thoroughly evaluated by taking detailed history and thorough physical examination. All the children with asthma were also evaluated by routine laboratory investigations like AEC, stool examination for ova and cyst and x-ray chest. Finally, all the children were studied by peak expiratory flow meter for measuring PEFR before and after inhalation of salbutamol. In the present study maximum numbers of cases were reported above 9 years of age comprising of 59 cases (68%) and the incidence below 9 years of age was 32%. It indicates that the incidence of bronchial asthma is more in children of more than 9 years of age. The mean age of this distribution is 9.61 years. This finding was similar to the finding of the study conducted by Gupta et al.[14] Where the prevalence of asthma was more in age group of 10-15 years when compared to 5-10 years of age group which had low prevalence. In the present study the most common symptom was recurrent cough which was observed in 80 children consisting of 93% followed by breathlessness comprising of 89% and wheeze comprising of 86%. So according to this study the major symptoms of bronchial asthma were cough, breathlessness and wheeze. Studies done by A. Krishna Prasad et al.[15] Gosai Dhara K et al.[16] and Seshagiri K et al.[17] had observed cough, breathlessness and wheeze as the most common symptom which was present in majority of the cases they studied. The analysis of the present study regarding the presenting features of cough and breathlessness was similar to the observations of the above authors. In the present study majority of children were graded under moderate persistent asthma consisting of 35%. Less number of children was graded under severe persistent asthma consisting of 8%. This finding is similar to a hospital based descriptive study conducted by A. Krishna Prasad et al.[15] who had observed 34/100 (34%) as moderate persistent, 26/100 (26%) as intermittent asthma and 13/100 (13%) suffering from severe asthma.

Shivakumar R et al.[18] study conducted a cross sectional study at a tertiary health care centre had observed majority of children were having Moderate persistent- 35.36% followed by Mild persistent in 26.82%; Severe persistent - 21.95%; intermittent persistent -15.85%.

Cross-sectional study conducted among school children in Srinagar by Qureshi UA et al.[19] observed majority of children had intermittent asthma (78.3%). Mild persistent asthma was seen in 12.7% and 10% had moderate persistent asthma. None of the children had severe persistent asthma. The present study was conducted in the hospital where the patients used to come with severe respiratory problems to the hospitals after taking preliminary medication at their native places was in correlation with the hospital based studies conducted by A. Krishna Prasad et al.[15] and Shivakumar R et al.[18] The incidence of asthma severity in the present study was not in correlation with the study of Qureshi UA et al.[19] Which was a community based study. The hospital study may not reflect the magnitude of the problem in the society and it only indicates the severity of asthma. In the present study it was observed that the incidence was more in lower middle class and upper middle class comprising of 58 (67%) cases out of 86. 28 out of 86 cases were seen in children of lower class, upper lower class and upper class comprising of 33%. This finding of the study was in correlation to the findings of studies done by A. Krishna Prasad et al.[15] who had observed majority of cases in middle class comprising of 58 cases (58%) followed by lower class and upper class consisting of 34 (34%) and 8 cases (8%). In the present study most of the children were from urban areas consisting of 72%. This observation was similar to the observation of the studies of A. Krishna Prasad et al.[15] with more number of cases hailing from urban areas comprising of 54% and in Srinivasa K et al.[20] study urban predominance was observed with 80% of cases from urban areas. The increased incidence of bronchial asthma in children of urban background has to be evaluated for which

a detailed study is required to know the exact cause for increased incidence.

In the present study incidence of bronchial asthma is more in term children comprising of 88% as against 12% in preterm infants. Ali Al-Eryaniet al.[21] study had observed asthma in 14/50 cases comprising of 28%. So there is no relationship of the incidence of bronchial asthma in children of low birth weight. In the present study it was found that the incidence was more in children born normally comprising of 63/86 (73%) as against the children born by LSCS with an incidence of 23/86 (27%). The incidence of bronchial asthma appear to be more in children born normally because large number of children were delivered normally. Sizeable number of children delivered by LSCS had bronchial asthma. H. Renz-Polste ret al.[22] study had observed a significant association between children delivered through LSCS and increased incidence of asthma in them. In the present study observation of influence of feeding in bronchial asthma showed that 23 cases (27%) were given exclusive breast milk for more than 6 months, 37/86 cases (43%) were given exclusive breast feeding for less than 6 months and only artificial feeding was given for 16 cases (18%). It indicates there is no influence of decreasing the incidence of bronchial asthma in children who were given exclusive breast feeding. EaJelding-Dannemand et al.[23] Study had observed that exclusive breast feeding has no effect on development of sensitization in early childhood or associated diseases like eczema, atopy, allergic rhinitis and asthma at school age in at-risk children. The most common triggering factor for an acute attack of asthma in the present study is exposure to allergens observed in 60% of cases followed by cold and infections which were observed in 52% and 42% of cases respectively. Study done by Balaji MD et al.[24] observed most factors which trigger an attack were dust, cold and exercise. Study done by ShivaKumar R et al.[18] had observed exposure to cold air and dust as the major precipitating factor.

Seshagiri K et al.[17] study had observed cold and upper respiratory infections as the important precipitating factor for an acute attack of asthma. In the present study it was found that 45 cases (52%) were having seasonal incidence. Rest of 41 cases (48%) were not having any seasonal incidence. Satish Kumar et al.[25] study had observed seasonal variation among 10 out of 48 children study consisting of 20.8%. Qureshi UA et al.[19] study had observed the incidence of bronchial asthma in any age group is more common in winter seasons starting from November to February where the viral infections are more which are the triggering factors for bronchial asthma. In the present study it was found 53% of children with good surroundings around house had bronchial asthma followed by satisfactory surroundings consisting of 24% and poor surroundings around house consisting of 23%. This observation was similar to study done by Amir M et al.[26] at Agra who had seen more number of cases in children who had good surroundings around house consisting of 55% and with satisfactory and poor surroundings around house in 25% and 20% respectively. According to "Hygiene Hypothesis"[13] suggest that increases in the prevalence of autoimmune and allergic diseases result from a decrease in the prevalence of childhood infections and improved hygiene. In the present study, the incidence of bronchial asthma was more in the children who are living in good hygienic surroundings. In the present study it was found pets were present in the house of 22 children (26%) and passive smoking was seen in 56 children (65%). This observation was similar to the studies done by Qureshi UA et al.[19] who had observed pets in the household of 22.7% of cases and passive smoking in children of 60.5%. Amir M et al.[26] study had observed pets in the household of 13.7% of cases and passive smoking in children of 32.7%.Weitzmann M et al.[27] and Strachan DP et al.[28] observed that the incidence of bronchial asthma was more in children exposed to tobacco smoke in the family.

In the present study it was found that 33% of children were associated with atopic diseases and 28% of children were associated with allergic rhinitis. Ali Al-Eryaniet al.[21] and Amir M et al.[26] studies had observed significant association between asthma and atopic diseases and allergic rhinitis. Atopy and allergic rhinitis are one of the triggering factors for bronchial asthma. Family history of asthma was observed in 50 of 86 children studied consisting of 58% in the present study. Ali Al-Eryaniet al.[21] study 43/50 cases studied consisting of 86%. K. Kavitha et al.[29] and Ravikumar P et al.[30] studies had observed significant association between asthma and family history of asthma. In the present study significant number of children was having bronchial asthma with family history of bronchial asthma. It indicates that there is a familial tendency of bronchial asthma which requires detailed investigation to know the exact cause of bronchial asthma. In the present study tachypnoea and wheeze was the most common finding which was observed in all the cases. Seshagiri K et al.[17] study had observed similar finding in their study. In the present study chest X ray abnormal was observed in 43% of children, elevated absolute eosinophil count was seen in 28% of children and stool microscopy was abnormal in 17% of children.

So the routine investigations in the present study slightly deferred from the study of other authors because these investigations are not specific for confirmation of bronchial asthma. In the present study the mean PEFR before and after administration of bronchodilator had shown improvement of 22.30% and when it was analysed by paired T test and had shown significance. This observation was in correlation with the study of Seshagiri K et al.[17] and Srinivasa K et al.[20] The finding of the present study was in correlation with findings of other authors because the PEFR is a good investigation to assess the functional capacity of the lungs.

CONCLUSIONS

The incidence of bronchial asthma was more in children of more than 9 years of age. The incidence was more in male children comprising of 58% when compared with female children which was 42%. The male to female ratio was 1.38:1. Cough and breathlessness were the major presenting symptoms of bronchial asthma. All the types of

bronchial asthma were observed during the study ranging from mild intermittent to severe persistent asthma. Mild persistent, moderate persistent and severe asthma were observed more in number comprising of 65/86 because it is a hospital study. The incidence of asthma was more in children of middle class comprising of 67%. The incidence was more in children living in urban areas when compared with children hailing from rural areas comprising of 62 and 24. The incidence was more in children born at term when compared with preterm children comprising of 76 and 10. So, preterm is not a major risk factor for causing bronchial asthma.

The incidence was more in children delivered normally against LSCS comprising of 63 and 23. The incidence of bronchial asthma appear to be more in children born normally because large number of children were delivered normally. Sizeable number of children delivered by LSCS had bronchial asthma. Bronchial asthma was seen in all the children irrespective of the feeding practices. Breast feeding which is supposed to be protective in many diseases is not having any such influence in bronchial asthma. Triggering factors like allergens, cold, infections, diet and exercise are all responsible for causing bronchial asthma, but allergens and cold are the major triggering factors. All the above precipitating factors can be reduced in reducing the incidence of bronchial asthma which may not be totally preventable. So, there is a seasonal factor for causing bronchial asthma in the present study mainly seen during the winter months where the infection rate is more. In the present study it was observed that the incidence of bronchial asthma is more in children who were living in good surroundings which is following the law of "Hygiene hypothesis." Children exposed to passive smoking and pets in the family are the definite triggering factors for bronchial asthma as observed in present study which can totally be preventable.

Presence of existing atopy and allergic rhinitis in the children of bronchial asthma are the predisposing factors as observed in this study. It is the observation in the present study that there is a familial tendency of developing bronchial asthma in children. Tachypnoea and wheeze were the leading examination findings in bronchial asthma. Routine investigations like blood examination, stool examination and x-ray chest are complimentary to PEFR. There is an increase of 22.30% of PEFR after nebulisation with 0.5% solution of salbutamol in children with bronchial asthma. Bronchial asthma is a major respiratory disease in children which causes morbidity and prolonged treatment to control and prevent acute exacerbations. The incidence of bronchial asthma can be reduced by preventing major risk factors but, it may not be possible to completely prevent it.

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