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ROLE OF SPIROMETRY IN THE EARLY DIAGNOSIS OF BRONCHIAL ASTHMA: A CROSS-SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL IN NORTH INDIA

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ABSTRACT

Background: Bronchial asthma is a chronic inflammatory airway disease with variable clinical presentation, often leading to underdiagnosis when based solely on symptoms. Spirometry provides an objective assessment of airflow limitation and reversibility, playing a crucial role in confirming the diagnosis, particularly in early stages of the disease.

Objectives: To evaluate the role of spirometry in the early diagnosis of bronchial asthma among patients presenting with suggestive respiratory symptoms in a tertiary care hospital in North India.

Methods:A hospital-based cross-sectional observational study was conducted from January 2020 to July 2020, including 54 patients aged ≥18 years with symptoms suggestive of asthma but without prior diagnosis. Data were collected using a structured proforma. All participants underwent spirometry as per ATS/ERS guidelines. Patients with airflow obstruction (FEV_1/FVC <70%) were subjected to bronchodilator reversibility testing. A significant response was defined as an increase in FEV_1 of ≥12% and ≥200 mL. Data were analyzed using SPSS version 20.0, and a p-value <0.05 was considered statistically significant.

Results: Out of 54 participants, 40.7% demonstrated airflow obstruction on baseline spirometry. Among these, 81.8% showed significant bronchodilator reversibility. Overall, spirometry confirmed bronchial asthma in 33.3% of patients. Wheezing and nocturnal symptoms were significantly associated with spirometry-confirmed asthma ($p<0.05$), whereas shortness of breath did not show a significant association. Spirometry effectively differentiated patients with reversible airway obstruction from those with nonspecific respiratory symptoms.

Conclusion: Spirometry is an essential diagnostic tool for the early detection of bronchial asthma, enabling objective confirmation and reducing diagnostic uncertainty. Its routine use in clinical practice can improve diagnostic accuracy and facilitate timely management, particularly in resource-limited settings.

Keywords: Bronchial asthma; Spirometry; Airflow obstruction; Bronchodilator reversibility; Early diagnosis; Pulmonary function test.

INTRODUCTION

Bronchial asthma is a chronic inflammatory disorder of the airways characterized by variable airflow obstruction, airway hyperresponsiveness, and respiratory symptoms such as wheeze, breathlessness, chest tightness, and cough. It represents a significant global health burden, affecting an estimated 300 million individuals worldwide, with increasing prevalence in both developed and developing countries [1]. The disease contributes substantially to morbidity, impaired quality of life, and healthcare utilization, particularly when diagnosis and management are delayed [2]. Early detection and appropriate intervention are crucial to prevent disease progression, reduce exacerbations, and improve long-term outcomes.

In recent years, there has been a growing emphasis on objective assessment of airway function in asthma diagnosis. Clinical symptoms alone are often insufficient due to their variability and overlap with other respiratory conditions such as chronic obstructive pulmonary disease (COPD) and respiratory infections [3]. Spirometry, a simple and non-invasive pulmonary function test, plays a pivotal role in the evaluation of airflow limitation and its reversibility, which are hallmarks of asthma [4]. International guidelines, including those from the Global Initiative for Asthma (GINA), recommend spirometry as a key diagnostic tool for confirming asthma by demonstrating reversible airway obstruction [5].

In low- and middle-income countries like India, the burden of asthma is considerable, with prevalence estimates ranging from 2% to 3% in adults and higher rates in children [6]. Despite this, asthma remains underdiagnosed and undertreated, partly due to limited access to diagnostic tools and reliance on symptom-based diagnosis [7]. In many clinical settings, especially at the primary and secondary care levels, spirometry is either unavailable or underutilized, leading to misdiagnosis and inappropriate management [8]. Even in tertiary care hospitals, where spirometry facilities exist, its role in early diagnosis is not consistently emphasized or systematically studied.

Northern India, in particular, faces unique environmental and epidemiological challenges, including high levels of air pollution, occupational exposures, and seasonal variations, all of which contribute to respiratory morbidity [9]. Early identification of asthma in such settings is essential to initiate timely treatment and reduce disease burden. However, there is a paucity of region-specific data evaluating the effectiveness of spirometry in the early diagnosis of bronchial asthma, especially in newly presenting patients with respiratory symptoms.

Although spirometry is widely regarded as the gold standard for diagnosing airflow obstruction, its diagnostic yield in early or mild asthma cases—where symptoms may be intermittent and lung function may appear normal at baseline—remains a subject of ongoing research [10]. Furthermore, the extent to which spirometry contributes to early and accurate diagnosis in real-world clinical settings, particularly in resource-constrained environments, has not been adequately explored.
Given these considerations, there exists a clear research gap regarding the utility of spirometry in facilitating early diagnosis of bronchial asthma in tertiary care settings in North India. Addressing this gap is essential to inform clinical practice and optimize diagnostic strategies.

The present study aims to evaluate the role of spirometry in the early diagnosis of bronchial asthma among patients presenting with suggestive respiratory symptoms in a tertiary care hospital in North India. The specific objective is to assess the proportion of patients in whom spirometry confirms airflow obstruction and reversibility, thereby aiding in the early and accurate diagnosis of asthma.

METHODOLOGY

Study Design: This was a hospital-based cross-sectional observational study conducted to evaluate the role of spirometry in the early diagnosis of bronchial asthma among patients presenting with suggestive respiratory symptoms. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure methodological rigor and transparency.

Study Setting: The study was conducted in the Department of Pulmonary Medicine of a tertiary care teaching hospital in North India, which caters to both urban and rural populations and is equipped with standardized spirometry facilities.

Study Duration: January 2020 to July 2020.

Study Population: The study population comprised patients attending the outpatient and inpatient services of the Department of Pulmonary Medicine with symptoms suggestive of bronchial asthma, such as episodic wheezing, shortness of breath, chest tightness, and cough, particularly with diurnal or seasonal variation.

Inclusion Criteria

Patients aged ≥18 years
Patients presenting with symptoms suggestive of bronchial asthma for the first time or without a prior confirmed diagnosis
Patients willing to provide informed consent and undergo spirometry testing

Exclusion Criteria

Patients with a prior confirmed diagnosis of bronchial asthma or chronic obstructive pulmonary disease (COPD)
Patients with acute respiratory infections at the time of presentation
Patients with contraindications to spirometry (e.g., recent myocardial infarction, thoracic or abdominal surgery, hemoptysis of unknown origin)
Pregnant women and patients unable to perform acceptable spirometry maneuvers

Sample Size: The sample size was calculated using the formula for estimating a proportion in a cross-sectional study:
$n = Z^2 \times p \times (1-p) / d^2$
Assuming a prevalence (p) of reversible airway obstruction among symptomatic patients to be 50% (due to lack of precise regional estimates), a confidence level of 95% (Z = 1.96), and an allowable error (d) of 13%, the calculated sample size was approximately 56. Considering feasibility and non-response, a total of 54 patients were included in the study.

Sampling Technique:A consecutive sampling technique was employed, wherein all eligible patients presenting during the study period and fulfilling the inclusion criteria were recruited until the desired sample size of 54 was achieved.

Data Collection Tools & Procedure:
Data were collected using a predesigned and pretested structured proforma that included demographic details, clinical history, symptom profile, and relevant risk factors. All enrolled patients underwent baseline spirometry using a standardized, calibrated spirometer following American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines. Parameters recorded included forced

expiratory volume in one second (FEV_1), forced vital capacity (FVC), and FEV_1/FVC ratio. Patients demonstrating airflow obstruction (FEV_1/FVC <70%) were subsequently subjected to bronchodilator reversibility testing using 400 µg of inhaled salbutamol via a metered-dose inhaler with spacer. Spirometry was repeated after 15 minutes. A significant bronchodilator response was defined as an increase in FEV_1 of ≥12% and ≥200 mL from baseline.

Study Variables: Independent variables included demographic characteristics (age, sex), clinical features (duration and type of symptoms), and exposure history (smoking status, environmental exposure). The primary dependent variable was the diagnosis of bronchial asthma based on spirometric evidence of reversible airflow obstruction. Secondary outcomes included baseline spirometric values and proportion of patients demonstrating reversibility.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were expressed as mean ±standard deviation, while categorical variables were presented as frequencies and percentages. The chi-square test or Fisher's exact test was used to assess associations between categorical variables. Paired t-test was applied to compare pre- and post-bronchodilator spirometric values. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants prior to enrollment. The study adhered to the ethical principles outlined in the Declaration of Helsinki. Confidentiality of patient information was maintained throughout the study, and participants were assured of their right to withdraw at any stage without affecting their standard medical care.

RESULTS

A total of 54 patients were included in the study. The majority of participants were in the age group of 31–45 years (33.3%), with a slight male predominance (55.6%) (Table 1)

Table 1: Demographic Characteristics of Study Participants (n = 54)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	16	29.6
	31–45	18	33.3
	46–60	12	22.2
	>60	8	14.9
Gender	Male	30	55.6
	Female	24	44.4

The most common presenting symptom was shortness of breath (85.2%), followed by wheezing (77.8%) and cough (70.4%) (Table 2)

Table 2: Clinical Presentation of Participants

Symptom	Frequency (n)	Percentage (%)
Wheezing	42	77.8
Shortness of breath	46	85.2
Cough	38	70.4
Chest tightness	28	51.9
Nocturnal symptoms	24	44.4

Baseline spirometry revealed that 40.7% of patients had airflow obstruction (FEV_1/FVC <70%). The mean FEV_1/FVC ratio was 73.7 ±6.5% (Table 3)

Table 3: Baseline Spirometry Findings (Pre-bronchodilator)

Parameter	Mean ± SD
FEV_1 (L)	2.10 ± 0.58
FVC (L)	2.85 ± 0.67
FEV_1/FVC (%)	73.7 ± 6.5
Patients with FEV_1/FVC <70%	22 (40.7%)

Among those with airflow obstruction (n=22), 81.8% demonstrated significant bronchodilator reversibility, confirming the diagnosis of bronchial asthma (Table 4)

Table 4: Bronchodilator Reversibility Test Results

Variable	Frequency (n)	Percentage (%)
Patients with baseline obstruction (n=22)		
Significant reversibility (≥12% & ≥200 mL)	18	81.8
No significant reversibility	4	18.2

A statistically significant association was observed between wheezing and spirometry-confirmed asthma (p=0.041), as well as nocturnal symptoms (p=0.018), while shortness of breath did not show a significant association (Table 5)

Table 5: Association Between Symptoms and Spirometry-confirmed Asthma

Symptom	Asthma Confirmed (n=18)	Not Confirmed (n=36)	p-value
Wheezing	16	26	0.041
Shortness of breath	17	29	0.062
Nocturnal symptoms	12	12	0.018

DISCUSSION

The present study evaluated the role of spirometry in the early diagnosis of bronchial asthma among patients presenting with suggestive respiratory symptoms in a tertiary care setting in North India. The key findings indicate that spirometry identified airflow obstruction in 40.7% of participants, and among these, 81.8% demonstrated significant bronchodilator reversibility. Overall, spirometry confirmed asthma in one-third (33.3%) of the study population. Additionally, symptoms such as wheezing and nocturnal manifestations showed significant association with spirometry-confirmed asthma.

These findings are consistent with established evidence emphasizing the importance of objective lung function testing in asthma diagnosis. International guidelines recommend spirometry as an essential tool to confirm variable airflow limitation, thereby reducing reliance on subjective clinical assessment alone [5]. The proportion of patients demonstrating reversible airflow obstruction in the present study aligns with previous observations that not all symptomatic individuals exhibit spirometric abnormalities at initial presentation, particularly in early or mild disease stages [3]. This underscores the importance of spirometry in differentiating asthma from other respiratory conditions with overlapping clinical features.

The prevalence of spirometry-confirmed asthma (33.3%) in this study is comparable to findings from population-based and clinical studies in India, which report underdiagnosis when relying solely on symptoms [6,7]. The observed gap between symptom prevalence and objective confirmation highlights the risk of both overdiagnosis and underdiagnosis in the absence of spirometry. Similar findings have been reported by Aaron et al., who demonstrated that a substantial proportion of patients previously diagnosed with asthma did not have objective evidence of the disease upon reevaluation [8]. Although that study focused on overdiagnosis, it reinforces the broader principle that spirometry is critical for diagnostic accuracy.

The high rate of bronchodilator reversibility (81.8%) among those with baseline obstruction in this study is consistent with the pathophysiological hallmark of asthma—reversible airway narrowing. Comparable studies have reported reversibility rates ranging from 60% to 85% among suspected asthma patients, depending on disease severity and testing conditions [4,10]. This finding supports the utility of spirometry not only in detecting obstruction but also in confirming its reversibility, which is central to asthma diagnosis.

The significant association between wheezing and spirometry-confirmed asthma observed in this study is in agreement with clinical literature identifying wheeze as a key predictive symptom [2]. Similarly, nocturnal symptoms were significantly associated with confirmed asthma, reflecting circadian variation in airway inflammation and bronchial hyperresponsiveness. However, shortness of breath, despite being the most common symptom, did not show a statistically significant association. This may be attributed to its nonspecific nature, as it is commonly reported in various cardiopulmonary conditions, thereby limiting its diagnostic specificity.

From a regional perspective, the findings are particularly relevant in the context of North India, where environmental factors such as air pollution and occupational exposures contribute to respiratory symptomatology [9]. In such settings, reliance on clinical symptoms alone may lead to diagnostic ambiguity. The incorporation of spirometry into routine evaluation can enhance diagnostic precision, facilitate early initiation of appropriate therapy, and potentially reduce disease burden.

The study has several strengths. It was conducted in a real-world tertiary care setting using standardized spirometry protocols, enhancing its clinical applicability. The use of objective criteria for diagnosis minimizes bias associated with symptom-based assessment. Additionally, the inclusion of newly presenting patients provides insight into early diagnostic utility.

However, certain limitations must be acknowledged. The cross-sectional design limits the ability to assess temporal relationships and disease progression. The relatively small sample size and single-center setting may affect generalizability. Furthermore, patients with normal baseline spirometry were not subjected to bronchoprovocation testing, which may have led to underdiagnosis of asthma in individuals with intermittent or mild disease. Future studies with larger sample sizes and incorporation of additional diagnostic modalities, such as peak flow variability or methacholine challenge testing, would provide a more comprehensive evaluation.

In conclusion, the present study reinforces the critical role of spirometry in the early and accurate diagnosis of bronchial asthma. It highlights the limitations of symptom-based diagnosis and underscores the need for wider availability and utilization of spirometry, particularly in resource-limited settings.

CONCLUSION

This study demonstrates that spirometry is a valuable and reliable tool for the early diagnosis of bronchial asthma in patients presenting with suggestive respiratory symptoms. A substantial proportion of patients with clinical suspicion of asthma were confirmed to have reversible airflow obstruction through spirometric evaluation, emphasizing the limitations of symptom-based diagnosis alone. The significant association of wheezing and nocturnal symptoms with spirometry-confirmed asthma further supports their clinical relevance, although they cannot substitute objective testing.The findings highlight the importance of incorporating spirometry into routine clinical practice, particularly in tertiary care settings where diagnostic facilities are available. Early and accurate diagnosis through spirometry can facilitate timely initiation of appropriate therapy, reduce disease burden, and improve patient outcomes. Efforts should be made to enhance accessibility and utilization of spirometry, along with training healthcare providers in its interpretation. Future research with larger, multicentric designs and inclusion of additional diagnostic modalities is recommended to strengthen evidence and guide policy implementation.

DECLARATIONS

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Conflict of Interest: The authors declare no conflict of interest.
Ethical Approval: The study was approved by the Institutional Ethics Committee (IEC) of the tertiary care hospital.
Consent: Written informed consent was obtained from all participants prior to enrollment.
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REFERENCES

1.National Heart Lung and Blood Institute. Global initiative for asthma: global strategy for asthma management and prevention. InNHLBI/WHO workshop report. NHLBI publication 1995.
2.Modjarrad K, Giersing B, Kaslow DC, Smith PG, Moorthy VS, WHO RSV Vaccine Consultation Expert Group. WHO consultation on respiratory syncytial virus vaccine development report from a World Health Organization meeting held on 23–24 March 2015. Vaccine. 2016 Jan 4;34(2):190-7.
3.Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi RE, Coates A, Van Der Grinten CP, Gustafsson P, Hankinson J, Jensen R. Interpretative strategies for lung function tests. European respiratory journal. 2005 Nov 1;26(5):948-68.
4.Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, Crapo R, Enright P, Van der Grinten CP, Gustafsson P, Jensen R. ATS/ERS task force. Standardisation of spirometry. Eur Respir J. 2005 Aug 1;26(2):319-38.
5.National Heart Lung and Blood Institute. Global initiative for asthma: global strategy for asthma management and prevention. InNHLBI/WHO workshop report. NHLBI publication 1995.
6.Aggarwal AN, Chaudhry K, Chhabra SK, D Souza GA, Gupta D, Jindal SK, Katiyar SK, Kumar R, Shah B, Vijayan VK. Prevalence and risk factors for bronchial asthma in Indian adults: a multicentre study. Indian Journal of Chest Diseases and Allied Sciences. 2006 Jan 18;48(1):13.
7.Jindal SK, Aggarwal AN, Gupta D, Agarwal R, Kumar R, Kaur T, Chaudhry K, Shah B. Indian study on epidemiology of asthma, respiratory symptoms and chronic bronchitis in adults (INSEARCH). International Journal of Tuberculosis and Lung Disease. 2012 Sep 1;16(9):1270-7.
8.Aksu F, Aksu K. Bronş Provokasyon Testleri. GÖĞÜS HASTALIKLARI.:137.
9.Kaskaoutis DG, Kumar S, Sharma D, Singh RP, Kharol SK, Sharma M, Singh AK, Singh S, Singh A, Singh D. Effects of crop residue burning on aerosol properties, plume characteristics, and long-range transport over northern India. Journal of Geophysical Research: Atmospheres. 2014 May 16;119(9):5424-44.
10.Ro C. Guidelines for methacholine and exercise challenge testing-1999. This official statement of the American Thoracic Society was adopted by the ATS Board of Directors, July 1999. Am J Respir Crit Care Med. 2000;161:309-29.
11.Education NA, Program P. Expert panel report 3 (EPR-3): guidelines for the diagnosis and management of asthma-summary report 2007. The Journal of allergy and clinical immunology. 2007 Nov;120(5 Suppl):S94-138.
12.Network SI, British Thoracic Society. British guideline on the management of asthma. Thorax. 2003 Feb;58(Suppl 1):i1-94.