

Original Article

Comparative Analysis of Measured Outcomes of Acute Asthma Patients in Karachi Undergoing Treatment with Inhaled β Agonists with or without Corticosteroids

Improvement in Pulmonary Function in Acute Asthma by Post Bronchodilator Affectivity

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ABSTRACT

Objective: To compare the outcome in acute asthma patients post treatment with inhaled beta agonists alone or in combination with corticosteroids.

Study Design: Prospective cohort study.

Place and Duration of Study: This study was conducted at the Medicare Cardiac & General Hospital, Karachi, from October 2024-till July 2025.

Methods: Out of a total of hundred patients with symptoms of asthma visiting OPD, were recommended spirometry test by the Pulmonologist. By spirometry, pulmonary functions were recorded, forced vital capacity, and forced expiratory volume in one second. Forced expiratory volume in one second/ forced vital capacity. Graph 1, 2 represent normal or obstructive lung diseases.

Results: General characteristics of these participants normal and asthmatic were, male(n=62) female (n= 38), age (mean: 31 + 12 vs 44± 15.9 years) , ethnicity of both groups were same(Pakistani), BMI (mean 23.58± 0.6 vs 27.17± 4.52 kg/ m²) shown in table 1. Pulmonary function test by spirometry was performed to record FVC, FEV₁, FEV₁/ FVC, PEF for groups with normal function and asthma patients t test was applied to compare both groups in table 1. Changes recorded in FEV₁/ FVC ratio post bronchodilator administered inhaled salbutamol alone (mean 75.96 ± 4.9), compared to salbutamol and corticosteroids (mean 79.82 ± 1.23) significance was determined by applying t –test (p < 0.005) table 2.

Conclusion: The study concludes that the outcomes of acute asthma treatment with inhaled β agonists in combination with inhaled corticosteroids were much better as compared to beta agonist alone.

Key Words: Spirometry, bronchodilators, beta agonists, corticosteroids

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INTRODUCTION

Asthma is now a serious global health issue, respiratory symptoms are wheezing, productive cough, chest tightness, and shortness of breath¹, and these are typical features of Asthma. Spirometry serves as a valuable tool in diagnosis and management of asthma and COPD.² It is one of most common respiratory obstructive diseases in different ethnicity all over the world¹. People suffering from asthma are in all age ranges³.

Asthma prevalence worldwide has seen a rapid increase in last few decades⁴. Studies³⁻⁵ have shown that asthma prevalence has rapidly increased in various regions of the world⁴. Nearly 4.3% population of Pakistan are suffering from asthma². Rise in asthma patients in Pakistan are similar to other countries in the south Asia. The rise of seasonal asthma cases is particularly notable in certain regions of the country². Majority of the recurrent episodes of asthma are caused by various indoor and outdoor allergens in air. Although some other risk factors are leading to occupational asthma due to unhealthy work surroundings, the major factors are environmental pollution and stressful life, contributing significantly to the rapid rise in asthma cases⁸. According to Global initiative for asthma (GINA) – guidelines² and recommendations, therapeutics for asthma³ are inhaled β 2-agonists, corticosteroids, muscarinic antagonists, leukotriene inhibitors, and some other expensive options as well but asthma still remains difficult to manage. The Pakistan Chest Society regularly revises its asthma guidelines, placing emphasis on training doctors and educating patients. The allergy and asthma institute Pakistan

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(AAIP) conducted a research and provides training for both academic and clinical practice in this field⁵. The AAIP is currently researching asthma, allergies and other chronic respiratory diseases (CRDs) in Pakistan, in association with the Respiratory Health Institute in the UK⁵. Asthma has been identified as serious health issue leading to frequent hospital admissions and results in heavy financial burden for lower income countries such as Pakistan. According to the WHO data published in 2020⁶, deaths due to asthma reached a staggering 20,750 or 1.42% of total deaths⁸ in Pakistan. A range of etiological factors, such as social and environmental factors that influence health, genetic susceptibility and outdoor air pollution, plays a role in asthma morbidity and mortality. Among these the deteriorating air quality index across the country requires particular attention as a major contributor to Asthma-related morbidity⁷. Airway inflammation in asthma is present in both central and peripheral airways. Hence optimal pulmonary deposition of medication is an important factor in achieving effective therapeutic outcomes⁴. The bronchial smooth muscle is directly supplied by the parasympathetic nervous system associated with muscarinic receptor stimulation and cause of bronchoconstriction³. Although the airways do not receive direct sympathetic innervation, the bronchi are rich in beta-2 adrenergic receptors. Therefore, both cholinergic and adrenergic receptors are important targets in bronchodilator therapy. Bronchodilation can occur through two main mechanisms³. First, stimulation of beta-2 adrenergic receptors directly relaxes bronchial smooth muscle. Second, muscarinic receptor antagonists (anticholinergic drugs) competitively block the action of acetylcholine at cholinergic receptors, leading to smooth muscle relaxation and subsequent bronchodilation³.

In acute asthma attack, patients often use short acting beta agonists (SABAs) after short intervals, numerous times⁹. However, SABA alone has poor effect on bronchial airway inflammation, and frequent usage of SABA's is linked to poor asthma control and a higher risk of severe exacerbations, fixed dose albuterol-budesonide has shown⁹ better asthma management. As severe asthma attack (status asthmaticus) is associated with significant morbidity and mortality, therefore, prevention of exacerbations is a critical priority in the asthma management. According to a study done in UK⁹ patients with uncontrolled moderate to severe asthma who were already receiving different inhaled glucocorticoid-based maintenance therapies, the risk of severe asthma exacerbations was lower with a fixed dose combination of 180 ug albuterol and 160 ug budesonide compared with albuterol alone. In 2021 a retrospective study was done at the Aga Khan University Hospital, Karachi, Pakistan, in which one hundred and fourteen children aged 6-11 years old, were participants. The participants were divided into 3

groups, 1st group with low dose, long-acting beta agonist-inhaled corticosteroid (LABA-ICS), 2nd group with very low dose formoterol-ICS, 3rd group with medium dose ICS and Inhaled corticosteroids-leukotriene receptor antagonists (ICS-LTRA). It was a comparative study conducted on pediatric asthma patients of three therapeutic option¹⁰. Among the three treatment groups, ICS- LABA group patients had the best values of Forced expiratory volume in one second and forced expiratory volume in 1 second /Forced vital capacity ratio after pulmonary function tests at 3 months follow-up as compared to ICS-LTRA and ICS group¹⁰.

However, the efficacy and side effects of SABA and inhaled corticosteroids combination remains unknown in acute asthma adult population of Karachi, Pakistan. In this study the effectiveness and outcome of β -Agonists and inhaled corticosteroids and their effects on FEV1, pulmonary function tests in the population were observed. In primary care, spirometry plays very important role in the diagnosis and management of COPD and asthma. In a study¹², the spirometry data, collected from asthma patients was compared with data collected from individuals who were nonsmokers without lung diseases. The lung size is larger in males than in females of the same age, height, and ethnicity. The study was aimed to compare the improvement in spirometry values (Forced expiratory volume in 1 second, forced vital capacity, and ratio of Forced expiratory volume in 1 second /Forced vital capacity) between patients treated with: Beta agonists alone and Combination therapy (beta agonists + corticosteroids). Second treatment modality leads to the more significant improvement in pulmonary function parameters in acute asthma patients in Karachi.

METHODS

Setting: Medicare Cardiac & General Hospital.

Study Design: Prospective cohort study.

Participants: Patients with symptoms asthma, Karachi.

Sample Size: 100 participants, with symptoms of asthma (cough, wheeze).

Sampling technique: convenience sampling.

Bronchodilation: Participants divided into groups inhaled salbutamol with or without corticosteroids.

Outcome Measures: bronchodilation, there were statistically significant differences in Forced expiratory volume in 1 second, forced vital capacity, and ratio of Forced expiratory volume in 1 second /Forced vital capacity among the two treatment groups after a standard intervention.

Data Collection: Medical records review, patient history, spirometry test and follow-up assessments.

Inclusion criteria: Participants must have a confirmed diagnosis of asthma as per established diagnostic criteria, with characteristics of asthma such that are

recurrent wheezing, coughing, chest tightness, and variable airflow obstruction.

Exclusion Criteria: All patients with respiratory diseases other than asthma, including chronic obstructive pulmonary disease (COPD) or restrictive lung diseases (cystic fibrosis) were excluded to ensure homogeneity of the study population.

Spirometry: By use of portable spirometer, maintain an upright posture throughout the process. Securing the mouthpiece firmly to prevent any air leaks. After 2 puffs of salbutamol or combination wait for 10-15 min before recording the values.

Interpretation: -

FEV1/FVC ratio

- FEV1/FVC < 70% (or less than the Lower limit of normal): Obstructive Pattern (COPD, Asthma)
- $\geq 70\%$: Normal or Restrictive disease

Statistical Analysis: The data of hundred participants was entered in SPSS Version 25.0. Descriptive analysis variables were age, gender, BMI, FVC, FEV1, FVC/FEV1, PEF for two groups. By applying t-test for

pre and post bronchodilator response in groups (Pre and Post Salbutamol alone or salbutamol and corticosteroid therapy).

Ethical Considerations & ERC approval: Approval was obtained from the Ethical Review Board (ERB), Sohail University prior to the commencement of the study. Informed consent was obtained from all participants. Protocol #: 00032/24.

RESULTS

A total of hundred patients with asthma visiting Medicare Cardiac and General hospital between October 2024 to July 2025 were recommended spirometry by pulmonologist. Baseline characteristics of these patient's gender, age, ethnicity, BMI are shown in Table 1. Pulmonary function test by portable spirometer to record FVC, FEV1, FEV1/ FVC, PEF for both groups pre and post salbutamol alone and with inhaled corticosteroids as given in Table 2. Improvement in post bronchodilator response was observed more significantly in combination group (Post Inhaled beta agonist and corticosteroids group).

Table No.1: Baseline Characteristics of participants

VARIABLES N=100	Normal	Asthma	p-value
Age(years)	16- 60 (mean 31 \pm 12.61)	12 – 63 (mean 44 \pm 15.9)	<0.00*
Gender M:F	30:20	24: 26	0.2
Ethnicity	Pakistani	Pakistani	0.1
BMI (m ² /kg)	24 \pm 0.6 (mean 23.58 \pm 0.6)	27 \pm 4.52 (mean 27.17 \pm 4.52)	<0.00*
SPIROMETRY			
FVC (L)	2.89 – 5.17 (mean 3.98 \pm 0.60)	1.28 \pm 3.70 (mean 2.19 \pm 0.45)	<0.00*
FEV ₁ (L)	1.49- 4.89 (mean 3.63 \pm 0.75)	1.05- 1.30 (mean 1.87 \pm 0.77)	<0.00*
FEV ₁ / FVC (%)	70- 89 (mean 72.84 \pm 8.15)	51- 67 (mean 66.6 \pm 14.98)	<0.00*
PEF (L)	3. 00- 9.02 (mean 6.33 \pm 1.68)	1.38 – 5.79 (mean 3.79 \pm 1.26)	<0.00*

*p-value – 0.05 was considered statistically significant.

Table No.2: Pulmonary function tests as recorded by performing spirometry before & Post-bronchodilator therapy

Spirometry FEV ₁ /FVC	Pre-Bronchodilator Response (%)	Post-Bronchodilator Response (%)	P-value
Inhaled Salbutamol group (n =35) (mild- severe obstruction)	51 – 67 (mean 66.96 \pm 12)	67-90 (mean 75.96 \pm 4.9 1)	<0.00*
Inhaled Salbutamol+ Steroids (n =35) (mild- severe obstruction)	52- 69 (mean 66.96)	70- 90 (mean 79.82 \pm 123)	<0.00*
Inhaled Salbutamol group (n =35) Inhaled Salbutamol+ Steroids (n =35)	51 – 67 (mean 66.96 \pm 12) 52- 60 (mean 66.96)	67-90 (mean 75.96 \pm 4.9 1) 70- 90 (mean 79.82 \pm 123)	<0.00*

*p-value – 0.05 was considered statistically significant. t-test was applied.

DISCUSSION

Total of hundred patients with asthma symptoms were included in this study. The age range of all participants was between 12-63 years, and male: female ratio was found 2:1. The range of FVC was normal vs asthma (mean 3.98 \pm 0.6 vs 2.19 \pm 0.45 L), FEV₁ (mean 3.63 vs 1.87 L) and FEV₁/FVC (mean 73% vs 67 %) for spirometry. Improvement in FEV1/FVC bronchodilation, salbutamol alone pre and post (mean

67 vs 76%) as compared to combination group pre and post (mean 67% vs 80%) respectively. Inhaled therapy salbutamol and corticosteroids had a greater advantage with least adverse effects. The use of inhaled salbutamol and corticosteroids together gave significant improvement in outcome of the two groups (moderate-severe) asthma. As it has been shown by study¹² inhaled bronchodilators having several advantages over oral and intravenous routes of administration.

Post corticosteroid and salbutamol therapy had shown to improve pulmonary function in 80-100% of these

patients. Whereas Salbutamol alone improvement seen in 70-90% only. Spirometry¹¹⁻¹² was found to be a useful tool in diagnosis of lung diseases and severity of asthma (mild- moderate- severe) and the effectivity of bronchodilation. It is advised to bring in a pulmonary function technologist from an affiliated pulmonary lab to offer education and mentorship. Additionally, it is essential that personnel conduct testing regularly to maintain proficiency and ensure quality results. In this study well trained PFT technologist performed the tests. Thus, study shows, spirometry is beneficial tool to determine the outcome of therapy of beta 2 agonist and ICS, as a bronchodilator they increase lung vital capacity, forced expiratory volume in one second in moderate – severe asthma patients. Study done by Sim et al¹³ reported that patients with lung disease, severity and intensity by performing spirometry was a beneficial tool.¹³

The difference in lung size between gender, age, racial differences in lung capacity must also be considered when performing spirometry testing. Most notably patients of African and south Asian origin are expected to have smaller lungs than Caucasians, Latinos and North Asian population. Studies has shown¹⁴⁻¹⁵ that the great beneficial effects of inhaler used in lung diseases not only benefit the pharmacokinetics; absorption, distribution, bioavailability also more clinical safe. Inhalation therapy with corticosteroids and long-acting β₂-agonists are very important in asthma management.¹⁵⁻¹⁶ Forced expiratory volume in one second is most beneficial measured by spirometry for assessment of therapy outcome for improvement in pulmonary functions .¹⁷ Study ¹⁸ shows combination of beta agonists with corticosteroids are more beneficial in reducing the risk of acute respiratory distress syndrome by reducing inflammation and lung secretions. Beta agonist alone do not reduce inflammation and secretions and higher dose can lead to adverse-effects¹⁹. ICS are unavailable or not affordable in low- and middle-income countries, uncontrolled asthma has been one of major cause of morbidity and mortality, arrangements should not be non- affordable ²⁰.

CONCLUSION

The study concludes, in acute asthma therapy compared to beta agonists alone, combination of inhaled beta agonists and corticosteroids combination has shown much results.

Author’s Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Noor-ul-Ain Kiran, Samia Perwaiz Khan
Drafting or Revising Critically:	Noor-ul-Ain Kiran, Nousheen Iqbal
Final Approval of version:	All the above authors
Agreement to accountable	All the above authors

for all aspects of work:	
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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