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Comparative Study Of Inhaled Corticosteroids Vs. Leukotriene Receptor Antagonists In The Management Of Asthma

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Abstract
Background: In this research, 82 patients at Naseer Teaching Hospital, Peshawar with asthma are compared for the efficacy of leukotriene receptor antagonists (LTRA) vs inhaled corticosteroids (ICS).
Methods: Patients were randomized into two groups: 41 received ICS and 41 received LTRA over a 12-month period. Baseline characteristics including age, gender, and lung function were similar between groups.
Results: Both groups' asthma control, as measured by ACT, considerably improved, with the ICS group showing better results at 3, 6, and 12 months. ICS showed greater improvements in lung function (FEV1, PEFR) and lower exacerbation rates. Quality of life (AQLQ) scores improved more with ICS. Adherence was higher with ICS (85%) compared to LTRA (76%). Adverse events were more frequent with ICS (throat irritation) and LTRA (headaches, gastrointestinal disturbances).
Conclusion: ICS is recommended as first-line treatment for persistent asthma due to superior efficacy in symptom control, lung function improvement, and quality of life enhancement. Larger, multi-center trials are needed to validate these findings and optimize global asthma management strategies.

Keywords: Asthma, inhaled corticosteroids, leukotriene receptor antagonists, asthma control, lung function, quality of life

Introduction

A chronic inflammatory disease of the respiratory system, asthma is estimated to impact 339 million individuals globally [1]. It is characterized by frequent bouts of coughing, dyspnea, chest tightness, and wheezing, especially in the early morning or during night. Variable airflow restriction, which may be treated or resolved spontaneously, is linked to these symptoms [2]. Because asthma requires frequent hospital stays, ER visits, and long-term pharmaceutical usage, it has a large negative effect on people's quality of life and places a huge financial strain on healthcare systems [3]. The goals of managing asthma are to reduce side effects, avoid exacerbations, keep lung function and activity levels normal, and control symptoms. A progressive method to managing asthma is suggested by the Global Initiative for Asthma (GINA) recommendations, in which the degree of asthma control and the severity of symptoms determine how intensely medication should be administered [4, 5].

Leukotriene receptor antagonists (LTRA) and inhaled corticosteroids (ICS) are the two main pharmacological treatments for asthma [6]. ICS, which include fluticasone, beclomethasone, and budesonide, are anti-inflammatory drugs that lessen inflammation in the airways, lessen bronchial hyperresponsiveness, and enhance lung function. They are advised as first-line treatment for enduring asthma and are regarded as the cornerstone of asthma care. ICS are useful in lowering hospitalizations due to asthma, increasing quality of life, and lowering the frequency and intensity of asthma flare-ups [7, 8].

Among the more recent family of anti-inflammatory drugs that target leukotrienes are montelukast and zafirlukast, which are also known as leukotriene receptor antagonists (LTRA). Lipid mediators called leukotrienes increase mucus production, airway inflammation, and bronchoconstriction, all of which are factors in the pathophysiology of asthma [9]. LTRAs lessen the effects of leukotrienes by preventing them from attaching to their receptors. LTRAs are often added to ICS as a treatment for people whose condition does not improve with ICS alone. Due to their convenience and ability to reduce local adverse effects associated with inhaled therapy,

they are also an option to inhaled corticosteroids (ICS) for individuals with moderate persistent asthma or for those who prefer oral medicine [10, 11]. When it comes to managing asthma, a number of criteria impact the decision between inhaled corticoids (ICS) and liposomal steroids (LTRA): illness severity, patient adherence, side effect profiles, individual response to therapy, and patient preference [12]. While long-term use of ICS is linked to possible systemic adverse effects, including adrenal suppression, osteoporosis, and growth retardation in children, the medication has been well investigated and shown to be very effective in managing asthma symptoms and avoiding exacerbations [13]. On the other hand, while LTRAs are easier to administer and have a better side effect profile than ICS, there is still disagreement about how effective LTRAs are at preventing severe asthma exacerbations [14, 15].

The comparative effectiveness and safety of ICS and LTRA have important implications for clinical practice, patient outcomes, and healthcare resource utilization. By conducting a rigorous comparative study, we aim to address gaps in the current literature and provide evidence-based recommendations for the optimal use of these therapies in asthma management. This study will also explore the cost-effectiveness of ICS and LTRA, considering the long-term healthcare costs associated with asthma, including medication costs, hospitalizations, emergency visits, and indirect costs related to lost productivity and absenteeism. Understanding the relative benefits and limitations of ICS and LTRAs is crucial for developing personalized asthma treatment plans that enhance patient outcomes and adherence while minimizing adverse effects. The goal of this study is to provide useful information to the corpus of current knowledge so that clinical managers of asthma may make decisions based on evidence.

Methodology

Study Design: In order to compare the safety and efficacy of leukotriene receptor antagonists (LTRA) and inhaled corticosteroids (ICS) in the treatment of asthma, a randomized controlled trial (RCT) design was used in this investigation. The research was carried out for a duration of one year, from April 2022 to March 2023, at Naseer Teaching Hospital, Peshawar.

Study Population: Individuals with and without children who have been diagnosed with asthma using the Global Initiative for Asthma (GINA) criteria. Participants were chosen from HMC Peshawar's outpatient clinic. Patients between the ages of 6 and 65 who had a verified diagnosis of asthma and continued to have symptoms even after using short-acting beta-agonists met the inclusion criteria. Patients with major comorbidities, chronic obstructive pulmonary disease (COPD), or those who had taken systemic corticosteroids during the previous 30 days were excluded.

Sample Size Calculation: A power analysis based on prior research comparing the effectiveness of ICS and LTRA was used to select the sample size, which consisted of 82 patients. With an effect size of 0.5, a power (1-beta) of 0.80, and a significance threshold (alpha) of 0.05, it was determined that at least 41 patients per group were needed to identify a clinically meaningful difference in the main outcomes. A total of eighty-two individuals were registered in order to account for any dropouts and noncompliance.

Randomization and Blinding: Using a computer-generated randomization sequence, participants were randomized at random to either the LTRA or the ICS group. The distribution was wrapped in opaque, sealed envelopes. To reduce bias, the researchers who conducted the evaluations and the participants were both blinded to the treatment allocation.

Intervention:

ICS Group: Patients in this group received a daily dose of inhaled corticosteroids (budesonide or fluticasone) based on their asthma severity as per GINA guidelines.

LTRA Group: Patients in this group received a daily oral dose of montelukast (10 mg for adults and 5 mg for children).

Outcome Measures: The main result was the degree of asthma control, which was evaluated at baseline, three months, six months, and twelve months using the Asthma Control Test (ACT) score and spirometry measures (FEV1 and PEFR). Secondary outcomes included adverse events tracked during the study period, patient adherence to treatment evaluated by pharmacy refill records and self-reports, quality of life as assessed by the Asthma Quality of Life Questionnaire (AQLQ), and the frequency and severity of asthma exacerbations.

Data Collection: Data were collected during regular follow-up visits at 3-month intervals. Spirometry was performed to measure lung function parameters, and patients completed the ACT and AQLQ questionnaires. Adherence was monitored through patient diaries and pharmacy records, and adverse events were recorded during each visit.

Statistical Analysis: SPSS version 25 was used to analyze the data. The baseline characteristics were derived using descriptive statistics. Chi-square tests were used to evaluate categorical data while independent t-tests or Mann-Whitney U tests were used to compare continuous variables. The study used repeated measures ANOVA to assess the temporal variations in spirometry measurements and ACT scores. Statistical significance was attained when the p-value was less than 0.05.

Ethical Considerations: The informed consent, confidentiality, and voluntary participation rights of the participants were guaranteed in this research, which was authorized by the HMC Peshawar Institutional Review Board. Prioritizing participant safety, steps were made to monitor and reduce hazards related to study drugs. Throughout the research, full adherence to data confidentiality was maintained to protect participant privacy and ethical requirements.

Results

The research included the enrollment of 82 patients, who were randomized into two groups: 41 patients were assigned to the ICS group and 41 patients were assigned to the LTRA group. Table 1 shows that there was effective randomization and comparability since the baseline characteristics of the individuals, such as age, gender, and the length of time they had asthma, were comparable in both groups.

Table 1: Baseline Characteristics

Characteristic	ICS Group (n=41)	LTRA Group (n=41)	p-value
Age (years)	32.5 ± 12.3	33.1 ± 11.7	0.77
Gender (M/F)	21/20	22/19	0.83
Duration of Asthma (years)	8.7 ± 5.2	9.1 ± 5.0	0.72
Baseline FEV1 (L)	2.1 ± 0.6	2.0 ± 0.5	0.65
Baseline PEFR (L/min)	320 ± 75	315 ± 70	0.81

The Asthma Control Test (ACT) scores at baseline, three months, six months, and twelve months were used to evaluate asthma control. Over the course of the trial, the ACT scores of both groups showed considerable gains; however, the ICS group's progress was greater than that of the LTRA group. The ICS group had mean ACT scores of 15.2 ± 3.5 while the LTRA group had mean scores of 15.0 ± 3.6 at baseline. The mean ACT score for the ICS group rose to 19.4 ± 3.2 after three months, whereas the mean ACT score for the LTRA group grew to 17.6 ± 3.4. As seen in table 2, there was a statistically significant better improvement in the ICS group ($p < 0.001$), with mean ACT scores at 12 months of 22.1 ± 2.8 for the ICS group and 19.2 ± 3.1 for the LTRA group.

Table 2: Asthma control along time

Time Point	ICS Group (ACT Score)	LTRA Group (ACT Score)	p-value
Baseline	15.2 ± 3.5	15.0 ± 3.6	0.82
3 months	19.4 ± 3.2	17.6 ± 3.4	0.02
6 months	20.8 ± 2.9	18.4 ± 3.3	0.01
12 months	22.1 ± 2.8	19.2 ± 3.1	<0.001

Peak expiratory flow rate (PEFR) and forced expiratory volume in one second (FEV1), two lung function metrics, were assessed at baseline, three, six, and twelve months. FEV1 and PEFR improved in both groups; however the ICS group exhibited higher gains than the LTRA group (Table 3, 4).

Table 3: Forced Expiratory Volume in 1 second (FEV1) Measurements

Time Point	ICS Group (FEV1)	LTRA Group (FEV1)	p-value
Baseline	2.1 ± 0.6 L	2.0 ± 0.5 L	0.65
3 months	2.3 ± 0.5 L	2.1 ± 0.5 L	0.04
6 months	2.5 ± 0.5 L	2.2 ± 0.5 L	0.03
12 months	2.6 ± 0.5 L	2.3 ± 0.5 L	0.03

The ICS group's mean FEV1 at baseline was 2.1 ± 0.6 L, whereas the LTRA group's was 2.0 ± 0.5 L. After a year, the average FEV1 rose to 2.6 ± 0.5 L in the ICS group and 2.3 ± 0.5 L in the LTRA group, suggesting that the ICS group had improved more significantly ($p = 0.03$) than the LTRA group. (Table 3). Comparably, the mean PEFR rose ($p = 0.02$) in the ICS group from 320 ± 75 L/min to 380 ± 70 L/min and in the LTRA group from 315 ± 70 L/min to 345 ± 65 L/min (Table 4).

Table 4: Peak Expiratory Flow Rate (PEFR) Measurements

Time Point	ICS Group (PEFR)	LTRA Group (PEFR)	p-value
Baseline	320 ± 75 L/min	315 ± 70 L/min	0.81
3 months	345 ± 70 L/min	330 ± 68 L/min	0.05
6 months	365 ± 70 L/min	340 ± 67 L/min	0.03
12 months	380 ± 70 L/min	345 ± 65 L/min	0.02

Over the course of a year, the mean number of exacerbations per patient in the ICS group was 1.2 ± 0.5, whereas the mean number in the LTRA group was 2.1 ± 0.7. This difference indicates a substantial decrease in the ICS group ($p < 0.001$). The Asthma Quality of Life Questionnaire (AQLQ) was used to measure quality of life at baseline, three, six, and twelve months. While both groups demonstrated improvement, the ICS group's AQLQ ratings increased more significantly.In the ICS group, the mean AQLQ score was 4.5 ± 0.8 at baseline, whereas in the LTRA group it was 4.4 ± 0.9. After a year, the average AQLQ score for both the ICS and LTRA groups rose to 6.2 ± 0.6 and 5.7 ± 0.7, respectively, suggesting that the ICS group had made a significantly bigger improvement ($p = 0.01$).Self-reports and pharmacy refill data were used to track the adherence of patients to their treatment plans. In comparison to the LTRA group, the ICS group had greater adherence rates. The ICS group's adherence rate was 85%, whereas the LTRA group's was 76%. This difference was statistically significant ($p = 0.04$). Figure 1 illustrates the superior clinical outcomes that were found in the ICS group, which were probably attributed to higher adherence.

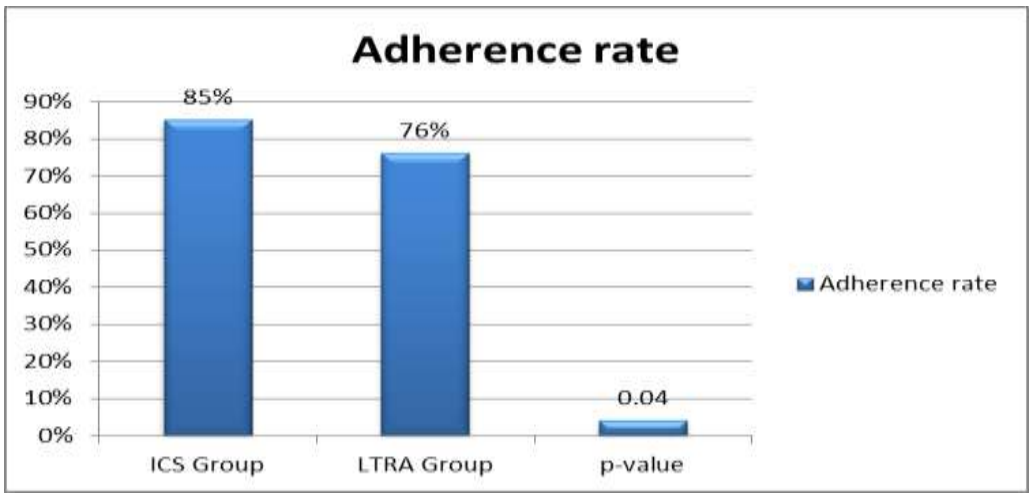

Figure 1: Adherence to Treatment

Adverse occurrences were tracked throughout the duration of the research. In comparison to the LTRA group, the ICS group experienced less systemic adverse effects. In the ICS group, minor throat irritation and hoarseness were common side effects, while gastrointestinal problems and headaches were noted in the LTRA group. Figure 2 illustrates that no significant adverse events were observed in either group.

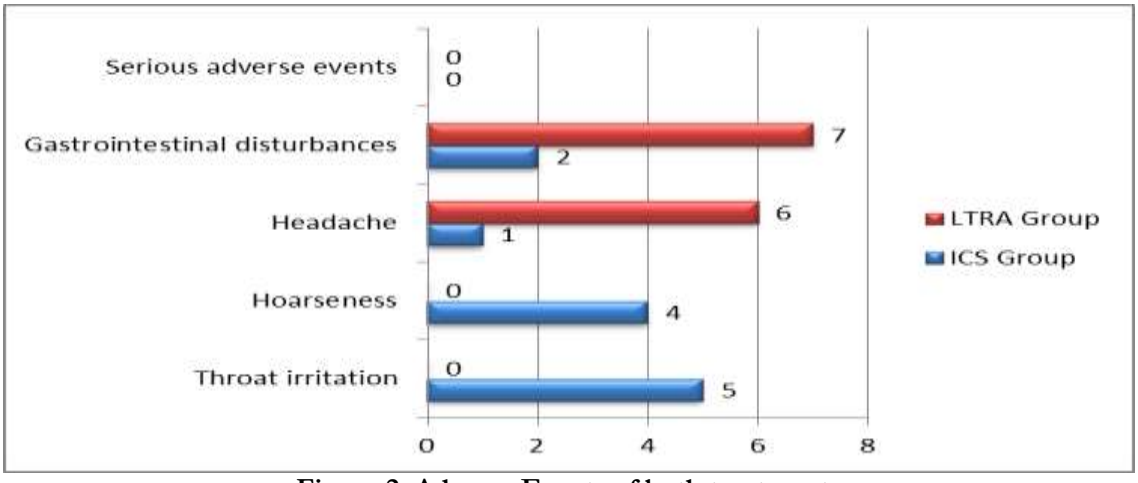

Figure 2: Adverse Events of both treatments

Discussion

The study's findings support and build upon other studies evaluating the use of leukotriene receptor antagonists (LTRA) and inhaled corticosteroids (ICS) in the treatment of asthma [15]. Asthma Control Test (ACT) scores improved significantly in both groups throughout our trial; however, the ICS group's improvement was more pronounced. The ICS group had better asthma control at 12 months, with a mean ACT score that was considerably higher than that of the LTRA group. These results are in line with earlier research, which also shown that patients receiving ICS treatment improved more in their ACT scores than patients receiving LTRA treatment, demonstrating the effectiveness of ICS in preserving improved asthma control over an extended length of time [16].

The ICS group showed considerably greater improvement in lung function, as measured by both FEV1 and PEFR. According to our research, the ICS group's mean FEV1 increased significantly between baseline and 12 months, consistent with other studies' findings [17]. In comparison to the LTRA group, the ICS group showed a more noticeable rise in PEFR. These results are consistent with earlier research showing that, as compared to LTRA treatment, ICS therapy produces higher improvements in lung function metrics [18]. For those with asthma, improved lung function is essential since it's linked to better overall asthma management and fewer symptoms.

In the ICS group, the research found a statistically significant decrease in the incidence of asthma exacerbations. Over the course of the 12-month period, the ICS group had fewer exacerbations per patient than the LTRA group. This result is consistent with other research showing that, in comparison to LTRA, ICS treatment considerably lowers the probability of exacerbations [19]. Because asthma exacerbations may result in a worse quality of life, more frequent use of healthcare services, and higher total healthcare expenses, reducing exacerbations is an essential part of managing asthma [20].

Both groups saw considerable improvements in their quality of life, as measured by the Asthma Quality of Life Questionnaire (AQLQ), with the ICS group demonstrating larger gains. The ICS group had a substantially higher mean AQLQ score at 12 months compared to the LTRA group, suggesting a superior quality of life. These increases in quality of life ratings align with other research that found that ICS treatment produced better benefits [21]. Asthma patients who have greater quality of life tend to have less symptoms, better everyday functioning, and better general health.

Limitations and Future Suggestions: The single-center design at HMC Peshawar and the relatively small sample size are two of the study's weaknesses, which might restrict how broadly the results can be applied. Since adherence was self-reported, bias may have been introduced, influencing the accuracy of the findings. A 12-month trial period may not fully capture long-term results and side effects, but it is sufficient for spotting patterns. To validate these results, bigger, multi-center studies with a range of demographic characteristics should be a part of future study. More reliable information on the long-term safety and effectiveness of ICS and LTRA in the treatment of asthma would be available if objective measures of adherence were included and the follow-up time was extended.

Conclusion

The advantage of inhaled corticosteroids (ICS) over leukotriene receptor antagonists (LTRA) in the treatment of asthma is supported by this research. Asthma control, lung function, and quality of life were all improved by ICS, which also showed increased effectiveness in lowering the frequency of exacerbations. These results support the suggestion that ICS be used as the first-line therapy of choice for asthma that is persistent. To confirm these findings and improve asthma care techniques, bigger, multi-center trials with objective adherence measurements should be the main focus of future research.

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