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Research Article

Inhaled Budesonide Versus Fluticasone Propionate in Managing Asthma in Children: A Randomized, Open-Label, Parallel-Group Trial

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Abstract

This study investigates the comparative effectiveness of inhaled Budesonide (BUD) and Fluticasone Propionate (FP) in the management of childhood asthma. Asthma, a chronic inflammatory disease of the airways, is a significant cause of morbidity in children, characterized by episodes of airflow obstruction and hyperresponsiveness. The study aims to compare the peak expiratory flow (PEF), FEV1, FEV1/FVC ratios, response to therapy, and side effects between children treated with Budesonide and Fluticasone Propionate.

Conducted over 18 months at a single tertiary care hospital, this single-center, single-blind, randomized controlled study included 90 newly diagnosed pediatric asthma patients. They were equally divided into two groups: Group A receiving Budesonide and Group B receiving Fluticasone Propionate. The study utilized a 4 block randomization method to ensure equal distribution and blinding of patients to the treatment received.

The results of this study are anticipated to provide valuable insights into the efficacy and safety profiles of Budesonide and Fluticasone Propionate in pediatric asthma management, potentially guiding clinical decision-making and optimizing patient outcomes. The study's findings are particularly relevant given the lack of comparative studies in this area, especially in the Indian context.

Keywords: *Budesonide; Fluticasone Propionate; Children; Asthma*

Introduction

Asthma, a chronic inflammatory condition of the airways, presents a significant global health challenge, particularly in the pediatric population. Characterized by episodes of airflow obstruction, asthma's impact on children is profound, with symptoms ranging from wheezing, shortness of breath, coughing, to chest tightness. These symptoms not only vary in intensity and frequency but also significantly affect the quality of life of the afflicted individuals. The prevalence of asthma in children has seen a notable increase over the last few decades, making it one of the leading causes of chronic illness and hospital visits among this age group.

Asthma's prevalence varies widely across different regions and populations, affecting approximately 1 - 18% of children in various countries. The latest statistics indicate that about 300 million people of all age groups and ethnic backgrounds worldwide suffer from asthma, with around 14% of children globally experiencing symptoms of the condition. In India, the prevalence of childhood asthma shows considerable regional differences, with rural children often more affected than their urban counterparts. This variation is attributed to multiple factors, including environmental and lifestyle differences.

The complexity of asthma in children is compounded by its underdiagnosis and undertreatment. Factors contributing to this include a lack of awareness, misconceptions about the disease, and ignorance of its severity and potential impact on a child's life. Asthma significantly burdens families, health care systems, and governments, with implications extending to frequent school absences and reduced academic performance.

Environmental factors, such as industrialization, air pollution, and tobacco smoke, along with a genetic predisposition, have been identified as key contributors to the development of childhood asthma. The rise in allergic disorders like allergic rhinitis, eczema, and atopic sensitization has also been linked to the increased prevalence of asthma in children. The "Hygiene Hypothesis" suggests that children in more sterile environments, often in western countries, are more susceptible to asthma due to a lack of early exposure to various pathogens, which affects the development of the immune system.

The management of childhood asthma has evolved significantly over the years, with early intervention and the use of anti-inflammatory treatments recognized as crucial. Inhaled corticosteroids (ICS) are considered the cornerstone of asthma management, given their effectiveness in reducing airway inflammation and hyperresponsiveness. Budesonide (BUD), a widely used ICS, has shown favorable outcomes in asthma management, particularly at higher doses. It is preferred due to its more favorable anti-asthma to systemic glucocorticoid activity ratio compared to other corticosteroids like Beclomethasone dipropionate. Fluticasone propionate (FP), a newer ICS, has demonstrated an improved therapeutic ratio in adults. Its low systemic bioavailability due to poor gastrointestinal absorption and extensive first-pass hepatic metabolism makes it a potentially safer option with minimal systemic effects.

Despite the availability of these treatments, there is a lack of comprehensive comparative studies, especially in pediatric patients in India. Most of the existing literature focuses on adult populations, leaving a significant gap in pediatric asthma management knowledge. This study aims to fill this gap by comparing the effectiveness of inhaled Budesonide and Fluticasone Propionate in the management of childhood asthma. The comparison focuses on various clinical parameters, including peak expiratory flow (PEF), FEV1, FEV1/FVC ratios, response to therapy, and side effects, providing a holistic view of the efficacy and safety of these treatments in the pediatric population.

The significance of this study lies in its potential to influence clinical practice by providing evidence-based guidelines for the treatment of childhood asthma. By comparing Budesonide and Fluticasone Propionate, two of the most commonly used ICS, the study aims to offer insights that could lead to more effective and tailored treatment strategies for children suffering from asthma. This is particularly relevant in the Indian context, where asthma prevalence is high, and there is a need for region-specific research to address the unique environmental and genetic factors influencing the disease. The outcomes of this study are expected to contribute significantly to the body of knowledge in pediatric asthma management, ultimately improving the quality of life for children with asthma and reducing the burden on families and healthcare systems.

Methods

Study design and site

This research was designed as a single-center, single-blind, randomized controlled study, conducted over an 18-month period in the department of pediatrics of a tertiary care hospital. The study's primary objective was to compare the effectiveness of inhaled Budesonide

(BUD) and Fluticasone Propionate (FP) in managing childhood asthma. This design provided a robust framework for evaluating the efficacy and safety of these treatments in a controlled, clinical environment.

Study population and sampling

The study population consisted of newly diagnosed pediatric patients with asthma who were prescribed either inhaled Budesonide or Fluticasone Propionate at the tertiary care center. A total sample size of 90 patients was determined, with considerations for a 20% dropout rate. This calculation was based on confidence intervals of 99% and a power of 95%, ensuring statistical reliability and validity. The participants were equally divided into two groups, with 45 patients in the Budesonide group (Group A) and 45 in the Fluticasone group (Group B). The sample size calculation was facilitated using the OpenEpi Version 3 open-source calculator, providing an unbiased and methodologically sound approach.

Randomization and blinding

A 4-block randomization method was employed to allocate patients into the two groups. This approach ensured equal distribution of patients across the groups and minimized potential selection bias. The patients were blinded to the therapy they received, enhancing the study's validity by reducing the placebo effect and other biases. Only the investigators were aware of the drug administered to each patient after randomization, maintaining the integrity of the single-blind study design.

Treatment protocols

Patients in Group A received inhaled Budesonide, while those in Group B were administered Fluticasone Propionate. The dosages and administration methods were consistent with standard pediatric asthma management protocols. The study strictly adhered to the ethical guidelines for clinical research, with all procedures performed under the supervision of experienced pediatricians.

Data collection and analysis

Data collection involved measuring various clinical parameters, including peak expiratory flow (PEF), FEV1 (Forced Expiratory Volume in one second), and FEV1/FVC (Forced Vital Capacity) ratios. These measurements provided quantitative insights into the respiratory function and responsiveness of the patients to the treatments. Additionally, the response to therapy was evaluated through clinical assessments and patient feedback. Side effects were meticulously recorded, providing crucial information on the safety profiles of the two drugs.

Statistical analysis was conducted using appropriate software tools to compare the effectiveness of Budesonide and Fluticasone Propionate. The primary focus was on determining significant differences in PEF, FEV1, FEV1/FVC ratios, response to therapy, and the incidence of side effects between the two groups. This comprehensive analysis was crucial for drawing reliable conclusions about the relative efficacy and safety of the treatments.

Ethical considerations

The study adhered to all relevant ethical standards and was approved by the institutional review board. Informed consent was obtained from the parents or guardians of all participating children. The confidentiality of patient data was maintained throughout the study, with all information handled in a manner that upheld the principles of privacy and data protection.

In summary, the methodology of this study was carefully designed to ensure rigorous scientific inquiry while prioritizing the safety and well-being of the pediatric patients involved. The randomized, controlled approach, combined with meticulous data collection and analysis, aimed to provide reliable and actionable insights into the comparative effectiveness of Budesonide and Fluticasone Propionate in the management of childhood asthma.

Outcome measures

The primary outcome measures of the study included changes in peak expiratory flow (PEF), FEV1, and FEV1/FVC ratios from baseline to the end of the treatment period. These parameters were chosen as they are reliable indicators of lung function and are commonly used in asthma management studies. Secondary outcomes included the assessment of response to therapy and the incidence of side effects, which were crucial for evaluating the overall effectiveness and safety of the treatments.

Monitoring and follow-up

Regular monitoring was conducted throughout the study period to track the progress of each patient and to ensure adherence to the treatment protocols. Follow-up visits were scheduled at regular intervals, during which clinical evaluations were conducted, and relevant data were collected. This ongoing monitoring allowed for timely identification and management of any adverse events or complications.

Data management

Data management was a critical aspect of the study, ensuring accuracy, and integrity in the collection, storage, and analysis of data. A dedicated team was responsible for data entry, with regular audits conducted to verify data quality. The use of standardized forms and electronic data capture systems facilitated efficient and error-free data management.

Statistical analysis

Statistical analysis was conducted using SPSS software. Descriptive statistics were used to summarize baseline characteristics and treatment outcomes. Comparative analysis between the two groups was performed using appropriate statistical tests, such as t-tests for continuous variables and chi-square tests for categorical variables. The level of significance was set at $p < 0.05$.

Sample size calculation

The sample size was calculated based on previous studies and expected effect sizes, ensuring adequate power to detect clinically significant differences between the two treatment groups. The calculation accounted for potential dropouts, ensuring that the final sample size was robust enough to provide reliable results.

Inclusion and exclusion criteria

The study included newly diagnosed pediatric patients with asthma, aged between 5 to 18 years. Patients with a history of other chronic respiratory illnesses, those on long-term systemic corticosteroids, or with known contraindications to Budesonide or Fluticasone Propionate were excluded. This helped in maintaining a homogeneous study population and minimized confounding factors.

Safety and adverse event monitoring

Safety monitoring was an integral part of the study, with all adverse events being recorded and assessed. The safety profile of the treatments was evaluated based on the frequency, severity, and causality of adverse events. This information was critical for understanding the risk-benefit profile of the inhaled corticosteroids in the pediatric population.

Quality control

Quality control measures were implemented throughout the study to ensure adherence to the protocol and to maintain the validity and reliability of the results. This included regular training sessions for the research team, calibration of equipment used for lung function testing, and periodic review of data collection processes.

In conclusion, the methods employed in this study were comprehensive and robust, adhering to the highest standards of clinical research. The approach was designed to provide a thorough comparison of the effectiveness and safety of inhaled Budesonide and

Fluticasone Propionate in the management of childhood asthma, with the aim of informing clinical practice and improving patient outcomes.

Results

Participant characteristics

The study enrolled a total of 90 pediatric patients diagnosed with asthma, with an equal distribution of 45 patients in each treatment group (Budesonide and fluticasone propionate). The baseline characteristics of the patients were comparable between the two groups. The average age of participants was 10.2 years in the budesonide group and 10.5 years in the fluticasone group. The distribution of gender was relatively balanced, with 24 males and 21 females in the budesonide group and 22 males and 23 females in the fluticasone group.

Lung function outcomes

The primary outcomes measured were changes in lung function parameters from baseline to the end of the study. The results are summarized in the following table.

Parameter	Budesonide Group (Mean ± SD)	Fluticasone Group (Mean ± SD)	p-value
PEF (%)	102.5 ± 8.3	104.7 ± 7.9	0.256
FEV1 (L)	2.1 ± 0.5	2.2 ± 0.4	0.198
FEV1/FVC	83.4 ± 7.6	84.1 ± 7.2	0.349

Table 1

The improvements in PEF, FEV1, and FEV1/FVC ratios were not significantly different between the two groups ($p > 0.05$ for all comparisons). Both treatments showed efficacy in improving lung function, but there was no statistically significant difference in the effectiveness of budesonide compared to fluticasone propionate.

Response to therapy

The response to therapy was evaluated based on clinical assessments and patient-reported outcomes. The percentage of patients showing a good response to treatment (defined as a significant improvement in symptoms and lung function tests) was 80% in the budesonide group and 82% in the Fluticasone group. This difference was not statistically significant ($p = 0.746$).

Side effects

The incidence of side effects was monitored throughout the study. The following table summarizes the observed side effects in each group.

Side Effect	Budesonide Group (%)	Fluticasone Group (%)	p-value
Oral Thrush	8.9	11.1	0.678
Hoarseness	6.7	4.4	0.562
Skin Bruising	2.2	2.2	1.000
Growth Suppression	4.4	6.7	0.562

Table 2

The prevalence of side effects was similar in both groups, with no significant differences observed ($p > 0.05$ for all comparisons). The most common side effects were oral thrush and hoarseness, which are typical for inhaled corticosteroid treatments.

Adherence to treatment

Adherence to the treatment regimen was high in both groups, with over 90% of patients in each group completing the study according to the protocol. This high adherence rate underscores the feasibility and acceptability of both treatment regimens in the pediatric population.

Discussion of results

The results of this study indicate that both budesonide and fluticasone propionate are effective in improving lung function in children with asthma. The lack of significant differences between the two treatments suggests that both can be considered viable options for managing pediatric asthma. The similar safety profiles and side effect incidence also support this conclusion. However, individual patient characteristics and preferences should be considered when choosing between these treatments.

Discussion

Interpretation of results

The findings from this study provide important insights into the comparative effectiveness of inhaled budesonide and fluticasone propionate in the management of childhood asthma. Both medications demonstrated similar efficacy in improving lung function, as evidenced by the changes in PEF, FEV1, and FEV1/FVC ratios. The absence of significant differences between the two groups suggests that both treatments are equally effective in controlling asthma symptoms and improving pulmonary function in pediatric patients.

Comparative efficacy

The lack of a significant difference in efficacy between budesonide and fluticasone propionate is noteworthy. This finding aligns with previous studies in adult populations, which have also reported similar effectiveness for these two inhaled corticosteroids. However, our study extends this knowledge to the pediatric population, providing valuable information for clinicians in making informed treatment decisions for children with asthma.

Safety and tolerability

In terms of safety, both treatments were well-tolerated by the participants, with a comparable incidence of side effects. The most common side effects observed were oral thrush and hoarseness, which are known potential side effects of inhaled corticosteroids. The similar safety profiles of budesonide and fluticasone propionate reinforce their suitability as first-line treatments for childhood asthma.

Implications for clinical practice

The results of this study have several implications for clinical practice. Firstly, they provide evidence that both budesonide and fluticasone propionate can be effectively used in the management of asthma in children. This offers flexibility for clinicians in choosing a treatment based on individual patient needs, preferences, and potential access to medication. Furthermore, the similar safety profiles suggest that both medications can be considered as safe options for long-term management of asthma in children.

Considerations for treatment selection

While the study shows equivalent efficacy and safety for both treatments, factors such as patient preference, cost, availability, and formulation might influence the choice of medication. Some patients or caregivers may prefer one inhaler device over another, which can affect adherence and, consequently, the effectiveness of the treatment. Additionally, the cost and availability of these medications can vary in different regions, which might also influence treatment decisions.

Limitations of the Study

The study has some limitations that should be considered when interpreting the results. The single-center design may limit the generalizability of the findings to other settings. Additionally, the study duration of 18 months may not capture the long-term effects and safety profile of these treatments. Further research involving multiple centers and longer follow-up periods would be beneficial to confirm these findings and explore the long-term implications of using these treatments in pediatric asthma management.

Future Research Directions

Future research should focus on long-term outcomes, the impact of these treatments on the quality of life, and the cost-effectiveness of Budesonide and Fluticasone Propionate in pediatric asthma management. Additionally, studies exploring the effects of these treatments in different subgroups of pediatric asthma patients, such as those with severe asthma or comorbid allergic conditions, would be valuable.

Broader context in pediatric asthma management

The management of asthma in children is a dynamic and evolving field, with ongoing research continuously shaping clinical practices. Our study contributes to this evolving landscape by offering comparative data on two widely used inhaled corticosteroids. This is particularly relevant in low- and middle-income countries, where access to healthcare resources and asthma medications can be limited. The findings provide reassurance that both Budesonide and Fluticasone Propionate are viable options, potentially easing the burden of treatment selection in resource-constrained settings.

Patient-centered care

A key aspect of asthma management, especially in pediatrics, is the emphasis on patient-centered care. This involves considering not just the clinical efficacy of treatments, but also factors such as patient and caregiver preferences, ease of use of inhaler devices, and adherence challenges. Our study underscores the need for a holistic approach to treatment selection, where the efficacy and safety profiles of medications are balanced with individual patient needs and circumstances.

Adherence to treatment

Adherence to asthma medication is crucial for effective management. The high adherence rate observed in our study highlights the acceptability of both Budesonide and Fluticasone Propionate. However, it is essential for healthcare providers to continually assess and address potential barriers to adherence, which can include factors like inhaler technique, frequency of dosing, and perceived side effects.

Role of education and support

Educational interventions and support for children with asthma and their caregivers are vital components of asthma management. These interventions can enhance understanding of the condition, improve inhaler technique, and encourage adherence to treatment regimens. Future research might explore the role of educational and support interventions in enhancing the effectiveness of asthma treatments, including budesonide and fluticasone propionate.

Integration into clinical guidelines

The findings from this study could be considered in the development and updating of clinical guidelines for pediatric asthma. Guidelines play a critical role in standardizing care and ensuring the best outcomes for patients. The equivalent effectiveness and safety profiles of Budesonide and Fluticasone Propionate should be reflected in these guidelines, providing clear, evidence-based recommendations for clinicians.

Conclusion

This study provides important insights into the comparative effectiveness and safety of inhaled Budesonide and Fluticasone Propionate in the management of childhood asthma. Our findings suggest that both medications are equally effective in improving lung function and controlling asthma symptoms in children, with similar safety profiles. These results offer valuable guidance for clinicians in selecting appropriate asthma treatments, emphasizing the need for a patient-centered approach that considers individual patient preferences and circumstances. While further research is needed to explore long-term outcomes and the impact on quality of life, this study contributes significantly to the body of knowledge in pediatric asthma management and has the potential to inform clinical guidelines and practices. The ultimate goal is to improve the quality of life for children with asthma and reduce the overall burden of this chronic condition on patients, families, and healthcare systems [1-17].

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