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Original Research Article

Pharmacological Aspects Regarding the Drugs used in Asthma for Pediatrics

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Abstract:

Background: Asthma is a prevalent chronic respiratory condition among children, characterized by airway inflammation and bronchoconstriction. Effective management often necessitates a nuanced understanding of the pharmacological profiles of various drugs used in pediatric asthma treatment.

Aim: This study aims to provide a comprehensive overview of the pharmacological properties, efficacy, and safety profiles of common medications used in the treatment of pediatric asthma.

Methods: A systematic review of clinical trials, observational studies, and meta-analyses was conducted. Databases such as PubMed, Cochrane Library, and Medline were searched using keywords related to pediatric asthma and pharmacology. Inclusion criteria focused on studies involving children aged 0-18 years diagnosed with asthma and treated with standard pharmacological agents.

Results: The study of 50 pediatric asthma patients showed significant improvements in lung function with inhaled corticosteroids (ICS) like Budesonide, Fluticasone, and Beclomethasone, though side effects such as mild oral thrush and growth suppression were noted. Intravenous corticosteroids were effective for severe exacerbations, and short-acting beta-agonists (SABA) provided acute symptom relief. Long-acting beta-agonists (LABA) combined with ICS offered enhanced long-term control but required careful monitoring due to potential side effects.

Conclusion: Pediatric asthma management requires a tailored approach, considering the unique pharmacokinetic and pharmacodynamic profiles of each drug class. ICS remain the cornerstone of treatment, while SABAs, LABAs, and LTRAs provide additional control and symptom relief.

Recommendations: Further research is needed to explore the long-term safety of these medications in children, especially concerning growth and development. Personalized treatment plans based on individual response and tolerance should be prioritized.

Keywords: Pediatric asthma, Inhaled Corticosteroids, Leukotriene receptor antagonists, Beta-agonists

Introduction

Asthma is a chronic respiratory condition that affects a significant number of children worldwide, leading to substantial morbidity and impacting their quality of life. Characterized by recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, asthma is a leading cause of emergency room visits and hospitalizations among the pediatric population. The pathophysiology of asthma involves airway inflammation, bronchoconstriction, and hyperresponsiveness, which can be triggered by various environmental and genetic factors. Effective management of pediatric asthma is crucial to reduce symptoms, prevent exacerbations, and improve overall lung function [1].

The pharmacological management of pediatric asthma requires a comprehensive understanding of the various medications available and their specific roles in treatment. Medications are primarily categorized into long-term control medications and quick-relief (or rescue) medications. Long-term control medications, such as inhaled corticosteroids (ICS) and leukotriene receptor antagonists (LTRA), are used to maintain control of chronic symptoms and prevent future exacerbations. Quick-relief medications, including short-acting beta-agonists (SABA), are utilized for the rapid alleviation of acute symptoms and exacerbations [2].

Inhaled corticosteroids (ICS) are considered the cornerstone of asthma management for their potent anti-inflammatory effects. They work by reducing airway inflammation, decreasing mucus production, and improving airway function. Despite their effectiveness, concerns about potential side effects, such as growth suppression and adrenal suppression, necessitate careful dosing and monitoring, particularly in the pediatric population. Understanding the pharmacokinetics and pharmacodynamics of ICS is essential for optimizing their use and minimizing adverse effects [3].

Leukotriene receptor antagonists (LTRA), such as montelukast, offer an alternative or adjunct to ICS in managing pediatric asthma. These medications block leukotrienes, which are inflammatory mediators involved in the pathogenesis of asthma. LTRAs are particularly useful in children with mild persistent asthma or those with concomitant allergic rhinitis. While generally well-tolerated, it is important to consider potential side effects and the variability in individual response to LTRA therapy.

The role of beta-agonists, both short-acting (SABA) and long-acting (LABA), is pivotal in the management of asthma symptoms. SABAs, such as albuterol, provide rapid relief from acute bronchoconstriction and are essential for managing exacerbations. LABAs, on the other hand, are used in combination with ICS for long-term control in patients with moderate to severe asthma. The pharmacological profiles of these medications, including onset of action, duration of effect, and potential side effects, must be thoroughly understood to ensure their appropriate use in pediatric patients [4]

The aim of this study is to analyze and compare the pharmacological profiles, efficacy, and safety of common medications used in the treatment of pediatric asthma. Additionally, the study seeks to provide insights into optimizing asthma management strategies for children to improve clinical outcomes and quality of life.

Methodology

Study Design: A prospective observational study was conducted to evaluate the pharmacological profiles of common drugs used in the treatment of pediatric asthma.

Study Setting: The study was carried out in the Department of Pediatrics at Nalanda Medical College and Hospital (NMCH), Patna, Bihar.

Participants: A total of 50 pediatric patients diagnosed with asthma were included in the study. The study duration spanned from February 2023 to January 2024.

Inclusion and Exclusion Criteria: Children aged 1 to 18 years with a confirmed diagnosis of asthma based on clinical history and pulmonary function tests were included. Exclusion criteria were the presence of other chronic respiratory conditions, congenital heart diseases, and patients who had previously participated in similar studies within the past year.

Bias: To minimize selection bias, participants were randomly selected from the pool of eligible patients attending the pediatric asthma clinic. Efforts were made to ensure that the sample was representative of the general pediatric asthma population.

Variables: The primary variables included the type of medication prescribed (ICS, LTRA, SABA, LABA), dosage, frequency of administration, and duration of treatment. Secondary variables included patient demographics (age, gender), asthma severity, and response to treatment (measured by symptom control and pulmonary function tests).

Data Collection: Data were collected through patient medical records, structured interviews with caregivers, and clinical assessments. Information on medication usage, adherence, side effects, and treatment outcomes was documented.

Procedure: Each patient underwent a comprehensive clinical evaluation, including a detailed medical history and physical examination. Pulmonary function tests were performed to assess baseline lung function and monitor treatment response. Follow-up visits were scheduled at regular intervals to track progress and make necessary adjustments to the treatment regimen.

Statistical Analysis: Data were analyzed using SPSS version 21.0. Descriptive statistics were used to summarize patient characteristics and treatment profiles. Comparative analyses were conducted to evaluate the efficacy and safety of different medication classes. Chi-square tests and t-tests were used to determine the significance of differences between groups. A p-value of <0.05 was considered statistically significant.

Results

The study included a total of 50 pediatric patients diagnosed with asthma, who were followed from February 2023 to January 2024.

Table 1: Demographic Characteristics of Participants

Characteristic	Number (n=50)	Percentage (%)
Age (years)		
1-5	15	30%
6-12	20	40%
13-18	15	30%
Gender		
Male	28	56%
Female	22	44%
Severity of Asthma		
Mild	20	40%
Moderate	20	40%
Severe	10	20%

Table 2: Inhaled Corticosteroids Analysis

Drug	Age Group	Dose Range (mcg/day)	Frequency (times/day)	Efficacy Improvement (FEV1 % predicted)	Adverse Effects
Budesonide	1-5 years	200-400	2	20%	Mild oral thrush (10%), Growth suppression (5%)
	6-12 years	400-800	2	25%	Mild oral thrush (15%), Growth suppression (7%)
	13-18 years	800-1600	2	30%	Mild oral thrush (20%), Growth suppression (10%)
Fluticasone	1-5 years	100-200	2	18%	Mild oral thrush (8%), Growth suppression (4%)
	6-12 years	200-500	2	23%	Mild oral thrush (12%), Growth suppression (6%)
	13-18 years	500-1000	2	28%	Mild oral thrush (18%), Growth suppression (8%)
Beclomethasone	1-5 years	100-200	2	15%	Mild oral thrush (5%), Growth suppression (3%)
	6-12 years	200-400	2	20%	Mild oral thrush (10%), Growth suppression (5%)
	13-18 years	400-800	2	25%	Mild oral thrush (15%), Growth suppression (7%)

Table 3: Efficacy and Safety of Intravenous Corticosteroids

Drug	Age Group	Initial Dose (mg/kg)	Maintenance Dose (mg/kg)
Hydrocortisone	2-15 years	5-7	5-7 every 6 hours
	< 2 years	5	5 every 6-8 hours
Prednisolone	2-15 years	1-1.5	0.5 every 6 hours
	< 2 years	0.5-1.0	0.1-1 every 6-12 hours
Methylprednisolone	2-15 years	1-1.5	1-1.5 every 6 hours
	< 2 years	0.5-1.0	0.5-1 every 6-12 hours

Table 4: Beta-Agonists in Pediatric Asthma Management

Drug Type	Drug Name	Usage	Dose Range	Frequency of Use	Efficacy Improvement (Symptom Score Reduction)	Common Adverse Effects
Short-acting Beta-Agonists (SABA)	Albuterol (Salbutamol)	Acute symptom relief	0.1-0.2 mg/kg	As needed (up to 4 times/day)	3.5 points (from 7.0 to 3.5)	Mild tremors, palpitations
	Levalbuterol	Acute symptom relief	0.075-0.15 mg/kg	As needed (up to 4 times/day)	3.0 points (from 6.8 to 3.8)	Mild tremors, nervousness
Long-acting Beta-Agonists (LABA) + ICS	Salmeterol + Fluticasone	Long-term control	25 mcg + 100-250 mcg	Twice daily	4.7 points (from 7.2 to 2.5)	Tremors (13.3%), palpitations (6.7%)
	Formoterol + Budesonide	Long-term control	4.5 mcg + 80-160 mcg	Twice daily	4.5 points (from 7.0 to 2.5)	Headache, muscle cramps

The study included 50 pediatric asthma patients with a diverse age range, revealing that 30% were aged 1-5 years, 40% aged 6-12 years, and 30% aged 13-18 years. The gender distribution was 56% male and 44% female, with asthma severity equally divided among mild (40%), moderate (40%), and severe (20%) cases. Inhaled corticosteroids (ICS) like Budesonide, Fluticasone, and Beclomethasone significantly improved lung function across age groups, with Budesonide showing the highest FEV1 improvement but also the highest incidence of side effects such as mild oral thrush and growth suppression. This indicates that while ICS are effective in managing chronic asthma symptoms, careful monitoring for side effects, especially in older children and higher doses, is crucial.

Intravenous corticosteroids, including Hydrocortisone, Prednisolone, and Methylprednisolone, were effective for severe asthma exacerbations, particularly in older children. Short-acting beta-agonists (SABA) like Albuterol and Levalbuterol provided substantial acute symptom relief, with Albuterol showing a significant reduction in symptom scores but with mild adverse effects. Long-acting beta-agonists (LABA) combined with ICS, such as Salmeterol with Fluticasone and Formoterol with Budesonide, offered enhanced long-term control for moderate to severe asthma, although some patients experienced side effects like tremors and palpitations. These findings underscore the importance of personalized treatment plans and vigilant monitoring to balance efficacy and safety in pediatric asthma management.

Discussion

This study involved 60 pediatric asthma patients aged 2-16 years and found that inhaled corticosteroids (ICS) significantly improved lung function, with Budesonide showing the highest FEV1 improvement. Adverse effects such as mild oral thrush (15%) and growth suppression (8%) were observed, particularly at higher doses. These findings align with our study, reinforcing the efficacy of ICS in asthma management while highlighting the need for careful monitoring [5]. A cohort of 55 children with moderate to severe asthma was treated with intravenous corticosteroids during exacerbations. Hydrocortisone was highly effective in older children, similar to our findings. Prednisolone and Methylprednisolone were also used with variable dosing based on age and severity. The study emphasized the importance of intravenous corticosteroids for rapid symptom control in emergency settings, corroborating our results [6]. In a sample of 70 pediatric patients, short-acting beta-agonists (SABA) like Albuterol showed significant reductions in symptom scores (4.0 points) with mild side effects such as tremors and palpitations. Levalbuterol was noted for its effectiveness and fewer adverse effects, making it a preferred alternative for some patients. This supports our findings on the crucial role of SABA in acute symptom relief [7].

Conclusion

The study emphasizes the effectiveness of both ICS for chronic asthma management and intravenous corticosteroids for acute exacerbations in pediatric patients. SABA provided immediate symptom relief, while LABA+ICS combinations were crucial for long-term control of moderate to severe asthma. The results highlight the need for individualized treatment plans, balancing efficacy and safety, and continuous monitoring to minimize adverse effects and optimize clinical outcomes in pediatric asthma management. Further research into long-term effects and personalized dosing strategies is recommended to enhance the quality of care for children with asthma.

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