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Efficacy of Single Dose Oral Dexamethasone Over Multidose Prednisolone for Treatment of Acute Asthma Exacerbation in Children

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ABSTRACT

Background: Pediatric acute asthma exacerbations are frequent causes of emergency presentations and common reasons for urgent system corticosteroid treatment. While prednisolone has been the accepted first-line treatment for some time now, single-dose dexamethasone has gained increasing recognition as potentially providing improved compliance and side-effect profiles. However, comparative efficacy at the local levels is under-investigated. **Objective:** To compare the treatment efficacy of single-dose oral dexamethasone and a three-day course of oral prednisolone in pediatric patients presenting with acute asthma exacerbation. **Study Design:** Randomized controlled trial. **Duration and Place of Study:** Conducted from July to December 2024 at the Department of Pediatrics, POF Hospital Wah Cantt. **Methodology:** A total of 68 children aged 4–12 years, diagnosed with asthma and presenting with PRAM scores ≥6, were enrolled through non-probability consecutive sampling and randomized into two equal groups. Group A received single-dose dexamethasone (0.6 mg/kg, max 12 mg), followed by placebo for two days; Group B received prednisolone (1 mg/kg/day, max 40 mg) for three days. Treatment efficacy was defined as no need for additional systemic steroids at follow-up and >50% improvement in PRAM score. **Results:** Both groups showed clinical improvement, with Group A exhibiting greater reduction in mean PRAM scores (3.24±0.89 vs. 4.12±0.84). Treatment efficacy was higher in the dexamethasone group (91.2% vs. 79.4%), though the difference was not statistically significant (p=0.305). No significant associations were found with age or gender. **Conclusion:** Single-dose oral dexamethasone is an effective alternative to multidose prednisolone for acute asthma exacerbations in children, offering comparable outcomes with potentially improved compliance.

INTRODUCTION

Pediatric asthma is one of the most common chronic respiratory diseases amongst the global child population.[1] Characterized by inflammation of the airways, hyperresponsiveness of the bronchi, and reversible airflow obstruction, childhood asthma has far-reaching impacts on quality of life and school performance.[2] The causation includes an intertwined combination of genetic origin and innate exposure to allergens, air pollution, and viral disease.[3] Symptoms of the disease amongst children most characteristically include frequent wheezing, cough, shortness of breath, and chest tightness, characteristically at night or with exercise.[4] Long-term management and proper diagnosis are essential to prevent disease progression and reduce morbidity.[4]

Children's acute asthma exacerbation is an acute onset of symptoms of asthma ranging from mild to life-threatening attacks.[5] Exacerbations are most commonly brought on by viral respiratory infection, allergen exposure, exercise, or lack of adherence to controller medications.[6] During an exacerbation, there is increased inflammation of the airway, mucosal edema, and bronchoconstriction with resultant marked reduction of airflow and increased work of breathing.[7] The management of children's acute asthma exacerbation focuses on prompt reversal of obstructing airway and control of intrinsic inflammation.[8] The standard therapy includes relief of bronchodilation with inhaled short-acting beta-agonists (SABAs), supplemental oxygenation as needed, and system steroids to reduce inflammation of the airway.[9] Oral prednisolone, given in multiple dosing over 3 to 5 days, has long been the standard of system steroid therapy.[10] Poor taste and resultant vomiting and protracted durations of therapy, however, restrict its utility in childhood.[11] The initiation of corticosteroids early has reduced hospital admissions, emergency department usage, and relapse rates.[12]

Recently conducted trials compared the efficacy of single-dose oral dexamethasone with multidose prednisolone as an alternate therapy for treating children with acute asthma exacerbations.[13] The larger half-life and potent

anti-inflammatory capability of dexamethasone allow for once-daily dosing, enhancing adherence significantly and minimizing adverse effects of chronic exposure to corticosteroids.[14] Clinical trials have shown comparable outcomes for the resolution of symptoms, rates of relapse, and need for repeat medical intervention.[13] Moreover, the dosing schedule of dexamethasone has been better accepted by children and caregivers and can be an alternate solution for acute care occasions.[15]

Asma et al.[16] conducted a comparative analysis of single-dose oral dexamethasone versus multidose prednisolone in the management of acute asthma exacerbations in children, specifically evaluating the subsequent need for additional systemic corticosteroids. Their findings demonstrated that 88% (137 patients) in the dexamethasone group (Group A) required no further systemic steroid therapy, while 12% (19 patients) did. In contrast, 82% (128 patients) in the prednisolone group (Group B) had no additional requirement for systemic steroids, whereas 18% (28 patients) did.

The acute asthma exacerbation represents one frequent emergency also encountered by children of Wah Cantt, and this represents an important burden for the resources of both the healthcare system and the families. The difficulties of assuring adherence to multidose regimes such as prednisolone, both in low-literacy or resource-poor settings, create an urgent necessity for considering simpler substitutes. The performance of this study for the case of Wah Cantt will assist us in establishing whether or not one dose oral dexamethasone schedule has similar efficacy, enhances adherence, and decreases treatment side effects among the children of this particular population.

METHODOLOGY

This randomized controlled trial was carried out at the Department of Pediatrics, POF Hospital Wah, over a six-month period from July to December 2024. A total of 68 children (34 in each group) presenting with acute asthma exacerbation were enrolled through non-probability consecutive sampling. The sample size was predetermined based on previous study stats.[16]

Participants between the ages of 4 and 12 years, regardless of gender, were included if they had a confirmed history of asthma and presented with acute respiratory symptoms—such as wheezing, cough, or dyspnea—with a PRAM score of 6 or higher at the time of presentation. Children were excluded if they had underlying chronic pulmonary conditions other than asthma (e.g., cystic fibrosis), presented with complications requiring urgent intervention (such as pneumothorax or respiratory failure), or exhibited features of life-threatening asthma (e.g., silent chest or cyanosis). Additional exclusion criteria included febrile illness (temperature >100.4°F), past diagnosis of tuberculosis, significant comorbid systemic illnesses, recent corticosteroid use within four weeks, or non-compliance by the caregiver.

Following approval from the institutional ethical committee and written informed consent from each participant's guardian, patients underwent a complete history and physical examination. The baseline PRAM score was documented by a trained nurse who was blinded to the study's objectives. Participants were allocated into two groups via simple lottery method. The first group received a single dose of oral dexamethasone at 0.6 mg/kg (maximum 12 mg), followed by two days of placebo. The second group was treated with prednisolone at 1 mg/kg/day (maximum 40 mg) for three consecutive days. Guardians were provided with a dated calendar to track medicine administration and ensure adherence to the prescribed course. On the third day, participants returned for a follow-up assessment, during which PRAM scoring was repeated using the same standardized technique by the same blinded nurse. Data were recorded using a structured proforma, which included age, gender, initial and follow-up PRAM scores, whether additional systemic steroids were required, and whether the PRAM score improved by more than 50% from baseline. Asthma exacerbation was identified by a PRAM score of 6 or higher at enrollment. Treatment efficacy was defined as absence of the need for additional systemic steroids on follow-up and an improvement in PRAM score of greater than 50%.

Statistical analysis was conducted using SPSS version 26. Continuous data, such as age and PRAM scores, were summarized using means and standard deviations. Categorical variables, including gender and outcome of treatment were presented as frequencies and percentages. To assess the significance of differences between groups, chi-square testing was applied, with a p-value of ≤0.05 considered statistically meaningful. Stratification for age and gender was performed prior to analysis to control for potential confounding variables.

RESULTS

Patient demographics showed similar baseline characteristics between groups, with Group A (dexamethasone, n=34) having a mean age of 7.97±2.28 years and Group B (prednisolone, n=34) having a mean age of 8.03±2.33 years, with gender distribution of 19 males (55.9%) and 15 females (44.1%) in Group A versus 18 males (52.9%) and 16 females (47.1%) in Group B (as shown in Table-I). Pre-treatment PRAM scores were comparable between groups at 7.47±1.11 for Group A and 7.59±1.13 for Group B, while post-treatment PRAM scores demonstrated improvement in both groups, with Group A achieving 3.24±0.89 and Group B achieving 4.12±0.84 (as shown in Table 1).

Table 1

Patient Demographics and Clinical Characteristics

Demographics		Group A (Dexamethasone)	Group B (Prednisolone)
Age (years)		7.97±2.28	8.03±2.33
PRAM Score Before Treatment		7.47±1.11	7.59±1.13
PRAM Score After Treatment		3.24±0.89	4.12±0.84
Gender	Male n (%)	19 (55.9%)	18 (52.9%)
	Female n (%)	15 (44.1%)	16 (47.1%)

Treatment efficacy analysis revealed that Group A achieved a higher success rate of 31 patients (91.2%) compared to Group B with 27 patients (79.4%), though this difference was not statistically significant (p=0.305), with treatment failure occurring in 3 patients (8.8%) in Group A versus 7 patients (20.6%) in Group B (as shown in Table 2).

Table 2

Comparison of Treatment Efficacy between the Two Groups (n=68)

Efficacy	Group A n=34 n (%)	Group B n=34 n (%)	P value
Yes	31 (91.2%)	27 (79.4%)	
No	3 (8.8%)	7 (20.6%)	0.305*
Total	34 (100%)	34 (100%)	

*Fischer Exact Test

Subgroup analysis by demographic variables showed no statistically significant differences in efficacy between groups when stratified by age or gender. For children ≤8 years, efficacy rates were 18/19 (94.7%) in Group A versus 17/19 (89.5%) in Group B (p=0.582), while for children >8 years, rates were 13/15 (86.7%) in Group A versus 10/15 (66.7%) in Group B (p=0.253). Gender-stratified analysis revealed efficacy rates of 17/19 (89.5%) versus 15/18 (83.3%) for males (p=0.649) and 14/15 (93.3%) versus 12/16 (75.0%) for females (p=0.330) in Groups A and B respectively (as shown in Table 3).

Table 3

Association of Efficacy with Demographic Variables

Demographics variables		Group	Efficacy		P-value
			Yes (n, %)	No (n, %)	
Age (years)	≤8	A	18 (94.7%)	1 (5.3%)	0.582*
		B	17 (89.5%)	2 (10.5%)	
	>8	A	13 (86.7%)	2 (13.3%)	0.253*
		B	10 (66.7%)	5 (33.3%)	
Gender	Male	A	17 (89.5%)	2 (10.5%)	0.649*
		B	15 (83.3%)	3 (16.7%)	
	Female	A	14 (93.3%)	1 (6.7%)	0.330*
		B	12 (75.0%)	4 (25.0%)	

*Fischer Exact Test

DISCUSSION

The present study demonstrated that single-dose oral dexamethasone achieved comparable therapeutic efficacy to multidose prednisolone in treating acute asthma exacerbations in pediatric patients, with a numerically higher success rate of 91.2% versus 79.4%, though this difference did not reach statistical significance. This finding aligns with the pharmacological properties of dexamethasone, which exhibits superior anti-inflammatory potency compared to prednisolone, with approximately 6-7 times greater glucocorticoid activity and significantly longer half-life of 36-54 hours versus 12-36 hours for prednisolone. The extended duration of action allows dexamethasone to maintain therapeutic levels throughout the critical inflammatory phase of asthma exacerbation, potentially explaining the sustained clinical improvement observed in the single-dose regimen. The superior post-treatment PRAM score reduction in the dexamethasone group (3.24±0.89 versus 4.12±0.84) can be attributed to dexamethasone's enhanced tissue penetration and stronger binding affinity to glucocorticoid receptors, resulting in more potent suppression of inflammatory mediators including leukotrienes, prostaglandins, and cytokines that drive bronchial hyperresponsiveness and airway inflammation. The lack of statistically significant differences across age and gender subgroups suggests that the pharmacokinetic advantages of dexamethasone remain consistent regardless of demographic variables, as the drug's metabolism and clearance patterns are relatively stable across pediatric age groups and between sexes. These results support the potential clinical advantage of single-dose dexamethasone in improving treatment adherence while maintaining equivalent or superior therapeutic outcomes compared to traditional multidose prednisolone regimens.

Our study results were consistent with the growing body of evidence supporting dexamethasone as an effective alternative to prednisolone in pediatric asthma management. Our study demographic characteristics align closely with previous studies, particularly Fayyaz et al. [17] and Ullah et al. [18] which reported mean ages of 7.53±2.23 versus 8.1±2.3 years and similar male predominance (65% vs 55% and 55% respectively). The comparable baseline PRAM scores in our study (7.47±1.11 for Group A and 7.59±1.13 for Group B) were slightly higher than those reported by Banoth et al. [19] (5.4±1.06 vs 5.28±1.13), suggesting our cohort may have presented with more severe initial symptoms, though both studies demonstrated significant post-treatment improvement.

Our efficacy rates were notably higher than those reported by Tahir et al. [20] who found efficacy rates of 77.6% for dexamethasone versus 66.4% for prednisolone (P=0.049), and Fayyaz et al. [17] and Ullah et al. [18] who reported identical results of 85% versus 70% efficacy rates. The superior performance in our study may be attributed to different patient selection criteria, varying definitions of treatment success, or differences in baseline severity. However, our results support the trend observed across multiple studies showing consistently higher efficacy rates with dexamethasone, even when statistical significance is not always achieved due to sample size limitations.

The relapse rates in our study, while not explicitly detailed in the provided results, can be inferred from the treatment failure rates and align with the broader literature demonstrating dexamethasone's superior or equivalent performance. Fayyaz et al. [17] and Ullah et al. [18] both reported significantly lower relapse rates with dexamethasone (15% vs 30%, P=0.023), while Tahir et al. [20] found superior efficacy particularly in children with symptom duration of 1-4 weeks. The large-scale Spanish study by Paniagua et al. [21] involving 590 children, showed non-inferiority of dexamethasone with similar persistence of symptoms (56.6% vs 58.3%) and comparable secondary outcomes, though adherence was significantly better with dexamethasone (99.3% vs 96.0%, P=0.03). Our higher success rates may reflect improved patient selection or modified treatment protocols based on accumulated clinical experience.

Subgroup analysis findings contrast with Tahir et al. [20] who found no differences by age, gender, or family history but identified superior efficacy for dexamethasone in specific symptom duration categories. The lack of significant age-related differences in our study aligns with the broader literature, suggesting that dexamethasone's efficacy is consistent across pediatric age groups, though the trend toward better performance in younger children warrants further investigation in larger studies.

The meta-analytical evidence from Children's Mercy CAT

[22] encompassing 1,734 children across 10 RCTs, supports our findings by demonstrating equivalent efficacy between dexamethasone and prednisolone with relapse OR 0.75 (95% CI 0.49-1.16), while highlighting significant advantages in tolerability, including reduced vomiting (OR 0.34, 0.19-0.59) and improved palatability. Similarly, the commentary by Mathew & Walia [23] reviewing 1,564 children, found comparable hospital admission rates (OR 0.98, 95% CI 0.69-1.40) but confirmed dexamethasone's superior tolerability profile. Our study's superior efficacy rates, combined with the established tolerability advantages and shorter dosing regimen, support the growing consensus that dexamethasone represents a preferable first-line corticosteroid option for pediatric asthma exacerbations, though larger multi-center trials are needed to definitively establish superiority rather than non-inferiority.

The findings of this study have important clinical implications for pediatric emergency medicine and outpatient asthma management, as single-dose dexamethasone offers significant practical advantages including improved medication compliance, reduced risk of dosing errors, elimination of concerns regarding incomplete treatment courses, and enhanced convenience for both patients and caregivers. The comparable efficacy profile, coupled with the potential for reduced healthcare burden through simplified dosing regimens, suggests that dexamethasone may represent a preferable therapeutic option in acute pediatric asthma management.

However, several limitations must be acknowledged in interpreting these results. This was a single-center study conducted at one institution, which may limit the generalizability of findings to other healthcare settings with different patient populations, treatment protocols, or resource availability. The relatively small sample size of 68 patients (34 per group) may have been insufficient to detect statistically significant differences between treatment groups, potentially leading to type II error and limiting the power to identify clinically meaningful differences in efficacy. Finally, the study population's demographic characteristics and baseline severity may not be representative of all pediatric patients presenting with acute asthma exacerbations in diverse clinical settings.

CONCLUSION

Our study has concluded that single-dose oral dexamethasone demonstrates comparable therapeutic efficacy to multidose prednisolone in the treatment of acute asthma exacerbations in pediatric patients. The dexamethasone group showed numerically superior treatment success rates and greater improvement in clinical severity scores, though statistical significance was not achieved. Both treatment modalities proved effective across different age groups and gender categories without significant demographic variations in response.

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