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Role of Preoperative Dexamethasone in Post Tonsillectomy Pain and Vomiting

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ABSTRACT

Background: Tonsillectomy is one of the most common surgical procedures of childhood, is complicated by postoperative pain and vomiting and thus causes significant morbidity with resulting delay in recovery. Different pharmacologic approaches, both systemic and topical, both before and after surgery, have been tried for reducing such complications. Dexamethasone, because of its anti-inflammatory and antiemetic activity, has come into prominence as a potential useful adjunct in the perioperative period. **Objective:** To compare the frequency of postoperative vomiting and pain with dexamethasone and placebo in tonsillectomy. **Study Design:** Randomized controlled trial. **Duration and Place of Study:** This trial was conducted in the Department of Otorhinolaryngology, CMH Jhelum, from January 2023 to July 2023. **Methodology:** A total of 160 children aged 4–12 years undergoing elective tonsillectomy were randomly allocated into two equal groups. Group A received dexamethasone 0.5 mg/kg (maximum 8 mg), while Group B received placebo. A standardized anesthetic protocol was followed, and all surgeries were performed using electro dissection. Postoperative vomiting was defined as three or more forceful episodes within four hours of extubation, while pain was assessed at intervals up to 24 hours using the Faces Visual Analogue Scale, with scores above 4 indicating significant pain. **Results:** Vomiting was significantly lower in the dexamethasone group (13.8%) compared with placebo (42.5%, p=0.000). Pain was also reduced, occurring in 42.5% of Group A versus 70% of Group B (p=0.001). Stratified analysis showed stronger benefits in younger children and those weighing ≤30 kg. **Conclusion:** Preoperative dexamethasone significantly reduces postoperative vomiting and pain in pediatric tonsillectomy, making it a safe and effective adjunct to improve recovery outcomes.

INTRODUCTION

Tonsillectomy is one among the very frequent procedures undertaken in otolaryngology, and it is very frequent in pediatric patients, but it can be used in adult patients on selected cases.[1] It is normally indicated in recurrent or chronic tonsillitis, obstructive sleep apnoea with hypertrophied tonsils, and in complication like peritonsillar abscess or suspected malignancy.[2] Although tonsillectomy is one very frequent and standard operation, it is never complication free and has high perioperative burden of morbidity.[3] Surgical resection of tonsils results in exposure of friable pharyngeal tissues, and it has the potential of inducing pain, hemorrhage, and other late sequelae.[4] Due to its frequency and complication, there has always been work in progress on improving perioperative care with the view of providing better patient comfort and outcomes.[5]

Post-tonsillectomy vomiting and pain remain two of the most frequent and irritating complications, cause prolonging recovery and negatively impacting adults and children alike undergoing this procedure.[6] Pain after this procedure is produced mostly due to inflammation of the tissues, muscle spasm, and nerve irritation within the operation field, resulting in distress on swallowing, poor oral intake, and dehydration.[7] Nausea and vomiting after the operation, on the other hand, are brought about through anesthetic agents, manipulation during operation, and operation-related aspiration of blood.[8] Moreover, being harmful to the patient's health, such complications can also elongate hospital discharge, increase re-admission, and in extreme scenarios, generate secondary issues like bleeding or electrolyte disturbance.[9]

Preoperative dexamethasone administration has been increasingly acknowledged as an adjunct of value in the

reduction of post-tonsillectomy morbidity.[10] By virtue of its actions as an extremely potent long-acting corticosteroid, dexamethasone manifests its beneficial effects through powerful anti-inflammatory activity, suppression of tissue swelling, and modulation of nociceptive transmission, thus minimizing postoperative pain.[11] In addition, through antiemetic actions mediated by the suppression of prostaglandin synthesis and reduced serotonin activity within the gastrointestinal tract, it significantly minimizes the occurrence of postoperative nausea and vomiting.[12] A host of randomized controlled studies and meta-analyses have presented evidence favorable to the administration of a single dose of dexamethasone preoperatively, with improved patient comfort, earlier oral feeding, and decreased dependence on supplementary analgesic or antiemetic agents.[13] Therefore, integration of preoperative dexamethasone within the regimen of conventional perioperative management constitutes an effective, safe, and straightforward means of optimizing recovery and enhancing the quality of care in tonsillectomy patients.[14]

In a study conducted by Hashmi MA et al., dexamethasone was associated with a markedly lower incidence of postoperative vomiting, occurring in 12% of patients (n = 6) compared to 30% (n = 15) in the placebo group.[15] Similarly, research by Najeeb T et al. reported that only 12% of patients experienced pain relief without dexamethasone, whereas 41% achieved pain-free outcomes when dexamethasone was administered.[16]

Minimal local evidence had been available from Jhelum on preoperative dexamethasone's efficacy in reducing post-tonsillectomy pain and postoperative emesis, although its efficacy had been clearly proven elsewhere in world literature. Due to differences between patient demographics, surgical, and perioperative practices, and the possibility of outcomes differing secondary to differences, we felt its efficacy had to be evaluated within this population. This task can be carried out in Jhelum in order to add regionally relevant information towards optimization of postoperative patient recovery following tonsillectomy.

METHODOLOGY

This randomized controlled trial was conducted in the Department of Otorhinolaryngology at CMH Jhelum over a six-month period from January 2023 to July 2023. Approval for the study was granted by the institutional ethics committee before commencement.

The sample size was determined with the World Health Organization calculator, using a 95% confidence level and 80% power. Anticipated proportions of postoperative vomiting were taken as 12% for one group and 30% for the other,[15] yielding a total of 160 participants. Patients were recruited by non-probability consecutive sampling and then randomly allocated into two equal groups of 80 each, one receiving dexamethasone and the other placebo.

Children aged 4 to 12 years of either sex who were scheduled for elective tonsillectomy were eligible. Those undergoing emergency surgery, with a recent history of tonsillar abscess, chronic analgesic use, corticosteroid dependence, immunosuppression, psychotic illness, or tuberculosis were excluded. Children who had received antiemetics, steroids, or antihistamines within the preceding week were also not enrolled. Informed written consent was obtained from parents or guardians after a full explanation of study objectives and procedures, ensuring that participation carried no additional risk. Demographic details such as age, sex, and weight were recorded for all participants.

A uniform anaesthetic protocol was maintained. Group A received dexamethasone at a dose of 0.5 mg/kg (up to 8 mg maximum), while Group B received an equivalent volume of normal saline. Pre-medication included glycopyrrolate and metoclopramide, followed by induction with propofol and atracurium. Anaesthesia was maintained with isoflurane in nitrous oxide and oxygen, and intraoperative analgesia was provided with ketorolac. Vital parameters including heart rate, blood pressure, oxygen saturation, temperature, and end-tidal CO_2 were monitored continuously. Neuromuscular blockade was reversed with neostigmine and atropine at the end of surgery. All tonsillectomies were performed by surgeons of comparable experience using the electrodissection technique. Patients were shifted to the recovery unit and observed until fully awake. Vomiting was considered present when three or more episodes of forceful gastric expulsion occurred within four hours of extubation. Postoperative pain was measured on the Faces Visual Analogue Scale ranging from 1 (no pain) to 10 (worst pain imaginable). A score above 4, assessed at 24 hours after extubation, was taken as significant pain. The scale was explained to both children and their parents preoperatively, and assessments were made at 4, 8, 12, and 24 hours after extubation.

Statistical analysis was performed using IBM SPSS version 26. Continuous data such as age, weight, and procedure duration were expressed as mean ± standard deviation, while categorical variables including sex, vomiting, and pain were summarized as frequencies and percentages. The chi-square test was applied for group comparisons, considering a p-value ≤ 0.05 statistically significant. Stratification was carried out by age, sex, weight, and operative duration to evaluate potential effect modifiers, and post-stratification analysis was done using the chi-square test.

RESULTS

The study included 160 pediatric patients undergoing tonsillectomy, equally divided between Group A (dexamethasone, n=80) and Group B (placebo, n=80). Patient demographics showed comparable baseline characteristics between groups, with mean ages of 8.000±2.53 years versus 8.050±2.61 years, mean weights of 28.800±9.69 kg versus 29.725±10.45 kg, and mean procedure durations of 35.350±4.96 minutes versus 35.575±5.33 minutes for Groups A and B respectively. Gender distribution was similar with 34 males (42.5%) and 46 females (57.5%) in Group A compared to 37 males (46.3%) and 43 females (53.8%) in Group B (as shown in Table-I).

Table I
Patient Demographics (n=160)

Demographics	Group A (n=80)	Group B (n=80)
	Mean ± SD	Mean ± SD
Age (years)	8.000±2.53	8.050±2.61
Weight (kg)	28.800±9.69	29.725±10.45
Duration of procedure (minutes)	35.350±4.96	35.575±5.33
Gender		
Male n (%)	34 (42.5%)	37 (46.3%)
Female n (%)	46 (57.5%)	43 (53.8%)

The primary outcome analysis demonstrated significant differences in postoperative complications between treatment groups. Vomiting occurred in 11 patients (13.8%) in the dexamethasone group compared to 34 patients (42.5%) in the placebo group (p=0.000), while pain was reported in 34 patients (42.5%) in Group A versus 56 patients (70%) in Group B (p=0.001), indicating substantial protective effects of preoperative dexamethasone administration (as shown in Table-II).

Table II
Comparison of outcomes between the two groups (n=160)

Outcomes	Group A n=80 n (%)	Group B n=80 n (%)	P value
Vomiting			
Yes	11 (13.8%)	34 (42.5%)	
No	69 (86.3%)	46 (57.5%)	**0.000**
Total	80 (100%)	80 (100%)	
Pain			
Yes	34 (42.5%)	56 (70%)	
No	46 (57.5%)	24 (30%)	**0.001**
Total	80 (100%)	80 (100%)	

Stratified analysis revealed age-dependent treatment effects for vomiting prevention, with significant benefits in younger children aged 4-8 years (Group A: 11 patients, 23.9% versus Group B: 31 patients, 70.5%, p=0.000) but no significant difference in older children aged 9-12 years (Group A: 0 patients, 0% versus Group B: 3 patients, 8.3%, p=0.085). For pain outcomes, younger children showed marked improvement with dexamethasone (Group A: 9 patients, 19.6% versus Group B: 31 patients, 70.5%, p=0.000), while older children demonstrated no significant difference (Group A: 25 patients, 73.5% versus Group B: 25 patients, 69.4%, p=0.705). Gender-based analysis showed no significant difference in vomiting rates among males (Group A: 6 patients, 17.6% versus Group B: 17 patients, 45.9%, p=0.815) but significant reduction in females (Group A: 5 patients, 10.9% versus Group B: 17 patients, 39.5%, p=0.011). Pain reduction was significant in both males (Group A: 16 patients, 47.1% versus Group B: 28 patients, 75.7%, p=0.013) and females (Group A: 18 patients, 39.1% versus Group B: 28 patients, 65.1%, p=0.014). Weight stratification revealed significant benefits for patients ≤30 kg for both vomiting (Group A: 11 patients, 22.9% versus Group B: 31 patients, 70.5%, p=0.000) and pain (Group A: 9 patients, 18.8% versus Group B: 31 patients, 70.5%, p=0.000), while patients >30 kg showed no significant vomiting difference (Group A: 0 patients, 0% versus Group B: 3 patients, 8.3%, p=0.095) and no significant pain difference (Group A: 25 patients, 78.1% versus Group B: 25 patients, 69.4%, p=0.418). Procedure duration analysis demonstrated significant improvements for both short (≤30 minutes) and long (>30 minutes) procedures, with vomiting rates of 4 patients (25%) versus 16 patients (88.9%) for short procedures (p=0.000) and 7 patients (10.9%) versus 18 patients (29%) for long procedures (p=0.011) in Groups A and B respectively, while pain rates were 3 patients (18.8%) versus 13 patients (72.2%) for short procedures (p=0.002) and 31 patients (48.4%) versus 43 patients (69.4%) for long procedures (p=0.010) in Groups A and B respectively (as shown in Table-III).

Table III
Association of Outcomes with Demographic Variables

Demographics variables	Group	Vomiting		P-value	Pain		P-value
		Yes (n, %)	No (n, %)		Yes (n, %)	No (n, %)	
Age (years)							
4-8	A	11 (23.9%)	35 (76.1%)	0.000	9 (19.6%)	37 (80.4%)	0.000
	B	31 (70.5%)	13 (29.5%)		31 (70.5%)	13 (29.5%)	
9-12	A	0 (0%)	34 (100%)	0.085	25 (73.5%)	9 (26.5%)	0.705
	B	3 (8.3%)	33 (91.7%)		25 (69.4%)	11 (30.6%)	
Gender							
Male	A	6 (17.6%)	28 (82.4%)	0.815	16 (47.1%)	18 (52.9%)	0.013
	B	17 (45.9%)	20 (54.1%)		28 (75.7%)	9 (24.3%)	
Female	A	5 (10.9%)	41 (89.1%)	0.011	18 (39.1%)	28 (60.9%)	0.014
	B	17 (39.5%)	26 (60.5%)		28 (65.1%)	15 (34.9%)	
Weight (kg)							
≤30	A	11 (22.9%)	37 (77.1%)	0.000	9 (18.8%)	39 (81.2%)	0.000
	B	31 (70.5%)	13 (29.5%)		31 (70.5%)	13 (29.5%)	
>30	A	0 (0%)	32 (100%)	0.095	25 (78.1%)	7 (21.9%)	0.418
	B	3 (8.3%)	33 (91.7%)		25 (69.4%)	11 (30.6%)	
Duration (minutes)							
≤30	A	4 (25%)	12 (75%)	0.000	3 (18.8%)	13 (81.2%)	0.002
	B	16 (88.9%)	2 (11.1%)		13 (72.2%)	5 (27.8%)	
>30	A	7 (10.9%)	57 (89.1%)	0.011	31 (48.4%)	33 (51.6%)	0.010
	B	18 (29%)	44 (71%)		43 (69.4%)	19 (30.6%)	

DISCUSSION

The current study proves that preoperative administration of dexamethasone significantly diminishes postoperative pain and vomiting after pediatric tonsillectomies, with overall rates of vomiting reducing from 42.5% to 13.8% and pain incidence decreasing from

70% to 42.5% among treated patients. Such results are congruent with anti-inflammatory and antiemetic effects of dexamethasone, acting via various mechanisms such as inhibition of the cyclooxygenase and lipoxygenase pathways, suppression of prostaglandin E2 synthesis, and membrane stabilization of cells to prevent tissue edema and inflammatory reaction around the surgical site.

The age-stratified analysis presents particularly notable findings, where the youngest children (4-8 yr) had significantly greater benefits of dexamethasone therapy compared with the oldest children (9-12 yr), particularly for the prevention of vomiting where there was no significant effect noted on the older group. This age-related response may be related to the increased baseline sensitivity of the youngest children to anesthetic drugs and surgical stress, such that they are more likely to suffer postoperative nausea and vomiting via increased activation of the vestibular system and chemoreceptor trigger zone.

The gender-related differences noted, especially the notable reduction in vomiting in females but not males, are readily accounted for by hormonal effects on the vestibular system and sensitivity of the chemoreceptor trigger zone, since fluctuation of estrogens and progesterone is known to affect neurotransmitter systems relevant to mechanisms of nausea and vomiting. Weight stratification outcomes with increased efficacy in children ≤30 kg suggest that the conventional dosing of dexamethasone is achieving optimal plasma levels in smaller patients, and larger children may need weight-adjusted dosing of dexamethasone to achieve therapeutic levels. The duration of procedure findings suggest the anti-inflammatory properties of dexamethasone are equally beneficial irrespective of surgical complexity, such that longer procedures tend to cause wider tissue damage, which dexamethasone may prevent by its sustained anti-inflammatory activity and suppression of pain sensitization pathways by cytokines.

Our observed vomiting rates of 13.8% in the dexamethasone group versus 42.5% in controls closely parallel those reported by Hashmi MA et al. [15] who found early vomiting rates of 12% versus 30% and late vomiting of 4% versus 16% with similar dosing regimens. Khan AS et al. [17] reported even more dramatic reductions with early vomiting rates of 17.8% versus 73.3%, while Khan MI et al. [18] demonstrated comparable antiemetic efficacy with vomiting frequencies of 4% versus 20%. The consistency of these findings across multiple studies reinforces the robust antiemetic properties of dexamethasone, which acts through inhibition of serotonin release from enterochromaffin cells and modulation of neurotransmitter pathways in the chemoreceptor trigger zone.

Pain reduction outcomes in our study, showing 42.5% versus 70% incidence rates, demonstrate substantial analgesic benefits that are supported by several investigations. Hashmi MA et al. [15] reported significantly lower Visual Analogue Scale scores at multiple time points with maximum reduction of approximately 1.9 points at 24 hours, while Khan AS et al. [17] observed maximum pain score reductions of 1.3 points at 6 hours. Malhotra V et al. [19] demonstrated even greater pain improvements with reductions of approximately 2.1 points on day 1, and Mahmoud KA et al. [20] achieved maximum reductions of 2.5 points on day 2 using multiple-dose regimens. These variations in pain reduction magnitude may be attributed to differences in dosing protocols, assessment timeframes, and patient populations, though all studies consistently demonstrate dexamethasone's analgesic efficacy through inhibition of inflammatory mediator synthesis and reduction of prostaglandin E2 production at the surgical site.

Age-stratified analysis in our study revealed particularly pronounced benefits in younger children (4-8 years) for both vomiting and pain prevention, with older children (9-12 years) showing diminished responses especially for vomiting outcomes. This age-dependent efficacy pattern has not been extensively explored in previous literature, though Najeeb T et al. [16] included both pediatric and adult populations and demonstrated significant pain reduction across age groups, suggesting that while dexamethasone remains effective in older patients, the magnitude of benefit may vary with developmental factors. The enhanced responsiveness in younger children likely reflects their increased susceptibility to anesthetic-induced nausea and heightened inflammatory responses due to immature physiological regulatory mechanisms.

Gender-based differences observed in our study, particularly the significant vomiting reduction in females but not males, represent a novel finding not specifically addressed in previous investigations. While studies by Khan MI et al. [21] and others included mixed gender populations, they did not provide gender-stratified analyses. This disparity may be explained by hormonal influences on vestibular sensitivity and neurotransmitter modulation, particularly estrogen's effects on serotonin pathways involved in nausea mechanisms. Weight-stratified results showing greater efficacy in children ≤30 kg align with dosing considerations discussed by Hashmi MA et al. [15] who used weight-based dosing up to 8 mg maximum, suggesting that fixed dosing may be suboptimal for larger patients requiring weight-adjusted therapeutic levels.

Notably, our findings contrast with those of Windfuhr JP et al. [22] who reported no significant difference in postoperative nausea and vomiting rates with routine dexamethasone use. However, this discrepancy may be attributed to their retrospective study design, variable dosing regimens (0.04-0.62 mg/kg), and different outcome assessment methodologies compared to the controlled prospective design employed in our investigation and other supportive studies. The procedural duration stratification in our study, showing benefits across both short and long operations, supports the sustained anti-inflammatory action of dexamethasone regardless of surgical complexity, which aligns with the prolonged half-life and tissue penetration characteristics of this corticosteroid. Aouad MT et al. [23] and Alhumaid H et al. [24] further support dexamethasone's efficacy profile, though with varying outcome measures and dosing protocols.

A few limitations of the study deserve mention. The single-center design may not generalize findings well to other healthcare facilities with different patient groups, surgical practices, or perioperative management practices. The sample size of 160 patients, although suitable for

primary endpoint analysis, might be too small statistically for the detection of smaller effect sizes in subgroup examinations, especially for rare demographic groups. Having a narrow age focus (4-12 yrs) on a population of children limits generalizability to adolescent and adult groups, and employing a single dosing regimen of dexamethasone does not permit comparison of optimal dosing practices. Furthermore, a short-term follow-up period may fail to detect delayed complication occurrences or longer-term sequelae, and failure to appraise and validate the assessment of blinding may introduce potential observer bias.

CONCLUSION

Preoperative dexamethasone administration has been found by our research to be effective at providing important clinical advantages in minimizing postoperative vomiting and pain after pediatric tonsillectomies. Intervention efficacy significantly surpassed placebo, with especially notable benefits realized among the youngest patients, female subjects, and those of low body weight. Such evidence recommends preoperative dexamethasone's inclusion in general standard perioperative practices among pediatric patients undergoing tonsillectomies.

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