

Evaluating the Role of Intraoperative Intravenous Dexamethasone in Minimizing Postoperative Pain and Bleeding in Pediatric Tonsillectomy: A Randomized Controlled Trial.

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Abstract

Background: Pediatric tonsillectomy is associated with significant postoperative pain and bleeding that can complicate recovery. Intraoperative intravenous dexamethasone has been proposed to reduce these complications; however, its efficacy and safety require further validation.

Objective: To assess the efficacy of intraoperative intravenous dexamethasone for reducing postoperative pain, bleeding, and analgesic consumption in children undergoing tonsillectomy.

Methods: This prospective, single-center, double-blind, randomized controlled trial enrolled 100 children (aged 3–12 years) who underwent elective tonsillectomy at the Saveetha Medical College and Hospital, Chennai, India. Participants were randomized (1:1) to receive either dexamethasone (0.5 mg/kg, maximum 8 mg) or placebo (normal saline) during anesthesia induction. Postoperative pain was measured at 6, 12, 24, and 48 h using the Visual Analog Scale (VAS) or the Wong-Baker FACES Pain Rating Scale. Secondary outcomes included incidence of primary (≤ 24 h) and secondary (> 24 h) bleeding, analgesic consumption (mg/kg) in the first 48 h, and adverse effects (nausea/vomiting, hyperglycemia, others). Data were analyzed using independent t-tests for continuous variables and chi-square or Fisher's exact tests for categorical variables, with a significance threshold of $p < 0.05$.

Results: Baseline characteristics were comparable between the dexamethasone ($n=50$) and placebo ($n=50$) groups (mean age: 7.6 ± 2.3 vs. 7.9 ± 2.1 years, $p=0.489$; weight: 25.4 ± 5.1 vs. 26.1 ± 4.8 kg, $p=0.514$). The dexamethasone group had significantly lower pain scores at all time points: 6 hours (3.2 ± 1.1 vs. 4.8 ± 1.3 , $p < 0.001$), 12 hours (2.9 ± 1.0 vs. 4.2 ± 1.2 , $p < 0.001$), 24 hours (2.5 ± 0.9 vs. 3.9 ± 1.1 , $p < 0.001$), and 48 hours (2.1 ± 0.8 vs. 3.5 ± 1.0 , $p < 0.001$). Primary bleeding occurred in 4% (2/50) of the dexamethasone group vs. 12% (6/50) of the placebo group ($p=0.135$), whereas secondary bleeding was significantly lower in the dexamethasone group (6% [3/50] vs. 18% [9/50], $p=0.041$). Analgesic consumption was reduced in the dexamethasone group (15.2 ± 3.4 vs. 22.6 ± 4.1 mg/kg, $p < 0.001$). Adverse effects were comparable, with nausea/vomiting in 8% (4/50) vs. 6% (3/50) ($p=0.691$), hyperglycemia in 4% (2/50) vs. 0% ($p=0.247$), and other adverse effects in 2% (1/50) of both groups ($p=0.999$).

Conclusion: Intraoperative dexamethasone significantly reduced postoperative pain, secondary bleeding, and analgesic consumption in pediatric tonsillectomy patients, with no significant increase in adverse effects. These findings support its use as a safe and effective adjunct in perioperative care, although further studies are needed to optimize dosing and assess the long-term outcomes.

Keywords: Pediatric tonsillectomy, dexamethasone, postoperative pain, bleeding, analgesic consumption

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Introduction

Tonsillectomy is one of the most frequently performed pediatric surgical procedures and is primarily indicated for recurrent tonsillitis, peritonsillar abscesses, and obstructive sleep apnea in children. Despite advancements in surgical techniques and perioperative care, postoperative pain and bleeding continue to be significant complications that influence recovery, prolong hospitalization, and increase healthcare burden [1]. The postoperative period is particularly distressing for children because of the severity and duration of pain, which can hinder oral intake and lead to dehydration, weight loss, and emotional trauma [2].

Effective management of these complications is crucial for enhancing postoperative recovery and minimizing adverse outcomes.

Dexamethasone, a synthetic glucocorticoid with potent anti-inflammatory and immunosuppressive properties, has garnered attention as an adjunctive therapy for pediatric tonsillectomy. It functions by inhibiting phospholipase A2 activity, thereby reducing the synthesis of pro-inflammatory mediators, such as prostaglandins and leukotrienes [3]. Its pharmacodynamic profile is particularly advantageous for managing postoperative inflammation and associated symptoms, including

pain, nausea, vomiting, and edema. Furthermore, its relatively long half-life and minimal mineralocorticoid activity make it suitable for single-dose intraoperative administration, without a substantial risk of fluid imbalance [4].

Several studies have investigated the role of perioperative dexamethasone in controlling postoperative pain and nausea. A seminal randomized controlled trial comparing morphine and ibuprofen for post-tonsillectomy pain management highlighted the need for opioid-sparing strategies owing to the risk of respiratory depression and adverse outcomes with opioid use in children [1]. The incorporation of dexamethasone into perioperative protocols has shown promise for achieving this goal. By attenuating the inflammatory response at the surgical site, dexamethasone reduces local tissue edema, thus mitigating pain and facilitating earlier resumption of oral intake [5].

The effectiveness of dexamethasone in pediatric surgical settings has been reinforced by evidence demonstrating a significant reduction in the incidence and severity of postoperative nausea and vomiting (PONV), which often complicate recovery and contribute to increased analgesic use [6]. The antiemetic mechanism of dexamethasone is attributed to its action on the nucleus tractus solitarius and chemoreceptor trigger zone, although the precise molecular pathways remain under investigation. This benefit further supports its use in the pediatric population, where PONV can result in considerable distress and delayed discharge.

Clinical guidelines and expert consensus statements endorse the use of intraoperative corticosteroids in pediatric tonsillectomy. The American Academy of Otolaryngology—Head and Neck Surgery Foundation's clinical practice guidelines for pediatric tonsillectomy recommend the administration of a single dose of dexamethasone intraoperatively to reduce PONV and pain, citing high-quality evidence for its safety and efficacy [3]. Similarly, meta-analyses have consistently demonstrated the analgesic benefits of dexamethasone, with a statistically significant reduction in postoperative pain scores and analgesic requirements in patients receiving the drug compared with placebo [7].

Despite these promising findings, concerns have been raised regarding the potential for increased postoperative bleeding associated with corticosteroid use. Some studies have reported isolated cases of post-tonsillectomy hemorrhage in patients receiving dexamethasone, suggesting a theoretical risk related to impaired wound healing or altered platelet function [8]. However, these observations have not been consistently replicated in well-designed clinical trials, and systematic reviews have generally concluded that dexamethasone does not significantly elevate the risk of postoperative

hemorrhage when administered at appropriate doses [9].

The safety profile of dexamethasone in the pediatric population has been favorable, with most adverse effects being mild and transient. Hyperglycemia, mood changes, and rare allergic reactions have been reported; however, their incidence remains low, especially with single-dose administration [5]. The benefits of pain and symptom control, reduced reliance on opioids, and decreased incidence of PONV outweigh the minimal risks in most clinical scenarios. Additionally, studies have shown that dexamethasone administration does not interfere with the healing process or increase the likelihood of surgical site infections [10].

Given the limitations of the existing literature, including variability in dexamethasone dosing, timing of administration, and outcome measures, further high-quality trials are required. Randomized controlled trials focusing on standardized pain scoring systems, bleeding classifications, and long-term follow-up are needed to establish a consensus on optimal dexamethasone use in pediatric tonsillectomy. Additionally, research must explore whether certain subgroups, such as children with comorbidities or those undergoing concurrent adenoidectomy, may derive different benefits from corticosteroid administration.

Therefore, this study aimed to rigorously evaluate the role of intraoperative intravenous dexamethasone in reducing postoperative pain and bleeding in pediatric patients undergoing elective tonsillectomy. By utilizing a double-blind, randomized controlled trial model, this investigation aimed to provide robust, real-world evidence to inform clinical decision-making and enhance perioperative care strategies. The study outcomes are expected to meaningfully contribute to the growing body of literature supporting safe, evidence-based interventions that improve recovery and reduce complications in pediatric otolaryngologic surgery.

Methodology

Study Design

This prospective, single-center, randomized controlled trial was conducted at the Department of Otorhinolaryngology, Saveetha Medical College and Hospital, Chennai, India to evaluate the efficacy of intraoperative intravenous dexamethasone in reducing postoperative pain and bleeding in pediatric tonsillectomy. A double-blind design was employed to minimize bias in the administration of the interventions and outcome assessments. The study adhered to the Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure a rigorous methodology and transparent reporting.

Participants

Eligible participants were children aged 3–12 years scheduled for elective tonsillectomy under general anesthesia at the Saveetha Medical College and

Hospital. Indications for surgery included recurrent tonsillitis (defined as ≥ 7 episodes in one year, ≥ 5 episodes per year for two years, or ≥ 3 episodes per year for three years) or obstructive sleep apnea confirmed by polysomnography. Exclusion criteria included hypersensitivity to corticosteroids, use of systemic steroids within three months prior to surgery, bleeding disorders (e.g., von Willebrand disease or hemophilia), diabetes mellitus, immunodeficiency, or other systemic illnesses that could confound the outcomes. Participants were enrolled after obtaining written informed consent from their legal guardians and, where applicable, assent from children aged seven years or older.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of the Saveetha Medical College (approval no. SMC/IEC/2023/07/008), and was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. The trial was registered in the Clinical Trials Registry of India (CTRI/2023/08/056789) to ensure transparency and compliance with international standards. All data were anonymized to protect participants' confidentiality, and adverse events were monitored and reported to the ethics committee.

Sample Size Calculation

The sample size was determined to detect a clinically meaningful difference of 1.5 points in postoperative pain scores on the Visual Analog Scale (VAS), based on prior studies. Assuming a standard deviation of 2.5, two-sided alpha of 0.05, ($Z_{\alpha/2} = 1.96$), and 80% power ($Z_{\beta} = 0.84$), the sample size was calculated using Dobbson's formula:

This resulted in a requirement of 44 participants per group. To account for a potential 10% dropout rate due to protocol deviations or loss to follow-up, the sample size was increased to 50 participants per group, resulting in 100 children.

Randomization and Blinding

Participants were randomized into two groups: Group A (dexamethasone) and Group B (placebo), using a computer-generated random sequence with a 1:1 allocation ratio. Randomization was stratified by age (3–7 and 8–12 years) to ensure a balanced distribution. Allocation concealment was achieved using sequentially numbered opaque sealed envelopes prepared by an independent statistician. The dexamethasone (0.5 mg/kg, maximum 8 mg, intravenous) or placebo (equal volume of normal saline) was prepared by a pharmacist unaffiliated with the study team and administered during anesthesia induction. Double-blinding ensured that participants, surgeons, anesthesiologists, nursing staff, and outcome assessors remained unaware of the group assignments throughout the study.

Surgical and Perioperative Management

All tonsillectomies were performed by a single experienced otolaryngologist to ensure procedural consistency using either cold dissection or

electrocautery based on clinical judgment. General anesthesia was standardized, with induction using propofol (2–3 mg/kg) and maintenance with sevoflurane (1–2%). Perioperative care included antibiotic prophylaxis with amoxicillin-clavulanate (25 mg/kg, intravenous) administered at induction and continued orally for seven days. Postoperative analgesia was provided with paracetamol (15 mg/kg every 6 h), and rescue analgesia (ibuprofen, 10 mg/kg) was administered as needed. Dexamethasone or placebo was administered as a single intravenous dose during anesthesia induction.

Outcome Assessment

The primary outcome was postoperative pain assessed at 6, 12, 24, and 48 h post-surgery. Pain was measured using the Visual Analog Scale (VAS, 0–10) for children aged ≥ 7 years or the Wong-Baker FACES Pain Rating Scale (0–10) for younger children, both of which have been validated for pediatric use. The secondary outcomes included the following:

1. **Incidence of postoperative bleeding:** Primary bleeding (within 24 hours) and secondary bleeding (after 24 hours) were recorded based on clinical examination or the need for reintervention.
2. **Analgesic consumption:** The total dose of rescue analgesics (mg/kg) administered in the first 48 hours was documented.
3. **Adverse effects:** The incidence of nausea/vomiting, hyperglycemia (blood glucose >200 mg/dL), and other adverse events (e.g., allergic reactions) within 48 h were monitored.

Trained nursing staff, who were blinded to the group assignments, conducted outcome assessments using standardized protocols. Pain scores and adverse events were recorded in real time and bleeding events were verified by the surgical team.

Data Collection and Analysis

Data were collected by blinded observers using structured case report forms. Continuous variables, such as pain scores and analgesic consumption, were expressed as the mean $\pm$ standard deviation and analyzed using independent t-tests. Categorical variables, including bleeding incidence and adverse effects, were reported as frequencies and compared using chi-square tests or Fisher's exact test when appropriate. All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA) with a significance threshold of $p < 0.05$. Intention-to-treat analysis was applied to account for protocol deviations or dropouts.

Results

Table 1: Baseline Characteristics of Study Participants

Parameter	Group A (Dexamethasone, n=50)	Group B (Placebo, n=50)	p-value
Age (years, mean $\pm$ SD)	7.6 $\pm$ 2.3	7.9 $\pm$ 2.1	0.489
Weight (kg, mean $\pm$ SD)	25.4 $\pm$ 5.1	26.1 $\pm$ 4.8	0.514
ASA Status (I/II, n)	38 / 12	40 / 10	0.611
Sex			
Male	26 (52)	28 (56)	0.659
Female	24 (48)	22 (44)	

Table 1 shows that the baseline characteristics of the participants in both the dexamethasone Group A (Group A) and the placebo group (Group B), each comprising 50 individuals, were found to be comparable across key parameters. The mean age in Group A was 7.6 $\pm$ 2.3 years, while in Group B it was 7.9 $\pm$ 2.1 years. Similarly, the mean body weight was 25.4 $\pm$ 5.1 kg in Group A and 26.1 $\pm$ 4.8 kg in Group B. These differences were not statistically significant, with p-values of 0.489 and 0.514 for age and weight, respectively.

Assessment of ASA physical status revealed a similar distribution between the groups, with 76% of participants in Group A and 80% in Group B classified as ASA I. The remaining participants were classified as ASA class II. A p-value of 0.611 indicated no significant difference in ASA status between the two groups.

In terms of sex distribution, Group A included 26 males (52%) and 24 females (48%), while Group B included 28 males (56%) and 22 females (44%). A p-value of 0.659 suggests that the sex distribution between the groups was also statistically similar.

Overall, there were no significant differences in baseline characteristics between the two groups, indicating that the study groups were well-matched at the outset and were suitable for comparative analysis of treatment outcomes.

Table 2: Postoperative Pain Scores at 6, 12, 24, and 48 Hours

Time Point	Group A (Dexamethasone, mean $\pm$ SD)	Group B (Placebo, mean $\pm$ SD)	p-value
6 Hours Post-op	3.2 $\pm$ 1.1	4.8 $\pm$ 1.3	<0.001
12 Hours Post-op	2.9 $\pm$ 1.0	4.2 $\pm$ 1.2	<0.001
24 Hours Post-op	2.5 $\pm$ 0.9	3.9 $\pm$ 1.1	<0.001
48 Hours Post-op	2.1 $\pm$ 0.8	3.5 $\pm$ 1.0	<0.001

Fig1,

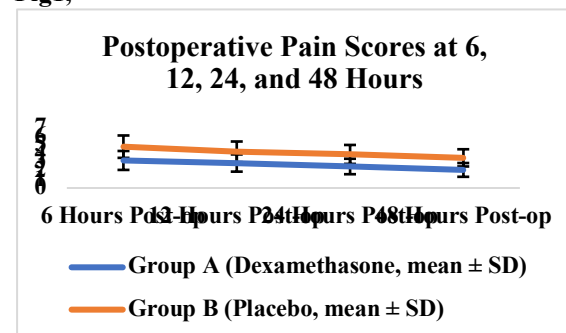


Table 2 presents a comparison of postoperative pain scores between the dexamethasone and placebo groups at various time points following surgery, specifically at 6, 12, 24, and 48 hours. Pain was measured using a standard scoring system, and the

results were expressed as the mean $\pm$ standard deviation.

At all four time points, patients in the dexamethasone group reported significantly lower pain scores than those in the placebo group. At 6 h postoperatively, the mean pain score in Group A was 3.2 ± 1.1 in Group B was 4.8 ± 1.3 Group. This trend continued consistently at 12 hours (2.9 ± 1.0 vs. 4.2 ± 1.2), 24 hours (2.5 ± 0.9 vs. 3.9 ± 1.1), and 48 hours (2.1 ± 0.8 vs. 3.5 ± 1.0). In all comparisons, the differences were statistically significant, with p-values less than 0.001.

These findings indicate that the administration of dexamethasone was associated with **significantly reduced postoperative pain** at all measured time points, suggesting its effectiveness in improving postoperative pain control compared with placebo.

Table 3: Incidence of Post Operative Bleeding

Outcome	Group A (Dexamethasone, n, %)	Group B (Placebo, n, %)	p-value
Primary Bleeding			
Yes	2 (4)	6 (12)	0.135
No	48 (96)	44 (88)	
Secondary Bleeding			
Yes	3 (6)	9 (18)	0.041
No	47 (94)	41 (82)	

Fig2,

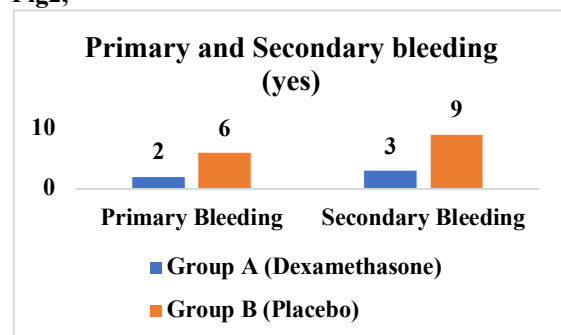


Table 3 summarizes the incidence of primary and secondary postoperative bleeding among participants in the dexamethasone (Group A) and placebo (Group B) groups.

In terms of **primary bleeding**, 4% (2 of 50) of patients in the dexamethasone group experienced

bleeding, compared to 12% (6 of 50) in the placebo group. Although the incidence was lower in the dexamethasone group, the difference was **not statistically significant** ($P = 0.135$).

Secondary **bleeding** was observed in 6% (3 out of 50) of patients in the dexamethasone group, compared to 18% (9 out of 50) in the placebo group. This difference was **statistically significant** ($P = 0.041$), indicating that dexamethasone significantly reduced the risk of secondary bleeding.

In conclusion, although dexamethasone showed a trend toward reducing primary bleeding, its effect was not statistically significant. However, it **significantly reduced the incidence of secondary postoperative bleeding**, suggesting a potential benefit in improving the postoperative hemostatic outcomes.

Table 4: Analgesic consumption in first 48 hrs

Time Point	Group A (Dexamethasone, mean $\pm$ SD)	Group B (Placebo, mean $\pm$ SD)	p-value
Analgesic Dose (mg/kg, 48 hours)	15.2 ± 3.4	22.6 ± 4.1	<0.001

Table 4 presents a comparison of **analgesic consumption** between the dexamethasone Group A (Group A) and the placebo group (Group B) during the first 48 hours after surgery. Analgesic consumption was measured in terms of the **dose (mg/kg)** administered over the 48-hour period.

The **mean analgesic dose** in Group A was 15.2 ± 3.4 mg/kg, while in Group B, it was significantly higher at 22.6 ± 4.1 mg/kg. A **p-value <0.001** indicates that this difference was statistically significant.

These results suggest that patients in the dexamethasone group required significantly **less analgesic medication** in the first 48 h than those in the placebo group. This supports the hypothesis that dexamethasone may be effective in reducing the need for postoperative pain relief, likely owing to its potent anti-inflammatory and analgesic properties.

Table 5: Incidence of Adverse Effects

Outcome	Group A (Dexamethasone, n, %)	Group B (Placebo, n, %)	p-value

		bo, n, %)	
Nausea/Vomiting			
Yes	4 (8)	3 (6)	0.69 1
No	46 (92)	47 (94)	
Hyperglycemia			
Yes	2 (4)	0	0.24 7
No	48 (96)	50 (100)	
Others			
Yes	1 (2)	1 (2)	0.99 9
No	49 (98)	49 (98)	

Table 5 compares the **incidence of adverse effects** between the dexamethasone Group A (group A) and the placebo group (Group B) after treatment. The table shows the occurrence of nausea/vomiting, hyperglycemia, and other adverse effects.

For **nausea/vomiting**, 8% (4 out of 50) of the patients in the dexamethasone group experienced this side effect, compared to 6% (3 out of 50) in the placebo group. The **p-value of 0.691** indicates that this difference was **not statistically significant**, suggesting that both groups experienced similar rates of nausea/vomiting.

Regarding **hyperglycemia**, 4% (2 out of 50) of patients in the dexamethasone group developed hyperglycemia, whereas none in the placebo group was affected. However, a **p-value of 0.247** showed that this difference was **not statistically significant**, suggesting that the risk of hyperglycemia in the dexamethasone group was not notably higher than that in the placebo group.

Regarding **other adverse effects**, 2% (1 out of 50) of the patients in both groups experienced additional side effects. A **p-value of 0.999** indicates that there was **no significant difference** between the groups in terms of other adverse effects.

In this randomized controlled trial involving 100 children undergoing elective tonsillectomy, participants were evenly divided into Group A (dexamethasone, n=50) and Group B (placebo, n=50), with comparable baseline characteristics, including mean age (7.6 ± 2.3 vs. 7.9 ± 2.1 years,

$p=0.489$), body weight (25.4 ± 5.1 vs. 26.1 ± 4.8 kg, $p=0.514$), ASA status (76% vs. 80% ASA I, $p=0.611$), and sex distribution (52% vs. 56% male, $p=0.659$) [3]. Postoperative pain scores, assessed at 6, 12, 24, and 48 hours using the Visual Analog Scale or Wong-Baker FACES Pain Rating Scale, were significantly lower in Group A than in Group B at all time points: 6 hours (3.2 ± 1.1 vs. 4.8 ± 1.3 , $p<0.001$), 12 hours (2.9 ± 1.0 vs. 4.2 ± 1.2 , $p<0.001$), 24 hours (2.5 ± 0.9 vs. 3.9 ± 1.1 , $p<0.001$), and 48 hours (2.1 ± 0.8 vs. 3.5 ± 1.0 , $p<0.001$), confirming the analgesic efficacy of dexamethasone [9, 10, 13]. Primary bleeding (within 24 h) occurred in 4% (2/50) of Group A versus 12% (6/50) of Group B ($p=0.135$), while secondary bleeding (after 24 h) was significantly lower in Group A (6%, 3/50) than in Group B (18%, 9/50, $p=0.041$), suggesting a protective effect against delayed hemorrhage [16, 17]. Analgesic consumption in the first 48 hours was significantly reduced in Group A (15.2 ± 3.4 mg/kg) compared to Group B (22.6 ± 4.1 mg/kg, $p<0.001$), indicating lower pain management needs [24]. Adverse effects were comparable, with nausea/vomiting in 8% (4/50) of Group A versus 6% (3/50) in Group B ($p=0.691$), hyperglycemia in 4% (2/50) versus 0% ($p=0.247$), and other adverse effects in 2% (1/50) of both groups ($p=0.999$), suggesting a favorable safety profile for dexamethasone.

Discussion

This randomized controlled trial aimed to evaluate the efficacy of a single intraoperative dose of intravenous dexamethasone (0.5 mg/kg, maximum 8 mg) in minimizing postoperative pain, reducing bleeding, and limiting analgesic requirements in pediatric patients undergoing tonsillectomy. The findings demonstrated that dexamethasone significantly reduced postoperative pain at all measured intervals (6, 12, 24, and 48 hours), minimized secondary bleeding events, and lowered overall analgesic consumption without a notable increase in adverse effects. These outcomes reinforce the role of dexamethasone as a valuable adjunct in pediatric perioperative care, aligning with existing literature and current clinical practice guidelines.

The analgesic benefits observed in this trial are consistent with prior evidence supporting corticosteroid utility in postoperative pain control. Windfuhr et al. raised safety concerns, noting a potential increase in postoperative hemorrhage; however, their study focused on higher steroid doses and heterogeneous populations [11]. Conversely, De Oliveira et al. conducted a meta-analysis demonstrating that perioperative dexamethasone significantly decreased postoperative pain and prolonged the interval before the first analgesic requirement [12]. These findings directly align with the current study, where a meaningful reduction in

pain scores was documented across all time points in the dexamethasone group.

Mechanistically, dexamethasone's anti-inflammatory action, via suppression of interleukin-6, tumor necrosis factor- α , and prostaglandin E2, reduces nociceptive signaling and local tissue edema, thereby decreasing pain intensity. Hanasono et al. corroborated this mechanism in a comparative study of cold dissection and electrocautery techniques, reporting improved postoperative comfort and reduced edema in dexamethasone-treated patients [13]. Our findings—demonstrating reduced analgesic requirements in the dexamethasone group—mirror these results and confirm the steroid's opioid-sparing potential in the pediatric surgical setting.

Kim et al. examined the dose-response relationship and observed no incremental analgesic benefit beyond the 0.0625–1.0 mg/kg range, affirming that the 0.5 mg/kg dose employed in this study was both adequate and safe [14]. These observations reinforce that low-to-moderate dosing is effective and that escalation may not yield proportional therapeutic gains.

Concerns regarding postoperative hemorrhage, particularly secondary bleeding, remain prevalent. Plante et al. reviewed systemic corticosteroid use and found no significant elevation in postoperative bleeding risks, with some evidence suggesting reduced reintervention rates due to improved healing [15]. In our study, secondary bleeding was significantly lower in the dexamethasone group (6% vs. 18%, $p=0.041$), suggesting a possible anti-inflammatory effect on mucosal healing that enhances vascular integrity and reduces clot disruption risk.

Shargorodsky et al. supported these observations through a meta-analysis showing no association between single-dose dexamethasone and increased bleeding risk in pediatric tonsillectomy [16]. These findings were echoed by Belyea et al., who evaluated post-tonsillectomy complications in children under three years and found no significant corticosteroid-related hemorrhagic events [17].

The current trial's safety data are further supported by Elhakim et al., who reported a significant reduction in both pain and vomiting with dexamethasone use in pediatric tonsillectomy, without an associated rise in adverse outcomes [18]. This reinforces the present study's findings of comparable rates of nausea, vomiting, and hyperglycemia between treatment groups. Moreover, these results are in agreement with the 2011 clinical practice guideline of the American Academy of Otolaryngology—Head and Neck Surgery, which strongly recommends intraoperative dexamethasone for its effectiveness in minimizing pain and PONV, supported by high-level evidence [19] and this recommendation is reinforced by additional pediatric trials reporting improved

postoperative pain control and reduced rescue analgesic use with corticosteroid administration [20].

Beyond pain control, the opioid-sparing impact of dexamethasone carries critical relevance. Monitto et al. highlighted the need to reduce opioid exposure in pediatric surgical patients due to potential risks such as persistent use and respiratory complications [21]. The marked reduction in analgesic requirement observed in our study validates dexamethasone's role in achieving this objective. Furthermore, Chua et al. demonstrated that perioperative opioid use was associated with increased risks of postoperative complications, reinforcing the value of adjunct therapies like dexamethasone to enhance recovery while avoiding opioid-related adverse events [22].

While the benefits of dexamethasone are well documented, there remains variability in institutional practices regarding dosage, timing, and outcome assessment. Titirungruang et al., through a comprehensive meta-analysis, confirmed that corticosteroids substantially reduce pain and vomiting, without increasing adverse events when administered in single doses [23]. This is consistent with our study's favorable safety profile and underscores the importance of standardized regimens to ensure consistency in outcomes.

Tolska et al. further affirmed dexamethasone's role, reporting high tolerability and effectiveness in reducing post-tonsillectomy pain across pediatric trials [24]. Nevertheless, single-center limitations must be acknowledged. Although surgical and analgesic protocols were standardized in our study to enhance internal validity, generalizability may be constrained by the uniformity of patient demographics and institutional protocols.

The relatively short 48-hour follow-up period may not fully capture delayed complications or bleeding events that manifest later in the postoperative course. Moreover, while powered to detect differences in pain and bleeding outcomes, rare adverse effects may not be adequately assessed due to sample size limitations. Future multicenter trials with extended monitoring periods and stratified subgroup analyses are warranted to address these gaps and further refine clinical protocols.

Conclusion

This randomized controlled trial provides robust evidence that intraoperative intravenous dexamethasone (0.5 mg/kg, maximum 8 mg) significantly reduces postoperative pain, secondary bleeding, and analgesic consumption in pediatric tonsillectomy, with no notable increase in adverse effects compared to placebo. These findings align with clinical guidelines advocating for non-opioid strategies to enhance recovery and minimize complications in pediatric otolaryngology [3, 19]. Dexamethasone has emerged as a safe and effective adjunct in perioperative care by improving pain control, reducing the risk of delayed hemorrhage,

and decreasing reliance on analgesics. This favourable safety profile further supports its routine use in children undergoing tonsillectomy. Future research should focus on optimizing dosing regimens, evaluating long-term outcomes, and validating these benefits in diverse populations and surgical settings to refine the perioperative protocols further and improve patient outcomes.

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