

Comparison between Nebulized Ketamine, Magnesium and Dexmedetomidine in Attenuating Paediatrics Sore Throat Following Tonsillectomy Surgery, 2023

Original Article

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ABSTRACT

Background: In the literature, Postoperative sore throat (POST) is a frequently occurring challenge after pediatric tonsillectomy, significantly impacting recovery and Comfort of the patient.

This study was conducted to compare the effect between Nebulized Dexmedetomidine, Ketamine and Magnesium to reduce POST in pediatrics.

Methods: A blind clinical trial study was conducted at Al-Maadi Military Hospital, 192 pediatric patients were randomized into three groups, each receiving a preoperative nebulization dose: Ketamine (0.75 mg/kg), Magnesium Sulfate (250 mg), or Dexmedetomidine (2 mcg/kg). POST severity was assessed after surgery (0, 2, 4, 8, 12, and 24 hours) using a validated four-point scale. The age of ASA physical status I and II tonsillectomy patients of either sex was 5–8.

Results: The results revealed Dexmedetomidine (Group D) as the most effective agent in reducing both the incidence and severity of POST across all time points.

At 8 hours post-operation, only 12.5% of patients in Group D experienced POST in comparison to 37.5% in Group K and 29.7% in Group M. Furthermore, by 24 hours, POST incidence in Group D was reduced to 3.1%, demonstrating a statistically significant advantage ($p < 0.05$). The study also noted that Dexmedetomidine provided better hemodynamic stability and lower intraoperative analgesic requirements compared to Ketamine and Magnesium Sulfate.

Conclusion: This study highlights the promising role of dexmedetomidine as an optimal preoperative nebulized treatment for managing postoperative sore throat (POST) in pediatric tonsillectomy patients. Its superior efficacy in reducing discomfort, combined with a favorable safety profile and minimal side effects, underscores its potential as a transformative approach in perioperative care. By enhancing postoperative recovery, reducing the need for additional analgesics, and improving overall parental satisfaction, dexmedetomidine represents a significant advancement in optimizing pediatric surgical outcomes. Further research and clinical integration may establish it as a standard component of multimodal analgesia in pediatric otolaryngologic procedures.

Key Words: Analgesia, pain, recovery, tonsillectomy.

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INTRODUCTION

Tonsillectomy is one of the most commonly performed day-case surgeries in pediatric patients. Despite its routine nature, post-operative sore throat (POST) remains a significant cause of morbidity, leading to discomfort and reduced parental satisfaction^[1]. While global incidence rates of POST are well-documented, there is a lack of solid epidemiological data regarding its prevalence in Egypt.

During tonsillectomy, the shared surgical and anesthetic field poses a risk of airway manipulation, necessitating close cooperation between the surgeon and anesthesiologist to maintain adequate oxygenation and a clear operative

field^[2]. Intraoperative blood or fluid aspiration can further exacerbate upper airway irritation, contributing to POST^[3]. Given the impact of POST on patient well-being, effective preventive strategies are essential for optimizing post-operative recovery^[4].

Various pharmacological and non-pharmacological approaches have been explored to mitigate POST. Pharmacological interventions, such as corticosteroids and non-steroidal anti-inflammatory drugs (NSAIDs), have demonstrated efficacy but are associated with an increased risk of post-operative bleeding^[5]. Alternatively, non-pharmacological strategies, including meticulous airway

handling and refined surgical techniques, offer potential benefits. Among pharmacological agents, nebulized ketamine and magnesium have gained attention for their efficacy and safety in managing POST^[6,7].

Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, is widely recognized for its potent analgesic and antidepressant properties at sub-anesthetic doses^[8,9]. Magnesium, which also acts as an NMDA receptor antagonist, is readily available and has been proposed as an effective, low-cost, and non-invasive treatment for POST when administered via nebulization^[7]. Compared to intravenous administration, nebulization provides a rapid, painless, and easily accessible alternative, potentially enhancing drug absorption through the respiratory epithelium^[10].

Several studies have demonstrated the superiority of nebulized ketamine over intravenous ketamine in reducing post-tonsillectomy pain in pediatric patients^[11]. Furthermore, a combination of nebulized dexmedetomidine and low-dose ketamine has been shown to provide superior hemodynamic stability and analgesia compared to either agent alone, with no significant adverse effects and a faster recovery profile in pediatric dental procedures^[12]. Similarly, Thomas *et al.* (2020)^[13] reported that combining low-dose nebulized ketamine with dexmedetomidine resulted in improved intraoperative hemodynamic stability compared to nebulized ketamine alone.

Despite these promising findings, no studies have directly compared the efficacy of nebulized ketamine, magnesium, and dexmedetomidine in minimizing POST in pediatric patients aged 6 to 8 years undergoing tonsillectomy. This study aims to address this gap by evaluating and comparing the effectiveness of these nebulized agents in reducing POST, with the goal of optimizing pain management strategies in pediatric tonsillectomy patients.

PATIENTS AND METHODS AND PREOPERATIVE PREPARATION

Research design

Double blinded Randomized Interventional study.

Inclusion Criteria

- Patients classified as ASA physical status I or II.
- Male and female patients aged between 5 and 8 years.
- Undergoing tonsillectomy under general anesthesia.
- Surgical procedures with a duration of less than one hour.

Exclusion Criteria

- Patients with a Mallampati score > 2.
- Presence of preoperative sore throat (ST).
- History of upper respiratory tract infection.
- Known allergy to the study drug.
- Surgical procedures lasting more than one hour.
- Patients or their legal representatives unwilling to provide written informed consent in accordance with legal and ethical guidelines.

Sampling and Sample size

A total of 192 patients were randomly assigned into three equal groups 64 subjects in each group considering 20% drop-out rate, to get this difference at power of 80% and type I error 5%.

Ethical considerations

The Armed Forces College of Medicine Ethical Review Committee gave its approval to the study proposal (IRB: AFCM, meeting date: 28/1/2023; serial number: 148). Prior to their registration in the study, the guardians of each participant provided written informed permission. The study complied with the Revised Helsinki Declaration of Biomedical Ethics' guidelines. Strict adherence to the data confidentiality policy was maintained.

Randomization and allocation

Of 64 patients each. Randomization was performed using computer-generated random number tables, and allocation was concealed using opaque, sealed envelopes. These envelopes were prepared by an anesthesiologist who was not involved in the study to ensure blinding. A staff nurse, who was also not engaged in the study, opened the sealed envelopes and prepared the nebulization solutions accordingly. All patients received preoperative nebulization with one of the following treatments: Group D (Dexmedetomidine Group), Group M (Magnesium Group) and Group K (Ketamine Group)

Procedure

All patients underwent preoperative nebulization. Group D (dexmedetomidine group) received 2 mcg/kg dexmedetomidine, Group M (magnesium group) received a fixed dose of 250 mg magnesium sulphate, and Group K (ketamine group) received 0.75 mg/kg ketamine nebulization. Normal saline was used to bring the volume of each drug up to 3 ml

Intraoperative preparation

Anesthesia was induced via 100% oxygen and sevoflurane; then IV access was secured. Fentanyl 1-2 µg/

kg was given. An appropriate-sized endotracheal tube was inserted Using a Macintosh laryngoscope blade size 1 or 2, a direct laryngoscopy was performed out to manage the airway with low cuff pressure <15 cm water using cuff pressure Manometer. Anesthesia was maintained with sevoflurane on spontaneous ventilation. Echocardiogram, spo₂, end-Tidal CO₂ and heart rate was monitored every 5 minutes and recorded every 10 minutes. Extubation was performed on the tonsillectomy position. Anaesthesia duration and recovery time was recorded. Then the patient was transferred to the PACU. All measurement was recorded by an investigator who was unaware about the study design or intervention.

In the PACU

1. POST was evaluated by recording its intensity at the fourth postoperative hour. ST was evaluated using a four-point rating system (0–3)^[14] 0 (no ST) 1 (mild ST (complains of ST only on asking)) 2 (moderate ST (complains of ST on his/her own)) 3 (severe ST (change in voice or hoarseness, associated with throat pain))

Beginning with admission to the PACU, the pain treatment regimen called for 15 mg/kg of intravenous paracetamol every 6 hours, if necessary. The first dose and the total amount of the analgesic were recorded. During the first 24 hours following surgery, the total amount of paracetamol administered to each patient was identified and documented.

2. The baseline values for heart rate and mean arterial blood pressure were noted, after skin incision by 5,15,30 minutes and at the end of the operation.
3. Intraoperative Fentanyl consumption was measured.
4. Patient was discharged with a modified Aldrete score more than 9.

Post operative Assessment

I- Emergence agitation was assessed by a scoring system for Emergence delirium.

1 (sleeping), 2 (awake, calm), 3 (irritable, crying) 4 (inconsolable crying) 5 (severe restlessness, disorientation)

II- The Wong-Baker FACES Pain Rating Scale (WBS) was used in children to rate pain severity postoperatively.



Fig. 1: Wong-Baker FACES Pain Rating Scale (WBS)

Statistical analysis

The data were statistically described using frequencies and percentages for qualitative data, median and range for non-parametric data, and mean $\pm$ standard deviation for numerical parametric data. Numerical variables between the study groups were compared using ANOVA or Kruskal Wallis tests. The categorical variable was subjected to the chi-square test. Wilcoxon Subgroup analysis was done using the signed-rank test. Statistical significance was defined as a *P-value* of less than 0.05. For all statistical computations, SPSS software was utilized.

RESULTS

We manually collected the data and entered it into a computer for analysis using SPSS software (version 22).

Quantitative data were expressed as mean $\pm$ standard deviation (SD), while qualitative data were presented as frequencies and percentages. For statistical analysis, ANOVA and t-tests were used for quantitative variables, while the chi-square test was applied to qualitative data.

A 95% confidence interval was set for all statistical tests. The level of significance was determined based on the *P-value*: $P > 0.05$: Not significant, $P < 0.05$: Significant

Results are shown in tables below:

Table 1: Post incidence according to groups

As regard POST incidence, table 7 and figure 12 showed significant difference between groups at 2H, 4H, 8H and 12 hours after operation. While there was no significant difference between groups at 0H and 24H after operation.

This table showed that 21, 20 and 10 patients had POST immediately after the procedure in group K, M and D respectively. 23, 24 and 12 patients had POST 2 hours after the procedure in group K, M and D respectively. 24, 21 and 11 patients had POST 4 hours after the procedure in group K, M and D respectively. 24, 19 and 8 patients had POST 8 hours after the procedure in group K, M and D respectively. 12, 10 and 3 patients had POST 12 hours after the procedure in group K, M and D respectively. 10, 8 and 2 patients had POST 24 hours after the procedure in group K, M and D respectively.

Table 2 showed that there is no statistically significant difference between the 3 groups regarding age, sex, weight, ASA score and duration of the procedure. Mean age was (7 ± 0.89), (7.14 ± 0.9) and (7.17 ± 0.98) in group K, M and D respectively. Mean weight was (25.14 ± 5.4), (23.4 ± 5.06) and (24.56 ± 5.2) in group K, M and D respectively. Mean duration of the operation was (44.8 ± 11.4), (44.03 ± 7.23) and (43.26 ± 6.23) in group K, M and D respectively. 32 patients in group K were males while 33 and 31 patients in groups M and D were males. 63 patients in group K were ASA 1 while 62 and 63 patients in groups M and D were ASA 1. Data was not significantly different.

As regard MAP, (Table 3) showed that there was no statistically significant difference between the 3 groups at T0 and T2. While there was statistically significant difference at T1, T3, T4 with P-value (0.07) (0.076) (0.001) respectively. Mean MAP at baseline was (69.22 ± 7.08), (66 ± 7.9) and (71.25 ± 7.34) in group K, M and D respectively. Mean MAP at T1 was (68.78 ± 7.29), (60.14 ± 7.73) and (69.5 ± 6.49) in group K, M and D respectively. Mean MAP at T2 was (75.22 ± 9.72), (62.14 ± 12.84) and (69.5 ± 10) in group K, M and D respectively. Mean MAP at T3 was (72.89 ± 16.7), (63.71 ± 12.34) and (73.5 ± 10.2) in group K, M and D respectively. Mean MAP at T4 was (71.67 ± 15.26), (63.29 ± 7.7) and (72.58 ± 12.58) in group K, M and D respectively. Data was significant between groups at T4.

As regard Heart rate there was no statistically significant difference between the 3 groups. This table showed that Mean Heart rate at baseline 111.2 ± 11.2 , 112.23 ± 10.7 and 113.23 ± 10.56 in group K, M and D respectively. Mean Heart rate at T1 was 120.37 ± 10.03 , 132.6 ± 12.87 and 121.39 ± 11.02 in group K, M and D respectively. Mean Heart rate at T2 was 120.2 ± 9.12 , 122.12 ± 10.23 and 124.67 ± 10.76 in group K, M and D respectively. Mean Heart rate at T3 was 122.3 ± 10.1 , 119.21 ± 9.3 and 120.23 ± 9.45 in group K, M and D respectively. Mean Heart rate at T4 was 133.3 ± 10.1 , 120.21 ± 9.3 and 125.23 ± 9.45 in group K, M and D respectively.

As regard POST severity, according to Four-point Scale (Table 4) showed significant difference between groups at 2H, 4H, 8H and 12 hours after operation. While there was no significant difference between groups at 0H and 24H after operation. This table showed that 7, 3 patients had POST grade 1 and 2 in group D immediately after the procedure.

No patients had grade 3 in group D. 10, 6 and 4 patients had POST grade 1, 2 and 3 in group M immediately after the procedure. 12, 6 and 3 patients had POST grade 1, 2 and 3 in group K immediately after the procedure.

11, 1 patients had POST grade 1 and 2 in group D 2 hours after the procedure. No patients had grade 3 in group D. 7, 10 and 7 patients had POST grade 1, 2 and 3 in group M 2 hours after the procedure. 6, 11 and 6 patients had POST grade 1, 2 and 3 in group K 2 hours after the procedure. 9, 1 and 1 patients had POST grade 1, 2 and 3 in group D 4 hours after the procedure. 7, 10 and 4 patients had POST grade 1, 2 and 3 in group M 4 hours after the procedure. 8, 12 and 4 patients had POST grade 1, 2 and 3 in group K 4 hours after the procedure. 6 and 2 patients had POST grade 1 and 2 in group D 8 hours after the procedure. 7 and 12 patients had POST grade 1 and 2 in group M 8 hours after the procedure. 10 and 14 patients had POST grade 1 and 2 in group K 8 hours after the procedure.

3, 10 and 12 patients had POST grade 1 in group D, M and K 12 hours after the procedure respectively. 1, 2 and 8 patients had POST grade 1 in group D, M and K 24 hours after the procedure respectively.

This table showed that 1, 3 and 0 patients had vomiting as a side effect of drug use in group K, M and D respectively. 4, 6 and 3 patients had cough as a side effect of drug use in group K, M and D respectively. 0, 1 and 4 patients had sedation as a side effect of drug use in group K, M and D respectively. 4 patients had Hallucinations as a side effect of drug use in group K, 5 patients had Nystagmus as a side effect of drug use in group K. Data showed no statistically significant difference except for Nystagmus incidence and Hallucinations.

Table 1: Post incidence according to groups

Time	POST	Group K (n=64)		Group M (n= 64)		Group D (n=64)		P
		N	%	N	%	N	%	
0 h	Absent	43	67.1875	44	68.75	54	84.375	0.051
	Present	21	32.8125	20	31.25	10	15.625	
2 h	Absent	41	64.0625	40	62.5	52	81.25	0.03
	Present	23	35.9375	24	37.5	12	18.75	
4 h	Absent	40	62.5	43	67.1875	53	82.8125	0.03
	Present	24	37.5	21	32.8125	11	17.1875	
8 h	Absent	40	62.5	45	70.3125	56	87.5	0.004
	Present	24	37.5	19	29.6875	8	12.5	
12 h	Absent	52	81.25	54	84.375	61	95.3125	0.04
	Present	12	18.75	10	15.625	3	4.6875	
24 h	Absent	54	84.375	56	87.5	62	96.875	0.054
	Present	10	15.625	8	12.5	2	3.125	

POST: post operative sore throat

P value >0.05 not significant.

P value <0.05 significant

Table 2: Demographic data

Parameters		Group K (n=64)	Group M (n= 64)	Group D (n=64)	<i>p-value</i>
Age (Years)		7 ± 0.89	7.14 ± 0.9	7.17 ± 0.98	0.54
Sex (Male / Female)	Males	32 (50%)	31 (48.43%)	33 (51.56%)	0.93
	Females	32 (50%)	33 (51.56%)	31 (48.43%)	
Weight (Kg)		25.14±5.4	23.4±5.06	24.56±5.2	0.16
ASA (I / II)	I	63 (98.4%)	62 (96.9%)	63 (98.4%)	0.96
	II	1 (1.56%)	2 (3.125%)	1(1.56%)	
Duration of the procedure (minutes)		44.8±11.4	44.03±7.23	43.26±6.23	0.59

Data were expressed as mean (±) standard deviation (SD), or Numbers (N), and percentage (%), ASA: (American Society of Anesthesiologists).

P value>0.05 not significant.

P value<0.05 significant

Table 3: MAP measures during the operation

MAP (mmHg)	Group K (n=64)	Group M (n= 64)	Group D (n=64)	<i>P value</i>
T 0	69.22 ± 7.08	66 ± 7.9	71.25 ± 7.34	0.25
T 1	68.78 ± 7.29	60.14 ± 7.73	69.5 ± 6.49	0.07
T 2	75.22 ± 9.72	62.14 ± 12.84	69.5 ± 10	0.8
T 3	72.89 ± 12.7	63.71 ± 12.34	73.5 ± 12.2	0.076
T 4	71.67 ± 15.26	63.29 ± 7.7	72.58 ± 12.58	0.001

MABP: mean arterial blood pressure.

P value>0.05 not significant.

P value <0.05 significant

Table 4: Heart rate measures during the operation

Heart Rate (beats/min)	Group K (n=64)	Group M (n= 64)	Group D (n=64)	<i>P value</i>
T 0	111.2±11.2	112.23±10.7	113.23±10.56	0.87
T 1	120.37±10.03	132.6±12.87	121.39±11.02	0.14
T 2	120.2±9.12	122.12±10.23	124.67±10.76	0.46
T 3	122.3±10.1	119.21±9.3	120.23±9.45	0.88
T 4	133.3±10.1	120.21±9.3	125.23±9.45	0.88

P value>0.05 not significant.

P value<0.05 significant

Table 5: POST severity

Time	Grades	Group K (n=64)		Group M (n= 64)		Group D (n=64)		<i>P value</i>
		N	%	N	%	N	%	
0 h	0	43	67.19	44	68.75	54	84.37	0.25
	1	12	18.75	10	15.625	7	10.93	
	2	6	9.375	6	9.375	3	4.6875	
	3	3	4.69	4	6.25	0	0	
2 h	0	41	64.06	40	62.5	52	81.25	0.004
	1	6	9.375	7	10.9375	11	17.18	
	2	11	17.18	10	15.625	1	1.56	
	3	6	9.375	7	10.93	0	0	
4 h	0	40	62.5	43	67.18	53	82.81	0.039
	1	8	12.5	7	10.93	9	14.06	
	2	12	18.75	10	15.625	1	1.5625	
	3	4	6.25	4	6.25	1	1.5625	
8 h	0	40	62.5	45	70.31	56	87.5	0.012
	1	10	15.6	7	10.93	6	9.375	
	2	14	21.875	12	18.75	2	3.125	
12 h	0	52	81.25	54	84.37	61	95.31	0.04
	1	12	18.75	10	15.62	3	4.69	
24 h	0	54	84.375	56	87.5	62	96.875	0.54
	1	10	15.625	8	12.5	2	3.125	

POST: post operative sore throat

P value>0.05 not significant.

P value<0.05 significant

Table 6: Side effects of drugs used.

Symptoms	Group K (n=64)		Group M (n= 64)		Group D (n=64)		<i>p-value</i>
	N	%	N	%	N	%	
Vomiting	1	1.5625	3	4.6875	0	0	0.16
Cough	4	6.25	6	9.375	3	4.6875	0.56
Sedation	0	0	1	1.5625	4	6.25	0.069
Hallucinations	4	6.25	0	0	0	0	0.016
Nystagmus	5	7.8125	0	0	0	0	0.005

P value>0.05 not significant.

P value<0.05 significant

DISCUSSION

This study aimed to compare the effects of nebulized dexmedetomidine, ketamine, and magnesium sulfate in reducing POST in pediatric patients aged 6 to 8 years undergoing elective tonsillectomy. This interventional study included 192 pediatric patients admitted to Al-Maadi Military Hospital. Participants were randomly assigned to one of three equal groups (64 patients per group):

- Group K: Received ketamine nebulization.

- Group M: Received magnesium sulfate nebulization.

- Group D: Received dexmedetomidine nebulization.

The current study found no significant differences in heart rate or mean arterial pressure (MAP) among the three study groups at any follow-up time point. However, 24 hours postoperatively, the Dexmedetomidine group exhibited a statistically significant reduction in MAP compared to the other groups. This difference, however, was

not clinically significant. These findings align with Mostafa *et al.* (2018)^[15], who conducted a randomized, double-blind study on the effects of magnesium sulfate, dexamethasone nebulization, and prophylactic ketamine on postoperative pain in children undergoing general anesthesia. Their study found that nebulized drugs had minimal and statistically non-significant effects on hemodynamics, consistent with findings from Sharma *et al.* (2017)^[16], Mehrotra *et al.* (2017)^[17], and Salama & El-Badawy (2016)^[18]. Similarly, Ben Sasi *et al.* (2022)^[19] reported no significant differences in baseline MAP and heart rate among patients receiving nebulized ketamine or dexamethasone in thyroid surgery. Hemodynamic parameters remained stable at multiple time points intraoperatively and post-extubation.

Conversely, Thomas *et al.* (2020)^[13] observed a significant increase in heart rate, systolic, and diastolic blood pressure following ketamine nebulization, whereas dexmedetomidine was associated with greater hemodynamic stability.

Incidence of Postoperative Sore Throat (POST)

The present study found that Dexmedetomidine was the most effective in reducing POST incidence, followed by Magnesium, while Ketamine had the highest POST incidence at 2, 4, 8, and 12 hours postoperatively.

These results are consistent with Kunwar *et al.* (2023)^[20], who found that while magnesium sulfate had a comparable effect to dexamethasone at 4, 6, and 24 hours postoperatively, dexamethasone was more effective immediately after surgery. Similarly, Kumari *et al.* (2019)^[21] reported that dexamethasone nebulization significantly reduced POST incidence compared to ketamine at multiple time points.

Ben Sasi *et al.* (2022)^[19] also found that control groups experienced a higher incidence of POST compared to dexamethasone and ketamine groups, with the ketamine group exhibiting higher POST rates than dexamethasone at early postoperative time points. However, by 12 and 24 hours postoperatively, no significant differences were noted between ketamine and dexamethasone groups.

In contrast, Thomas *et al.* (2020)^[13] reported no significant differences in POST incidence between dexmedetomidine and ketamine groups at any postoperative time point following thyroidectomy. Similarly, Mostafa *et al.* (2018)^[15] found that ketamine reduced POST incidence more effectively than magnesium and dexamethasone at 4 hours postoperatively. Discrepancies between their findings and the current study may be attributed to differences in sample size, surgical procedure, and ketamine dosage.

Additionally, Segaran *et al.* (2018)^[22] found that ketamine nebulization resulted in a lower incidence of POST at 4 and 6 hours compared to magnesium sulfate in adults undergoing laryngoscopy. This contrasts with the current study, potentially due to variations in study

population, sample size, and surgical procedure. Jain *et al.* (2017)^[23] also reported that both ketamine and magnesium sulfate reduced POST incidence compared to controls, though no significant difference was observed between these two groups. Orji *et al.* (2020)^[24] found that both ketamine and magnesium sulfate reduced POST incidence compared to saline at 4-, 8-, 12-, and 24-hours post-extubating.

Severity of POST

The present study found that Dexmedetomidine resulted in the lowest POST severity, followed by Magnesium, while Ketamine was associated with the highest severity at 2, 4, 8, and 12 hours postoperatively. These findings are consistent with Kumari *et al.* (2019)^[21], who reported significantly lower POST severity in the dexamethasone group compared to ketamine at multiple postoperative time points. Ben Sasi *et al.* (2022)^[19] also found that POST severity was significantly higher in the control group compared to dexamethasone and ketamine groups, with ketamine associated with greater severity than dexamethasone in the early postoperative period.

Thomas *et al.* (2020)^[13] found that dexmedetomidine and ketamine significantly reduced POST severity compared to controls. However, Mostafa *et al.* (2018)^[15] reported that at 4 hours postoperatively, the ketamine group had the lowest POST severity, followed by dexmedetomidine, while magnesium had the highest severity. Discrepancies may be attributed to differences in sample size and surgical procedures.

Segaran *et al.* (2018)^[22] found that ketamine significantly reduced POST severity at 4 and 6 hours compared to magnesium sulfate, which contrasts with the current study. Similarly, Orji *et al.* (2020)^[24] found that both ketamine and magnesium reduced POST severity at 4 and 8 hours post-extubation. Kamel & Nasrallah (2021)^[25] reported that ketamine was associated with lower sore throat scores compared to magnesium and control groups at 0, 2, and 4 hours postoperatively.

Yu *et al.* (2020)^[26] conducted a systematic review and network meta-analysis of 32 trials, concluding that nebulized corticosteroids, magnesium, and ketamine were effective in preventing POST, with corticosteroids being the most effective option overall.

Adverse Effects

The current study found no significant differences among the three groups in terms of vomiting, coughing, sedation, or hallucinations. However, nystagmus was significantly more common in the Ketamine group. The highest incidence of side effects was observed in the Magnesium and Ketamine groups, while the Dexmedetomidine group had the lowest incidence.

These findings align with Mostafa *et al.* (2018)^[15], who reported that nebulized drugs resulted in minimal and clinically insignificant adverse effects, such as drowsiness, nausea, and vomiting. This outcome has been attributed to the low systemic absorption of inhaled medications, minimizing systemic side effects. Similar findings were reported by Sharma *et al.* (2017), Mehrotra *et al.* (2017), and Salama & El-Badawy (2016).

LIMITATIONS OF THE STUDY

- A single center study which may affect generalizability
- lack for control group
- relatively short follow up period.

CONCLUSION

In conclusion, the current study showed that the use of either nebulized ketamine, magnesium of dexmedetomidine were safe and effective in attenuating pediatrics sore throat following tonsillectomy surgery.

The current study established the superiority of nebulized dexmedetomidine over nebulized ketamine and magnesium in reducing the incidence and severity of POST, with lower side effects among pediatrics underwent tonsillectomy surgery.

ABBREVIATIONS

ADP: Adenosine diphosphate, **ATP:** Adenosine triphosphate, **AVP:** Action of vasopressin, **BPS:** Behavioral Pain Scale, **cAMP:** Cyclic adenosine monophosphate, **CPOT:** Critical Care Pain Observation Tool, **CRPS:** Complex regional pain syndrome, **CSF:** Cerebrospinal fluid, **CYP:** Cytochrome P450, **EC50:** Effective concentration, **FPS-R:** Revised Facial Pain Scale, **GERD:** Gastroesophageal reflux disease, **Glu:** Glutamate, **GPCR:** G-protein-coupled receptor, **IASP:** International Association for the Study of Pain, **ICU:** Intensive care unit, **IM:** Intramuscularly, **IP3:** Inositol triphosphate, **IV:** Intravenously, **LDK:** Low-dose ketamine, **MgSO4:** Magnesium sulphate, **NCA:** Nurse-controlled analgesia, **NMDA:** N-methyl-D-aspartate, **NRS:** Numerical Rating Scale, **NSAID:** non-steroidal anti-inflammatory, **NVPS:** Nonverbal Pain Scale, **PCA:** Patient-controlled analgesia, **PD:** Pharmacodynamic, **Pi:** Inorganic phosphate, **PLC:** Phospholipase C, **POST:** Post-operative sore throat, **PTH:** Parathyroid Hormone, **SDB:** Sleep-disordered breathing, **VAS:** Visual Analog Scale, **WBS:** Wong-Baker FACES Pain Rating Scale.

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AUTHORS' CONTRIBUTIONS

IM conceptualized the study. WE, IM designed the study. AA designed the data collection tool. IM and IF carried out data collection. IF performed the data analysis and interpretation. IM wrote the original draft. AA, WE and IF revised the article before submission. AT edited the paper and corresponded to reviewers

CONFLICT OF INTERESTS

There are no conflicts of interest.

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