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EFFECTS OF PREOPERATIVE DEXAMETHASONE AND RELAXANT-FREE ANAESTHESIA ON OPTIMISING PAEDIATRIC ADENO-TONSILLECTOMIES IN A LOW-RESOURCE SETTING

[1]OJO Abayomi Kolawole, [2] ADEDEJI Taiwo Oluwagbemiga,

[1]Department of Anaesthesia and Intensive care, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria.
[2] Department of Otorhinolaryngology – Head and Neck Surgery, UNIOSUN Teaching Hospitals, Osogbo, Nigeria.

Corresponding Author: Dr. Taiwo Oluwagbemiga ADEDEJI Email: doctadedejitaiwo@gmail.com

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Abstract

Background: Adenoidectomies and tonsillectomies are common paediatric procedures, however, may be accompanied by severe postoperative complications. We evaluated the effects of preoperative dexamethasone and relaxant-free anaesthesia on adenotonsillectomy outcome in a low-resource setting (LRS).

Methods: This retrospective study was conducted at UNIOSUN Teaching Hospital (UTH), Osogbo, Nigeria. Records of 112 patients, aged 2 – 10 years, with American Society of Anesthesiologists (ASA) status I and II, were retrieved and separated. Group A had relaxant-free anaesthesia and IV dexamethasone 4mg both overnight and at induction, while group B had conventional anaesthesia, without the above modalities., Postoperative numerical rating scale (NRS) pain scores, nausea and vomiting (PONV), bleeding, respiratory problems, and home readiness were compared.

Results: Demographics i.e., mean age (3.8 ± 1.6 vs 5.2 ± 2.2 years), male 28 (43.8%) vs 22 (45.8%), female 36 (56.2%) vs 26 (54.2%) and, body mass index (BMI) 22.18 vs 24.22 kg/m,^{2} were comparable, between group A and B, respectively. The mean postoperative NRS pain score was 2.2 ± 0.4 in group A, which is statistically lower than 3.6 ± 0.8 in group B, with p-value 0.011. PONV was 12 (18.6%) in group A, which was lower than 14 (29.2%) in group B, p-value 0.001. Bleeding was similar in both groups, p-value 0.332. Incidence of respiratory problems was 6 (9.4%) in group A, which is lower than 7 (14.6%) in group B, p-value 0.012. Time to home readiness was 24.2 ± 4.6 hours in group A, which is lower than 36.4 ± 6.2 hours in group B, p-value < 0.001 (Table 2).

Conclusion: Preoperative dexamethasone and relaxant-free anaesthesia reduces postoperative NRS pain scores, PONV, and respiratory problems, and promotes home readiness in paediatric adenotonsillectomies. This technique is beneficial and improves surgical outcome in LRS.

Keywords: adenoidectomy, dexamethasone, relaxant-free anaesthesia, postoperative nausea and vomiting, pain, respiratory compromise

Introduction

Adenoid and tonsillar surgeries are one of the most common paediatric otorhinolaryngological (ORL) procedures, in sub-Saharan Africa (SSA). Benefits include the relief of airway obstruction (AO), sleep apnoea and snoring, decreased recurrent infections e.g., adenoiditis, rhinitis, otitis media, and improved overall quality of life (QoL).[1,2]

Indications for adenotonsillectomy includes adeno-tonsillar hypertrophy with obstructive symptoms manifesting as apnoea and hypoxic

spells, behavioural problems, speech or feeding difficulties, tonsillar abscess, and malignancy. Others are chronic otitis media, obstructive sleep apnoea (OSA), sleep disordered breathing (SDB), and chronic sinusitis.[2]

Though routine, it may be accompanied by severe postoperative complications such as delayed recovery, respiratory compromise e.g., hypoxia and hypoventilation, pain, postoperative nausea and vomiting (PONV), and tonsillar bleeding. These challenges are concerning, particularly in children.[2,3]

Safety and early return to premorbid function are the aims of anaesthesia. Several measures have been used to provide optimal care, reduce postoperative morbidity and enhance positive outcome in this patient population.

Prophylactic dexamethasone has gained widespread use in anaesthesia due to its anti-inflammatory and analgesic properties. It reduces pro-inflammatory cytokines transcription, and leukocyte migration, and stabilises lysosomal membranes.[3] Studies have shown that perioperative dexamethasone lowers pain, PONV, and respiratory problems in adeno-tonsillectomies.[1,3,4]

Furthermore, relaxant-free anaesthesia technique i.e., the omission of muscle relaxants (MR), decreases the risks of residual muscle blockade, delayed recovery and respiratory compromise.[5]

In low-resource settings (LRS), with limited resources such as a lack of monitoring and postoperative interventional devices, techniques that enhance safety, decrease complications, and promote early discharge are valuable. However, data on the combined effect of steroids and MR omission on adenotonsillectomy outcomes are limited.

The aim of the study is to evaluate the effects of preoperative dexamethasone and relaxant-free anaesthesia on paediatric adenotonsillectomies outcome i.e., PONV, pain scores, respiratory problems, bleeding, and time to home readiness. Thus, we seek to provide evidence on whether this modified technique offers a safe and more effective anaesthesia modality for optimising perioperative care in LRS.

Methodology

Study Design: This was a retrospective study, conducted at UNIOSUN Teaching Hospital (UTH), Osogbo, Nigeria. Data of patients who had adenoidectomy, tonsillectomy or combined procedures were retrieved from surgical records, anaesthesia chart and perioperative nursing notes.

Study protocol: In our centre, paediatric adenotonsillectomies were done under general anaesthesia (GA), tracheal intubation (TI), with or without muscle paralysis. Prophylactic dexamethasone was available for use.

Inclusion/exclusion criteria: Children, aged 2 – 10 years, with American Society of Anesthesiologist (ASA) physical status I and II, undergoing elective surgery, with complete records were included. Patients with craniofacial anomalies, co-morbidities e.g., sickle cell disease, bleeding disorders, incomplete records, malignancy, postoperative intensive care unit (ICU) admission, or prolonged procedures were excluded.

Study population; Children, aged 2 to 10 years, who had adenoid and tonsillar procedures between January 2020 and December 2024, were sorted into two groups.

Group A patients (Intervention group) (n = 64) received IV prophylactic dexamethasone 4mg overnight, and at induction, as well as relaxant-free anaesthesia, while group B patients (Control

group) (n = 48), had conventional anaesthesia with MR, however, without dexamethasone.

Patients with dexamethasone omission and MR use in group A, and dexamethasone use and MR omission in group B, were removed from the study. A total of 112 records were included.

Pre-anaesthesia care: Children were seen in the ward a day before surgery. History and examination were done, and rapport was established. Full blood count, electrolytes, urea and creatinine, plain chest radiograph, and electrocardiograph (ECG) results were reviewed. Consent was taken from the parent, and patients were weighed. Patients were fasted from solid food for six hours before surgery. Breast milk and clear water was allowed for four and two hours before surgery, respectively. Intravenous (IV) access was gained the night before surgery and IV dexamethasone 4mg was given.

On the morning of surgery, the anaesthesia machine was checked. Drugs were drawn, based on weight, and labelled. Children were taken to the theatre, insulated from the cold. Baseline pulse rate, non-invasive blood pressure, saturation, and 5-lead ECG were taken using a DASH-5000 monitor with age-specific devices. IV atropine 0.01mg/kg premedication was given. IV fluids using Ringer's lactate were commenced at paediatric maintenance dose.

Co-induction was achieved with halothane MAC 1 – 3%, or sevoflurane 2 – 3%, and either IV ketamine 1 – 2mg/kg or propofol 2 – 3mg/kg. IV succinylcholine 1 – 2mg/kg was used to facilitate airway relaxation. Age-specific reinforced endotracheal tube (ETT), was used for intubation, using an appropriate Miller's blade size. Correct ETT placement was confirmed with auscultation, and connected to the anaesthesia machine, using a paediatric breathing system. Maintenance was provided with isoflurane MAC 1 – 2%.

Euvolaemia, normo-oxygenation, normocapnia and normothermia were maintained. Warm fluids, and room temperature were used to maintain body temperature. IV paracetamol 15mg/kg and diclofenac 1mg/kg were given for analgesia. Anaesthesia depth or degree of muscle paralysis was not measured, as the devices were unavailable.

After the surgery, if used, MR was reversed with IV atropine 0.01mg/kg and neostigmine 0.05mg/kg. Airway was suctioned, and ETT was removed, with the patient placed in left lateral, tonsillar position, and a facemask using 100% oxygen was attached. In the recovery room, postoperative care was standardised, till discharge to the ward.

Patient records including age, sex, weight, height, tonsilitis history, tonsil size, duration of surgery, use of dexamethasone and MR were extracted. Postoperative profile i.e., NRS pain scores, PONV, bleeding, and respiratory problem i.e., delayed extubation, or challenges necessitating oxygen supplementation after extubation, e.g., hypoxic spells, apnoea, or hypoventilation, laryngospasm, time to full recovery and home readiness were recorded. Respiratory problems lasting more than 45 minutes were taken as significant. IV pentazocine 0.5mg/kg is prescribed for breakthrough postoperative pain, at 6-hour intervals. Patient was transferred to the ward if the criteria were met.

Data analysis: Data were extracted, cleaned and entered into SPSS version 25.0 (IBM). Continuous variables i.e., NRS pain scores, time to home discharge written as means ± standard deviation was analysed using student t-tests. Categorical variables i.e., PONV, haemorrhage incidence, expressed as frequencies and percentages was

analysed using the Chi-square test or Fisher's exact test. A p-value of < 0.05 was considered statistically significant. Research and Ethic committee of UTH, Osogbo, gave clearance waiver for the study.

Results

Out of 480 surgeries, 112 (23.3%) records met the inclusion criteria, with n–64 in the interventional group and n–48 in the control group.

Demographics profile, i.e., mean age (3.8 ± 1.6yrs vs 5.2 ± 2.2yrs), sex i.e., male (28 (43.8%) vs 22 (45.8%) and female 36 (56.2%) vs 26 (54.2%) and body mass index (BMI) 22.18 ± 2.21 vs 24.22 ± 1.42 kg/m^2, were comparable with p-value of 0.644, 0.816, and 0.352, respectively. The mean tonsillitis history was 6.2 ± 2.2 months in group A, which is comparable with 7.83 ± 1.4 months in group B, p-value 0.497. The mean duration of surgery was 42.36 ± 8.86 mins in group A which is similar to 44.04 ± 6.24 mins in group B, p-value 0.302 (Table 1).

Table 1. Demographic and clinical profile

	Group A N=64	Group B N=48	p-value
Age (years)	3.8 ± 1.6	5.2 ± 2.2	0.644
Gender	N (%)	N (%)	
Male	28 (43.8)	22 (45.8)	0.816
Female	36 (56.2)	26 (54.2)	
BMI (kg/m^2)	22.18 ± 2.21	24.22 ± 1.42	0.352
	Mean ± SD	Mean ± SD	
Tonsillitis history (months)	6.2 ± 2.2	7.83 ± 1.4	0.497
Duration of surgery (mins)	42.36 ± 8.86	44.04 ± 6.24	0.302
Tonsil size	N (%)	N (%)	
grade III	46 (71.9)	36 (75.0)	0.912
grade IV	18 (28.1)	12 (25.0)	

The mean postoperative NRS pain score is 2.2 ± 0.4 in group A, which is statistically lower than 3.6 ± 0.8 in group B, p-value 0.011. The mean postoperative opioid consumed was 20.55 ± 10.25 mg in group A, which is lower than 30.45 ± 10.75 mg in group B, p-value < 0.001. The mean incidence of PONV was 12 (18.6%) in group A, which is lower than 14 (29.2%) in group B, p-value 0.001. The mean postoperative haemorrhage incidence was 6 (9.4%) in group A, which is similar to 5 (10.6%) in group B, p-value 0.332. The mean incidence of postoperative respiratory problem was 5 (7.8%) in group A, which is lower than 7 (14.9%) in group B, p-value 0.012. The mean time to full recovery was 3.6 ± 0.8 hours in group A which is lower than 4.8 ± 1.4 hours in group B, p-value 0.001. The mean time to home readiness was 24.2 ± 4.6 hours in group A which is lower than 36.4 ± 6.2 hours in group B, p-value < 0.001 (Table 2).

Table 2. Postoperative recovery profile

	Group A N=64	Group B N=48	p-value
	Mean ± SD	Mean ± SD	
Mean postoperative NRS pain score	2.2 ± 0.4	3.6 ± 0.8	0.011
Postoperative opioid use (mg)	20.55 ± 10.25	30.45 ± 10.75	< 0.001
	N (%)	N (%)	
Mean PONV	12 (18.6)	14 (29.2)	0.001
Mean incidence of postoperative haemorrhage	6 (9.4%)	5 (10.6%)	0.332
Need for postoperative supplemental oxygenation > 30 mins	6 (9.4%)	7 (14.6%)	0.012
	Mean ± SD	Mean ± SD	
Time to full recovery (hours)	3.6 ± 0.8	4.8 ± 1.4	0.001
Time to home readiness (hours)	24.2 ± 4.6	36.2 ± 5.2	< 0.001

Discussion

This study showed that prophylactic IV dexamethasone alongside relaxant-free anaesthesia reduced postoperative NRS pain scores, PONV and, respiratory problems, as well as lower the time to home readiness, without increasing bleeding in paediatric adenotonsillectomies.

This is not surprising. Dexamethasone's cell-stabilising, anti-inflammatory, anti-emetic, and anti-nociceptive properties are known. It reduces the transcription of pro-inflammatory cytokines such as interleukin-1, IL-6, and TNF-alpha. It upregulates annexin-1, which blocks phospholipase A2, and in turn decrease prostaglandin and leukotriene synthesis. It modulates lysosomal membranes, preventing the release of inflammatory enzymes. It suppresses adhesion molecules and chemokines on the cell membrane and reduce leukocyte migration to inflammation sites.[3,4]

Similarly, Chen et al[6] in a study of 240 children aged 2 to 18 years, who had tonsil and adenoid surgeries, observed that preoperative dexamethasone reduced postoperative pain, bleeding and PONV incidence, compared to placebo. Niimi et al[7] in a meta-analysis of 16 studies, stated that IV dexamethasone significantly reduces postoperative pain, and opioid consumption, without increasing re-admission and reoperation incidence due to postoperative bleeding. Kubala et al[8] observed that in 245 patients who had adenoidectomies and tonsillectomies, postoperative steroid reduces PONV, pain, bleeding and re-admission rate. Malhotra et al[9] reported that dexamethasone during anaesthesia induction, reduce postoperative pain severity. Geißler et al[10] in a meta-analysis of 111 studies involving 7,566 children and adults, showed that IV dexamethasone lowers postoperative pain severity after tonsillectomy.

Severe postoperative pain negatively affects post-tonsillectomy recovery profile, i.e., time to full recovery, feeding, and length of hospital stay. Our data showed a lower mean postoperative NRS pain scores with dexamethasone use. This aligns with the study by Diakos et al[11] who corroborated

the anti-nociceptive properties of dexamethasone in tonsillectomy patients.

The antiemetic properties of dexamethasone are beneficial. We found that dexamethasone significantly reduces PONV incidence in our cohort. This is a useful outcome, as PONV is a frequent, discomforting and distressing complication in adeno-tonsillectomies. Predisposing factors such as young age, adenoid and tonsillar surgeries, pain and opioids use are present in our patient population. PONV promotes aspiration, (exacerbated by blood or secretions in the oropharynx), dehydration, electrolyte imbalance, and delayed feeding. Vomiting increases abdominal and upper airway pressure, which can precipitate bleeding from the adenoidectomy site. PONV is multi-factorial, involving chemoreceptor trigger zone (CTZ) in the area postrema, neurotransmitters, e.g., serotonin, acetylcholine, and dopamine, the vagal and accessory nerves, and the gut.[12]

We found no difference in the incidence of postoperative bleeding with or without dexamethasone. Chen et al[7] found that preoperative IV dexamethasone reduced postoperative bleeding in adenoidectomies. Diakos et al[11] in a systematic review of seven randomised trials with 580 patients, showed that dexamethasone lowers bleeding, PONV, and overall postoperative complications post-tonsillectomy. The retrospective design in our study may explain the different outcome.

The positive effect of relaxant-free anaesthesia on adeno-tonsillectomy outcome reported in this study is vital. Residual paralysis from the use of MR promotes AO, laryngospasm, and other respiratory problems. These can lead to hypoxia, apnoea, hypoventilation, and increased work of breathing, promoting delayed extubation, re-intubation, postoperative non-invasive ventilation and ICU admission.[13]

Perhaps, the most clinically significant outcome of this study is the positive effects on home readiness. We noted that dexamethasone decreased the time to reach discharge criteria. This is valuable in LRS, with high surgery volume, staff shortage, and limited resources.[14]

There are limitations to this study. The retrospective design decreases the ability to control confounding variables. The sample size, is context-specific and may not be inclusive. Postoperative pain and PONV assessments were reliant on clinical documentation, which introduced the potential for selection and recording bias. A prospective, randomised trial would be valuable to validate these findings and evaluate the long-term outcomes.

Conclusion: Preoperative dexamethasone and a relaxant-free anaesthesia in paediatric adenotonsillectomies reduces postoperative NRS pain scores, PONV, and respiratory problems incidences and enhance the time to home readiness without increasing bleeding. This is a safe, useful and promising anaesthesia strategy in LRCs.

Ethics: The procedures in this study were in accordance with the ethical standards of the institutional committee on human experimentation, and with the Helsinki Declaration of 1975, as revised in 2000.

Funding: Surgical materials were provided hospital management as well as the patient.

Conflict of Interest: The Authors declare no conflict of interest.

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