Perioperative Medicine

RESEARCH

Open Access

Anesthetic outcomes in pediatric tonsillectomy: insights from the Palestinian experience

Ramzi Shawahna[1,2*], Shahed Radwan[3], Dana Alyan[3], Rawand Obaid[3], Suha Sholi[4], Mohammad Jaber[3,4*], Iyad Maqboul[3,4*], Hatim Hijaz[3,4] and Samer Bustame[3,4]

Abstract

Background Despite advancements in anesthesia, the anesthetic outcomes in pediatric tonsillectomy remain largely underexplored, notably in resource-limited healthcare systems. This study aimed to assess the anesthetic outcomes in pediatric tonsillectomy, including induction-to-incision time and predictors of duration of surgery.

Methods The study was conducted at one of the major surgical hospitals in the West Bank of Palestine, which is a tertiary referral center known for its comprehensive surgical and anesthetic services. The data were collected retrospectively from pediatric patients who underwent tonsillectomy with or without adenoidectomy in the period between 2021 and 2022. The data were collected using a standardized data collection form.

Results Of the 238 pediatric patients included in this study, 231 (97.1%) were operated for adenotonsillar hypertrophy, and 7 (2.9%) were operated for recurrent/chronic tonsillitis. The mean age of the patients was 5.6 ± 3.1 years. Of the patients, 151 (63.4%) were male, 13 (5.5%) had an allergy to foods or drugs 13 (5.5%) had other comorbidities, and 21 (8.8%) had a past surgical history. Of the patients, 230 (96.6%) received propofol and 183 (76.9%) received fentanyl as anesthesia induction agents. The mean induction to incision time was 5.2 ± 1.1 min, and the mean duration of surgery was 26.4 ± 5.4 min. Of the patients, 53 (22.3%) received antibiotics during surgery. The induction to incision time was significantly longer for male patients (5.4 ± 1.3 vs. 5.0 ± 0.7, p-value = 0.022). The duration of surgery was significantly longer for female patients, 5 years and older, who had allergies, had chronic tonsillitis, and received antibiotics during the surgery. Multiple linear regression showed that longer duration of surgery could be predicted by being operated for recurrent/chronic tonsillitis ($\beta = 0.15$) and receiving antibiotics during the surgery ($\beta = 0.13$).

Conclusion The findings of this study revealed that patient-specific factors influenced induction-to-incision time and duration of surgery. The findings of this study highlight the need for tailored preoperative assessment and individualized perioperative management to optimize resource utilization and improve surgical efficiency in resource-limited settings.

Keywords Tonsillectomy, Duration of surgery, Anesthesia, Surgical practice, Palestine, Hospitals

*Correspondence:
Ramzi Shawahna
ramzi_shawahna@hotmail.com; ramzi.shawahna@najah.edu
Mohammad Jaber
m.jaber@najah.edu
Iyad Maqboul
imaqbool@najah.edu
Full list of author information is available at the end of the article

Background

Tonsillectomy, adenoidectomy, and adenotonsillectomy are the most commonly performed surgical procedures in children around the globe (Murto et al. 2017). Tonsillectomy refers to the surgical removal of tonsils, adenoidectomy refers to the surgical removal of adenoids, and adenotonsillectomy refers to the surgical removal of both tonsils and adenoids (Schneuer et al. 2022). These surgical procedures are often indicated for sleep-disordered breathing caused by adenotonsillar hypertrophies or malignancies, chronic or recurrent tonsillitis, adenoiditis, otitis media, and/or sinusitis with effusion (Han et al. 2023; Murto et al. 2017; Patel et al. 2014; Schneuer et al. 2022). While there are limited statistics on the number of procedures performed in the Palestinian practice, 559,900 ambulatory and 7100 inpatient tonsillectomies with or without adenoidectomy were performed in the USA in 2019 (Johnson et al. 2023).

In pediatric patients, tonsillectomy with or without adenoidectomy is performed under general anesthesia, and the patients are cared for by general or pediatric anesthesiologists (Brennan et al. 2024). Anesthesiologists select the appropriate anesthetic technique depending on several key factors, including the age of the pediatric patient, the presence of other comorbidities, and the planned surgical approach (Brennan et al. 2024; Ortega et al. 2022; Zeng et al. 2025).

Induction-to-incision time and duration of surgery are important metrics in assessing the efficiency of pediatric tonsillectomy (Albornoz et al. 2024; Edmonson et al. 2022; Spencer et al. 2025). Previous studies have shown that the indications and outcomes of tonsillectomy and adenotonsillectomy and outcomes of pediatric patients were affected by gender, race/ethnicity, and age (Han et al. 2023; Wikner et al. 2025). Although many studies have reported on tonsillectomy techniques and anesthetic management in high-resource environments, few studies were conducted to describe anesthetic outcomes in pediatric tonsillectomy, notably induction to incision time and the overall duration of surgery in resource-limited settings such as Palestine.

It is well-established that efficient operating room management is particularly critical in resource-limited healthcare settings (Neighbour et al. 2023). In pediatric patients, tonsillectomy with or without adenoidectomy is a fairly common surgical procedure. Currently, there is a gap in the literature concerning the anesthetic outcomes in pediatric tonsillectomy in the Palestinian practice, notably about the time from anesthesia induction to surgical incision and duration of surgery. Understanding the influence of patient demographic and health status factors, including age, sex, and allergy status can help anesthesiologists, surgeons, and other providers of perioperative care services tailor anesthesia protocols to the individual needs of the patients (Han et al. 2023). In addition, this focus could also improve the safety of the patients and the efficiency of operating room management where resources and standardized protocols are limited.

This study was conducted to assess the anesthetic outcomes of pediatric tonsillectomy in the Palestinian practice. The study assessed the anesthesia induction techniques, airway management strategies, time from anesthesia induction to incision, and predictors of surgical duration and outcomes. The findings of this study may provide actionable insights that can help improve the outcomes of the patients scheduled to undergo tonsillectomy in resource-limited settings.

Methods

Study design and settings

The study was conducted at one of the major surgical hospitals in the West Bank of Palestine, which is a tertiary referral center known for its comprehensive surgical and anesthetic services. The data were collected retrospectively from pediatric patients who underwent tonsillectomy with or without adenoidectomy in the period between 2021 and 2022. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. Adherence to the statement is shown in Supplementary Table S1.

Patients

The study sample was all pediatric patients (under 18 years old) who underwent tonsillectomy with or without adenoidectomy under general anesthesia. The patients were eligible for inclusion in the study when they had complete anesthesia and surgical records. The patients with incomplete or missing data were excluded. The electronic surgical database of the hospital was used to search for and identify the pediatric patients to be included in the study. Additionally, a manual review of the anesthesia records was also conducted. Moreover, recovery notes, discharge summaries, and postoperative appointment notes of the patients were also reviewed to identify any documented postoperative complications.

A total of 238 pediatric tonsillectomy cases with complete anesthesia and surgical records were identified through the electronic database of the hospital. In this study, the tonsillectomies were performed using the cold steel technique. This conventional technique is known for its effectiveness and safety in minimizing intraoperative blood loss (Lieberg et al. 2019).

Variables and data collection

A standardized data collection form that was developed based on a thorough literature review of the relevant studies was used (Allford & Guruswamy 2009; Brennan et al. 2024; D'Eredita 2010; Huang et al. 2024; Lee & Hache 2022; McGuire & Doyle 2021; Mitchell et al. 2019; Schneuer et al. 2022; Yang et al. 2022). The data collection form is provided in Supplementary Table S2. The data collection form consisted of three sections. The first section collected the demographic and health variables of the pediatric patients, including age, height, weight, and sex. The body mass index was calculated based on weight and height. In addition, this section also collected information on the presence of known food and drug allergies, comorbidities, past surgical history, and chronic medications. The second section collected information on the indication for tonsillectomy, preoxygenation, laryngoscopy, and the technique used to prevent aspiration of gastric contents. This section also collected the agents used for induction and maintenance of anesthesia, induction time, induction of anesthesia to incision time, agents administered to achieve adequate muscle relaxation, agents administered to achieve intraoperative analgesia, and antibiotics administered to reduce the risk of postoperative infections. The third section collected information on the duration of surgery, intraoperative systolic and diastolic blood pressure, heart rate, and amount of intraoperative normal saline administered. The data collection form was reviewed by surgeons ($n=3$), anesthesiologists ($n=2$), and a pharmacologist for content and face validity.

Statistical analysis

The data were entered into MS Excel sheets and then transferred into IBM SPSS v.21.0 for statistical analysis. Categorical data were expressed as frequencies (n) and percentages (%) and continuous data were expressed using means and standard deviations (SD). Differences in induction-to-incision time and duration of surgery in relation to the variables of the patients were assessed using t-tests. To control potentially confounding variables, the variables that were associated with the t-tests were included in a multiple linear regression model. Goodness-of-fit was assessed through a statistically significant R^2. The absence of multicollinearity issues was indicated by tolerance values of above 0.2 and variance inflation factor values of less than 5. The effect size of each indicator that represented how strongly the independent variable was associated with the dependent variable was assessed using the standardized coefficients (β).

Ethical approval

This study was conducted in adherence to the national and international ethical principles including those in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of An-Najah National University. Additional approvals were also obtained from the Office of Health Education of the Ministry of Health for governmental hospitals, and approvals from the managers of each private hospital were also obtained. The data was collected anonymously, and no information leading to the identification of the patient was made public.

Results

Characteristics of the patients

Of the 238 pediatric patients included in this study, 231 (97.1%) were operated for adenotonsillar hypertrophy, and 7 (2.9%) were operated for recurrent/chronic tonsillitis. The mean age of the patients was 5.6 ± 3.1 years. Of the patients, 151 (63.4%) were male, 13 (5.5%) had an allergy to foods or drugs 13 (5.5%) had other comorbidities, and 21 (8.8%) had a past surgical history. The demographic characteristics, past medical history, and past surgical history of the patients are shown in Table 1.

Preparation, airway management approach, induction and maintenance of anesthesia, surgery, and recovery of the patients

Preparation, airway management approach, induction and maintenance of anesthesia, surgery, and recovery of the patients are detailed in Table 2. In this study, all patients (100%) received preoxygenation before induction of anesthesia as an important component of airway management to improve oxygen reserves and prevent hypoxemia during episodes of apnea. A McGRATH® MAC video laryngoscope which used a Macintosh-style blade with video assistance to visualize the larynx in all patients and oral tracheal intubation was used to maintain open airways. The cricoid pressure technique was used to prevent aspiration of gastric contents in 2 (0.8%) patients. Of the patients, 230 (96.6%) received propofol and 183 (76.9%) received fentanyl as anesthesia induction agents. The mean induction to incision time was 5.2 ± 1.1 min, and the mean duration of surgery was 26.4 ± 5.4 min. Of the patients, 53 (22.3%) received antibiotics during surgery. At the end of the surgery, all the patients were discharged to the post-anesthesia care unit. As a standard of care, all patients received postoperative antibiotics and analgesics. In this study, 1 (0.4%) patient returned with bluish discoloration of the left upper eyelid.

Table 1 Demographic characteristics, past medical history, and past surgical history of the patients

Variable	Mean ± SD or *n* (%)
Age (years), mean ± SD	5.6 ± 3.1
Height (m), mean ± SD	1.1 ± 0.2
Weight (kg), mean ± SD	21.5 ± 13.7
Body mass index (kg/m^2), mean ± SD	17.4 ± 5.9
Gender	
Male, *n* (%)	151 (63.4)
Female, *n* (%)	87 (36.6)
Allergy	
No known food and drug allergies, *n* (%)	225 (94.5)
Has a known allergy, *n* (%)	13 (5.5)
Past medical history	
Free, *n* (%)	225 (94.5)
Febrile convulsion, *n* (%)	3 (1.3)
Epilepsy, *n* (%)	2 (0.8)
Atrial septal defect, *n* (%)	1 (0.4)
Bronchial asthma, *n* (%)	1 (0.4)
Laryngomalacia, *n* (%)	1 (0.4)
Meningitis 2 week ago, *n* (%)	1 (0.4)
Reactive airway disease, *n* (%)	1 (0.4)
Seasonal allergy, *n* (%)	1 (0.4)
Thalassemia A, *n* (%)	1 (0.4)
Ventricular septal defect, *n* (%)	1 (0.4)
Past surgical history	
Free, *n* (%)	307 (129.0)
Inguinal hernia repair, *n* (%)	5 (2.1)
Orchidopexy, *n* (%)	4 (1.7)
Adenoidectomy, *n* (%)	2 (0.8)
Frenotomy, *n* (%)	1 (0.4)
Bilateral tympanostomy, *n* (%)	1 (0.4)
Congenital nasolacrimal duct obstruction, *n* (%)	1 (0.4)
Coronary artery bypass graft, *n* (%)	1 (0.4)
Meatotomy, *n* (%)	1 (0.4)
Orchidectomy, *n* (%)	1 (0.4)
Polypectomy, *n* (%)	1 (0.4)
Previous direct laryngoscopy for a foreign body aspiration, *n* (%)	1 (0.4)
Tendon transposition in his leg, *n* (%)	1 (0.4)
Thigh abscess drainage, *n* (%)	1 (0.4)
Chronic medications	
Free, *n* (%)	235 (98.7)
Divalproex sodium/carbamazepine, *n* (%)	2 (0.8)
Carbamazepine, *n* (%)	1 (0.4)

Association between induction to incision time and variables of the patients

The induction to incision time was significantly longer for male patients. Age, allergy status, past medical and surgical history, indication for surgery, and receiving antibiotics during the surgery were not associated with induction-to-incision time. Associations are shown in Table 3.

Association between duration of surgery and variables of the patients

The duration of surgery was significantly longer for female patients, 5 years and older, who had allergies, had chronic tonsillitis, and received antibiotics during the surgery. Differences are shown in Table 4.

To control confounding variables, the variables that were significantly associated with the univariate analysis were included in a multiple linear regression model. The model showed that a longer duration of surgery could be predicted by being operated on for recurrent/chronic tonsillitis ($\beta = 0.15$) and receiving antibiotics during the surgery ($\beta = 0.13$). These associations are shown in Table 5.

Discussion

Historically, tonsillectomy was primarily indicated for children suffering from recurrent/chronic infections, such as frequent episodes of tonsillitis (Han et al. 2023; Huoh et al. 2021). In recent years, there has been a significant shift in clinical practice. Today, an increasing number of children undergo tonsillectomy with or without adenoidectomy mainly because of obstructive symptoms, including overt obstructive sleep apnea, obstructive sleep-disordered breathing, and habitual snoring, which are attributable to adenotonsillar hypertrophy (Albornoz et al. 2024; Han et al. 2023; Huoh et al. 2021; Patel et al. 2014). This shift in clinical practice could be attributed to the deeper understanding of how untreated adenotonsillar hypertrophies contribute to cardiovascular diseases, neurocognitive, and developmental issues. Thus, highlighting the need for timely surgical interventions.

In this study, the vast majority of the pediatric patients underwent tonsillectomy for adenotonsillar hypertrophy. This might reflect a contemporary practice that aligns with the international shift in clinical practice by prioritizing surgical management of obstructive sleep-disordered breathing disorders over management of recurrent/chronic tonsillitis. The trends reported in this study are currently supported by the latest international guidelines and align with the global standards in pediatric otolaryngology.

In this study, all pediatric patients underwent a standardized anesthetic protocol that involved preoxygenation before induction of anesthesia. Airway management was then secured using oral tracheal intubation via a MAC video laryngoscope. This should have ensured accurate tube placement through direct visualization of the larynx. Previous studies have reported difficult laryngoscopy

Table 2 Preparation, airway management approach, induction and maintenance of anesthesia, surgery, and recovery of the patients

Variable	*n* (%)
Airway management and intubation	
Preoxygenation preceding anesthetic induction and intubation, *n* (%)	238 (100.0)
Oropharyngeal airway to maintain unobstructed passage, *n* (%)	238 (100.0)
Oral-tracheal intubation to maintain open airway, *n* (%)	238 (100.0)
MAC video laryngoscope combines both direct and video laryngoscope in an affordable handheld device, *n* (%)	238 (100.0)
Cricoid pressure technique used in endotracheal intubation, *n* (%)	2 (0.8)
Anesthesia induction agents	
Propofol, *n* (%)	230 (96.6)
Fentanyl, *n* (%)	183 (76.9)
Ketamine, *n* (%)	55 (23.1)
Midazolam, *n* (%)	25 (10.5)
Induction to incision time (min), mean ± SD	5.2 ± 1.1
Anesthesia maintenance	
Sevoflurane, *n* (%)	227 (95.4)
Nitrous oxide, *n* (%)	61 (25.6)
Isoflurane, *n* (%)	11 (4.6)
Oxygen, *n* (%)	238 (100.0)
Muscle relaxants	
Rocuronium, *n* (%)	213 (89.5)
Intraoperative analgesics/pain management	
Lidocaine to preventing propofol-induced pain, *n* (%)	43 (18.1)
Pethidine, *n* (%)	5 (2.1)
Morphine, *n* (%)	10 (4.2)
Intraoperative antibiotics	
Cefazolin, *n* (%)	48 (20.2)
Ceftriaxone, *n* (%)	3 (1.3)
Cefixime, *n* (%)	1 (0.4)
Cefuroxime, *n* (%)	1 (0.4)
Intravenous line size	
16 Fr, *n* (%)	1 (0.4)
18 Fr, *n* (%)	2 (0.8)
20 Fr, *n* (%)	9 (3.8)
22 Fr, *n* (%)	138 (58.0)
24 Fr, *n* (%)	88 (37.0)
Arterial line	
22 Fr, *n* (%)	1 (0.4)
24 Fr, *n* (%)	2 (0.8)
Intraoperative systolic blood pressure (mmHg)	110.6 ± 13.1
Intraoperative diastolic blood pressure (mmHg)	65.6 ± 11.5
Intraoperative heart rate (beat/min)	115.3 ± 18.3
Duration of surgery (min)	26.4 ± 5.4
Swabs and instruments count	
Correct, *n* (%)	238 (100.0)
Estimated amount of blood loss	
Minimal, *n* (%)	238 (100.0)
Condition of the patient at the end of the procedure	
Stable, *n* (%)	238 (100.0)
Patient discharge to	
Post-anesthesia care unit, *n* (%)	238 (100.0)

Table 2 (continued)

Variable	*n* (%)
Postoperative antibiotics	
Amoxicillin/clavulanic acid, *n* (%)	234 (98.3)
Ceftriaxone, *n* (%)	2 (0.8)
Cefixime, *n* (%)	1 (0.4)
Azithromycin, *n* (%)	1 (0.4)
Postoperative analgesics	
Paracetamol, *n* (%)	195 (81.9)
Diclofenac, *n* (%)	7 (2.9)
Medications for nausea/vomiting/anti-inflammatory	
Dexamethasone, *n* (%)	177 (74.4)
Postoperative complications	
Bluish discoloration of the left upper eyelid, *n* (%)	1 (0.4)

Fr French

Table 3 Association between induction-to-incision time and variables of the patients

		Induction-to-incision time (min)	
Variable	***n*** **(%)**	**Mean (SD)**	***p*-value**
Gender			
Male	151 (63.4)	5.4 ± 1.3	**0.022**
Female	87 (36.6)	5.0 ± 0.7	
Age (years)			
< 5	103 (43.3)	5.2 ± 1.2	0.889
≥ 5	135 (56.7)	5.2 ± 1.1	
Allergy			
No known food and drug allergies	225 (94.5)	5.2 ± 1.1	0.613
Has a known allergy	13 (5.5)	5.4 ± 1.4	
Past medical history			
Free	225 (94.5)	5.2 ± 1.2	0.446
A past medical history	13 (5.5)	5.0 ± 0.0	
Past surgical history			
Free	217 (91.2)	5.3 ± 1.2	0.324
A past surgical history	21 (8.8)	5.0 ± 0.0	
Indication for surgery			
Adenotonsillar hypertrophy	231 (97.1)	5.2 ± 1.1	0.066
Chronic tonsillitis	7 (2.9)	6.0 ± 1.9	
Received antibiotics during surgery			
No	185 (77.7)	5.2 ± 1.2	0.653
Yes	53 (22.3)	5.2 ± 0.8	

among pediatric patients (Stein et al. 2023; Takeuchi et al. 2023); however, in this study, no instances of difficult airways were reported. This might have indicated effective airway management among the cases included in this study.

Table 4 Association between duration of surgery and variables of the patients

		Duration of surgery (min)	
Variable	**n (%)**	**Mean (SD)**	***p*-value**
Gender			
Male	151 (63.4)	25.9 ± 4.8	**0.048**
Female	87 (36.6)	27.3 ± 6.3	
Age (years)			
< 5	103 (43.3)	25.6 ± 5.2	**0.049**
≥ 5	135 (56.7)	27.0 ± 5.5	
Allergy			
No known food and drug allergies	225 (94.5)	26.2 ± 5.2	**0.017**
Has a known allergy	13 (5.5)	29.9 ± 7.3	
Past medical history			
Free	225 (94.5)	26.4 ± 5.4	0.881
A past medical history	13 (5.5)	26.2 ± 5.5	
Past surgical history			
Free	217 (91.2)	26.4 ± 5.5	0.895
A past surgical history	21 (8.8)	26.5 ± 4.1	
Indication for surgery			
Adenotonsillar hypertrophy	231 (97.1)	26.2 ± 5.4	**0.012**
Chronic tonsillitis	7 (2.9)	31.4 ± 5.6	
Received antibiotics during surgery			
No	185 (77.7)	25.9 ± 5.3	**0.009**
Yes	53 (22.3)	28.1 ± 5.6	

There was a significant positive correlation between the volume of normal saline used with intraoperative systolic blood pressure (Pearson's r = 0.15, *p*-value = 0.020), and body mass index (Pearson's r = 0.26, *p*-value < 0.001).

Many previous studies have reported on the impact of different anesthetic regimens on the postoperative outcomes and recovery of pediatric patients who

Table 5 Factors predicting duration of surgery

Variable						Collinearity statistics	
	B	SE	*β*	*t*	*p*-value	Tolerance	VIF
Sex	0.99	0.72	0.09	1.39	0.167	0.96	1.04
Age	1.06	0.70	0.10	1.51	0.131	0.94	1.06
Allergy	2.56	1.54	0.11	1.66	0.098	0.93	1.07
Indication for surgery	4.07	1.78	0.15	2.28	**0.023**	0.89	1.12
Antibiotics administered during surgery	1.75	0.82	0.13	2.14	**0.034**	0.98	1.02

B unstandardized coefficients, *β* standardized coefficients, *SE* standard error, t t-statistics, *VIF* variance inflation factor.

underwent tonsillectomy (Albornoz et al. 2024; Brennan et al. 2024; D'Eredita 2010; McGuire & Doyle 2021; Mitchell et al. 2019; Ortega et al. 2022; Yang et al. 2022; Zeng et al. 2025). Earlier studies have reported that propofol, sevoflurane, and halothane caused less irritation to the airways compared to thiopental and desflurane (Bangera 2017; Hatcher & Stack 1999). Therefore, propofol, sevoflurane, and halothane were preferred for pediatric tonsillectomy. In this study, propofol was used for anesthesia induction, rocuronium was used for neuromuscular blockade, and sevoflurane was used for the maintenance of anesthesia. These practices align with international guidelines and recommendations on pediatric tonsillectomy. These guidelines and recommendations were developed to reduce the incidence of postoperative nausea and vomiting compared to regimens relying on agents such as isoflurane (Albornoz et al. 2024; Brennan et al. 2024; Han et al. 2023; Höhne 2014). Furthermore, the use of lidocaine, morphine, and pethidine should have provided adequate pain control and should have allowed a faster return to oral feeding while reducing the risks of bleeding, infection, and other complications after the surgery. These findings emphasize the need for the adoption of standardized protocols, particularly those focused on anesthetic techniques, which are often lacking in lower-middle-income countries, to improve clinical outcomes and recovery time after surgery in children with pediatric tonsillectomy.

The findings of this study showed that the induction-to-incision time was significantly higher among male patients compared to female patients. Although more studies are needed to fully illustrate the mechanisms behind this difference, the effectiveness and speed of airway management might be influenced by subtle physiological or anatomical differences between male and female patients (Han et al. 2023; Klabusayova et al. 2022; Krishna et al. 2018; Opfermann et al. 2023). In addition, variations in airway dimensions or tissue composition might lead to a slightly more challenging intubation process in males. Moreover, variations in the levels of cooperation between male and female patients could also affect the transition from induction of anesthesia to surgical incision. Understanding the impact of these nuances might have practical implications on tailoring anesthesia induction protocols used for male patients to improve the efficiency and allocation of resources during airway management in pediatric tonsillectomy.

In this study, the duration of surgery was associated with female sex, being 5 years or older, allergy, being operated on for recurrent/chronic tonsillitis, and receiving antibiotics during the surgery. Regression analysis showed that a longer duration of surgery could be predicted by being operated on for recurrent/chronic tonsillitis and receiving antibiotics during the surgery. Although the literature did not report extensively on the sex- and age-related differences in surgical duration for pediatric tonsillectomy, these differences might be explained by sex- and age-related anatomical or compositional variations in tonsillar size, degree of vascularity, and tissue density (Han et al. 2023; Husman et al. 2025; Stanisce et al. 2018; Yoon et al. 2022). Moreover, the presence of allergy might reflect persistent inflammation of the tonsillar tissues (De Corso et al. 2021; Funakoshi et al. 2021). Inflammation can result in edematous and hyperemic tissues that are more fragile and prone to bleeding. Similarly, patients with recurrent/chronic tonsillitis can develop fibrotic changes and scarring as a result of the long-standing inflammation. Furthermore, receiving antibiotics during surgery could be a marker of pronounced inflammation. Together, sex-, age-, and inflammation-related variations can make dissecting and maintaining hemostasis more technically challenging which might necessitate more cautious surgical maneuvers and meticulous hemostatic control. These findings might indicate that

surgeons might need to tailor their surgical maneuvers and techniques to the individual needs of the patients.

In contrast to the limited data on anesthesia-related complications in tonsillectomy within Palestinian practice, our retrospective review did not reveal any adverse respiratory events or complications in the operating room or recovery area. This finding is consistent with recent evidence that modern anesthetic protocols that are characterized by the use of intravenous induction agents, non-opioid adjuncts, and multimodal analgesia techniques were shown to significantly reduce common complications such as postoperative nausea, vomiting, and respiratory depression (Albornoz et al. 2024; Bangera 2017; Brennan et al. 2024; Han et al. 2023; Huoh et al. 2021; Husman et al. 2025; McGuire & Doyle 2021). A previous study demonstrated that opioid use increases the incidence of postoperative nausea and vomiting, delayed removal of the airway device, and respiratory depression (Kim et al. 2017). However, current strategies emphasize opioid-sparing protocols that have been shown to mitigate these risks. These findings underscore the advantages of adopting integrated, evidence-based anesthesia practices to enhance patient safety and recovery in resource-limited settings.

Strengths of the study

This study has a number of strengths. First, this was the first assessment of anesthetic outcomes in pediatric tonsillectomy in the Palestinian practice. Few studies were conducted in resource-limited settings, particularly on the effects of various anesthetic techniques, airway management, and induction agents on the outcomes of pediatric tonsillectomy. Second, the data were collected using a detailed and standardized data collection form. This form allowed the collection of and description of detailed demographic, health, and anesthetic outcomes in pediatric tonsillectomy performed in the Palestinian practice. Third, the data collected allowed describing the anesthetic and airway management protocols, including the use of intravenous propofol for induction, rocuronium for muscle relaxation, and sevoflurane for maintenance of anesthesia. Fourth, the study focused on assessing operative metrics, including induction-to-incision time and duration of surgery. In addition, the study also assessed the impact of patient-specific factors, including demographics and health characteristics on these metrics. Finally, rigorous statistical methods, including univariate analysis and multiple linear regression, were used to identify the factors that can be used to predict the operative metrics. Therefore, this should have provided actionable insights for optimizing intraoperative management and improving patient outcomes.

Limitations of the study

This study had some limitations that should be acknowledged. First, the study was conducted in a retrospective design. This design could be associated with selection bias and limited ability to establish causal relationships. Second, the data were collected from a single center over 2 years. This could have limited the generalizability of the findings to the entire population of pediatric patients who underwent tonsillectomy in different settings. Third, details of the immunological markers, including immunoglobulin E (IgE) or eosinophil counts were not systematically documented. The lack of these important data could have limited a wider understanding of the underlying mechanisms of allergy. Fourth, while this study assessed the immediate and short-term complications, long-term complications were not assessed. Finally, the observed association between intraoperative antibiotic administration and prolonged surgical duration may be confounded by the underlying case complexity and increased inflammatory state, suggesting the need for prospective studies to better clarify these relationships.

Conclusion

In conclusion, the findings of this study revealed that patient-specific factors influenced induction-to-incision time and duration of surgery. The induction-to-incision time was significantly longer for male patients and the duration of surgery could be predicted by being operated on for recurrent/chronic tonsillitis and receiving antibiotics during the surgery. The findings of this study highlight the need for tailored preoperative assessment and individualized perioperative management to optimize resource utilization and improve surgical efficiency in resource-limited settings. Future studies are needed to understand the underlying mechanisms driving these differences and to further refine these management protocols.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13741-025-00537-5.

Supplementary Material 1. Supplementary Table S1. Adherence to the STROBE Statement. Supplementary Table S2. The data collection form.

Acknowledgements

An-Najah National University (www.najah.edu) is acknowledged for making this study possible.

Authors' contributions

Ramzi Shawahna, Mohammad Jaber, Iyad Maqboul, Hatim Hijaz, and Samer Bustame were involved in the conception and design of the work, analysis, and interpretation of data, and drafting and final approval of the manuscript. Shahed Radwan, Dana Alyan, Rawand Obaid, and Suha Sholi were involved

in the data acquisition, analysis, drafting of the work, and final approval of the version to be published. All authors approved the final manuscript.

Funding
This study did not receive any specific funding.

Data availability
All data analyzed in this study were included in the manuscript. The datasets used in the analysis or entered into statistical software can be obtained from the corresponding author upon making a reasonable request.

Declarations

Ethics approval and consent to participate
This study was conducted in adherence to the national and international ethical principles including those in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of An-Najah National University. Additional approvals were also obtained from the Office of Health Education of the Ministry of Health for governmental hospitals, and approvals from the managers of each private hospital were also obtained. The data was collected anonymously, and no information leading to the identification of the patient was made public.

Consent to publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Physiology, Pharmacology, and Toxicology, Faculty of Medicine and Allied Health Sciences, An-Najah National University, Nablus, Palestine. [2]Clinical Research Center, An-Najah National University Hospital, Nablus, Palestine. [3]Department of Medicine, Faculty of Medicine and Health Sciences, An-Najah National University, Nablus, Palestine. [4]Najah National University Hospital, Nablus, Palestine.

Received: 23 November 2024 Accepted: 27 April 2025
Published online: 09 May 2025

References

Albornoz AE, Rana M, Hayes J, Englesakis M, Tsang M, Amin R, Gilfoyle E, Petre MA, Campisi P, Aoyama K. Perioperative clinical practice recommendations for pediatric tonsillectomy: a systematic review. Can J Anaesth. 2024;71:187–200.
Allford M, Guruswamy V. A national survey of the anesthetic management of tonsillectomy surgery in children. Paediatr Anaesth. 2009;19:145–52.
Bangera A. Anaesthesia for adenotonsillectomy: an update. Indian J Anaesth. 2017;61:103–9.
Brennan MP, Webber AM, Patel CV, Chin WA, Butz SF, Rajan N. Care of the pediatric patient for ambulatory tonsillectomy with or without adenoidectomy: the Society for Ambulatory Anesthesia Position Statement. Anesth Analg. 2024;139:509–20.
De Corso E, Galli J, Di Cesare T, Lucidi D, Ottaviano G, Seccia V, Bussu F, Passali GC, Paludetti G, Cantone E. A systematic review of the clinical evidence and biomarkers linking allergy to adeno-tonsillar disease. Int J Pediatr Otorhinolaryngol. 2021;147: 110799.
D'Eredita R. Tonsillectomy in children: a five-factor analysis among three techniques–reporting upon clinical results, anesthesia time, surgery time, bleeding, and cost. Laryngoscope. 2010;120:2502–7.
Edmonson MB, Zhao Q, Francis DO, Kelly MM, Sklansky DJ, Shadman KA, Coller RJ. Association of patient characteristics with postoperative mortality in children undergoing tonsillectomy in 5 US states. JAMA. 2022;327:2317–25.
Funakoshi U, Yonekura S, Iinuma T, Arimoto Y, Nakano A, Yamaide A, Tomiita M, Hoshioka A, Sakurai D, Okamoto Y. The influence of tonsillectomy on allergic diseases in pediatric patients. Int J Pediatr Otorhinolaryngol. 2021;140: 110503.
Han CJ, Bergman M, Harley RJ, Harley EH. The pediatric indications for tonsillectomy and adenotonsillectomy: race/ethnicity, age, and gender. Laryngoscope Investig Otolaryngol. 2023;8:577–83.
Hatcher I, Stack C. Postal survey of the anaesthetic techniques used for paediatric tonsillectomy surgery. Pediatr Anesth. 1999;9:311–5.
Höhne C. Postoperative nausea and vomiting in pediatric anesthesia. Current Opinion in Anesthesiology. 2014;27:303–8.
Huang Y, Tai J, Nan Y. Effect of fasting time before anesthesia on postoperative complications in children undergoing adenotonsillectomy. Ear Nose Throat J. 2024;103:711–6.
Huoh KC, Haidar YM, Dunn BS. Current status and future trends: pediatric intracapsular tonsillectomy in the United States. Laryngoscope. 2021;131(Suppl 2):S1–9.
Husman T, Benjamin T, Durr ML, Chang JL. Sex differences in obstructive patterns on drug-induced sleep endoscopy. Otolaryngol Head Neck Surg. 2025;172:329–35.
Johnson RF, Zhang J, Chorney SR, Kou YF, Lenes-Voit F, Ulualp S, Liu C, Mitchell RB. Estimations of inpatient and ambulatory pediatric tonsillectomy in the united states: a cross-sectional analysis. Otolaryngol Head Neck Surg. 2023;169:258–66.
Kim N, Park JH, Lee JS, Choi T, Kim MS. Effects of intravenous fentanyl around the end of surgery on emergence agitation in children: systematic review and meta-analysis. Pediatr Anesth. 2017;27:885–92.
Klabusayova E, Klucka J, Kratochvil M, Musilova T, Vafek V, Skrisovska T, Djakow J, Kosinova M, Havrankova P & Stourac P. Airway Management in Pediatric Patients: Cuff-Solved Problem? Children (Basel). 2022;28;9(10):1490. https://doi.org/10.3390/children9101490.
Krishna SG, Bryant JF, Tobias JD. Management of the difficult airway in the pediatric patient. J Pediatr Intensive Care. 2018;7:115–25.
Lee AC, Hache M. Pediatric anesthesia management for post-tonsillectomy bleed: current status and future directions. Int J Gen Med. 2022;15:63–9.
Lieberg N, Aunapuu M, Arend A. Coblation tonsillectomy versus cold steel dissection tonsillectomy: a morphological study. J Laryngol Otol. 2019;133:770–4.
McGuire SR, Doyle NM. Update on the safety of anesthesia in young children presenting for adenotonsillectomy. World J Otorhinolaryngol Head Neck Surg. 2021;7:179–85.
Mitchell RB, Archer SM, Ishman SL, Rosenfeld RM, Coles S, Finestone SA, Friedman NR, Giordano T, Hildrew DM, Kim TW, Lloyd RM, Parikh SR, Shulman ST, Walner DL, Walsh SA, Nnacheta LC. Clinical practice guideline: tonsillectomy in children (Update). Otolaryngol Head Neck Surg. 2019;160:S1–42.
Murto KTT, Katz SL, McIsaac DI, Bromwich MA, Vaillancourt R, van Walraven C. Pediatric tonsillectomy is a resource-intensive procedure: a study of Canadian health administrative data. Can J Anaesth. 2017;64:724–35.
Neighbour R, Raker R, Smiley R. How to establish and maintain a functional operating room in a low-resource environment. In: Hardy MA, Hochman BR, editors. Global Surgery: How to Work and Teach in Low- and Middle-Income Countries. Cham: Springer International Publishing; 2023. p. 131–6.
Opfermann P, Schmid W, Obradovic M, Kraft F, Zadrazil M, Marhofer D, Marhofer P. Sex differences in pediatric caudal epidural anesthesia under sedation without primary airway instrumentation. PLoS ONE. 2023;18: e0288431.
Ortega B, Stramiello JA, Brigger M, Nation J. Anesthetic injections and analgesia use in pediatric post-tonsillectomy patients: a meta-analysis and systematic review. Int J Pediatr Otorhinolaryngol. 2022;152: 110976.
Patel HH, Straight CE, Lehman EB, Tanner M, Carr MM. Indications for tonsillectomy: a 10 year retrospective review. Int J Pediatr Otorhinolaryngol. 2014;78:2151–5.
Schneuer FJ, Bell KJ, Dalton C, Elshaug A, Nassar N. Adenotonsillectomy and adenoidectomy in children: the impact of timing of surgery and postoperative outcomes. J Paediatr Child Health. 2022;58:1608–15.
Spencer GM, Wilson CA, Davidson J, Strychowsky JE, Lawlor CM, Burns H, Bhargava EK, Fowler J, Graham ME. Global tonsillectomy practice patterns - a survey study of pediatric otolaryngologists. Int J Pediatr Otorhinolaryngol. 2025;191: 112276.
Stanisce L, Sims E, Hou C, Koshkareva Y, Gaughan JP, Kuzin I, Bottaro A. Differential cellular composition of human palatine and pharyngeal tonsils. Arch Oral Biol. 2018;96:80–6.

Stein ML, Park RS, Kiss EE, Adams HD, Burjek NE, Peyton J, Szmuk P, Staffa SJ, Fiadjoe JE, Kovatsis PG, Olomu PN, Pe DICI. Efficacy of a hybrid technique of simultaneous videolaryngoscopy with flexible bronchoscopy in children with difficult direct laryngoscopy in the Pediatric Difficult Intubation Registry. Anaesthesia. 2023;78:1093–101.

Takeuchi R, Hoshijima H, Mihara T, Kokubu S, Sato Boku A, Nagumo T, Mieda T, Shiga T & Mizuta K. Comparison of indirect and direct laryngoscopes in pediatric patients with a difficult airway: a systematic review and meta-analysis. Children (Basel). 2023; 11:60.

Wikner E, Nguyen C, Vazifedan T, Almirante J, Chilampath B, Mason L & Derkay C. Risk Factors Associated With Pediatric Post-Tonsillectomy Complications: A Focuson Racial, Ethnic and Socioeconomic Factors. Ann Otol Rhinol Laryngol. 2025;24:34894251328095. https://doi.org/10.1177/00034894251328095.

Yang Y, Cao J, Chen X, Liu D, Lv Q, Ma J, Zhang Y, Song X. Perioperative pain management based on enhanced recovery after surgery in children undergoing adenotonsillectomy: a prospective, randomized controlled trial. Laryngoscope Investig Otolaryngol. 2022;7:1634–42.

Yoon A, Abdelwahab M, Bockow R, Vakili A, Lovell K, Chang I, Ganguly R, Liu SY, Kushida C, Hong C. Impact of rapid palatal expansion on the size of adenoids and tonsils in children. Sleep Med. 2022;92:96–102.

Zeng Y, Zhang Y, Wu J, Li Q, Liu F, Gao G & Chen L. Optimizing the Recovery of Pediatric Tonsillectomy: Application of Opioid-Free Anesthesia and Analgesia. J Perianesth Nurs. 2025;5:S1089-9472(24)00556-2. https://doi.org/10.1016/j.jopan.2024.11.013.

Publisher's Note