

Incidence and predictive factors of bleeding following tonsillectomy among pediatrics

A retrospective cohort study

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ABSTRACT

الأهداف: تقدير نسبة حدوث النزيف بعد استئصال اللوزتين وتحديد العوامل المخففة له بين الأطفال.

المنهجية: أجريت دراسة أتريابية بأثر رجعي على 1280 مريضاً من الأطفال (18 عاماً أو أقل) خضعوا لعملية استئصال اللوزتين في مستشفى الملك عبد الله التخصصي للأطفال، الرياض، المملكة العربية السعودية خلال الفترة 2019 و2020. تم تقسيم عينة الدراسة إلى مجموعتين بناءً على تطور النزيف بعد العملية الجراحية وتمت مقارنتها باستخدام اختبار Chi-square واختبار T المستقل. قمنا بإدراج متغيرات كبيرة ($p\text{-value} \leq 0.05$) في نموذج الانحدار اللوجستي لتحديد تنبؤات النزيف بعد استئصال اللوزتين.

النتائج: كان معدل النزيف بعد استئصال اللوزتين 3.4% في 43 (فاصل الثقة 2.4-4.5) مريضاً ثقة 95%. في نموذج الانحدار اللوجستي متعدد المتغيرات، كانت المؤشرات الهامة لنزيف ما بعد استئصال اللوزتين هي العمر 12 عاماً وأكبر (نسبة الأرجحية=2.685، $p=0.027$)، وانخفاض تناول الطعام بالفم بعد العملية الجراحية (نسبة الأرجحية: 4.244، $p=0.042$)، والاستخدام الفردي لمسكن الألم بعد العملية الجراحية (نسبة الأرجحية: 53.124، $p>0.001$). من بين 43 مريضاً، تعرض 39 (90.7%) مريضاً لنزيف ثانوي، واحتاج أكثر من نصف المرضى الذين أصيبوا بنزيف إلى تدخل جراحي 27 (62.8%).

الخلاصة: استئصال اللوزتين هو إجراء جراحي آمن وشائع ولكنه يحمل مخاطر النزيف بعد العملية الجراحية. العمر 12 عاماً وأكبر، وسوء تناول الطعام بالفم بعد العملية الجراحية، واستخدام مسكن واحد بعد العملية الجراحية يزيد من خطر النزيف. نحن نشجع مقدمي الرعاية الصحية على التأكد من الاستئصال المبكر لتناول الطعام عن طريق الفم والتحكم الفعال للألم. نوصي بنظام مسكن مزدوج متناوب مع جرعات تعتمد على الوزن للتحكم الأمثل في الألم. علاوة على ذلك، فإن تفتيق مقدمي الرعاية حول أهمية تناول كمية كافية من الطعام عن طريق الفم بعد استئصال اللوزتين قد يحسن نتائج المرضى.

Objectives: To estimate the incidence of post tonsillectomy bleeding and to identify its predisposing factors among the pediatric population.

Methods: A retrospective cohort study included 1280 pediatric patients (18 years or younger) who underwent tonsillectomy at King Abdullah Specialized Children Hospital, Riyadh, Saudi Arabia between 2019 and 2020. The study sample was divided into 2 groups based on the development of postoperative bleeding and were compared using Chi-square test and independent t-test. Significant variables ($p\text{-value} \leq 0.05$) were included in the logistic regression model to determine the predictors of bleeding following tonsillectomy.

Results: The bleeding rate following tonsillectomy was 3.4% in 43 (95% confidence interval [CI] 2.4-4.5) patients. In the multivariable logistic regression model, the significant predictors of post tonsillectomy bleeding were age ≥ 12 years (odds ratio [OR]: 2.685, $p=0.027$), decreased postoperative oral intake (OR: 4.244, $p=0.042$), and single use of postoperative analgesia (OR: 53.124, $p<0.001$). Out of the 43 patients, 39 (90.7%) patients experienced secondary bleeding, and more than half of the patients who developed bleeding required surgical intervention 27 (62.8%).

Conclusion: Tonsillectomy is a safe and common surgical procedure but carries risks for postoperative bleeding. Age ≥ 12 years, poor postoperative oral intake, and the use of a single postoperative analgesic increase the risk of bleeding. We encourage healthcare providers to ascertain early resumption of oral intake and ensure effective pain management. We recommend a dual alternating analgesic regimen with weight-based dosing for optimal pain control. Furthermore, educating caregivers about the importance of adequate oral intake following tonsillectomy may improve patient outcomes.

Keywords: tonsillectomy, recurrent tonsillitis, bleeding

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Tonsillectomy is one of the most common surgical procedures performed in the pediatric population worldwide.^{1,2} The indications for tonsillectomy, with or without adenoidectomy, vary; however, recurrent tonsillitis and obstructive sleep-disordered breathing remain the two most common indications.³

Despite its high frequency, tonsillectomy carries risks and complications, including bleeding, respiratory distress, pain, fever, nausea, vomiting, and dehydration.⁴⁻⁸ Post tonsillectomy readmission rates range from 3.6% to 16.6% and contribute significantly to hospital admissions.⁹⁻¹⁴ In a recent study investigating the leading causes of readmission following the procedure, bleeding was identified as the second most common cause, after poor oral intake, accounting for 49.4% of their readmitted patients.¹⁴ Post tonsillectomy bleeding represents a significant challenge in pediatric patients worldwide, with incidence rates ranging from 0.2% to 11.9%.^{9,15-17}

Post tonsillectomy bleeding is typically classified into primary and secondary bleeding. Primary bleeding occurs within the first 24 hours following surgery and is often attributed to factors such as ineffective hemostasis during the intraoperative phase, which may result in rebleeding from small-caliber arteries.^{18,19} Conversely, secondary bleeding arises beyond the initial 24-hour period and is frequently associated with impaired wound healing and premature sloughing or separation of eschar, primarily due to infections that precipitate fibrin clot formation.²⁰ Both primary and secondary post tonsillectomy bleeding can be complicated and can potentially lead to fatal consequences. However, primary post tonsillectomy bleeding is generally considered more hazardous due to increased risk of aspiration, laryngospasm, and circulatory collapse from insensible swallowed blood loss.²¹ Given the prevalence of tonsillectomy and the high risk of postoperative bleeding, it is crucial to understand the incidence and causes contributing to this complication. This study aims to estimate the incidence of post tonsillectomy bleeding and explore its predisposing factors among the pediatric population.

Methods. A retrospective cohort study was carried out at King Abdullah Specialized Children Hospital (KASCH), Riyadh, Saudi Arabia. All pediatric patients

(aged 18 years or younger) who underwent tonsillectomy from January 2019 to December 2020 were included in the study. The institutional review board (IRB) of King Abdullah International Medical Research Center (KAIMRC) approved the study (NRC21R/426/10). All patients received opioid-free general anesthesia with propofol, sevoflurane, dexmedetomidine, and dexamethasone. The patients were followed for a minimum of 30 days following tonsillectomy to estimate the incidence of postoperative bleeding and the need for bleeding control. All patients who had active bleeding or blood clots within the tonsillar fossa underwent bleeding control in the operating room (OR). Patients with a history of bleeding but unremarkable examination were managed conservatively.

The patients' electronic records were reviewed using the hospital's health care information system. The data collection form included demographic details (such as age, gender, body mass index [BMI]), as well as the presence of comorbidities (such as asthma and reactive airway disease, coagulopathy, hematologic disorders, metabolic and cardiac disorders, and congenital syndromes), American Society of Anesthesiologists (ASA) score, recurrent tonsillitis attacks (documentation of ≥ 7 episodes of tonsillitis in one year, ≥ 5 episodes per year in 2 consecutive years, or ≥ 3 episodes per year in three consecutive years), and history of sleep breathing disorder/obstructive sleep apnea were also recorded. Surgical details (such as, concurrent procedures and tonsillectomy technique), type and time of post tonsillectomy bleeding (any bleeding occurring within the first 24 hours after the procedure is considered a primary bleeding, while bleeding that occurs after 24 hours is classified as secondary bleeding), postoperative antibiotic use, and postoperative single or dual analgesic use. The protocol of analgesic use post tonsillectomy in our institution consists of paracetamol with nonsteroidal anti-inflammatory drugs (NSAIDs) (example: dual analgesic); however, patients who are allergic to NSAIDs or have severe bronchial asthma received paracetamol only (example: single analgesic).

Statistical analysis. Data were analyzed using Statistical Package for the Social Sciences ((IBM Corp, Armonk, NY, USA) version 25. The categorical variables were presented as frequencies and proportions, while the numerical variables were reported as means and standard deviations (SD). The study sample was divided into two groups based on the bleeding status. The groups were compared using a Chi-square and independent T-test for categorical and continuous variables, respectively. The variables were included in a multivariable logistic regression model to determine the

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predictors of bleeding post-tonsillectomy. A p -value of ≤ 0.05 was declared as statistically significant.

Results. The study included 1280 pediatric patients who underwent total tonsillectomy. Male gender was the dominant gender 795 (62.1%), with a mean age of 6.47 years. Almost half of the patients 630 (49.2%) had an ASA score of 1. Majority of tonsillectomy patients also underwent adenoidectomy 1199 (93.7%). The rate of bleeding post tonsillectomy was 43 3.4% (Table 1).

Table 2 summarizes the comparison between the bleeding and control groups. Patients aged ≥ 12 years experienced a significantly higher rate of bleeding following the procedure with a $p=0.030$. The bleeding group ($n=43$) included a significantly larger number of syndromic patients than the control group ($p=0.018$). Furthermore, the bleeding group had a higher rate of vomiting compared to the other group with a significant p -value (<0.05 level). In addition, both poor postoperative oral intake and single use of postoperative analgesia were significantly associated with post tonsillectomy bleeding ($p=0.000$).

In the multivariable logistic regression analysis model, age ≥ 12 years, poor postoperative oral intake, and single use of postoperative analgesia remained the only significant predictive factors (Table 3). Older age (≥ 12 years) significantly increased the probability of postoperative bleeding by 2.685 times ($p=0.027$). Poor oral intake postoperatively increased the likelihood of bleeding post tonsillectomy by 4.244 times ($p=0.042$). Moreover, single postoperative analgesia, as opposed to dual analgesia, was associated with a higher probability of postoperative bleeding (OR=53.124, $p=0.001$).

A sub-analysis of patients with post tonsillectomy bleeding is presented in (Table 4). Most patients (90.7%) developed secondary post tonsillectomy bleeding. Surgical intervention was required to control bleeding in more than half of the patients (62.8%), whereas 16 (37.2 %) were managed conservatively. Only 2 of our patients required bleeding control twice (4.7%). The mean time interval between the surgery and bleeding was 6.93 days with a mean duration of 2.14 days of admission.

Discussion. Tonsillectomy is one of the most prevalent surgical procedures performed in the pediatric population.¹⁻³ Despite the simplicity of the procedure, postoperative bleeding is a critical complication that carries significant risk to pediatric patients.^{11,12} Hence, the present study aimed to identify the predictive factors and estimate the incidence of bleeding following tonsillectomy in pediatric patients. Our findings

revealed a post tonsillectomy bleeding rate of 3.4%, which falls within the reported range in published literature.^{9,15-17}

Table 1 - Demographics and baseline clinical characteristics of all tonsillectomy patients.

Variables	Statistics (n = 1280)
Age	6.473 (\pm 3.28)
<12 years	1162 (90.8)
≥ 12 years	118 (9.2)
Gender	
Male	795 (62.1)
Female	485 (37.9)
BMI	17.39 (\pm 5.11)
ASA Score	
ASA 1	630 (49.2)
ASA 2	607 (47.4)
ASA 3	43 (3.4)
SDB	793 (62.0)
Recurrent tonsillitis	976 (76.3)
Concurrent procedure	
Adenoidectomy	1199 (93.7)
Myringotomy	61 (4.8)
Laryngobronchoscopy	2 (0.2)
Post tonsillectomy bleeding	43 (3.4)

Values are presented as numbers and percentages (%) for categorical variables or mean \pm standard deviation (SD) for continuous variables. ASA: American Society of Anesthesiologists

Table 2 - Predictors of bleeding following tonsillectomy compared to the control group.

Variables	Bleeding n=43 (%)	No bleeding n=1237 (%)	P-value
Age	6.95 \pm 3.86	6.46 \pm 3.25	0.328
<12 years	1127 (91.1)	35 (81.4)	0.030*
≥ 12 years	110 (8.9)	8 (18.6)	
Gender			
Male	30 (69.8)	765 (61.8)	0.292
Female	13 (30.2)	472 (38.2)	
Body mass index	18.87 \pm 6.04	17.34 \pm 5.07	0.053
ASA Score			
ASA 1	15 (34.9)	61 (49.7)	0.097
ASA 2	25 (58.1)	582 (47.0)	
ASA 3	3 (7.0)	40 (3.2)	
SDB	25 (58.1)	768 (62.1)	0.600
Recurrent tonsillitis	33 (76.7)	943 (76.2)	0.938
Bleeding disorder	1 (2.3)	18 (1.5)	0.643
Syndromes	4 (9.3)	36 (2.9)	0.018*
Tonsillectomy technique			
Hot tonsillectomy	42 (97.7)	1202 (97.2)	0.630
Cold steel tonsillectomy	1 (2.3)	35 (2.8)	
Intraoperative local anesthesia	33 (76.7)	976 (78.9)	0.734
Postoperative poor oral intake	7 (16.3)	50 (4.0)	0.000*
Postoperative vomiting	2 (4.7)	12 (1.0)	0.023*
Postoperative analgesia			
Single	15 (34.9)	32 (2.6)	0.000*
Dual	28 (65.1)	1205 (97.4)	

Table 3 - Multi-variable logistic regression analysis of predictors independently associated with bleeding post tonsillectomy.

Variable	Odds ratio	P-value	95% LCI	95% UCI
Age (≥ 12 years)	2.685	0.027*	1.121	6.431
Gender (male)	1.690	0.153	0.823	3.472
Bleeding disorder	2.368	0.413	0.301	18.646
Syndromes	2.089	0.250	0.596	7.330
Tonsillectomy technique (hot)	1.490	0.344	0.653	3.399
Postoperative poor oral intake	4.244	0.042 *	1.057	17.044
Postoperative vomiting	1.096	0.923	0.171	7.011
Postoperative analgesia (single)	53.124	<0.001*	17.538	160.920

*Statistically significant *p*-value of ≤ 0.05 . LCI: lower confidence interval, UCI: upper confidence interval

Table 4 - Sub-analysis of patients with post tonsillectomy bleeding

Variables	n=43 (%)
<i>Type of post tonsillectomy bleeding</i>	
Primary	9.3 (9.3)
Secondary	39 (90.7)
Time to postoperative bleeding (days)	6.93 \pm 3.10
<i>Management</i>	
Conservative management	16 (37.2)
Surgical intervention	27 (62.8)
Required bleeding control twice	2 (4.7)
Durations of admission (days)	2.14 \pm 1.10

Values are presented as numbers and percentages (%) for categorical variables or mean \pm standard deviation (SD) for continuous variables.

The present study revealed a mean age of 6.47 years, predominantly males, which aligns with the reported range of 2.3 to 8.8 years.^{6,9,12,16,19,20} Our study's findings were consistent with existing literature regarding the older age, as several studies have reported higher frequencies of post tonsillectomy bleeding in children aged ≥ 12 years.^{13,16-17,19,22} Interestingly, syndromic pediatric patients were found to have a higher bleeding rate than non-syndromic patients. Tweedie et al²³ found that syndromic patients had a higher risk of developing postoperative complications.²³ However, this finding was not significant in the multivariable analysis.

Our study explored the potential factors contributing to postoperative bleeding, such as vomiting, poor oral intake, and the use of a single analgesia. Vomiting has been recognized as a significant cause of readmission in the literature.^{2,10,11} Despite observing a greater occurrence of vomiting in the bleeding group, our study showed no significant association between vomiting and bleeding in the multivariable analysis.

In our multivariable logistic regression analysis (Table 3), poor oral intake and the utilization of single analgesia postoperatively were identified as significant predictors of post tonsillectomy bleeding. These factors create a dual risk for postoperative bleeding, emphasizing

their critical interplay. Therefore, addressing the challenges associated with poor oral intake and inadequate pain control is crucial for minimizing bleeding risk and optimizing patient recovery following tonsillectomy. Despite advancements in tonsillectomy techniques, the persistence of poor oral intake has been highlighted in the study conducted by Demir et al.²⁴ Additionally, a recent local study by Alsalamah et al¹⁴ identified poor oral intake as a contributing cause to readmission following the procedure. However, the study by Rohlfing et al²⁵ did not find a significant association between poor oral intake and readmission.

While postoperative pain may be associated with postoperative bleeding, its direct correlation remains underexplored in the existing literature. Sarny et al²⁶ highlighted that patients experiencing severe or increasing pain within the first days following tonsillectomy had a significantly higher risk of bleeding. Additionally, Shelton et al⁹ demonstrated that using dual analgesia after surgery, similar to our approach, reduces hospital readmissions due to bleeding. The maximum pain intensity is usually experienced on the fourth and fifth postoperative days and is associated with increased dehydration and poor oral intake.²⁷ This association can be further underscored by the predominance of secondary post tonsillectomy bleeding in our study, which is consistent with the literature.^{17,20,28}

Our study estimated the mean time to develop bleeding to be 6.93 days, which aligns with other studies reporting an average time from the procedure to bleeding of 5.7 to 7.8 days.^{29,30} Effective pain control measures can reduce the risk of readmission due to postoperative complications.⁹ Charde et al³¹ and Aziz et al³² found that the effectiveness of pain control among patients who received dual therapy with both NSAIDs and paracetamol was superior to the monotherapy group. Our study concurs with these findings, as dual analgesic use successfully provided optimal pain control.

Nonsteroidal anti-inflammatory drugs inhibit the cyclooxygenase enzyme, thereby reducing the synthesis of prostaglandins and thromboxane A₂, which can result in prolonged bleeding time.³³ The clinical significance of this increased bleeding risk remains unclear, as studies have shown various results.³⁴⁻³⁶ Recent research indicates that different doses of NSAIDs, such as ibuprofen, provide comparable pain relief without an increase in adverse events.³⁶ Conversely, several studies have failed to demonstrate an increased risk of post tonsillectomy bleeding with postoperative NSAIDs use.^{34,35}

The incidence of bleeding following tonsillectomy requiring operative bleeding control varies widely, ranging between 0.2% and 6%.^{17,22,30} Our findings showed that approximately 2.1% of patients who underwent tonsillectomy required surgical intervention to control bleeding, which is consistent with the range reported in the literature. Additionally, only 2 patients required bleeding control twice; one of them had a coagulation disorder, whereas the other did not have an identifiable cause. Windfuhr et al³⁷ emphasized that recurrent episodes of bleeding following tonsillectomy should be considered a red flag for potential excessive bleeding from the tonsillar fossae, and surgeons should advise readmission for these patients.

Study limitations. The current study has certain limitations; the retrospective design of the study limits our ability to establish causal relationships, and the implementation is within a single tertiary healthcare center, which may not represent the population of Saudi Arabia. Additionally, despite the large initial sample size, the effective sample size is small as it only includes patients who experienced postoperative bleeding. This limited sample size may lack sufficient statistical power to detect significant differences.

In conclusion, Post tonsillectomy bleeding is a common complication in the pediatric population. Age ≥ 12 years, poor postoperative oral intake, and the use of a single postoperative analgesia are associated with a higher risk of post tonsillectomy bleeding. We recommend educating caregivers about the need for good pain control and educating patients and their families about the importance of adequate oral intake following tonsillectomy.

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