Turkish Archives of Otorhinolaryngology

Original Investigation

Turk Arch Otorhinolaryngol
DOI: 10.4274/tao.2026.2026-3-26

Risk Factors for Post-Tonsillectomy Hemorrhage: A 10-Year Retrospective Cohort Study at a Tertiary Military Hospital in Thailand

Juthamard Moungthong[1], Anisong Pilakasiri[2]

[1]Department of Otorhinolaryngology, Royal Thai Armed Forces Headquarters, Bangkok, Thailand
[2]Department of Otolaryngology, Phramongkutklao Hospital and College of Medicine, Bangkok, Thailand

Abstract

Objective: Tonsillectomy is one of the most frequently performed surgical procedures worldwide, and several patient—and procedure—related factors have been associated with post-tonsillectomy hemorrhage (PTH). Severe hemorrhage may require reoperation under general anesthesia to achieve hemostasis. The aim of this retrospective cohort study was to identify pre-, intra-, and postoperative factors associated with PTH.

Methods: Records of 549 patients who underwent tonsillectomy at a tertiary military hospital in Thailand between 2010 and 2020 were reviewed, with PTH ascertained by detailed manual chart review.

Results: The mean age was 26.89±15.69 years. PTH occurred in 56 patients (10.2%), most commonly on postoperative day 6. Multivariate logistic regression identified the following independent risk factors: male sex [p=0.039; adjusted odds ratio (aOR) 2.11, 95% confidence interval (CI) 1.04-4.30], age<19 years (p=0.016; aOR 7.96, 95% CI 1.46-43.27), age 19-45 years (p=0.024; aOR 5.74, 95% CI 1.26-26.11), surgeon experience <15 years (p=0.023; aOR 2.85, 95% CI 1.16-7.01), elevated mean arterial pressure (MAP) (p=0.002; aOR 1.04 per mmHg, 95% CI 1.02-1.07), intravenous (IV) antibiotic prescription (p=0.036; aOR 2.03, 95% CI 1.05-3.92), and a day-1 pain score >5 (p=0.037; aOR 2.25, 95% CI 1.05-4.81). As the >45-year reference group had few events, the age odds ratios were imprecise; a Firth-penalized pediatric estimate was 6.33 (95% CI 1.52-37.37), and a pooled age <45 versus ≥45 contrast gave aOR 5.07 (95% CI 1.56-26.00).

Conclusion: Male sex, age under 45 years, and surgeon experience less than 15 years were the principal independent predictors of PTH; elevated postoperative MAP, a day-1 pain score above 5, and IV antibiotic prescription further characterized higher-risk patients.

Keywords: Tonsillectomy, postoperative hemorrhage, risk factors, retrospective studies, postoperative complications, blood pressure, pain measurement

ORCID IDs of the authors:
J.M. 0009-0003-2005-6415
A.P. 0000-0001-8193-5227

Cite this article as: *Moungthong J, Pilakasiri A. Risk factors for post-tonsillectomy hemorrhage: a 10-year retrospective cohort study at a tertiary military hospital in Thailand. Turk Arch Otorhinolaryngol. [Epub Ahead of Print]*

Corresponding Author:
Anisong Pilakasiri, MD;
anisong.pi@pcm.ac.th

Received Date: 03.04.2026
Accepted Date: 14.07.2026
Epub: 22.09.2026

Introduction

The palatine tonsils are paired lymphoid organs lying within the tonsillar fossae, delimited anteriorly by the palatoglossal arch and posteriorly by the palatopharyngeal arch (1). As components of Waldeyer's ring, they participate in mucosal immune defense and antigen sampling (1). When these tonsils become chronically infected or hypertrophic, tonsillectomy is undertaken for recurrent or chronic tonsillar disease, upper-airway obstruction, or suspected malignancy (2).

Among postoperative complications including pain, hemorrhage, airway obstruction, pulmonary edema, velopharyngeal insufficiency, nasopharyngeal stenosis, and the rare Eagle's syndrome, post-tonsillectomy hemorrhage (PTH) carries the greatest clinical consequence, as extensive blood loss may necessitate reoperation under general anesthesia or blood transfusion, and in severe cases may result in death from airway obstruction, anemia, or hemorrhagic shock.

Muninnobpamasa et al. (3) reported a PTH incidence of 4% among 481 patients at our institution between 2003 and 2006. Østvoll et al. (4) demonstrated a rising national trend in readmission for post-tonsillectomy bleeding from approximately 1% in 1987 to 5% in 2013. At our institution, internal audit data for 2017-2019 recorded PTH rates of 10% (7/68), 15% (10/66), and 8% (6/76) in successive years, yielding an aggregate rate of 11% over the three-year period (23 of 210 patients). This increasing trend prompted the present investigation.

Lechner et al. (5) reported that chronic tonsillitis as a surgical indication was associated with higher PTH incidence, with bipolar cautery being the most widely used technique. Wulu et al. (6) suggested that tonsillar pillar suturing may reduce hemorrhage when electrocautery techniques are used. In contrast, Galindo Torres et al. (7) found no statistically significant association between tonsillectomy indication and PTH. Manimaran et al. (8) identified preoperative factors and surgeon experience as significant contributors. The prevalence of PTH worldwide ranges from approximately 1.5% to 21.8%, with regional variations: 3.16-16.1% in the United States (9-11), 1.5-9.2% in the United Kingdom (12-14), 5.21% in Spain (7), 2.86-6% in Germany (15,16), 2.2% in Taiwan (17), and 11.6-21.84% in Japan (18,19). The global mean prevalence has been estimated at 6.44%. A recent United States pediatric study by Johnson et al. (20) also noted a 2.18% rate of return to the emergency department for postoperative bleeding.

Given the rising incidence at our institution and the divergence between local rates and the published benchmarks, this study aimed to identify the prevalence and independent risk factors for PTH and evaluate the pre-, intra-, and postoperative risk factors associated with this complication at our institution over a 10-year period.

Methods

Study Design and Population

This was a retrospective cohort study. The study population comprised patients who underwent tonsillectomy at the department of otolaryngology in a tertiary military hospital, Thailand, between 2010 and 2020. The study protocol was reviewed and approved by the Institutional Review Board of the Royal Thai Army Medical Department (approval no: R085h/63_Exp, date: 13 June 2020). Informed consent was waived due to the retrospective nature of the study, in accordance with the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Patients who were admitted for tonsillectomy and operated on by attending physicians or residents between 2010 and 2020, and whose records were retrievable from the hospital database were included. Patients whose records were incomplete or missing, and those who were referred from other hospitals specifically for management of PTH were excluded.

Data Collection and Sampling

Data were retrieved using hospital numbers from the hospital database using ICD-9-CM procedure codes 28.2 (tonsillectomy without adenoidectomy), 28.3 (tonsillectomy with adenoidectomy), and 28.7 (control of hemorrhage after tonsillectomy and adenoidectomy). Using the corrected formula $n=Z^2P(1-P)/d^2$ (Z=1.96 for 95% confidence level, p=0.06 based on prior literature, d=0.02 for precision), the minimum required sample size was 542 patients (4). From the 1,481 eligible cases, 549 records were selected for detailed review. Two levels of case ascertainment were applied. For the full cohort of 1,481 patients, PTH status was derived from ICD-9-CM procedure code 28.7 (control of hemorrhage after tonsillectomy and adenoidectomy), yielding a rate of 6.14%. Because code 28.7 identifies only patients who underwent a procedure to control hemorrhage, this figure represents the rate of procedurally treated, administratively identified hemorrhage rather than the overall PTH rate; administrative coding was recognized to under-ascertain PTH, as conservatively managed or jointly coded bleeds were omitted, so this figure represents a conservative lower bound rather than the true event frequency. In the 549-patient subset, PTH was ascertained by detailed manual chart review, which captured the bleeding episodes missed by coding and yielded a higher, more complete rate of 10.2%. This subset rate is corroborated by our institutional morbidity-and-mortality audit (11%; 23 of 210 patients, 2017-2019), which was likewise chart-based. The two rates therefore reflect differing ascertainment methods rather than sampling bias, and the 549-patient rate is not intended to estimate the administratively coded cohort figure.

Variables Analyzed

Preoperative: Sex, age group, body mass index (BMI; kg/m^2) or ideal body weight for patients aged ≤18 years, comorbidities, current medications, baseline vital signs, occupation, tonsillar size, and indication for surgery.

Intraoperative: Surgical technique (cold dissection, dissection with snare, or electrocautery), use of suturing, anesthetic technique, intubation route (transoral vs. transnasal), operative time, and surgeon experience (Category I: attending surgeon ≥15 years of ear, nose and throat training; Category II: attending surgeon <15 years and/or with resident assistance; Category III: primary and assisting surgeons both residents).

Postoperative: Vital signs in the first 24 hours and at discharge, daily pain scores, analgesic and antibiotic type and dose (classified as: no antibiotics; oral antibiotics only; intravenous antibiotics), length of hospital stay, oral hygiene protocol, and histopathology report.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using STATA/MP version 12 (StataCorp LP, College Station, TX, USA). Frequencies with percentages summarized categorical data, whereas continuous data were reported as mean ± standard deviation or as median with interquartile range according to their distribution, which was examined with the Shapiro-Wilk test. Continuous variables were compared between groups using the Student's t-test when the distribution was normal and the Mann-Whitney U test when it was not, while categorical variables were compared using the chi-square or Fisher's exact test as appropriate. Records containing missing values were handled by complete-case analysis. Univariate analyses were performed initially to identify factors potentially associated with PTH. Variables entered in the multivariable logistic regression model were selected based on univariate analysis results ($p<0.05$), literature review, and clinical relevance. Results from logistic regression analyses are reported as adjusted odds ratio (aOR) with 95% confidence interval (CI). Statistical significance was defined as a two-tailed p-value <0.05. Specifically, the following variables were entered into the multivariable model: sex, age group (<19 years, 19-45 years, and >45 years as the reference category), surgeon experience category (Category I, II, and III), postoperative mean arterial pressure (MAP), postoperative day-1 pain score, intubation route, antibiotic type (none, oral, or intravenous), and oral hygiene protocol all of which demonstrated statistical significance on univariate analysis or were deemed clinically relevant a priori based on the literature. Given the small number of bleeding events in the oldest age stratum (>45 years, two events) and the resulting events-per-variable ratio, we performed pre-specified sensitivity analyses to assess model stability: a Firth penalized logistic regression, re-specification of the age reference category (19-45 years), collapse of age into a binary contrast (<45 vs. ≥45 years), and modelling of age as a continuous variable.

Results

Of the 1,481 patients who underwent tonsillectomy between 2010 and 2020, procedurally treated PTH identified by ICD-9-CM procedure code 28.7 occurred in 6.14%; this administratively identified rate does not capture conservatively managed bleeding episodes. A subset of 549 patients was analyzed by detailed chart review, with approximately equal numbers per year (Table 1). In this chart-reviewed subset, 56 patients (10.2%) had PTH; this higher rate reflects more complete case detection by chart review, corroborated by the institutional audit (11%), rather than sampling bias, as described in the methods section and the limitations. The mean participant age was 26.89±15.69 years (median 24 years, interquartile range 15-37 years, range 3-72 years). The Shapiro-Wilk test confirmed a non-normal age distribution ($p<0.001$), indicating a heterogeneous cohort comprising both pediatric and adult patients, consistent with the military-hospital setting. PTH occurred in 56 patients (10.2%), most commonly on postoperative day 6.

On univariate analysis, sex and age group were significantly associated with PTH ($p<0.05$). BMI, body weight, comorbidities, current medications, and tonsillar size were not statistically significant. Chronic tonsillitis as the surgical indication, intraoperative and postoperative factors, including surgeon experience, intubation route, postoperative pain scores, antibiotic administration, and oral hygiene protocol, showed significant differences between groups (Tables 2 and 3). Surgical technique, use of suturing, operative duration, anesthetic agents, and perioperative vital signs other than MAP were not significantly associated with PTH.

Multivariate logistic regression (Table 4) identified the following independent risk factors for PTH: male sex: 13.27% incidence; aOR 2.11 (95% CI 1.04-4.30); p=0.039. Age <19 years (pediatric group): 7.14% incidence; aOR 7.96 (95% CI 1.46-43.27); p=0.016. Age 19-45 years (young adult group): 13.44% incidence; aOR 5.74 (95% CI 1.26-26.11); p=0.024. Surgeon experience (Category II, attending surgeon experience <15 years): 14.9% incidence; aOR 2.85 (95% CI 1.16-7.01); p=0.023. Category III (both surgeons as residents) did not reach statistical significance on multivariate analysis (aOR 1.94, 95% CI 0.80-4.69; p=0.142). Elevated postoperative MAP: mean 90.00±13.15 mmHg; aOR 1.04 per 1-mmHg increase (95% CI 1.02-1.07); p=0.002. Postoperative day 1 pain score >5: 18.67% incidence; aOR 2.25 (95% CI 1.05-4.81); p=0.037. Intravenous antibiotic administration: 18.67% incidence (oral antibiotics only: 64.8%; no antibiotics: 16.5%); aOR 2.03 (95% CI 1.05-3.92); p=0.036.

Table 1. Demographic data

Variables	No hemorrhage (n=493)	Hemorrhage (n=56)	p-value
Gender			0.004
Female	212 (94.22%)	13 (5.78%)	
Male	281 (86.73%)	43 (13.27%)	
Age group			0.007
≤18 years	143 (92.86%)	11 (7.14%)	
19-45 years	277 (86.56%)	43 (13.44%)	
>45 years	73 (97.33%)	2 (2.67%)	
IBW (children) | BMI			0.079
<P5 | <18.5	27 (100.00%)	-	
P5-P95 | 18.5-24.9	256 (87.67%)	36 (12.33%)	
>P95 | ≥25	210 (91.30%)	20 (8.70%)	
Occupation			0.056
Student	179 (90.86%)	18 (9.14%)	
Government officer	139 (90.85%)	14 (9.15%)	
Military officer	40 (75.47%)	13 (24.53%)	
Employee	91 (89.21%)	11 (10.78%)	
Other	44 (100.00%)	-	
DM			0.709
Negative	475 (89.62%)	55 (10.38%)	
Positive	18 (94.74%)	1 (5.26%)	
HT			0.816
Negative	445 (89.90%)	50 (10.10%)	
Positive	48 (88.89%)	6 (11.11%)	
Snoring			0.105
Negative	355 (88.53%)	46 (11.47%)	
Positive	138 (93.24%)	10 (6.76%)	
Anticoagulants			1.000†
Negative	490 (89.74%)	56 (10.26%)	
Positive	3 (100.00%)	-	
Left tonsil grading			0.706
Small (grade 1-2)	251 (89.32%)	30 (10.68%)	
Large (grade 3-4)	242 (90.30%)	26 (9.70%)	
Right tonsil grading			0.874
Small (grade 1-2)	241 (89.59%)	28 (10.41%)	
Large (grade 3-4)	252 (90.00%)	28 (10.00%)	
Indication			
CHT	348 (88.32%)	46 (11.68%)	
Snoring/OSA	120 (95.24%)	6 (4.76%)	
Unilateral/CA	15 (93.75%)	1 (6.25%)	
Peritonsillar abscess	10 (76.92%)	3 (23.08%)	

†: Fisher's exact test, BMI: Body mass index, CA: Carcinoma, CHT: Chronic hypertrophic tonsillitis, DM: Diabetes mellitus, HT: Hypertension, IBW: Ideal body weight, OSA: Obstructive sleep apnea

Table 2. Intraoperative factors

Variables	No hemorrhage (n=493)	Hemorrhage (n=56)	p-value
Operation			0.013
Tonsillectomy	351 (87.31%)	51 (12.69%)	
T&A	62 (98.41%)	1 (1.59%)	
UPPP+Tonsil	70 (94.59%)	4 (5.41%)	
Other	10 (100.00%)	-	
Technique			0.689
Cautery	388 (90.23%)	42 (9.77%)	
Cold/snare	105 (88.98%)	13 (11.02%)	
Suture			0.105
Negative	189 (92.65%)	15 (7.35%)	
Positive	303 (88.34%)	40 (11.66%)	
Surgeon experience			0.003
Category I	192 (95.52%)	9 (4.48%)	
Category II	128 (85.91%)	21 (14.09%)	
Category III	173 (86.93%)	26 (13.07%)	
Duration range			0.560
Short (≤90 min)	349 (89.49%)	41 (10.51%)	
Long (>90 min)	144 (91.14%)	14 (8.86%)	
Route of intubation			0.045
Nasal	301 (87.76%)	42 (12.24%)	
Oral	190 (93.14%)	14 (6.86%)	
Induction drug			0.160
Propofol	173 (86.07%)	28 (13.93%)	
Thiopental	315 (92.11%)	27 (7.89%)	
Other	2 (100.00%)	-	
Intubation drug			0.367
Succinyl	233 (92.09%)	20 (7.91%)	
Tracrium	85 (85.00%)	15 (15.00%)	
Nimbex	167 (88.83%)	21 (11.17%)	
Pavulon and none	5 (100.00%)	-	
Analgesic drug			0.363
Fentanyl	483 (89.78%)	55 (10.22%)	
Morphine or Pethidine	7 (100.00%)	-	
None	1 (50.00%)	1 (50.00%)	
Sedate drug			0.318
Dormicum	148 (88.62%)	19 (11.38%)	
Propofol	2 (66.67%)	1 (33.33%)	
Valium	8 (100.00%)	-	
None	333 (90.49%)	35 (9.51%)	
Reverse drug			0.622
Atropine+Prostigmine	321 (88.92%)	40 (11.08%)	
Neostigmine+Atropine	8 (88.89%)	1 (11.11%)	
Atropine	1 (100.00%)	-	
None	161 (91.48%)	15 (8.52%)	

Table 2. Continued

Variables	No hemorrhage (n=493)	Hemorrhage (n=56)	p-value
Dexamethasone IV			0.074
Negative	28 (80.00%)	7 (20.00%)	
Positive	465 (90.47%)	49 (9.53%)	
Parecoxib IV			0.530
Negative	350 (89.29%)	42 (10.71%)	
Positive	143 (91.08%)	14 (8.92%)	

Surgeon experience: Category I =main surgeon with ENT training at least 15 years; Category II =main surgeon with <15 years' experience and/or assisted by residents; Category III =main and assisted surgeons are residents. IV: Intravenous, T&A: Tonsillectomy and adenoidectomy, UPPP: Uvulopalatopharyngoplasty, ENT: Ear, nose and throat

Table 3. Postoperative factors

Variables	No hemorrhage (n=493)	Hemorrhage (n=56)	p-value
Admission day (days)			0.636
Mean ± SD	3.16±1.97	3.29±1.24	
Median (min-max)	3 (2-32)	3 (2-7)	
Temperature (°C)			0.818
Mean ± SD	36.83±0.47	36.85±0.50	
Median (min-max)	36.8 (35.8-38.5)	36.9 (35.9-38.0)	
Postoperative fever			0.772
≤37.5 °C	462 (89.88%)	52 (10.12%)	
>37.5 °C	31 (88.57%)	4 (11.43%)	
Postoperative BP (mmHg)			0.078
Normal	437 (91.04%)	43 (8.96%)	
Hypotension (≤90/60)	1 (100.00%)	-	
Hypertension (>140/90)	55 (82.09%)	12 (17.91%)	
Postoperative MAP (mmHg)			0.001
Mean ± SD	84.58±11.74	90.00±13.15	
Median (min-max)	83.33 (57.0-123.3)	88.0 (65.7-127.3)	
Postoperative HR (bpm)			0.760
Mean ± SD	83.35±15.88	82.65±16.92	
Median (min-max)	82 (50-152)	80 (54-147)	
Postoperative HR group			0.890
<60 bpm	16 (88.89%)	2 (11.11%)	
60-120 bpm	465 (89.94%)	52 (10.06%)	
>120 bpm	12 (92.31%)	1 (7.69%)	
Pain score			0.009
Mild (≤5/10)	432 (91.14%)	42 (8.86%)	
Severe (>5/10)	61 (81.33%)	14 (18.67%)	
NSAID drug			0.806
Negative	448 (89.78%)	51 (10.22%)	
Positive	45 (91.84%)	4 (8.16%)	

Table 3. Continued

Variables	No hemorrhage (n=493)	Hemorrhage (n=56)	p-value
IV antibiotics			0.030
Negative	374 (91.44%)	35 (8.56%)	
Positive	119 (85.00%)	21 (15.00%)	
Oral care			0.036
None	267 (90.51%)	28 (9.49%)	
SMW	57 (95.00%)	3 (5.00%)	
NSS	116 (90.63%)	12 (9.38%)	
Both	53 (80.30%)	13 (19.70%)	
Pathology report			0.625
ACT/AET	285 (89.62%)	33 (10.38%)	
CHT/RT/LH	152 (89.94%)	17 (10.06%)	
SCCA/NHL	4 (80.00%)	1 (20.00%)	
Colonization			0.784
Negative	173 (90.10%)	19 (9.90%)	
Actinomycete	268 (89.33%)	32 (10.67%)	

ACT: Acute on chronic tonsillitis, AET: Acute exudative tonsillitis, BP: Blood pressure, CHT: Chronic hypertrophic tonsillitis, HR: Heart rate, LH: Lymphoid hypertrophy, MAP: Mean arterial pressure, NHL: Non-Hodgkin lymphoma, NSS: Normal saline, RT: Recurrent tonsillitis, SCCA: Squamous cell carcinoma, SMW: Special mouth wash, IV: Intravenous, SD: Standard deviation, NSAID: Non-steroidal anti-inflammatory drug

Discussion

Our overall figure of 10.2% falls within the upper range of published global estimates (1.5-21.84%), a rate that warrants targeted institutional intervention. This rate is notably higher than that reported in Taiwan (2.2%) and comparable to rates observed in Japan (11.6-21.84%) and the upper range reported in the United States (3.16-16.1%), suggesting that our institutional rate reflects a pattern consistent with higher-volume Asian teaching-hospital settings (9-11,17-19).

Male sex and age were confirmed as independent risk factors in two distinct groups: patients aged under 19 years (pediatric group; aOR 7.96, 95% CI 1.46-43.27) and those aged 19-45 years (young adult group; aOR 5.74, 95% CI 1.26-26.11), consistent with findings by Ikoma et al. (18) and Inuzuka et al. (19). The observation that the pediatric group had a lower crude bleeding rate (7.14%) yet the highest aOR is consistent with negative confounding (a suppression effect): younger patients more frequently presented with protective covariates, notably lower baseline MAP and a higher proportion of obstructive sleep apnea as the surgical indication, that attenuated the crude association. After adjustment for these covariates, the underlying age-related risk was unmasked, raising the aOR. This estimate must nonetheless be interpreted with caution. The reference category (age>45 years) contained only two bleeding events, and the ratio of events to model parameters was low; both conditions produce sparse-data instability and account for the wide CIs (pediatric group, 95% CI 1.46-43.27).

Table 4. Univariate and multivariate analysis

Variables	No hemorrhage n (%)	Hemorrhage n (%)	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
1. Preoperative factors						
Gender						
Female	212 (94.22)	13 (5.78)	1		1	
Male	281 (86.73)	43 (13.27)	2.50 (1.31-4.76)	0.005	2.11 (1.04-4.30)	0.039
Age group						
>45 years	73 (97.33)	2 (2.67)	1		1	
≤18 years	143 (92.86)	11 (7.14)	2.81 (0.61-13.00)	0.187	7.96 (1.46-43.27)	0.016
19-45 years	277 (86.56)	43 (13.44)	5.67 (1.34-23.94)	0.018	5.74 (1.26-26.11)	0.024
2. Indication						
Snoring/OSA	120 (95.24)	6 (4.76)	1			
CHT	348 (88.32)	46 (11.68)	2.64 (1.10-6.35)	0.030		
Unilateral/CA	15 (93.75)	1 (6.25)	1.33 (0.15-11.84)	0.796		
Peritonsillar abscess	10 (76.92)	3 (23.08)	6.00 (1.30-27.67)	0.022		
3. Intraoperative factors						
Route of intubation						
Oral	190 (93.14)	14 (6.86)	1			
Nasal	301 (87.76)	42 (12.24)	1.89 (1.01-3.56)	0.048		
Dexamethasone IV						
Yes	465 (90.47)	49 (9.53)	1			
No	28 (80.00)	7 (20.00)	0.42 (0.18-1.02)	0.054		
Operation						
T&A	62 (98.41)	1 (1.59)	1			
Tonsillectomy	351 (87.31)	51 (12.69)	9.01 (1.22-66.39)	0.031	7.48 (0.92-61.00)	0.060
UPPP+Tonsil	70 (94.59)	4 (5.41)	3.54 (0.39-32.55)	0.264	1.79 (0.16-19.46)	0.634
Other	10 (100.00)	-	N/A	N/A	N/A	N/A
Surgeon experience						
Category I	192 (95.52)	9 (4.48)	1		1	
Category II	128 (85.91)	21 (14.09)	3.50 (1.55-7.89)	0.003	2.85 (1.16-7.01)	0.023
Category III	173 (86.93)	26 (13.07)	3.21 (1.46-7.03)	0.004	1.94 (0.80-4.69)	0.142
4. Postoperative factors						
MAP (mmHg)						
Mean ± SD	84.58±11.74	90.00±13.15	1.04 (1.01-1.06)	0.002	1.04 (1.02-1.07)	0.002
Pain score						
Mild (≤5/10)	432 (91.14)	42 (8.86)	1		1	
Severe (>5/10)	61 (81.33)	14 (18.67)	2.36 (1.22-4.58)	0.011	2.25 (1.05-4.81)	0.037
IV antibiotics						
Negative	374 (91.44)	35 (8.56)	1		1	
Positive	119 (85.00)	21 (15.00)	1.89 (1.06-3.37)	0.032	2.03 (1.05-3.92)	0.036
Oral care						
None	267 (90.51)	28 (9.49)	1			
SMW	57 (95.00)	3 (5.00)	0.50 (0.15-1.71)	0.270		
NSS	116 (90.63)	12 (9.38)	0.99 (0.49-2.01)	0.970		
Both	53 (80.30)	13 (19.70)	2.34 (1.14-4.81)	0.021		

The “other” operation category (n=10, with no bleeding events) produced quasi-complete separation and could not be estimated in the multivariable model; its adjusted odds ratio and p-value are therefore reported as N/A. CA: Carcinoma, CHT: Chronic hypertrophic tonsillitis, IV: Intravenous, MAP: Mean arterial pressure, OSA: Obstructive sleep apnea, SMW: Special mouth wash, T&A: Tonsillectomy and adenoidectomy, UPPP: Uvulopalatopharyngoplasty, SD: Standard deviation, NSS: Normal saline, N/A: Not applicable, OR: Odds ratio, CI: Confidence interval

Table 5. Sensitivity analyses for the age-PTH association using Firth penalized logistic regression

Variable	aOR	95% CI	p
Panel A. Firth penalized model (reference age category >45 years)			
Male sex	2.02	1.03-4.16	0.044
Age ≤18 years (vs. >45)	6.33	1.52-37.37	0.018
Age 19-45 years (vs. >45)	4.46	1.35-23.11	0.029
Surgeon Category II	2.69	1.15-6.66	0.022
Surgeon Category III	1.90	0.83-4.66	0.132
Postoperative MAP (per mmHg)	1.04	1.01-1.07	0.003
Day-1 pain score >5	2.25	1.05-4.65	0.031
Intravenous antibiotic	2.04	1.06-3.86	0.029
Panel B. Alternative age parameterizations (Firth)			
Age ≤18 vs. 19-45 (reference)	1.42	0.61-3.13	0.391
Age >45 vs. 19-45 (reference)	0.22	0.04-0.74	0.029
Age <45 vs. ≥45 years	5.07	1.56-26.00	0.016
Age (continuous, per year)	0.97	0.94-1.00	0.038

Panel A is adjusted for all listed covariates plus operation type; Firth penalization was applied to address the small number of events in the >45-year reference category and quasi-complete separation in the operation variable. In Panel B, each row is a separate age parameterization within the same adjusted model. aOR: Adjusted odds ratio, CI: Confidence interval (profile penalized likelihood), MAP: Mean arterial pressure, PTH: Post-tonsillectomy hemorrhage

The CIs for the pediatric and young-adult estimates overlap substantially and are statistically indistinguishable. The direction and significance of the age association are therefore robust, but the precise magnitude of the pediatric aOR should be regarded as hypothesis-generating rather than definitive. These interpretations are supported by sensitivity analyses (Table 5). A Firth penalized logistic regression attenuated the pediatric aOR from 7.96 to 6.33 (95% CI 1.52-37.37) while retaining statistical significance; re-specifying the reference category as the 19-45-year age group rendered the pediatric and young-adult estimates statistically indistinguishable (aOR 1.42, 95% CI 0.61-3.13; p=0.391); and modelling age continuously demonstrated a modest decrease in the odds of PTH with increasing age (aOR 0.97 per year, 95% CI 0.94-1.00; p=0.038). Together, these analyses indicate that the apparent primacy of the pediatric group is largely an artifact of the sparse reference category rather than a genuinely greater risk than in young adults. The robust signal is instead one of higher risk among patients aged under 45 years. Clinically, the elevated risk in younger patients may additionally reflect differences in tonsillar vascularity, lower baseline blood pressure that may mask early hemorrhage warning signs, and the challenges of postoperative monitoring in this group, hypotheses that merit prospective evaluation.

Surgeon experience less than 15 years (Category II: attending surgeon with <15 years of ENT training, with or without resident assistance) was an independent predictor of PTH (aOR 2.85, 95% CI 1.16-7.01; p=0.023), whereas Category III (both primary and assisting surgeons as residents) did not reach statistical significance (aOR 1.94, 95% CI 0.80-4.69; p=0.142). This aligns with Manimaran et al. (8), Ikoma et al. (18), and Windfuhr et al. (15), all of whom identified surgeon-related variables as contributors to PTH in teaching-hospital settings. Structured operative supervision and standardized hemostatic training for residents therefore merit institutional priority. The 15-year threshold reflects the institutional credentialing policy at our institution, which classifies surgeons as junior or senior faculty for supervision purposes; this classification is institution-specific and may not be generalizable.

Elevated postoperative MAP independently predicted PTH (aOR 1.04 per mmHg). Although the per-unit odds ratio appears modest, the wide range of MAP values (90.00±13.15 mmHg) represents a clinically relevant cumulative risk across the observed MAP range, supporting close postoperative blood-pressure monitoring, particularly in hypertensive patients. These findings are consistent with prior studies reporting an association between elevated postoperative blood pressure and PTH; because the present data are observational, a causal mechanism cannot be established, and residual confounding cannot be excluded (8).

Elevated day-1 pain scores (>5) and intravenous antibiotic prescription were also independent predictors. As this is a retrospective observational study, these associations should not be interpreted causally. Severe pain more plausibly serves as a clinical marker of extensive intraoperative tissue trauma or difficult dissection—subject to confounding by indication—than as a direct mechanical cause of hemorrhage (19). In our cohort, intravenous antibiotics were prescribed selectively for patients with clinical signs of postoperative infection (fever >38.3 °C, purulent exudate) or marked intraoperative tissue trauma, at the attending surgeon's discretion. Both infection and trauma predispose to premature separation of the tonsillar eschar and secondary hemorrhage (9). While routine postoperative antibiotic use following tonsillectomy is not currently recommended by evidence-based guidelines, the intravenous antibiotic group in this study likely represents a higher-risk subgroup defined by disease severity rather than antibiotic exposure per se (2).

A comparison of smoking habits among adult patients was not feasible in the present study, as smoking status was inconsistently documented in retrospective records across the 10-year period (complete data available in approximately 60% of cases). Smoking is a recognized risk factor for impaired wound healing and secondary hemorrhage (19); future prospective studies should include systematic recording of smoking history.

Study Limitations

This study has several limitations. First, PTH ascertainment differed between the full cohort (ICD-9-CM procedure code

28.7, which identifies only procedurally treated hemorrhage) and the analyzed subset (detailed manual chart review). Administrative coding is known to under-ascertain PTH, so the cohort rate (6.14%) represents a conservative lower bound, whereas the chart-based subset rate (10.2%)—consistent with our prospective institutional audit—more completely captures the true event frequency. Detailed risk-factor analyses were necessarily confined to the chart-reviewed subset; although its rate aligns with independent audit data, residual differences between the subset and the source cohort in unmeasured characteristics cannot be fully excluded. Second, the single-center design limits generalizability to institutions with different surgical training paradigms or patient demographics. Third, smoking status was incompletely recorded, precluding its inclusion as a covariate. Fourth, the 15-year surgeon experience threshold is institution-specific and was not derived from a data-driven cut-point analysis. Fifth, as a single military-hospital cohort with a predominantly male and occupationally selected population, the case mix may differ from that of general hospitals, potentially limiting generalizability. Sixth, preoperative and intraoperative variables (relevant to preoperative risk stratification) and postoperative variables (relevant to postoperative monitoring) were combined in a single model; as some postoperative factors may lie on the causal pathway to hemorrhage, a degree of over-adjustment cannot be excluded, and the two groups of predictors are best interpreted according to their distinct clinical roles. A multicenter prospective study capturing patient behavioral data, microbiological findings, and a standardized smoking history would clarify the associations identified here.

Conclusion

This 10-year institutional analysis identifies male sex, patients aged under 19 years (pediatric group) and those aged 19-45 years (young adult group), and surgeon experience less than 15 years as the principal independent predictors of PTH. In particular, patients aged under 45 years—comprising both the pediatric (age<19 years) and young-adult (age 19-45 years) groups—carry significantly elevated adjusted odds of PTH; because the CIs for these two estimates are wide and overlapping, they should not be ranked against one another, but both warrant heightened postoperative surveillance. Elevated postoperative MAP, a day-1 pain score above 5, and intravenous antibiotic prescription further characterize patients at heightened risk. Careful documentation of pain scores and MAP, close monitoring of patients receiving intravenous antibiotics, and comprehensive postoperative patient education are recommended to reduce the incidence of PTH at our institution.

Ethics

Ethics Committee Approval: The study protocol was reviewed and approved by the Institutional Review Board of the Royal Thai Army Medical Department (approval no: R085h/63_Exp, date: 13 June 2020).

Informed Consent: Informed consent was waived due to the retrospective nature of the study, in accordance with the Declaration of Helsinki.

Acknowledgements

The authors thank Dr. Anupong Sirirungreung and Miss Worarachanee Imjaijitt for their assistance with the data analysis and for their valuable statistical advice.

Footnotes

Authorship Contributions

Concept: J.M., A.P., Design: J.M., A.P., Data Collection and/or Processing: J.M., Analysis or Interpretation: J.M., A.P., Literature Search: J.M., A.P., Writing: J.M., A.P.

Conflict of Interest: The authors declare that they have no conflict of interest.

Financial Disclosure: The authors declare that this study has received no financial support.

Main Points

- Post-tonsillectomy hemorrhage (PTH) is one of the most clinically significant complications of tonsillectomy, with an institutional incidence of 10.2% in this 10-year study.

- Independent risk factors for PTH include male sex, age under 19 years [pediatric group; adjusted odds ratio (aOR) 7.96] and 19-45 years (young adult group; aOR 5.74), surgeon experience less than 15 years, elevated postoperative mean arterial pressure, day-1 pain score >5, and intravenous antibiotic prescription.

- Patients aged under 45 years—both the pediatric (aOR 7.96) and young-adult (aOR 5.74) groups—show elevated adjusted odds of PTH; the wide, overlapping confidence intervals preclude ranking the two groups, and both warrant targeted postoperative surveillance.

References

1. Masters KG, Zezoff D, Lasrado S. Anatomy, head and neck, tonsils [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. [Crossref]

2. Mitchell RB, Archer SM, Ishman SL, Rosenfeld RM, Coles S, Finestone SA, et al. Clinical practice guideline: tonsillectomy in

children (update). Otolaryngol Head Neck Surg. 2019; 160(1_suppl): S1-42. [Crossref]

3. Muninnobpamasa T, Khamproh K, Moungthong G. Prevalence of tonsillectomy and adenoidectomy complication at Phramongkutklao Hospital. J Med Assoc Thai. 2012; 95 Suppl 5: S69-74. [Crossref]

4. Østvoll E, Sunnergren O, Stalfors J. Increasing readmission rates for hemorrhage after tonsil surgery: a longitudinal (26 years) national study. Otolaryngol Head Neck Surg. 2018; 158: 167-76. [Crossref]

5. Lechner M, Chandrasekharan D, Vithlani R, Sutton L, Grandidge C, Elmiyeh B. Evaluation of a newly introduced tonsillectomy operation record for the analysis of regional post-tonsillectomy bleed data: a quality improvement project at the London North West Healthcare NHS Trust. BMJ Open Qual. 2017; 6: e000055. [Crossref]

6. Wulu JA, Chua M, Levi JR. Does suturing tonsil pillars post-tonsillectomy reduce postoperative hemorrhage?: a literature review. Int J Pediatr Otorhinolaryngol. 2019; 117: 204-9. [Crossref]

7. Galindo Torres BP, De Miguel García F, Whyte Orozco J. Tonsillectomy in adults: analysis of indications and complications. Auris Nasus Larynx. 2018; 45: 517-21. [Crossref]

8. Manimaran V, Mohanty S, Jayagandhi SK, Umamaheshwaran P, Jeyabalakrishnan S. A retrospective analysis of peroperative risk factors associated with posttonsillectomy reactionary hemorrhage in a teaching hospital. Int Arch Otorhinolaryngol. 2019; 23: e403-7. [Crossref]

9. Collison PJ, Mettler B. Factors associated with post-tonsillectomy hemorrhage. Ear Nose Throat J. 2000; 79: 640-2. [Crossref]

10. Seshamani M, Vogtmann E, Gatwood J, Gibson TB, Scanlon D. Prevalence of complications from adult tonsillectomy and impact on health care expenditures. Otolaryngol Head Neck Surg. 2014; 150: 574-81. [Crossref]

11. Myssiorek D, Alvi A. Post-tonsillectomy hemorrhage: an assessment of risk factors. Int J Pediatr Otorhinolaryngol. 1996; 37: 35-43. [Crossref]

12. Alexander RJ, Kukreja R, Ford GR. Secondary post-tonsillectomy haemorrhage and informed consent. J Laryngol Otol. 2004; 118: 937-40. [Crossref]

13. Tomkinson A, Harrison W, Owens D, Harris S, McClure V, Temple M. Risk factors for postoperative hemorrhage following tonsillectomy. Laryngoscope. 2011; 121: 279-88. [Crossref]

14. Lowe D, van der Meulen J, Cromwell D, Lewsey J, Copley L, Browne J, et al. Key messages from the national prospective tonsillectomy audit. Laryngoscope. 2007; 117: 717-24. [Crossref]

15. Windfuhr JP, Chen YS, Remmert S. Hemorrhage following tonsillectomy and adenoidectomy in 15,218 patients. Otolaryngol Head Neck Surg. 2005; 132: 281-6. [Crossref]

16. Gonçalves AI, Rato C, de Vilhena D, Duarte D, Lopes G, Trigueiros N. Evaluation of post-tonsillectomy hemorrhage and assessment of risk factors. Eur Arch Otorhinolaryngol. 2020; 277: 3095-102. [Crossref]

17. Hsueh WY, Hsu WC, Ko JY, Yeh TH, Lee CH, Kang KT. Postoperative hemorrhage following tonsillectomy in adults: analysis of population-based inpatient cohort in Taiwan. Auris Nasus Larynx. 2019; 46: 397-406. [Crossref]

18. Ikoma R, Sakane S, Niwa K, Kanetaka S, Kawano T, Oridate N. Risk factors for post-tonsillectomy hemorrhage. Auris Nasus Larynx. 2014; 41: 376-9. [Crossref]

19. Inuzuka Y, Mizutari K, Kamide D, Sato M, Shiotani A. Risk factors of post-tonsillectomy hemorrhage in adults. Laryngoscope Investig Otolaryngol. 2020; 5: 1056-62. [Crossref]

20. Johnson RF, Beams DR, Zaniletti I, Chorney SR, Kou YF, Lenes-Voit F, et al. Estimated probability distribution of bleeding after pediatric tonsillectomy: a retrospective national cohort study of US children. JAMA Otolaryngol Head Neck Surg. 2023; 149: 431-8. [Crossref]