Received: 30 June 2020 | Revised: 25 September 2020 | Accepted: 23 October 2020

DOI: 10.1002/lio2.488

ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Risk factors of post-tonsillectomy hemorrhage in adults

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Abstract

Objective: Tonsillectomy is an essential surgery and is conducted on both children and adults. However, the risk factors of post-tonsillectomy hemorrhage for adult patients remain unclear. In this study, we analyzed post-tonsillectomy hemorrhage in adult patients.

Methods: We retrospectively analyzed 325 adult patients who underwent a tonsillectomy between 2014 and 2018 in our facilities.

Results: The average age of this study's population was 31.7 ± 10.5 years (range: 19-70 years), and 250 (76.9%) patients were male. Overall, post-tonsillectomy hemorrhage occurred in 71 (21.8%) patients and 5 (1.5%) patients required a second surgery for hemostasis. Post-tonsillectomy hemorrhage often occurred on postoperative day zero or six. Using multiple logistic regression analysis, current smoking status (odds ratio 3.491; 95% confidence interval 1.813-6.723), male sex (odds ratio 3.924; 95% confidence interval 1.548-9.944), and perioperative non-steroidal anti-inflammatory drug administration (odds ratio 7.930; 95% confidence interval 1.004-62.64) were revealed as overall post-tonsillectomy hemorrhage risk factors. To analyze the hemorrhage period after tonsillectomy, we categorized the post-tonsillectomy hemorrhage patients into the primary (bleeding within postoperative day one) and secondary hemorrhage (bleeding on or after postoperative day two) groups. The current smoking status and older age were risk factors for primary hemorrhage and the current smoking status and sex (male) were risk factors for secondary hemorrhage.

Conclusions: In this study, smoking status, sex, and perioperative non-steroidal anti-inflammatory drug administration were the clinical risk factors for adult post-tonsillectomy hemorrhage. Thus, smoking cessation is, at least, mandatory for patients who receive tonsillectomy to avoid post-tonsillectomy hemorrhage.

Level of Evidence: 4

KEYWORDS

adult, adult tonsillectomy, postoperative hemorrhage, smoking

1 | INTRODUCTION

Tonsillectomy is a common surgery performed by otolaryngologists worldwide. The procedure is performed in a broad range of age groups, including children and adults. In the United States, 399 000 ambulatory procedures were performed annually and 72.4% were children (<15 years).[1] In contrast, approximately 32 000 tonsillectomies were performed in Japan annually and the proportion of children (<19 years) was 48.2%, based on the National Database of Health Insurance Claims and Specific Health Checkups of Japan released by the Ministry of Health, Labour and Welfare in 2017.[2] These data show that the age distribution of patients receiving tonsillectomy differs across countries.

In the adult population, chronic infection remains the most common indication for tonsillectomy.[3] In contrast, the indications for tonsillectomy in children include sleep-disordered breathing, including obstructive sleep apnea, while watchful waiting is recommended for recurrent throat infection.[4] The criteria for tonsillectomy indication do not differ significantly between adults and children. Thus, the major difference between adults and children is the proportion of patients who do and do not meet the criteria.

Various complications may occur after tonsillectomy, including hemorrhage, infections, pain, nausea, vomiting, and dehydration.[5] Post-tonsillectomy hemorrhage (PTH) is the most critical complication and usually resolves with spontaneous hemostasis. However, surgery can be needed to stop bleeding as PTH can cause airway obstruction, or in rare cases, hemorrhagic shock.[6]

Most research has focused on children and the outcomes of tonsillectomy, including PTH. In a systematic review and meta-analysis of children, the surgical indication was reported as the risk factor of PTH. Children undergoing tonsillectomy for obstructive sleep-disordered breathing had lower rates of overall PTH than children with recurrent infections.[7] Moreover, the studies demonstrated that PTH rates were similar among the various surgical techniques (ie, cold dissection, electrocautery, and coblation). In addition, older age was indicated as a significant risk factor even among children.[8]

There are only a few reports on large populations of adults treated with tonsillectomy.[9-11] Most of the PTH research included both children and adults in their study population and demonstrated a higher PTH rate in older age. However, the risk factors for PTH in adults have not yet been identified.

We hypothesize that risk factors for PTH in adults include lifestyle practices such as smoking, surgical indications, and obesity, amongst others. In this study, we analyzed tonsillectomy exclusively in adult patients to investigate the associated risk factors.

2 | MATERIALS AND METHODS

The study population included adult patients, aged 19 years or older, who underwent a bilateral tonsillectomy at either the National Defense Medical College Hospital or Japan Self-Defense Forces Hospital during a 5-year period from January 2014 to December 2018. The study protocol was approved by the Institutional Review Board of the National Defense Medical College, Saitama, Japan. Written informed consent was obtained from all participants. We obtained the study data from electrical medical records retrospectively. Tonsillectomies with the following indications were included: (1) chronic/recurrent tonsillitis (defined as 3 or more episodes per year for more than 1 year), (2) tonsil hypertrophy impairing normal sleep, (3) obstructive sleep apnea syndrome (SAS) with Apnea-Hypopnea Index 20 or over (patients with AHI less than 20 were provided conservative treatment), and (4) systemic diseases caused by local tonsil inflammation (IgA nephropathy, palmoplantar pustulosis[12,13]). Criteria (2) and (3) occasionally included adenoidectomy and/or uvulopalatopharyngoplasty. We excluded tonsillectomies with a malignant tumor or peritonsillar abscess, or those that were concurrent operations for other head and neck conditions or hematologic disease.

All tonsillectomies were performed under general anesthesia. After intubation, we secured the pharyngeal operation field by Crowe-Davis mouth gag and incised mucosa, released along tonsil capsular by dissector and coagulated by bipolar or monopolar electrocautery. Other electrical or ultrasonic devices were not used. When the bleeding was not stopped by electrocautery, bleeding points were ligated with silk or absorbable sutures. Intravenous antibiotics were administered during and after the operation.

PTH was defined as complaints of pharyngeal hemorrhage, and bleeding or clot on the tonsillar bed confirmed by an otolaryngologist. It was classified into five grades based on Windfuhr's categorization[14] (Table 1). PTH was also categorized according to the period after surgery: primary hemorrhage was defined as bleeding within the postoperative day (POD) 1 and secondary hemorrhage as bleeding at or after POD 2.

Age, sex, obesity (BMI ≥ 25), smoking status, operative time, oral antibiotics after surgery, and types of analgesics were analyzed as the risk factors, as suggested by previous research.[15-18] Smoking status was categorized into never smokers, current smokers (smoking until surgery), and ex-smokers (stopped smoking before surgery). Ex-smokers were defined as patients who had a smoking history but stopped smoking at least 1 month prior to surgery. Oral antibiotics were administered perioperatively for 2 days at the discretion of the surgeon. We used opioids, such as fentanyl and/or remifentanil, during surgery, and non-steroidal anti-inflammatory drugs (NSAIDs) or acetaminophen for postoperative analgesia. Patients administered intravenous or oral NSAIDs once or more were defined as NSAID users; patients who received acetaminophen were defined as acetaminophen users.

TABLE 1 PTH classification based on Windfuhr's categorization of what procedure was done for hemostasis

Grade 1	Bleeding with a spontaneous cessation
Grade 2	Treatment under local anesthesia
Grade 3	Treatment under general anesthesia
Grade 4	Ligation of external carotid artery
Grade 5	Death

We divided patients into the PTH and non-PTH groups. Further, the PTH group was divided into primary hemorrhage and secondary hemorrhage groups. Statistical analyses were performed by the Mann-Whitney *U* test and Fischer's exact test for univariate analysis and multiple logistic regression for multivariate analysis of risk factors. We used JMP Pro14 (SAS Institute Inc, NC) for all analyses.

3 | RESULTS

3.1 | Patients

Charts of 346 adult patients who underwent tonsillectomy were reviewed and 21 were excluded. The reasons for exclusion were immediate tonsillectomies for peritonsillar abscess (eight patients), malignancy (seven patients), concurrent other head and neck surgery (five patients), and hematologic disease (one patient). In total, 325 patients were included in this study. There were 250 (76.9%) men and 75 (23.1%) women, with a mean age of 31.7 ± 10.5 years (range, 19-70 years; median 29 years). Regarding smoking status in male patients, the number of current, ex, and never smokers were 62 (24.8%), 69 (27.6%), and 119 (47.6%), respectively; in female patients, the proportion of smokers were 14 (18.7%), 5 (6.7%), and 62 (82.7%), respectively. The most common indication for surgery was chronic/recurrent tonsillitis (n = 240, 73.8%), followed by tonsillar focal infections (n = 48, 14.8%), IgA nephropathy (n = 46, 14.1%), SAS (n = 34, 10.5%), tonsil hypertrophy (n = 3;0.1%), and palmoplantar pustulosis (n = 2, 0.1%). Adenoidectomy was performed in 15 patients (4.6%) and uvulopalatopharyngoplasty was performed in 32 (9.8%) patients with SAS. The mean values of BMI of patients with and without adenoidectomy or UPPP were 25.7 ± 3.8 and 23.8 ± 3.7 kg/m^2, respectively. BMI was significantly higher in patients with adenoidectomy or UPPP (P = .004).

3.2 | Post-tonsillectomy hemorrhage (PTH)

PTH was noted in 71 patients (PTH group) and 254 patients recovered without bleeding (non-PTH group). The overall risk of PTH was 21.8% in this study. In the PTH group, 61 patients (85.9%) were Grade 1, five (7.0%) were Grade 2, and five (7.0%) were Grade 3. Ten patients (3.1%) needed hemostatic procedures (Grade 2 + 3), and five (1.5%) needed additional surgeries under general anesthesia (Grade 3). Of those undergoing tonsillectomy for chronic/recurrent tonsillitis, 55 (22.9%) experienced PTH, compared with those who underwent tonsillectomy for IgA nephropathy and SAS, wherein only seven (15.2%) and nine patients (26.5%) patients, respectively, experienced PTH (Table 2). There was no significant difference between the indications (P = .27, Fischer's exact test). Eight patients (11.3% of PTH) had a primary hemorrhage, and 63 patients (88.7%) had a secondary hemorrhage. There were two peaks of the number of PTH patients on POD 0 and 6 (Figure 1). We observed PTH at more than 2 weeks after surgery, but all PTH episodes occurred within 16 days of primary operations. Hemostasis resolved bleeding in all PTH patients.

3.3 | Risk factors of PTH

The risk factors of PTH were analyzed by univariate analysis, comparing the overall PTH, primary hemorrhage, secondary hemorrhage groups to the non-PTH group (Table 3). For every group (overall PTH, primary hemorrhage, secondary hemorrhage), the smoking status was significantly different from that of the non-PTH group (P < .001, P = .03, P < .001, respectively). The proportion of men was significantly higher in the overall PTH and secondary hemorrhage groups (P < .001, P = .003, respectively) than in the non-PTH group. Moreover, the average age was significantly higher in the primary hemorrhage group (P = .004). Other factors, such as obesity, operative time, postoperative oral antibiotics, and NSAID administration did not differ significantly.

We then calculated the odds ratios (ORs) for the above factors using multiple logistic regression analysis (Table 4). Current smokers were compared to never smokers (OR = 3.49; 95% confidence interval [CI] 1.81-6.72; P < .001) and ex-smokers (OR = 3.47; 95% CI 1.59-7.58; P = .002). We found a significant association between PTH and male sex (OR = 3.92; 95% CI 1.55-9.94: P = .04). Furthermore, perioperative NSAID administration was a significant risk factor compared to acetaminophen administration (OR = 7.93; 95% CI 1.004-62.64; P = .0496).

TABLE 2 Number of patients undergone tonsillectomy and the overall PTH, primary hemorrhage, and secondary hemorrhage

Indication	No. of patients	Overall PTH n (%)	Primary hemorrhage n (%)	Secondary hemorrhage n (%)
Chronic/recurrent tonsillitis	240	55 (22.9)	6 (2.5)	49 (20.4)
Tonsillar focal infections				
IgA nephropathy	46	7 (15.2)	1 (2.2)	6 (13.0)
Palmoplantar pustulosis	2	0 (0)	0 (0)	0 (0)
SAS	34	9 (26.5)	1 (2.9)	8 (23.5)
Tonsil hypertrophy	3	0 (0)	0 (0)	0 (0)
Total	325	71 (21.8)	8 (2.5)	63 (19.4)

Abbreviation: SAS, sleep apnea syndrome.

In the primary hemorrhage group, current smokers, compared to never smokers (OR = 7.24; 95% CI 1.03-50.91; P = .047) and ex-smokers (OR = 9.80; 95% CI 1.12-85.83; P = .04), and older age (OR = 1.14; 95% CI 1.05-1.25; P = .003) were the significant risk factors. Male sex (OR = 3.54; 95% CI 1.39-8.98; P = .008) and current smokers compared to never smokers (OR = 3.32; 95% CI 1.68-6.58; P < .001) and ex-smokers (OR = 3.22; 95% CI 1.48-7.33; P = .005) were significant risk factors in the secondary hemorrhage group.

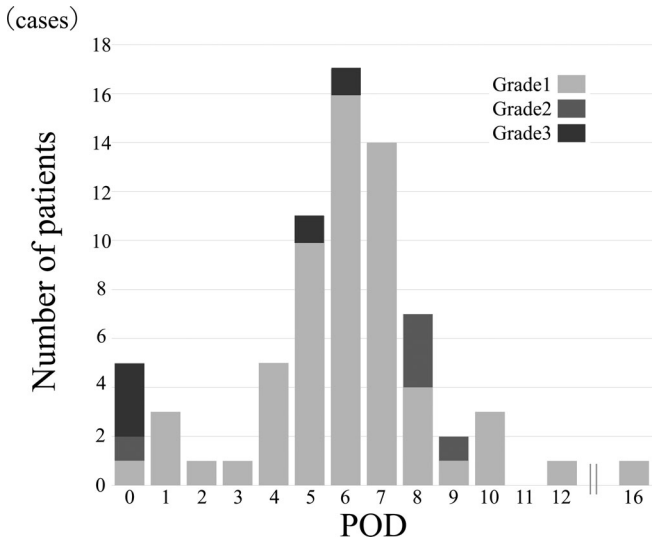

FIGURE 1 Periods and categories of PTH. Among the 71 patients, eight had primary hemorrhage, and 63 had secondary hemorrhage. There were two peaks of frequency on postoperative days 0 and 6

4 | DISCUSSION

This retrospective study on adult tonsillectomy identified smoking status, male sex, and perioperative NSAID administration as independent risk factors of PTH. Current smokers were shown to be at an increased risk for overall PTH, primary hemorrhage, and secondary hemorrhage. Smoking status has been reported to be a dependent risk factor of PTH for adult tonsillectomy in previous studies.[19-21] However, these studies did not mention the association of non-smoking duration for PTH. In the present study, we demonstrated that being an ex-smoker, including a cessation time within 1 month before surgery, did not increase the risk for PTH compared to never smokers. Smoking causes worsening of tonsillar infection and inflammation and prevents healing of the wound in tonsillar beds, both of which are associated with an increased occurrence of PTH.[22] In addition, smoking increases the number of goblet cells in the peripheral airway epithelium,[23] and smokers have a significantly increased intraoperative sputum volume

TABLE 3 The clinical data for patients of the non-PTH, primary hemorrhage, and secondary hemorrhage groups

	Non-PTH (n = 254)	PTH (n = 71)	*P* value	Primary hemorrhage (n = 8)	*P* value	Secondary hemorrhage (n = 63)	*P* value
Age							
(Average, year old)	31.5	32.6	.48	43.9	.004**	31.1	.85
Sex							
Male	185	65	<.001***	8	.12	57	.003**
Female	69	6		0		6	
BMI							
≧25	85	23	1.00	4	.45	19	.66
<25	169	48		4		44	
Smoking status							
Current	41	29	<.001***	4	.03*	25	<.001***
Ex	59	15		2		13	
Never	154	27		2		25	
Operative time (average, min)	78.2	77.1	.97	63.9	.16	78.8	.62
Postoperative antibiotics							
Continued orally	186	49	0.55	6	1.00	43	.44
Only injection	68	22		2		20	
Analgesia							
NSAIDs	226	70	0.06	8	1.00	62	.14
Acetaminophen	20	1		0		1	

Note: *P*-values demonstrate the results of univariate analysis compared to the non-PTH group.
Abbreviation: NSAIDs, non-steroidal anti-inflammatory drugs.
*P < .05.**P < .01.***P < .001.

TABLE 4 Multiple logistic regression analysis for risk factors of overall PTH, primary hemorrhage, and secondary hemorrhage

	PTH (n = 71)		Primary hemorrhage (n = 8)		Secondary hemorrhage (n = 63)	
Factor	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P*-value
Age	1.02 (0.99-1.05)	0.24	1.14 (1.05–1.25)	0.003**	1.00 (0.97-1.04)	0.79
Male gender	3.92 (1.55–9.94)	0.004**	—	—	3.54 (1.39–8.98)	0.008**
Obesity	0.64 (0.34-1.22)	0.17	0.55 (0.09-3.26)	0.51	0.62 (0.31-1.22)	0.16
Smoking: current vs never	3.49 (1.81–6.72)	<0.001***	7.24 (1.03–50.91)	0.047*	3.32 (1.68–6.58)	<0.001***
Smoking: current vs ex	3.47 (1.59–7.58)	0.002**	9.80 (1.12–85.83)	0.04*	3.22 (1.42-7.33)	0.005**
Smoking: ex vs never	1.01 (0.48-2.12)	0.99	0.74 (0.08-6.73)	0.79	1.03 (0.47-2.25)	0.94
Operative time	1.00 (0.99-1.01)	0.72	0.97 (0.94-1.01)	0.13	1.00 (0.99-1.01)	0.89
Antibiotics	0.84 (0.45-1.55)	0.57	0.96 (0.16-5.73)	0.97	0.82 (0.43-1.56)	0.55
Analgesia: NSAIDs	7.93 (1.004–62.64)	0.0496*	—	—	6.94 (0.87-55.39)	0.07

Abbreviation: NSAIDs, non-steroidal anti-inflammatory drugs.
*P < .05.**P < .01.***P < .001.

compared to the non-smokers.[24] It may lead to strong coughing after tonsillectomy, thereby causing hemorrhage. Therefore, it is critically important that surgeons strongly encourage adult patients for tonsillectomy stop smoking before surgery.

Sex is a significant risk factor of overall PTH and secondary hemorrhage, with men at an increased risk. Some earlier studies reporting on the role of sex and PTH found the same results. One possible explanation is the effect of estrogen on wound healing and its anti-inflammatory role.[25] In contrast, sex was not found to be a risk factor for PTH in children.[7,8] There are no differences in terms of sex hormones in children before puberty, which may support the estrogen hypothesis. Another research group reported a retrospective study, which found that men had significantly more regular alcohol consumption than women, resulting in an increased risk of complications from bacterial infections, including peritonsillar abscess, thereby increasing the incidence of PTH (hazard ratio 2, confidence interval 1.1-3.8).[26] Furthermore, there was a higher proportion of current smokers in male than in female patients (24.8% vs 18.7%). Smoking might be influenced significantly in male patients, but both male patients and smoking status were independent risk factors for PTH in multivariate analysis. Therefore, not only smoking status but also the sex of a patient, as mentioned above, could be correlated with PTH.

We also found that age was an independent risk factor of primary hemorrhage. Inflammation of tonsils tends to occur for longer periods in older patients,[8] which may explain this result. Also, aging may be associated with frail blood vessels, which may be related to bleeding in the short duration after surgery.

NSAID administration increases the overall PTH risk significantly. Some studies have demonstrated that NSAIDs increase PTH incidence because of the antiplatelet action caused by blocking cyclooxygenase.[27] One group reported that NSAIDs significantly increased the surgical treatment for PTH,[28] but another group found that it was not a risk factor of overall PTH and surgical intervention.[29] Thus, there is no consensus about NSAID administration being associated with PTH. The current study supports the notion that NSAID administration is a risk factor of PTH.

Obesity (BMI≥25), duration of operation, and oral antibiotics after surgery were not significant risk factors of PTH in this study. In our study, chronic/recurrent tonsillitis was the most common indication for tonsillectomy (73.8% of overall). In the adult population, the recurrence of tonsillitis causes repeated absences from work, resulting in more patients requesting tonsillectomy. There were also more male and younger adults included in this study, compared to preceding studies targeting adult tonsillectomy.[3,30] Our facilities operate under the Ministry of Defense and the patient population has a high proportion of uniformed young male military officials, which may explain this finding.

Previous reports link increasing postoperative bleeding in chronic tonsillitis patients to prolonged inflammation.[8,16] This study did not show a significant difference in indications. Though patients did not complain of tonsillitis, tonsils might have subclinical inflammation. Several reports support this hypothesis. Kim et al demonstrated that pro-inflammatory cytokines were highly expressed in the tonsils of OSA patients.[31] Tonsilloliths contain a biofilm structure with a slight inflammation[32] and occur more frequently in adults.[33] However, patients with tonsilloliths are usually asymptomatic and are diagnosed incidentally.[34] In addition, our choice of a study population with adult patients suggests that inflammation of tonsils would occur concurrently with other significant risk factors, such as smoking. Therefore, we could not demonstrate that tonsillectomy indication was indeed a significant risk factor for PTH.

The proportion of PTH grades in this study was 21.8% for Grade 1-3 and 1.5% for Grade 3. Previous studies found that overall PTH incidence ranged from 2.2 to 10%, and PTH was treated surgically in 1 to 6% of cases.[17,30,35] We observed a slightly higher rate of overall PTH than in previous studies. Regarding the management of perioperative term, patients with tonsillectomy are admitted for about 1 week in Japan whereas most patients are admitted for only a few days in other countries.[17,30] Patients with minor hemorrhage and spontaneous hemostasis may not be monitored by medical personnel. Thus, bleeding cases may have been underestimated in previous research. Our findings were consistent with other studies that reported the

proportion of PTH in adults ranging from 14.5% to 20.3%.[16,36] The proportion of cases needing surgical intervention (Grade 3) and the distribution of PTH cases by POD were equivalent to those in previous research.[15,16] The rate of primary hemorrhage was 11.3% of PTH patients in this study, compared with 9.0% to 22.6% in prior studies, so that our study demonstrated the similar proportions of primary and secondary hemorrhage.[16,17,36,37]

The limitation of this study was that we did not investigate other risk factors reported in previous studies, such as the use of power devices (ie, hot instrument vs cold surgery), the modality of devices,[38] other patient characteristics such as hypertension and diabetes mellitus which were not included in our study design, and the experience of the otolaryngologist.[8,9,39] Therefore, such associations may not be represented in our study. Furthermore, our study design had a predominantly young and male population. We evaluated the risk factors using multivariate analysis, but there might be an effect of that difference. To determine the accurate PTH risk in adult patients and accordingly manage the clinical procedures, a prospective research study including larger and more uniform populations is necessary.

5 | CONCLUSION

In this study, we examined bleeding after tonsillectomy in adults and analyzed the risk factors of PTH. We found that smoking status, male sex, and perioperative NSAID administration were significant risk factors of PTH. The rate of PTH occurrence in the adult population is higher than that in children, but the majority of PTH were self-limited. Conclusively, surgeons should strongly encourage patients to stop smoking before tonsillectomy because, as a modifiable risk factor, current smoking is strongly associated with PTH.

CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

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How to cite this article: Inuzuka Y, Mizutari K, Kamide D, Sato M, Shiotani A. Risk factors of post-tonsillectomy hemorrhage in adults. *Laryngoscope Investigative Otolaryngology*. 2020;5:1056–1062. https://doi.org/10.1002/lio2.488