A Retrospective Analysis of Peroperative Risk Factors Associated with Posttonsillectomy Reactionary Hemorrhage in a Teaching Hospital

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Abstract

Introduction Tonsillectomy is one of the most common otolaryngology procedures performed worldwide. It is also one of the first procedures learnt by residents during their training period. Although tonsillectomy is viewed relatively as a low-risk procedure, it can be potentially harmful because of the chance of posttonsillectomy hemorrhage.

Objective The objective of the present study is to analyze the effects of peroperative factors and experience of the surgeon on the incidence and pattern of posttonsillectomy reactionary hemorrhage.

Methods A retrospective review of medical charts was performed from 2014 to 2017 in a tertiary care hospital. A total of 1,284 patients who underwent tonsillectomy and adenoidectomy were included in the study. The parameters assessed were experience of the surgeon, operating time, intraoperative blood loss, difference in mean arterial pressure (MAP) and pulse rate.

Results A total of 23 (1.79%) out of the 1,284 patients had reactionary hemorrhage. Out of those 23, 16 (69.5%) patients had been operated on by trainees, while 7 (30.5%) had been operated on by consultants ($p = 0.033$, odds ratio [OR] = 0.04). Operating time, intraoperative blood loss, difference in MAP and pulse rate were significantly higher in the reactionary hemorrhage group, and showed a positive association with risk of hemorrhage ($p < 0.05$; OR >1). Re-exploration to control the bleeding was required in 10 (76.9%) out of the 23 cases.

Conclusion The experience of the surgeon experience and peroperative factors have an association with posttonsillectomy hemorrhage. Close surveillance and monitoring of the aforementioned peroperative factors will help in the identification of patients at risk of hemorrhage.

Keywords
► tonsillectomy
► reactionary hemorrhage
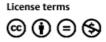► peroperative risk factors
► hemorrhage

Introduction

Tonsillectomy is one of the most common otolaryngology procedures performed worldwide. It is also one of the first procedures learnt by residents during their training period. Though technical advances and better instruments have led to the development of new surgical techniques, the cold steel (dissection and snare) method still remains the simplest and most common method performed.[1]

Although tonsillectomy is viewed relatively as a low-risk procedure, it can be potentially harmful because of the chances of posttonsillectomy hemorrhage (PTH),[2] which

can be classified as primary (within 24 hours) and secondary ($>$ 24 hours). Some authors use the term reactionary hemorrhage (RH) for primary PTH. Though the incidence of PTH varies widely in the literature, there is no specific criteria established to define it.[3,4] The presentation of PTH varies from blood-stained sputum to frank bleeding per oral leading to hemodynamic instability, hypovolemic shock and death. In the literature, increasing age, the male gender, the inexperience of the surgeons, recurrent tonsillitis and hot tonsillectomy techniques have been described as risk factors for bleeding in the postoperative period.[5–9]

Most of the studies in the past have described either secondary hemorrhage or PTH, and were more focused on preoperative factors. As in the literature there are only a few studies available focused on RH and peroperative factors, the present study was designed to evaluate the significance of peroperative factors with the incidence of RH. Peroperative factors include the experience of the surgeon, the technique, the total operating time, the estimated blood loss, the immediate postoperative blood pressure, and the pulse rate values.[10] As the operating time depends on the experience acquired during training, a separate analysis of the relationship between procedures performed by trainees and consultants with the incidence of RH would be more accurate. To eliminate the bias due to various etiologies and the technique used to perform the tonsillectomy, the authors have analyzed the incidence of hemorrhage only in the patients operated for chronic and recurrent acute tonsillitis by the cold steel method. The objective of the present study is to evaluate and compare the peroperative factors affecting the incidence and outcomes of reactionary PTH in a teaching hospital.

Method

A retrospective review of the medical records of all patients who underwent tonsillectomy with or without adenoidectomy in a tertiary care hospital from January 2014 to December 2017 was undertaken. The medical records of a total of 1,284 patients who underwent cold steel tonsillectomy (dissection and snare method) for chronic and/or recurrent acute tonsillitis were analyzed. Out of the 1,284 patients, 23 (1.79%) had presented with RH. The definition of RH used in the present study was patients with either static or progressive hematoma and/or active bleeding from the tonsillar fossa. Patients with history of bleeding per oral, blood-stained saliva, hemoptysis and hematemesis without signs of bleeding were excluded from the study.

Patients who underwent adenotonsillectomy for other indications and by other techniques were excluded. Moreover, patients presenting with postoperative hemorrhage from the adenoidectomy site and secondary hemorrhage ($>$ 24 hours) were excluded. Patients with abnormal preoperative hemoglobin and clotting values were also excluded.

The data analyzed included age, total operating time, experience of the surgeon, pre- and immediate postoperative pulse rate and mean arterial pressure (MAP), pattern of reactionary hemorrhage and mode of intervention.

The preoperative blood pressure and the pulse rate were taken in the preoperative holding room, while the postoperative values were taken in the postanesthetic recovery room immediately after shifting the patients from the operative room. Then MAP was calculated by using the following formula:

$$MAP = \{(2 \times diastolic\ pressure) + systolic\ pressure\}/\ 3.$$

Then, the difference between the post- and preoperative MAP and the pulse rates were calculated.

The total operating time was defined as the time taken from the application of the surgical drapes to the removal of the mouth gag.

Regarding the experience of the surgeons, they were classified as trainees or consultants. All of the trainees had observed and assisted at least 10 tonsillectomies before being allowed to perform surgery under supervision.

Depending on the pattern of presentation, the hemorrhage was classified as quiescent or active.

Patients with a non-progressive clot in the tonsillar fossa were classified as quiescent, while those with an active bleeding site or a progressive increase in clot size were classified as active.

The mode of intervention was classified as observation or exploration. The observation group was composed of patients who were treated successfully by conservative measures with hydrogen peroxide oral gargles (dilution of 1:4) periodically and adrenaline cottonoids in the tonsillar fossa.

The exploration group included the patients for whom the conservative approach failed and/or patients with hemodynamic instability who were taken for exploration of the tonsillar fossa under general anesthesia.

Statistical Analysis

The collected data was inserted into Excel (Microsoft Corp. Redmond, WA, US) spreadsheets and analyzed and evaluated statistically using the Statistical Package for the Social Sciences (SPSS, SPSS Inc., Chicago, IL, US) software, version 17.0. The quantitative data was expressed as means and standard deviations, while the qualitative data was expressed as percentages with a confidence interval (CI). A multiple logistic regression analysis was performed to find out the significance of the association between the various peroperative factors and PTH. The odds ratio (OR) was calculated and values of $p < 0.05$ were considered statistically significant.

Results

A total of 1,284 patients who underwent tonsillectomy by the dissection and snare method were analyzed. Bipolar diathermy and suture ligation were the hemostatic methods used.

In total, 23 (1.79%) patients who met the criteria for RH were included in the RH group. The rest of the patients were categorized as the non-RH (NRH) group.

Out of these 23 patients, 11 (47.82%) were male, and 12 (52.18%) were female; 17 were aged ≤ 18 years, and 6 were aged > 18 years. The authors couldn't find statistical significance in the incidence of RH with respect to age and sex (►**Table 1**).

Table 1 Comparison between the reactionary and non-reactionary hemorrhage groups with respect to sex and age

Parameter	Reactionary hemorrhage group	Non-reactionary hemorrhage group	p-value
Sample	23	1,261	
Male:Female ratio	11:12	564:697	0.767
Age ratio (< 18:> 18 years)	17: 6	753:508	0.998

Out of the total of 1,284 patients, 705 (54.9%) were operated on by trainees, and 579 (45.1%), by consultants.

A total of 16 (69.5%) out of the 23 patients in the RH group were operated on by trainees, while the remaining 7 (30.5%), by consultants ($p = 0.03$). The OR was of 0.04 (CI = 0.002–0.778), which is suggestive of a negative association between experience and RH.

Operating Time

The overall (trainees and consultants) mean operating time for the RH and NRH groups was of 45.26 ± 6.47 and 34.32 ± 9.75 minutes respectively ($p = 0.000$). The mean operating time for the trainees in the RH and NRH groups was of 47.73 ± 5.44 and 38.63 ± 8.46 minutes respectively ($p = 0.000$). Similarly, the mean operating time for the consultants in the RH and NRH groups was of 45.26 ± 6.47 and 34.32 ± 9.75 minutes respectively ($p = 0.001$). This shows that, irrespective of the experience of the surgeon, the operating time in the RH group was significantly higher than in the NRH group; this proves that a higher operating time is associated with higher chances of RH ($p = 0.014$; OR = 1.213 [CI = 1.040–1.415]). Further comparisons were made between trainees and consultants in both patient groups separately. The p-value was of 0.003 and 0.0001 for the RH and NRH groups respectively, which proves that the operating time in the procedures performed by trainees was significantly higher than that for the procedures performed by consultants in both groups.

Intraoperative Blood Loss (IBL)

The overall mean blood loss in the RH and NRH groups was of 99.78 ± 14.96 and 50.33 ± 21.89 mL respectively ($p = 0.000$). The mean blood loss in the procedures performed by the trainees in the RH and NRH groups was of 100.94 ± 13.9 and 58.88 ± 22.06 mL respectively. ($p = 0.000$). Regarding those performed by consultants, it was of 97.14 ± 17.9 and 40.03 ± 16.62 mL for the RH and NRH groups respectively ($p = 0.000$). This proves that the IBL was significantly higher in the RH group, and had a positive association ($p = 0.001$; OR = 1.144 [CI = 1.054–1.242]) with risk of hemorrhage. Further analyses between the procedures performed by trainees and consultants showed no significant association with risk of hemorrhage in the RH group ($p = 0.588$), while the NRH group presented a significant association ($p = 0.0001$).

Difference in Mean Arterial Pressure (MAP)

The overall mean difference in MAP between the RH and NRH groups was of 22.01 ± 5.23 mmHg and 12.33 ± 5.27 mmHg respectively ($p = 0.000$). Regarding the procedures performed by trainees, it was of 22.47 ± 5.56 mmHg and 12.25 ± 5.15 mmHg respectively ($p = 000$), and, for those performed by consultants, it was of 20.97 ± 4.59 mmHg and 12.43 ± 5.42 mmHg respectively ($p = 0.000$). The results showed that the difference in MAP was significantly higher in the RH group and had a positive association with risk of hemorrhage ($p = 0.020$, OR = 1.354 [CI = 1.048–1.749]). Further comparisons between the procedures performed by trainees and consultants showed no significant association with risk of hemorrhage in the RH ($p = 0.538$) and NRH groups ($p = 0.546$).

Difference in Pulse Rate

The overall mean difference in pulse rate between the RH and NRH groups was of 26.96 ± 7.43 per minute and 11.02 ± 7.39 per minute respectively ($p = 0.000$). For the procedures performed by trainees, it was of 28.62 ± 6.89 per minute and 10.8 ± 6.89 per minute respectively ($p = 0.000$). For those performed by consultants, it was of 23.14 ± 7.71 per minute and 11.28 ± 8.17 per minute respectively ($p = 0.000$). These results suggest that the difference in pulse rate was significantly higher in the RH group and had a positive association with risk of hemorrhage ($p = 0.002$, OR = 1.210 [CI = 1.075–1.362]). Further comparisons between the procedures performed by trainees and consultants showed no significant association with risk of hemorrhage in the RH ($p = 0.105$) and NRH groups ($p = 0.256$).

The aforementioned results have been summarized in ►**Table 2**.

Pattern of Presentation and Management of Reactionary Hemorrhage

In the RH group, 10 (43.4%) out of 23 patients presented with quiescent bleeding, and the remaining 13 (56.6%) patients presented with active bleeding.

Out of the 13 patients with active bleeding, 3 (23.1%) were managed with conservative measures, and 10 (76.9%) needed emergency exploration under general anesthesia and control of bleeding.

Out of these 10 patients who required exploration, 7 (70%) were operated on by trainees, and 3 (30%), by consultants.

All of the patients with quiescent bleeding were managed conservatively.

The most common site of bleeding was the superior pole (65.2%), followed by the lower pole (28%), and the tonsillar fossa (8.7%).

Tonsillar remnants were the source of bleeding in 5 (21.7%) out of 23 patients, while superior constrictor and mucosal tears were the source in the remaining 18 (78.3%) patients.

Discussion

Posttonsillectomy bleeding is one of the potential life-threatening complications an otolaryngologist might face in the clinical practice. Though hemodynamic instability and

Table 2 Comparison of various intraoperative factors between the study groups

	Reactionary hemorrhage group	Non-reactionary hemorrhage group	Association with posttonsillectomy hemorrhage
Mean operating time			
Trainees	47.73 ± 5.44	38.63 ± 8.46	$p = 0.014$, OR = 1.213 (CI = 1.040–1.415)
Consultants	39.68 ± 4.89	29.17 ± 8.64	
Overall	45.26 ± 6.47	34.32 ± 9.75	
p-value (trainees versus consultants)	0.003	0.0001	
Mean intraoperative blood loss (mL)			
Trainees	100.94 ± 13.9	58.88 ± 22.06	$p = 0.001$, OR = 1.144 (CI = 1.054–1.242)
Consultants	97.14 ± 17.9	40.03 ± 16.62	
Overall	99.78 ± 14.96	50.33 ± 21.89	
p-value (trainees versus consultants)	0.588	0.0001	
Difference in MAP (mmHg)			
Trainees	22.47 ± 5.56	12.25 ± 5.15	$p = 0.020$, OR = 1.354 (CI = 1.048–1.749)
Cconsultants	20.97 ± 4.59	12.43 ± 5.42	
Overall	22.01 ± 5.23	12.33 ± 5.27	
p-value (trainees versus consultants)	0.538	0.546	
Difference in pulse rate (per minute)			
Trainees	28.62 ± 6.89	10.80 ± 6.68	$p = 0.002$, OR = 1.210 (CI = 1.075–1.362)
Consultants	23.14 ± 7.71	11.28 ± 8.17	
Overall	26.96 ± 7.43	11.02 ± 7.39	
p-value (trainees versus consultants)	0.105	0.256	

Abbreviations: CI, confidence interval; MAP, mean arterial pressure; OR, odds ratio.

aspiration following PTH can occur in both RH and secondary hemorrhage, RH is considered more dangerous than secondary hemorrhage, as it occurs when the patient's responsiveness and protective airway reflexes are blunted by the postanesthetic and narcotic effects. Moreover, RH is more profuse and sudden in its onset.[10] Though there are various causes for RH, such as slipping of ligature knots, dislodgement of a blood clot, rebound hypertension in the immediate postanesthetic recovery period, and incomplete hemostasis during surgery, there is a continuing debate on the validity of these factors, thanks to the modern anesthetic and technical advancements.

Though hypotensive anesthesia may decrease intra-operative bleeding, it makes the identification of small bleeding points difficult. This bleeding may occur in the immediate postanesthetic period due to rebound hypertension, and it could be avoided by the re-inspection of the surgical site after raising the MAP to its original preoperative value.

Windfuhr[8] conducted a meta-analysis and reported that the rate of PTH varies from 0.3 to 10%.[8] Though the incidence of RH was not calculated separately, the overall incidence varied considerably across studies because of different study designs, follow-up periods and definitions of postoperative bleeding. Hence, a clear definition and standardization of postoperative bleeding is required.

Comparison with Previous Studies

In the present study, the incidence of RH was of 1.79%, which is lower than the rates described by Windfuhr and Chen[9] and Tami et al.[10] However, we have to consider that the definition of PTH provided in those studies was different.

In the present study, the incidence rates of RH in the procedures performed by trainees was higher than in those performed by consultants, and was statistically significant. This result is similar to those of a few studies in the literature that have described a significant higher incidence of PTH and re-exploration rates in procedures performed by trainees. The reason for these higher incidence rates could be attributed to the learning curve associated with trainees. Hinton-Bayre et al[11] found that there was no significant difference in RH rates, but the procedures performed by trainees had significantly higher rates of secondary hemorrhage and return to the operation theater.[11] Harju and Numminen[12] and Tomkinson et al,[5] reported a higher incidence of PTH in the procedures performed by trainees compared with those performed by consultants, irrespective of the day of the onset of the hemorrhage. But none of these studies analyzed the validity of intraoperative risk factors associated with the experience of the surgeon.

Given the fact that most cases of RH occur within 6 hours of surgery, the possibility of incomplete primary hemostasis as the main cause could not be ruled out. The parameters which

might be affected due to incomplete hemostasis include delay in the operating time, high IBL, and hemodynamic changes like those in arterial pressure and pulse rate.

The cold steel tonsillectomy technique is quite simple and cost-effective when compared with hot tonsillectomies. The most important step in this technique is finding the right plane between the capsule and the superior constrictor muscle, which is relatively avascular. Dissection in the wrong plane may traumatize the tonsillar parenchyma or the superior constrictor muscle, causing more bleeding, making further dissection difficult, as well as the achievement of hemostasis at the end. This could possibly explain the prolonged operating time and higher blood loss in the RH group compared with the total sample. However, the bias due to the learning curve of trainees and intraoperative bleeding from adenoidectomy affecting the total operating time and blood loss could not be ruled out.

Canter and Rogers[13] evaluated the routine use of pulse rate monitoring in the postoperative period. However, they couldn't find any significant association between increased pulse and postoperative bleeding.[13] Basjrah et al[14] evaluated the anxiolytic and hemostatic role of beta blockers in tonsillectomies. They found a significant decrease in the incidence of postoperative bleeding. However, in their study, the sample size was quite small.[14] Postoperative hypertension following surgery could be due to postoperative pain, anesthetic drugs or emotional instability. Although the pharmacological drugs that control blood pressure and pulse rate might decrease the chances of PTH, there is no direct evidence to support such a conclusion. The results of the present study support the concept proposed by Canter and Rogers,[13] as we have observed that the differences in MAP and pulse rate were significantly higher in the RH group, thus proving that these patients have a predisposition to PTH.

In the RH group in the present study, 10 (43.4%) patients required surgical exploration to control bleeding. This is high when compared with the rates reported by Whelan at al.[15] The authors assume that the increased rate of exploration is due to the definition criteria of RH used in the present study, in which only active and quiescent bleeders were included, excluding inactive bleeders.

Limitations and Recommendations

The small sample size in the RH group is an obvious limitation of the present study. However, the fact that the authors have excluded hemorrhage due to other causes and techniques for the purpose of a better standardization of the results must be considered. The authors therefore recommend a longer study for a better analysis of the incidence and pattern of RH with respect to each technique and indication.

Conclusion

The rate of RH after tonsillectomy was similar in the procedures performed by trainees and consultants in the present study. Operating time, total blood loss, changes in MAP and pulse rate were significantly higher in the RH group compared with the NRH group. Hence, close surveillance and

monitoring of these peroperative risk factors will help in the identification of patients prone to RH, thereby avoiding unnecessary morbidity and possible re-exploration.

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