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Journal of Otolaryngology Research

RESEARCH ARTICLE

ISSN: 2638-3616

Seasonal Variation Effect on the Incidence of Secondary Post-Tonsillectomy Bleeding in Saudi Arabia: A Tertiary Centre Experience

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Citation: Alobaid F, Alhuthaily K, Arafat A, Alhazmi B, Almegbel M, et al. (2019) Seasonal Variation Effect on the Incidence of Secondary Post-Tonsillectomy Bleeding in Saudi Arabia: A Tertiary Centre Experience. J Otolaryngol Res 2: 201

Abstract

Introduction: Tonsillectomy is a surgical procedure performed to excise the palatine tonsils. It is currently one of the most commonly performed procedures for children in the United States. Secondary post-tonsillectomy bleeding (SPTB) is a known and serious complication of tonsillectomy. Previous studies have suggested an increase incidence of SPTB depending on the season during which the surgery was performed. Herein, we aimed to determine the seasonal variation of SPTB.

Methods: A retrospective cohort study was conducted in a tertiary hospital in the central region of Saudi Arabia. Patients with no prior medical history, (2 to 47 years of age) who underwent tonsillectomy in our hospital during the period from 2012 to 2014 were included in our study. We assessed patient age and gender, the surgical technique used (cold or hot dissection), and the season of the year in which the surgery was done. Numbers and percentages were used to describe the data. The χ^2 test and Fisher's exact test were used to compare categorical variables; the z-test was used for one-sample test of proportions.

Results: Five-hundred fourteen patients underwent tonsillectomies; Four-hundred and eighty-one (93.6%) patients were in the paediatric age group (≤ 14 years of age), while thirty-three (6.4%) were adults (> 14 years of age). In total, fifteen patients (3%) developed SPTB. There were no significant differences in the rates of SPTB among the 4 seasons of the year; no other variables revealed statistically significant correlations.

Conclusion: Seasonal variation does not significantly affect the rate of SPTB.

Keywords: Secondary Post-tonsillectomy Bleeding; Tonsillectomy; Seasonal Variation; Saudi Arabia

Introduction

Tonsillectomy is a surgical procedure performed to excise the palatine tonsils, which comprise lymphoid tissue found in the lateral wall of the oropharynx [1,2]. Recurrent tonsillitis and obstructive sleep apnoea are the most prevalent indications for tonsillectomy in both children and adults [2,3]. The practice guidelines of the American Academy of Otolaryngology – Head and Neck Surgery [4]. Indications for tonsillectomy include: (1) Recurrent tonsillitis (> 7 episodes in the last year, > 5 episodes per year in the each of the last 2 years, or > 3 episodes per year in each of the last 3 years). (2) Enlarged tonsils causing severe upper airway obstruction. (3) A peritonsillar abscess that is not responsive to medication or drainage. 4. A positive test for throat streptococcus infection.

Furthermore, tonsillectomy is currently one of the most commonly performed procedures and has become the third most frequent procedure for children in the United States [4]. Tonsillectomy was first introduced in India in 1000 B.C.E [5]. This procedure was originally performed by removing a portion of a tonsil, but now involves several techniques to remove the entire tonsil along with its capsule [4,6]. The procedure is completed under general anaesthesia as a 1-day surgery, and typically requires 30-40 minutes of operative time [7]. Of the several methods to remove the tonsils, cold-knife (steel) dissection and electrocautery

(electric mono- or bi-polar cautery) are the most commonly utilized instruments [2,3]. More advanced methods include cryosurgery, radiofrequency ablation (co-ablation), Plasma-Knife, and thermal welding [2]. Electrocautery is accomplished by introducing electrical energy to produce heat that separates the tonsil from the surrounding tissue; cold dissection is performed by removing the tonsil with a dissector [3]. Each technique uses a different approach; notably, the choice of the technique is based on instrument availability and the surgeon's proficiency and preference [2].

Although many tonsillectomy techniques are available, the procedure continues to exhibit many post-operative complications [8]. These include pain, haemorrhage, dehydration, and infection [2,4]. Pain and post-operative bleeding are the most commonly reported causes of re-visits. Some studies have reported a stronger association between pain and methods that utilize heat, such as electrocautery, which results in less bleeding; conversely, cold dissection reportedly exhibits a strong association with post-operative bleeding and causes less pain [2,9]. Post-operative bleeding comprises either primary haemorrhage, which occurs within the first 24 hours after surgery, or secondary haemorrhage, which occurs > 24 hours after surgery [2]. The incidence of secondary post-tonsillectomy bleeding (SPTB) requiring hospital admission in the literature ranges from 2 to 10.3% [10]. Many factors have been studied regarding their relationship with the risk of post-procedure bleeding; these include clotting factors, choice of anaesthesia, surgical management, choice of medication after surgery, and even the weather conditions on the day of the operation [11,12]. Seasonal changes have been also associated with pathological changes, such as vasoconstriction, cerebrovascular events and infarction, stroke, and Raynaud's phenomenon [13-15]. For instance, the rate of SPTB was reportedly higher in the warmer months in some studies performed in the United States [16]. Additionally, Chadha performed the largest analysis of post-tonsillectomy bleeding and showed that it is a multifactorial complication, which is affected by month and season: winter and summer both showed high rates of post-tonsillectomy bleeding [17]. However, seasonal variation remains one of the less investigated factors in SPTB. Up to our knowledge, there are no regional studies on the subject and prior studies were conducted in other geographical areas that differ from the climate in the central region of Saudi Arabia, which comprises a dry winter and long dry summer. In this retrospective cohort study, we aimed to characterise the relationship between SPTB and seasonal variation. Since tonsillectomy is mostly performed as an elective procedure, the outcome of this study might be helpful in advising the patients or their families on the optimal time for surgery.

Methods

This retrospective single cohort study was performed to review the effect of seasonal variation on the incidence of SPTB in patients who underwent tonsillectomies in a single tertiary care center during the period from December 2012 to January 2014. As this is a single cohort study, patients who did not develop SPTB were used as internal controls. Cause and effect relationship was possible to assess in this study design as the data were obtained in a chronological pattern. The main variable herein was seasonal variation, but other variables were also assessed. Ethical approval of the study was provided by the institutional review board at the hospital. No formal patient consent was required because the study was performed by chart review.

Sample size was calculated using the following formula [Required sample size = $(\text{Z-score})^2 \times$ standard deviation $\times$ (1-standard deviation)/$(\text{margin of error})^2$] assuming a 95% confidence level, ± 5% confidence interval (margin of error), and a standard deviation of .5 yielding a minimum sample size of 385 patients. All patients operated on for tonsillectomy from December 2012 to January 2014 were included equating for a total 514 patients who satisfied the inclusion criteria. The data were collected using a convenience sampling technique, such that all patients without underlying medical problems who underwent tonsillectomy as a 1-day surgery during the study period were included.

The patient's medical records were reviewed for patient age and gender, operative details, presentation of bleeding, and management of bleeding. A data collection sheet was used to extract the desired variables in a consistent manner. The patients were divided into two age groups: paediatric (≤ 14 years of age) and adult (> 14 years of age). Northern Meteorological division data were used in our study to describe the seasons, rather than the Astronomical division, because the meteorological data are more consistent in weather forecasting. Therefore, each year (2012-2014) was divided into 4 seasons of 3 months each:

- Spring: March 1st - May 31st
- Summer: June 1st - August 31st
- Autumn: September 1st - November 30th
- Winter: December 1st - February 28th, or 29th in a Leap Year.

Statistical Analysis

Medical data were retrieved and the incidence of SPTB was calculated based on the total number of tonsillectomies performed, with 95% confidence interval. Data were analysed using the Statistical Package for the Social Sciences (SPSS), version 21.0. Descriptive statistics were used to describe the data. For quantitative variables, means ± standard deviations (SDs) were used; for qualitative variables, frequencies and percentages were used. The χ^2 test and Fisher's exact test were used to compare categorical variables; the z-test was used for one-sample test of proportions. All statistical tests were conducted with the significance level set at alpha = 0.05.

Surgical Technique

All surgeries were performed under general anaesthesia. The surgical techniques used were cold technique in which cold-knife (steel) is used for dissection, and hot technique which utilizes electrocautery (electric mono- or bi-polar cautery) for dissection. Post-operative care (specifically, antibiotics and analgesics) was similar for all patients. Any emergency department visits within 24 hours post-operatively with active bleeding were considered in the analysis. Bleeding was treated medically with supportive measures, including observation, fasting, intravenous fluid hydration, and intravenous analgesics; laboratory analyses included complete blood count, coagulation profile, and blood type. Surgical control of bleeding was achieved by cauterization of the bleeding site in the tonsillar bed under general anaesthesia.

Results

Descriptive analysis

Records were reviewed for 514 patients without underlying medical illnesses who underwent tonsillectomy during the study period. The demographic characteristics are shown in Table 1. Majority of the patients were males (n = 290, 56%); patients ranged in age from 2 years to 47 years. Four-hundred and eighty-one (93.6%) patients were in the paediatric group (≤ 14 years of age), while thirty-three (6.4%) were in the adult group (> 14 years of age); the mean age of all patients was 7.3 years.

Characteristics	Total	Post-Tonsillectomy Bleeding	Free of Post-Tonsillectomy Bleeding	P-value
	n (%)	n (%)	n (%)	
Sample Size	514 (100)	15 (2.9)	499 (97.08)	
Gender				< 0.0001*
Male	290 (56.4)	6 (40)	284 (97.9)	0.193 ** |n.s.|
Female	224 (43.6)	9 (60)	215 (96.0)	
Age				
≤ 14	481 (93.6)	6 (40)	481 (98.8)	< 0.0001***
> 14	33 (6.4)	9 (60)	24 (72.7)	
Surgical Technique				
Cold dissection	396	10 (66.7)	386 (97.5)	0.246*** |n.s.|
Hot dissection	118	5 (33.3)	113 (95.8)	
Season				
Spring	154	5 (33.3)	149 (96.8)	
Summer	130	2 (13.3)	128 (98.5)	0.086** |n.s.|
Autumn	114	1 (6.7)	113 (99.1)	
Winter	116	7 (46.7)	109 (94)	

*Z-test, one-sample test of proportions; ** χ^2 test; *** Fisher's exact test; |n.s.| non-significant

Table 1: The incidence of SPTB and its association between gender, age, and surgical technique

Of the 514 patients who underwent tonsillectomies, 15 (3%) developed SPTB. Although males comprised a slight majority of the overall patient population, 60% (n = 9) of the patients who developed post-tonsillectomy bleeding were females. Moreover, 60% (n = 9) of the patients who developed post-tonsillectomy bleeding were > 14 years old. Cold dissection was performed in 77% (n = 396) of the overall patients and in 67% (n = 10) of patients who developed post-tonsillectomy bleeding; hot dissection was used in 23% (n = 118) of the overall patients and 33% (n = 5) of patients who developed bleeding.

Most operations (30.2%, n = 154) were performed in spring, followed by Summer, Winter, and Autumn (25.3%, n = 130; 22.6%, n = 116; and 22.2%, n = 114, respectively). In contrast, 46.7% (n = 7) of SPTB occurred in winter, followed by Spring (33.3%, n = 5), Summer (13.3%, n = 2) and Autumn (6.7%, n = 1). The highest rate of SPTB was found in Winter (6.03%); Spring, Summer, and Autumn exhibited rates of 3.24%, 1.53%, and 0.87%, respectively (Table 2).

	Autumn	Winter	Spring	Summer	Total
	n (%)	n (%)	n (%)	n (%)	
Cases	114	116	154	130	514 (100%)
SPTB	1 (0.9%)	7 (6%)	5 (3.2%)	2 (1.5%)	15 (3%)

Table 2: Rates of secondary post-tonsillectomy bleeding (SPTB) in each season

Second-week post-tonsillectomy bleeding was documented in 53.3% (n = 8) of patients; only 1 patient presented in both the first and second weeks, and none presented in the first 24 hours. Bleeding was controlled surgically in 40% (n = 6) of patients; 60% (n = 9) of patients were treated conservatively. Table 3 illustrates operation details, presentation, and management.

Characteristics	Total	Post-Tonsillectomy Bleeding
	n (%)	n (%)
Sample Size	514 (100)	15 (2.9)
Surgical Technique		
Cold Dissection	396 (77)	10 (66.7)
Hot Dissection	118 (23)	5 (33.3)
Season		
Spring	154 (30.2)	5 (33.3)
Summer	130 (25.3)	2 (13.3)
Autumn	114 (22.2)	1 (6.7)
Winter	116 (22.6)	7 (46.7)
Timing of Presentation		
1st Week Post-Op	-	6 (40)
2nd Week Post-Op	-	8 (53.3)
1st and 2nd Week Post-Op	-	1 (6.7)
Management		
Medical	-	9 (60)
Surgical	-	6 (40)

Table 3: Operation details, presentation, and management

Analytical analysis

The overall incidence rate of SPTB for the study period was 2.9% (n = 15 patients). Associations between gender, age, surgical technique, and season with the development of SPTB are listed in Table 1. There were no significant differences in the rates of SPTB among patients who underwent tonsillectomy in each of the 4 seasons of the year; moreover, no other variables revealed statistically significant correlations.

Discussion

Despite the progress in surgical techniques to conduct tonsillectomy, post-tonsillectomy haemorrhage remains the most common post-operative complication [2,16]. In this retrospective cohort study, we aimed to characterise the associations between seasonal factors and post-tonsillectomy bleeding. The association between SPTB and surgical techniques as well as patient-related factors were also studied. The rate of SPTB requiring admission to the hospital has generally been reported between 2 to 10.3% [10]. In the present study, the rate was estimated to be 3%. None of our population sample exhibited primary post-operative haemorrhage (< 24 hours post-operatively); in contrast, of those who developed SPTB, 40% presented in the first week, 53.3% in the second week, and 6.7% in both first and second weeks.

There is no clear consensus whether seasonal factors significantly affect the incidence of SPTB. Both Chadha and Eski, *et al.* reported an increase in the incidence of SPTB when performing tonsillectomy in winter [17,18]. In the other hand, Lee, *et al.* demonstrated the lack of an association between SPTB and seasonal variation, considering a negative correlation among mean air temperature, humidity, and SPTB; however, they suggested that performing tonsillectomy in warmer weather may reduce the incidence of SPTB [12]. Mendel, *et al.* conducted a retrospective cohort study of 4438 patients who underwent tonsillectomy ± adenoidectomy; 9.73% patients developed post-tonsillectomy bleeding, with 7.16% occurring more than 3 days after surgery [19]. Although there was no significant association between meteorological factors and bleeding rate in patients who bled > 3 days after surgery, slightly less bleeding was found after 3 days in patients who had the surgery during summers, relative risk (RR) 0.82, 95% confidence interval ([95%CI] 0.69–0.97). Interestingly, when patients without post-operative bleeding were compared to those who had post-tonsillectomy bleeding in the first 3 days post-operatively, a higher risk for bleeding during warmer seasons was found. Moreover, a temperature of 20.-25 °C and above 25 °C at the day of the surgery had a higher risk for post-tonsillectomy bleeding: RR 1.74, 95% CI 1.39-19 and RR 1.49, 95% CI 1.18-1.87, respectively. In another study, Cadd, *et al.* analysed a cohort of 941 patients who had a 7.7% post-tonsillectomy bleeding average rate [20]. No significant difference was found in bleeding rates between dry and wet seasons (p = 0.279). Their findings also showed no correlation between other meteorological factors including temperature (p = 0.74), water vapour pressure (p = 0.94) and humidity (p = 0.66) and post-operative bleeding rate. Although our results showed an increasing tendency for post-operative haemorrhage in winter, followed by spring, summer, and then autumn, this relationship was not statistically significant.

The type of surgical technique has previously shown a strong association with post-operative bleeding; a study comparing ligation with cauterisation revealed that ligation was more strongly associated with primary haemorrhage, while cauterisation was more strongly associated with secondary haemorrhage [21]. In another study, Pizzuto, *et al.* [22], found that the utilisation of cold techniques was associated with more post-operative bleeding than electro-cauterisation; this has been demonstrated in more recent studies [21,22]. Likewise, our study showed that in 66.7% of patients who developed post-tonsillectomy bleeding, cold dissection was used, while such bleeding only occurred in 33.3% of patients who underwent hot dissection.

Other factors that have been analysed in relation to post-operative bleeding are patient age and gender. Some studies have shown no significant difference between patient demographics and SPTB, while others revealed that increasing age and male sex were both risk factors for SPTB [23-25]. Likewise, our results showed that a higher percentage (60%) of patients older than 14 exhibited SPTB. However, in our study, post-operative haemorrhage was more prevalent among female patients, who constituted a total of 60% of patients with SPTB.

The fact that this cohort is from a single institution may pose a limitation for this study. Moreover, meteorological variables which might have influenced the bleeding rate including vapour pressure, temperature, temperature fluctuation, and relative humidity were not examined. Nevertheless, this study was of a relatively large sample size of more than 500 patients, both paediatrics and adults. Unlike case control and cross-sectional studies, the employed study design allows for reliable investigation of the incidence and possible association of multiple factors with SPTB. The present study showed that seasonal variation did not significantly affect the rate of SPTB which is consistent with some of the previous literature, therefore we have no specific recommendations regarding the timing of tonsillectomy surgery.

Conclusion

In the current study, the incidence of SPTB was 3% among the studied population. In addition, there was a peak in the incidence of SPTB in winter, with a rate of 6.03%, yet not statistically significant.

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