

Postoperative bleeding after microdebrider-assisted intracapsular tonsillectomy and extracapsular tonsillectomy. A retrospective cohort study.

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ABSTRACT

Introduction: Post-tonsillectomy bleeding is one of the most common complications of tonsillectomy. The rate varies with different methods.

Objective: The purpose of the study was to compare the prevalence of postoperative bleeding after total, extracapsular tonsillectomy, and after subtotal, intracapsular, microscope- and microdebrider-assisted tonsillectomy.

Methods: We retrospectively analyzed patients who underwent a tonsillectomy in a period of two years. We compared two surgical methods, extracapsular tonsillectomy and microscope- and microdebrider-assisted intracapsular tonsillectomy.

Results: Five hundred seventy patients were included in the study. Postoperative hemorrhage occurred in 100 patients (17.5%). By the extracapsular tonsillectomy method, postoperative bleeding was noted in 82 patients (19.7%), while by the intracapsular technique in 18 (11.7%) patients. A return-to-theatre to achieve hemostasis was required in 38 patients (9.1%) and 3 patients (1.9%), respectively.

Conclusion: Our study showed a statistically significant lower incidence of post-tonsillectomy bleeding and need to perform revision surgery under general anesthesia to control bleeding after intracapsular tonsillectomy.

Keywords: Tonsillectomy; Hemorrhage; Bleeding; Microdebrider; Intracapsular; Extracapsular

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Introduction

Tonsillectomy is one of the most frequently performed surgical procedures, although, in the last years, a gradual decrease in the number of performed tonsillectomies is noted [1]. The most common indication for tonsillectomy is acute recurrent tonsillitis/chronic tonsillitis or adenotonsillar hypertrophy that results in sleep-related disordered breathing. The procedure is performed in both adults and children and is associated with significant postoperative morbidity [2]. The overall incidence of post-tonsillectomy bleeding (PTB) varies significantly in the literature. A large population-based inpatient cohort study of different types of tonsillar surgery, conducted in Germany, showed an overall rate of PTB of 6.44% [1]. Multiple surgical techniques are used in practice, without consensus on the optimal technique or instrumentation.

Tonsillectomy can be performed by dissecting the tonsil from its surrounding capsule (total or extracapsular tonsillectomy). A relatively high rate of PTB led to the development of methods, in which a part of the tonsillar tissue is being preserved, the so-called subtotal or intracapsular tonsillectomy [2].

The use of the powered microdebrider for the intracapsular tonsillectomy was first reported by Koltai et al. [3]. In this procedure, the microdebrider shaves away most of the tonsillar tissue, leaving a thin rim of tissue overlying the capsule. Because the tonsil is removed from a medial to a lateral aspect, the resection is performed distal to the primary tonsillar vessels. Only the smaller vessels are being exposed, which seem to be less prone to delayed hemorrhage [3]. Furthermore, the preservation of the capsule and the reduced exposure of the pharyngeal musculature and vessels seems to cause a reduction of the perioperative morbidity, including reduction of postoperative pain and recovery time [4,5].

The aim of this institutional review and analysis of 570 retrospective cases was to determine the

prevalence of PTB after total, extracapsular tonsillectomy and after subtotal, intracapsular, microscope - and microdebrider-assisted tonsillectomy. Secondary objectives were to evaluate differences in bleeding rates in male and female patients and between different age groups, and whether the technique used influenced its onset.

Materials and Methods

Study setting and data analysis

All patients undergoing tonsillectomy at the Otorhinolaryngology Department of our institution between January 1, 2018, and December 31, 2019, were retrospectively analyzed. For each case, variables concerning operative technique, the occurrence of postoperative hemorrhage, postoperative day of hemorrhage, and transfer to the operating room were collected. Details of the type of intervention, such as non-operative or operative intervention, were also recorded.

Two different operative methods were compared. The operation was always performed under general anesthesia. The method of anesthesia induction and patient's positioning was similar for most patients undergoing tonsillectomy, regardless of which technique was used. The patient was placed in the supine position and was orally intubated. The endotracheal tube was taped to the patient's chin in the midline. A McIvor mouth gag was inserted and expanded to keep the mouth open for the duration of the procedure.

The first technique was the total extracapsular dissection tonsillectomy (ET). In this technique, the tonsil capsule was dissected from the surrounding tissue using a scissor, scalpel, and dissector, and the inferior pole was amputated with a tonsil snare. Hemostasis was performed using mainly bipolar cautery (40 W) and rarely suture ligations. The second method was the microscope- and microdebrider-assisted, intracapsular dissection tonsillectomy (IT). In this method, the tonsillar tissue was first reduced using monopolar diathermy (60 W), and all remnants between the palatine arches were

then removed with a microdebrider (oscillatory duction, 2,500 rpm) (Storz SCB Unidrive III ENT, Karl Storz Endoskope, Germany) down to the inner surface of the tonsillar capsule. The microdebrider cuts the tissue using a small, rapidly rotating blade. Simultaneously, thanks to irrigation and aspiration function, it sucks the cut tissue away from the surgical field. The tissue and tonsillar capsule remain as a "biologic dressing," which protects the pharyngeal muscles overlying the tonsillar fossa. Finally, hemostasis was performed using bipolar cautery (40 W) (Figure 1).

It should be noted that critical for the effect of the bipolar cautery is not only the power but also the duration of the cauterization. We tried to reduce the transfer of energy to the deeper tissues, by minimizing the time of exposure to cauterization. After the dissection, the tonsillar fossae were packed with gauzes soaked in normal saline to clean the tonsillar beds and reduce the lateral thermal spread.

Study definition

Postoperative bleeding was defined as any bleeding episode after extubation independent of the resulting therapy. The type of treatment was categorized according to a modified version of the standardization system first proposed by Windfuhr [6]:

Grade I was bleeding, historical, or observed with spontaneous cessation that did not require any intervention.

Grade II was bleeding that required control with local measures under topical or local anesthesia.

Grade III was bleeding that required control with suture ligation and/or aggressive cauterization under anesthesia in the operating room.

Grade IV was bleeding that required external carotid artery ligation or embolization.

Grade V was bleeding that led to the patient's death.

In uneventful cases, patients were discharged five days after tonsillectomy. Patients who had

experienced postoperative hemorrhage were discharged according to their general condition, laboratory parameters, and state of wound healing. Most patients were discharged two days after bleeding control under general anesthesia and one day after conservative treatment. All patients were instructed to visit the hospital immediately if they noted any kind of postoperative bleeding, even when it was minimal.

Inclusion criteria

Included in the study were patients who underwent surgery because of chronic/recurrent tonsillitis. Patients who reported 3-5 episodes of tonsillitis in the last three years were treated with the IT method. In patients who reported six or more episodes of tonsillitis in the last year, ET was performed.

Exclusion criteria

Excluded from the database were patients

- (a) who underwent surgery because of acute tonsillitis or peritonsillar abscess,
- (b) who underwent surgery because of tonsillar hypertrophy,
- (c) who underwent surgery because of tonsil cancer or underwent tonsillar biopsy,
- (d) with pathologic coagulation profile (pathological prothrombin time or partial thromboplastin time values), and
- (e) who had initial surgery performed at a different hospital or were transferred from other centers.

Statistical analysis

A descriptive statistical analysis was performed to describe and summarize data. Chi-square and Mann–Whitney U tests for independent samples were performed to analyze differences between the two groups (mean values and standard deviation, SD). A p-value < 0.05 was considered as significant. All statistical procedures were conducted using the IBM SPSS Version 20.0 (IBM Corp., Armonk, NY, USA).

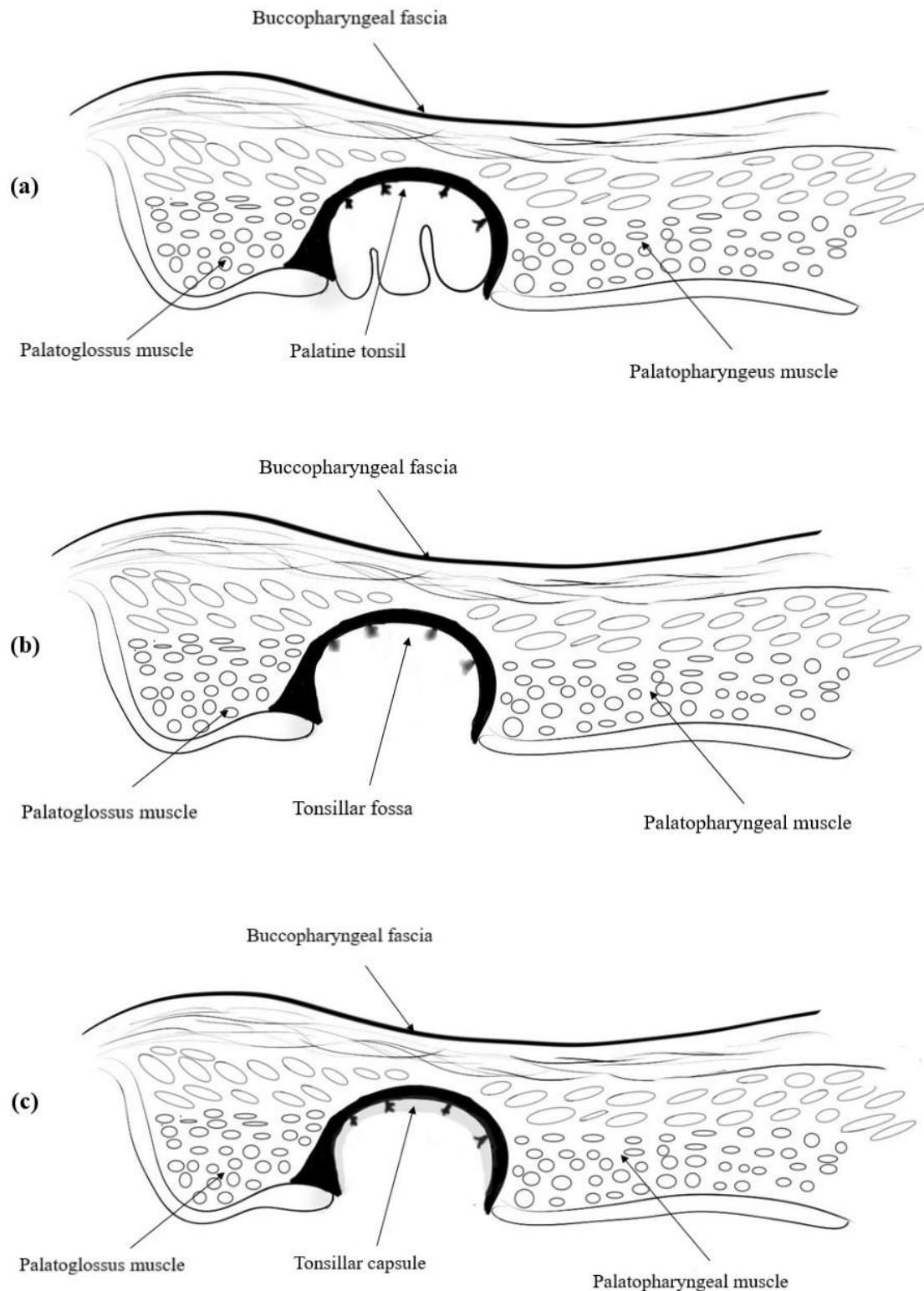


Figure 1: Surgical technique of the extracapsular tonsillectomy and the microdebrider-assisted intracapsular tonsillectomy: (a) status at begin of the operation, (b) by the extracapsular dissection technique, the tonsil capsule is dissected from the surrounding tissue. Hemostasis of the vessels of the tonsillar fossa is performed using mainly bipolar cautery, (c) by the microscope- and microdebrider-assisted, intracapsular dissection tonsillectomy the tonsillar tissue is first reduced using monopolar diathermy, and remnants between the palatine arches is then removed with a microdebrider. A tonsillar remnant and the tonsillar capsule remain as a "biologic dressing," which protects the pharyngeal muscles overlying the tonsillar fossa.

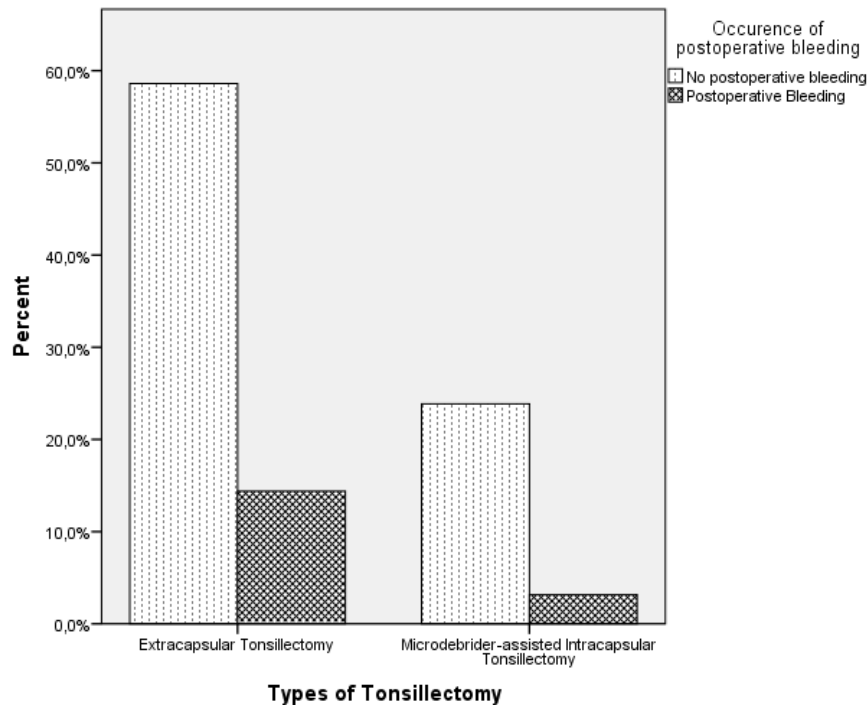


Figure 2: Occurrence of post-tonsillectomy bleeding after extracapsular tonsillectomy (ET) and microdebrider-assisted, intracapsular tonsillectomy (IT). By the ET method, postoperative bleeding was noted in 82 patients (19.7%), while by the IT technique in 18 (11.7%) patients. Surgical hemostasis in general anesthesia was required in 38 patients (9.1%) and three patients (1.9%), respectively. The differences were statistically significant.

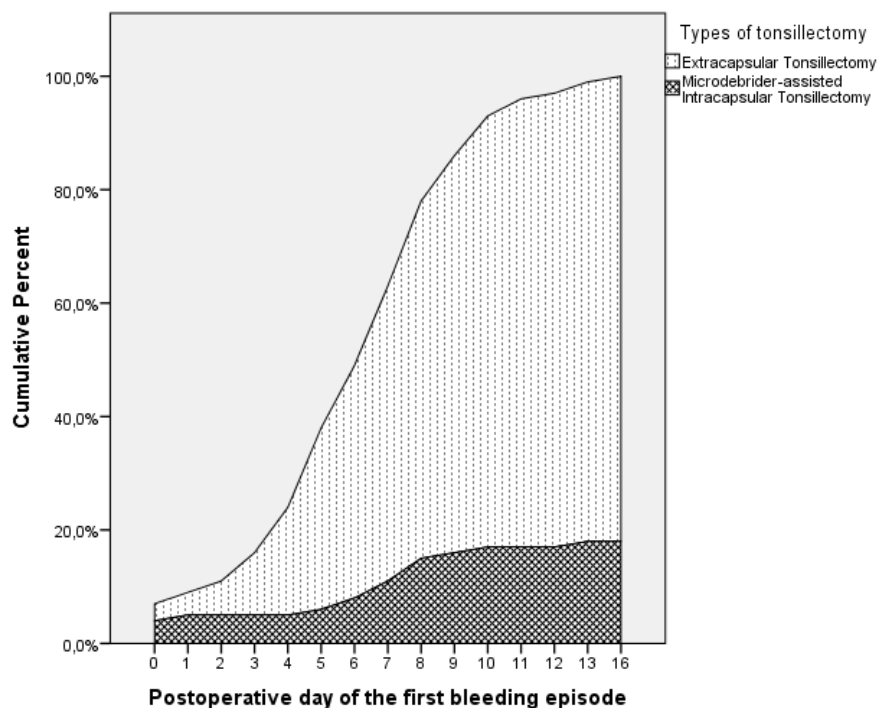


Figure 3: Postoperative day of occurrence of the first hemorrhagic episode, demonstrated as a cumulative percentage. We compared the time of occurrence of the first hemorrhagic episode between the two surgical techniques. The majority of the bleeding episodes occurred between days 4 and 9 postoperatively. Primary bleedings were rare. In the extracapsular technique, the first postoperative bleeding episode occurred mainly on day 5-6, whereas in the intracapsular technique occurred on day 7.

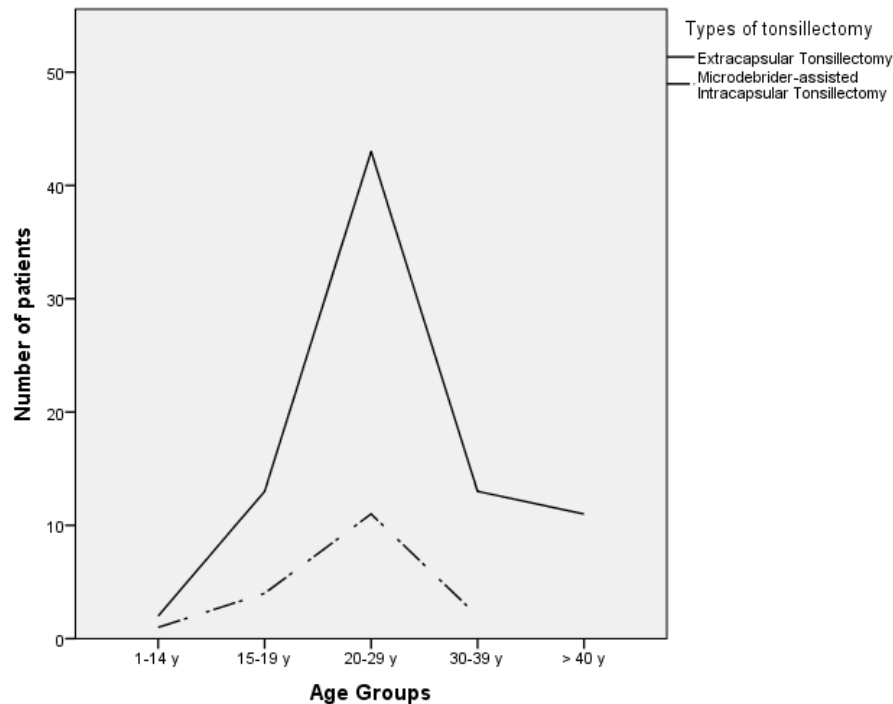


Figure 4: Occurrence of postoperative bleeding in different age groups. A peak is noted between 20-29 years.

Results

Epidemiological data

We included in the study a total of 570 patients undergoing tonsillectomy. Two hundred thirty-three patients (40.9%) were male, and 337 patients (59.1%) were female. The mean age of the patients was 25.3 ± 10.8 years (range: 2 – 69 years). The mean age in the ET group was 27.6 ± 10.2 years (range: 7 – 69 years). The mean age in the IT group was 19.3 ± 9.9 years (range: 2 – 50 years).

Frequency of each operative method

Of the 570 patients, 416 (73%) underwent a total tonsillectomy, and 154 (27%) underwent the microdebrider-assisted, intracapsular technique.

Frequency of postoperative hemorrhage

Of the 570 included patients, postoperative hemorrhage occurred in 100 patients (17.5%). Fifty-five patients were male (55%), and 45 patients were female (45%). By the ET method, postoperative bleeding was noted in 82 patients (19.7%), while by the IT technique in 18 (11.7%) patients. Surgical hemostasis was required in 38 patients (9.1%) and three patients (1.9%), respectively (Fig. 2). A Mann–Whitney U test

showed a statistically significant higher postoperative risk for the ET ($p = 0.03$) and no difference between male and female patients ($p = 0.428$).

Type of treatment

About half of all bleeding episodes (57%, $N = 57$) were treated conservatively (spontaneous cessation, Grade I). Two of the hemorrhagic episodes (2%) were treated in local anesthesia (Grade II). The rest of the patients (41%, $N = 41$) were treated in the operating room under general anesthesia (Grade III). An external carotid artery ligation was never required (Grade IV). No deaths occurred (Grade V). Concerning the bleeding episodes between the two groups, we noted that in the ET method, 38 out of a total of 416 patients (9.1%) required revision surgery under general anesthesia, while the number of patients in the IT method group was 3 (1.9%). A Chi-square test showed a significant difference between the two operative techniques and the frequency of admission to the operating theatre for postoperative bleeding ($p = 0.003$).

Time of occurrence of the first postoperative bleeding episode

We compared the time of occurrence of the first bleeding episode between the two surgical techniques. Independent of the method used, we noticed that 70% of the bleeding episodes occurred between days 4 and 9 postoperatively. Primary bleeding occurred in 3 of the 415 patients (0.7%) after the ET technique and in 4 of the 154 patients (2.6%) and using the IT technique. Concerning the ET, we found that the first postoperative bleeding episode occurred mainly on day 5-6 (median= 6.5, mean = 6.5, SD = 2.96), whereas by the IT technique the first episode occurred on day 7 (median = 7, mean = 5.72, SD = 3.92). A Man-Whitney test did not show a significant difference concerning the day of occurrence of the first bleeding episode between the two techniques ($p = 0.715$) (Fig. 3).

Multiple bleeding episodes after tonsillectomy

Multiple bleeding episodes were recorded in 24 patients (4.2% of all patients), which means that one in four patients experiencing post-tonsillectomy bleeding had recurrent bleeding episodes. No statistically significant difference concerning the number of bleeding episodes and the technique used was noted (Mann-Whitney test; $p = 0.680$).

Influence of age on the occurrence of postoperative bleeding

We divided the patients into five age groups (group 1: 1-14 years; group 2: 15-19 years; group 3: 20-29 years; group 4: 30-39 years; group 5: over 40 years old). We compared the occurrence of PTB in the different age groups, and we found a statistically significant higher rate between ages 20-29 years when compared to patients 1-14 years old (one-way ANOVA; $p = 0.005$) (Fig. 4). A comparison between age groups and the need to return-to-theater did not reveal a statistical significance. Comparing the cases of PTB between the two surgical methods did not reveal a significant influence of age.

Discussion

The overall incidence of PTB varies significantly in the literature. This is caused by the variety in

the documentation and definition of the PTB. A previous study performed in the same geographical region documented a PTB rate of 11.9%. We documented an overall rate of PTB of 17.5%. It should be noted that this relatively high rates of PTB were partially caused due to the high awareness of PTB in the otorhinolaryngology community and the strict advice of the patients to refer to our hospital, even for self-limited hemorrhagic episodes. Fifty-five of the patients who presented with PTB were male (55%), and 45 patients were female (45%). The difference was not statistically significant. A large longitudinal study, performed in Germany, covered 12 years, included all types of tonsillar surgery, and concluded that the male gender is a significant risk factor for bleeding ¹. In contrast, a 10-year register study in Sweden, including 54,696 operations, analyzed the incidence of primary bleeding following tonsillectomy and correlated female sex with increased risk of bleeding ^[7].

We noted a higher occurrence of PTB between ages 20-29 years when compared to patients 1-14 years old. Our data sample is relatively small in order to compare multiple, different groups equally. The previous mentioned, population-based study performed by Windfuhr et al., comparing different types of tonsil surgery, showed peaks of PTB in the age groups 5-10 and 15-20 years old ^[1]. Our study did not show that specific age groups are prone to PTB after performing one of the two surgical methods.

Comparing the two surgical techniques, we observed that the IT group showed a significantly lower rate of PTB. This finding is consistent with previous studies. A meta-analysis of 12 studies showed a lower risk of bleeding after IT than after ET ^[8]. This reduced risk seems not to be relevant with the indication of surgery (obstructive sleep apnea or recurrent tonsillitis) or the patient age group included in the study. Tunkel et al. studied in a prospective, nonrandomized clinical trial 19 children who underwent intracapsular tonsillectomy for moderate obstructive sleep apnea syndrome

and noted PTB in only two patients (0.7%), that did not require surgical intervention ^[9]. Sorin et al. studied 278 patients with obstructive sleep apnea treated with microdebrider-assisted IT and also recorded only two patients (0.7%) with PTB, and similarly, no intervention was required ^[10]. Schmidt et al. performed a retrospective chart review of 1731 patients undergoing intracapsular tonsillectomy and 1212 patients undergoing electrodissection tonsillectomy, including indications of obstruction or infections. They found a significantly lower rate of PTB in the intracapsular dissection group (1.1%) ^[11].

In our study, we noted that in the ET group 38 patients out of a total of 416 patients (9.1%) returned to the operating theatre for revision surgery under general anesthesia, while the number of the patients in the IT method group was 3 (1.9%) ($p = 0.003$). This finding shows that, although the rate of PTB even after IT seems relatively high (11.7%), admission to the operating theatre was required only in 1.9% ($N=3/154$) of the patients. It seems that the tonsillar capsule and the tonsillar remnant act as a protective barrier for the underlying vessels. Likewise, a meta-analysis, including 19 studies of postoperative events after tonsillectomy, identified that the incidence of return-to-theater due to postoperative bleeding was statistically lower in the IT group than in the control group ^[5].

The time of occurrence of the first PTB varies significantly between different institutes. Our study showed that 70% of the PTB occurred between day 4 and 5 after surgery, independent of the method used. Primary bleedings episodes (< 24 h) were relatively rare, and the majority of the bleeding episodes were noted after 24 hours (secondary bleeding). No significant difference was noted between the two groups. Taking into consideration that the IT resulted only in 3/154 patients to a bleeding episode requiring admission to the operating theatre and the majority of these episodes (2/3) occur on the day of surgery, it may indicate that an in-hospital-stay of 24 hours could be appropriate for these patients. However, this should be individualized,

and other factors, such as general condition, state of wound healing, and postoperative pain, should also be taken into account. Concerning the postoperative pain after IT, previous studies have shown a significantly lower level and duration of pain after the IT technique ^[3,4,12]. If further studies confirm these findings, a reduced hospitalization may be justified. We strongly recommend that each institution performs statistics concerning the occurrence and the risk factors of postoperative bleeding, thus facilitating improvement measures.

The intracapsular tonsillectomy with the use of the microdebrider allows precise removal of the tonsillar tissue, leaving behind a thin rim of lymphoid tissue and the tonsillar capsule. To achieve a precise dissection, but also a subtotal tissue removal ($> 90-95\%$), the intraoperative use of the microscope is essential. It should be noted that the microdebrider causes increased intraoperative bleeding, but this bleeding seems not to be clinically (hemodynamically) significant, although it might be statistically significant ^[13,14]. The increased bleeding towards the end of the debridement deteriorates the visualization of the surgical field and, consequently, the identification of the tonsillar capsule. This is the reason we find that the use of the surgical microscope is critical to preserve and not violate the fibrous capsule and expose the pharyngeal musculature.

On the other side, one should take into consideration the higher costs of performing microdebrider-assisted IT. The costs for the microdebrider blade range between \$80 - \$100 per operation ^[4,15], but these costs could be equalized, if we take into consideration, that patients who have undergone microdebrider-IT return faster to regular activity, stop taking analgesics earlier and return to regular diet quicker ^[16]. The reduced pain encountered in the IT group is likely caused by the fact that the pharyngeal muscles are not injured, and the wound healing process is not dependent on the building of a new epithelial layer as in the ET ^[3]. Baik et al. performed a hypothetical cost analysis

of the two methods and concluded that IT was overall less expensive ^[17].

An argument against leaving residual tonsillar tissue on the capsule is the theoretical risk of recurrent tonsillitis, which was the primary indication of the surgery. Current studies could not find a statistically significant increased risk of recurrent infections after comparing the two methods, despite the higher rates of visible, residual tonsillar tissue after IT ^[8,18]. Both methods seem to reduce disease symptoms equally as effectively ^[19]. Furthermore, a tonsillar regrowth after performing a subtotal tonsillectomy is a possible risk. However, it seems that it has limited clinical significance, as it does not seem to be a risk factor for further recurrent tonsillitis, compared with a total tonsillectomy ^[20]. Further larger, randomized studies are required to address this question. In our institution, we had only one patient (30 years old), who was readmitted for total tonsillectomy after one year due to further recurrent infections.

The present study has some limitations, as does every study with a retrospective and not a randomized design. Firstly and most importantly the two patient groups do not share the same selection criteria. In the IT group patients had 3-5 episodes of tonsillitis in the last three years and in the ET group patients suffered from 6 or more episodes of tonsillitis in the last year. This is because we believe by the last patients exists a clear indication for total tonsillectomy. The IT technique was offered as a therapeutic option for patients with fewer episodes. A higher number of episodes of tonsillitis could influence the rate of PTB after total tonsillectomy. However, it should be noted that 3-5 episodes of tonsillitis in the last three years are also considered as chronic tonsillitis so that we do not think it influences significantly the results. The PTB rates between the tonsillectomy techniques might indeed vary and may depend not just upon the tonsillectomy technique and equipment, but also upon factors related to the surgeon and surgical practice. Despite the direct supervision of trainees from an experienced surgeon, the

effect of the experience of the surgeon cannot be overlooked. We noticed a relatively long learning curve before the surgeon was able to identify the tonsillar capsule and learned to leave behind the appropriate amount of tonsillar tissue. That is why we did not compare operation time between the two techniques. Having different surgeons performing the same technique can cause biased results due to their different approaches. Future prospective studies are advised to include tonsillectomies performed by the same surgeon or by surgeons of comparable experience and to use a standardized surgical procedure. Nevertheless, the procedure cannot be easily "standardized", as there exists no consensus of how much tonsillar remnant is "allowed" and no anatomical landmark, to compare the different operations fairly. Lastly, concerning the postoperative administration of analgesics, it should be noted that in our patient study, a standardized pain medication regime was used in the majority of the patients, minimizing the bias. However, the individualized response of each patient may also play a role.

Conclusions

The microscope- and microdebrider-assisted, intracapsular dissection tonsillectomy leads to a significantly lower risk of post-tonsillectomy bleeding and the need to return-to-theatre, compared with the extracapsular dissection technique.

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Conflict of Interest: The authors have no conflicts of interest to disclose.

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Compliance with Ethical Standards: All procedures performed in this study were in accordance with the ethical standards of the institution or practice at which the studies were

conducted (Ethics committee approval: F-2020-050).

Level of Evidence: 3b

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