

## Original Article

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# Incidence of post-tonsillectomy haemorrhaging in Denmark

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### ABSTRACT

**Introduction:** Tonsillectomy is one of the most common procedures in the field of ear, nose and throat procedures. In 2012, the annual incidence in Denmark was 129.4 per 100,000 inhabitants. A common complication is post-tonsillectomy haemorrhaging (PTH). The overall PTH rates vary widely among studies ranging from 0.5% to 33%.

**Methods:** This was a nationwide open-population, retrospective and registry-based cohort study in Danes who underwent tonsillectomy complicated by PTH in hospitals and private otorhinolaryngology (ORL) offices in the period from 1991 to 2012.

**Results:** In the 1991-2012 period, a total of 177,211 tonsillectomies were performed among which 9,221 had a registered PTH (rPTH) (5.2%). The annual incidence rate of rPTH increased from 3% in 1991 to 13% in 2012 ( $p < 0.05$ ). Males aged 20-40 years had a significantly higher risk of rPTH with the highest increase in rPTH incidence rates from 9.0% in 1998 to 16.4% in 2012 ( $p < 0.05$ ). Approx. 12% had a primary rPTH within the first 24 hours; the maximum incidence of rPTH was on day six (14%).

**Conclusions:** The rate of rPTH increased from 1991 to 2012 in hospitals and in private ORL office settings alike. There was a significantly higher rate of rPTH in the age group of 20-40 years and a significant geographical difference in rPTH. The highest risk of rPTH was observed on the day of surgery and on day six.

**Trial registration:** The Danish Data Protection Agency (record number 2012-41-0158) approved this study.

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Tonsillectomy is one of the most common procedures in the field of ear, nose and throat, and in 2012 the annual incidence in Denmark was 129.4 per 100,000 inhabitants, with a more than three times higher incidence seen in patients aged 0-4 and 15-19 years of age [1].

A common complication is post-tonsillectomy haemorrhaging (PTH). It is typically divided into primary (occurring  $\leq 24$  hours after surgery) and secondary (occurring more than 24 hours after surgery) complications. The overall PTH rates vary widely among studies ranging from 0.5% to 33%, while death is reported in one of 20,000 patients undergoing tonsillectomy [1-3].

Numerous studies have been conducted to establish risk factors for PTH, and the more consistent risk factors seem to be gender and age. Alcohol consumption and use of corticosteroids have also been suspected to increase the risk of PTH [4]. Several studies have pointed towards the surgical techniques using any “hot” technique for dissection and/or haemostasis (diathermy, diathermy scissors, coblation, ultrascision) as an independent risk factor for PTH compared with cold dissection (cold steel instruments only) and cold haemostasis (compression, infiltration with epinephrine, ties or suture ligation) [5-8].

The preferred technique in Denmark is either hot or cold dissection using diathermy to obtain haemostasis. Coblation was shortly used in Denmark until the increased risk of PTH was identified [5, 8].

Wintertime surgery was previously suggested to increase the risk of PTH [2].

The aim of this study was to identify whether Denmark has experienced a change in registered PTH (rPTH) over the consecutive 22-year study period and, if so, to clarify whether any change is associated with certain factors: age, sex, geographical location, surgery being performed at public hospitals versus private otorhinolaryngology (ORL) offices, and calendar time of surgery.

## METHODS

### **Ethical considerations**

The Danish Data Protection Agency (record number 2012-41-0158) approved this study. No other approvals were needed for this registry-based study.

### **Design and setting**

This study is partially based on the cohort described and presented in [1].

This was a nationwide open-population, retrospective and registry-based cohort study based on two comprehensive Danish health registries in the period from 1991 to 2012. In this study, winter is defined as the period from 1 October to 31 March [1].

### **Data sources, participants and variables**

A description of the data sources used in this study is presented in a previous article [1]. Specifically for this study, we paired all registered tonsillectomies, adenotonsillectomies,

tonsillotomies or adenotonsillotomies with the International Classification for Diseases Version 10 (ICD-10) code for postsurgical bleeding DT81.0 within three weeks post-surgery. If a patient was admitted with the diagnosis DT81.0 and a subsequent PTH occurred during the same admission, only the first PTH incident was accounted for. Data on influenza epidemics in Denmark were obtained from Statens Serum Institut [9]. Aggregated data from the National Patient Registry from the 2013-2018 period are available online [10].

## Statistical methods

The statistical software R was used for all data processing, analyses and graphics [11]. Statistics and illustrations were produced using dplyr, lubridate and graphed using ggplot2 [12-14]. Difference of proportion test (two-tailed, independent) was used for testing of seasonal variance and differences in PTH rates in hospital versus ORL office setting. A p-value  $\leq 0.05$  was considered statistically significant. A difference of proportions test is a parametric test which relies on normally distributed variables in small samples. Since all tests in this study consist of several thousand observations, the sampling distribution approaches a normal distribution because of the central limit theorem; a simple rule of thumb says that there should be a minimum of 20 observations in each group, which is met and surpassed in this study. We used hypothesis tests to assess the statistical significance of our results and thus used a pooled estimate of proportions since this is what is implied under the null hypothesis of no difference, i.e. that the proportions are the same.

## RESULTS

In the 1991-2012 period, a total of 177,211 tonsillectomies were performed, among which 9,221 were registered with a PTH (5.2%). The relative number of rPTHs during wintertime was significantly higher than during summertime; 55.4% versus 44.6% ( $p < 0.01$ , 95%) (Table 1). There was a significant increase in the overall rPTH rates when comparing the initial part of the study period (1991-2001; mean 3.3%) with the latter (2002-2012; mean 6.9%) ( $p < 0.05$ , 95%). Overall, males had a greater risk of PTH (Table 1).

In the 1998-2012 period (for which more complete demographic data were available), 118,797 tonsillectomies were performed and 7,308 had a minimum of one rPTH (6.2%). The annual incidence rate of rPTH increased almost linearly in the study period from 3% in 1991 to 13% in 2012 ( $p < 0.05$ ), Figure 1.

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**TABLE 1 /** Demographics on patients with post-surgical haemorrhage after tonsillectomy in Denmark. Nationwide data 1991-2012<sup>a</sup>

Patients, n (%) %

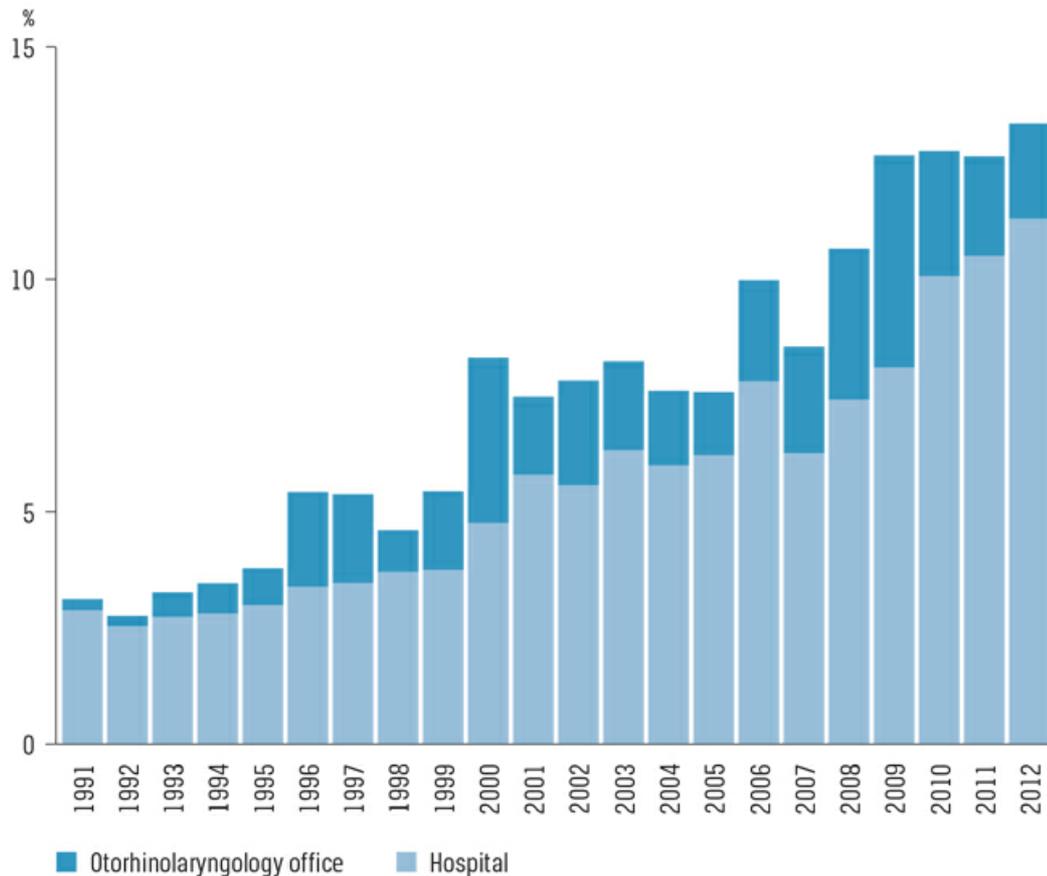
1991-2012	
Winter	5,113 (55.4)
Summer	4,108 (44.5)
<i>Demographic data on rPTH patients, 1998-2012</i>	7,308
Gender:	
Males	3,809 (52.1)
Females	3,499 (47.9)
Age, yrs:	
0-4	468
5-9	604
10-14	475
15-19	1,444
20-24	1,242
25-29	987
30-34	869
35-39	566
≥ 40	653
<i>Post-tonsillectomy haemorrhage rates by region in Denmark, 2008-2012</i>	
Capital Region of Denmark	6.3
Region of Southern Denmark	5.6
North Denmark Region	5.3
Region Zealand	4.5
Central Denmark Region	4.0

rPTH = registered post-tonsillectomy haemorrhaging.

a) Data on gender and age were available for the period 1998-2012 only.

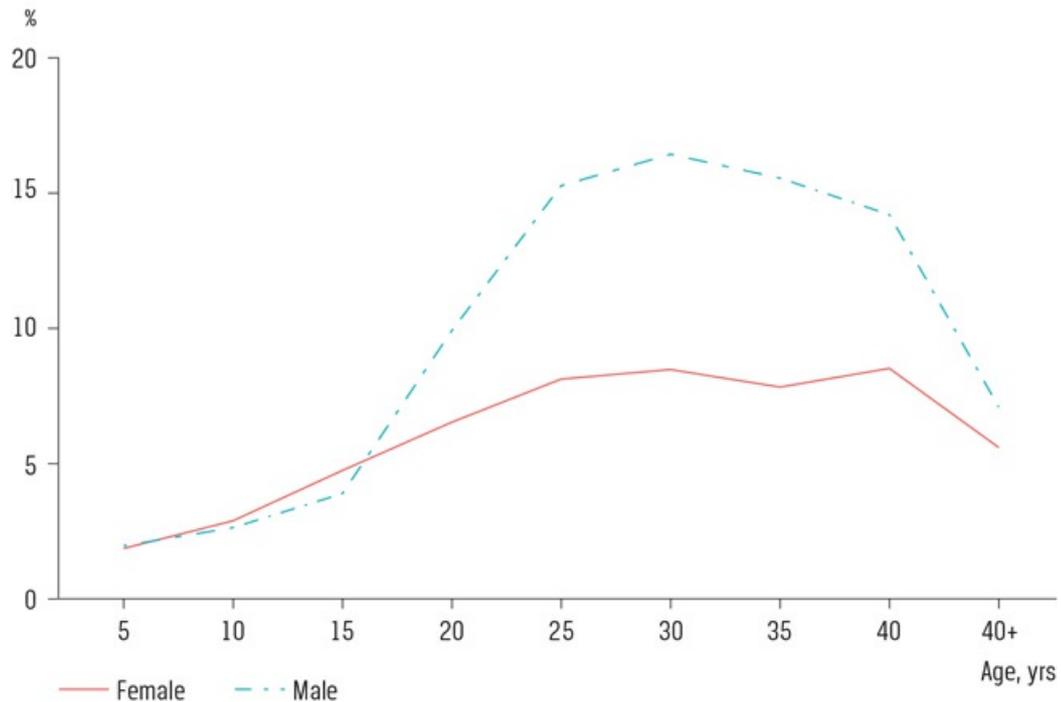
Males aged 20-40 years had a significantly higher risk of PTH than females and all other age groups with the highest increase seen in rPTH incidence rates from 9.0% in 1998 to 16.4% in 2012 ( $p < 0.05$ ). For females aged 20-40 years, a less steep increase in rPTH incidence from 6.5% in 1998 to 8.5% in 2012 was noted, **Figure 2**.

**FIGURE 1 /** Percentual post-tonsillectomy haemorrhage divided on hospital and otorhinolaryngology practice from 1991 to 2012.



The rPTH incidence rate in private ORL offices was on average 4.3% lower than the rPTH rate in hospitals ( $p < 0.01$ , 95% confidence interval: 4.1-4.6%), Figure 2. A significant increase in rPTH incidence rates was observed among patients undergoing tonsillectomy in hospitals from 3.5% in 1991 to 7.6% in 2012 ( $p < 0.05$ ). Private ORL offices also experienced an increase in rPTH from 1.4% to 2.5% ( $p < 0.05$ ).

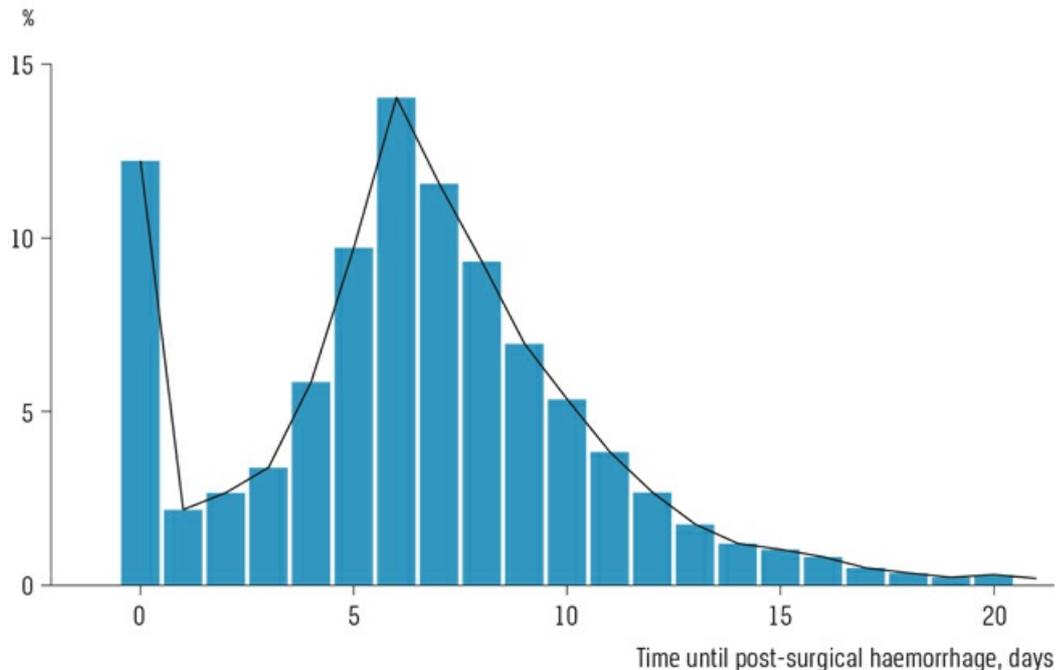
**FIGURE 2 /** Post-tonsillectomy haemorrhage and age in the period 1998-2012 divided on gender: % of total number of age-specific tonsillectomies.



In the latter part of the study period from 2007 to 2012, when Denmark was divided into regions, regional differences in the rate of rPTH were noted. In the five geographical regions in Denmark, the rPTH incidence rate ranged from 4.0% in the Central Denmark Region to 6.3% in the Capital Region of Denmark ( $p < 0.05$ ), Table 1.

**Figure 3** presents the number of days from tonsillectomy to admittance to hospital with rPTH. Around 12% of all rPTH incidents were a primary PTH within the first 24 hours. The bell-like curve reaches its maximum on day six, when 14% of all rPTH incidents occur. Less than 1% of all rPTH incidents occur after day 15.

**FIGURE 3 /** Rates of post-tonsillectomy haemorrhage: % of total number of haemorrhage per day post-operatively among all reported cases, 1991-2012.



## DISCUSSION

Among 177,211 tonsillectomies performed, the main findings of this study were a mean rPTH rate of 5.2% in the 1991-2012 period. Overall, we found a significant increase ( $p < 0.05$ ) in the rPTH incidence rate from 3% in 1991 to 13% in 2012.

The risk of PTH increased with age and peaked for both genders between 25 to 40 years of age. Males aged 25-40 years had almost twice as high a risk of PTH as females of the same age.

A multicentre study from England and Northern Ireland found an overall risk of PTH of 3.3%. The highest risk of PTH was found in coblation with a relative risk of 3.4. A relative risk of 3.1 was found when hot technique was applied for both dissection and haemostasis. This should be compared with a relative risk of 2.2 when dissection was conducted with cold steel and diathermy. The reference was cold steel tonsillectomy alone [8].

A Swedish study comprising 15,734 patients, more late PTH episodes were seen in procedures involving electrical scissors of the “ultrascision” type (odds ratio = 5.6) and bipolar scissors (odds ratio = 4.3) than with cold steel dissection and cold haemostasis [5].

A Danish study on 1,365 patients found a re-operation rate of 3.4% due to PTH; 4.0% among patients having a tonsillectomy à chaud and 3.3% among patients who underwent tonsillectomy à froid [15]. When grouped, patients older than 35 years of age had a 2.3 times

higher risk of PTH than patients under the age of 35 years. The authors found no association between sex or type of surgery and the risk of PTH [15]. This is the only study on surgical techniques in tonsillectomy published from Denmark that we are aware of.

Unfortunately, our registry-based data do not contain information on type of surgical procedure. It would, however, be interesting to assess whether the increase in rPTH among Danish patients may be explained in part by a shift in surgical procedure from cold to hot technique.

A German study from 2012 in 2,216 patients undergoing tonsillectomy or tonsillotomy found a PTH incidence rate of 10% and a re-operative rate due to PTH of 6%. Tonsillectomy conducted due to recurrent tonsillitis carried an increased risk for PTH among males, those aged > 25 years and waiving perioperative antibiotics. Tonsillectomy also increased the risk of PTH compared with tonsillotomy among patients with tonsil hypertrophy [16].

Our incidence rates are in the high end compared with some previous reports [2, 8, 17], whereas other researchers have found similar PTH rates in comparable populations [3, 16].

The rate of rPTH was lower in the private ORL offices than in hospitals. Part of the explanation may be that the private ORL offices tend to perform tonsillotomy on younger children (3-5 years old) on the indication hypertrophy of the tonsils. Tonsillotomy had no separate surgical code in the study period and would thus be perceived as a tonsillectomy. Tonsillotomy has a re-bleeding risk as low as 0.2%, which is significantly lower than the re-bleeding risk of tonsillectomy [16, 18]. Also, patients in private ORL offices are generally healthier, since most patients with concomitant diseases, overweight, prior history of bleeding and other risk factors will usually be referred to a hospital setting.

The bell-shaped peak in incidence of rPTH around day six (Figure 3) is usually explained by the sloughing of the primary eschar as the tonsil bed heals by secondary intention [19].

Our study period concludes in 2012, but the question is whether the increasing trend continued or levelled off since then? Aggregated data from the Danish National Patient Registry are available online for the 2013-2018 period, which includes all tonsil surgeries performed at hospitals, accounting for approximately 73% of all tonsil surgeries in Denmark. The remaining surgeries are conducted in private ORL offices [1]. A data extract from this registry including the procedure codes KEMB10 (tonsillectomy), KEMB15 (tonsillotomy), KEMB20 (adenotonsillectomy) and the ICD-10 code DT81.0 (postsurgical bleeding) for 0-19-year olds shows a decreasing number of procedures (from 4,189 to 2,667 (including the 27% surgeries that private ORL offices account for)) and an increase in postsurgical bleeding (from 4.9% to 9.5%) from 2013 to 2018. This data extract on tonsillectomy and postsurgical bleeding is not linked by the unique identification number as was the case for the period 1991-2012, and further postsurgical bleeding includes all surgical procedures. However, this finding combined with our observations from clinical

work indicates no decrease in postsurgical bleeding after tonsillectomy in the past decade.

## **Strengths and limitations of this study**

The national registries of the Danish health system contain information on all citizen contacts and data are collected independently from this study. Furthermore, a 22-year study period allows observation of changes over time; and owing to the large study population, confidence intervals narrow. However, in an observational study like ours, we cannot conclude on causality.

We were unable to control for risk factors like change in surgery techniques from cold to hot, level of experience among surgeons and registration bias due to more comprehensive reporting of PTH incidents. Regarding the registration bias in the early part of the study period, PTHs may first have been registered with the ICD-10 code DT81.0 when requiring general anaesthesia. Likewise, part of the increase in rPTH in the latter part of the study period might be due to a more comprehensive registration of PTH; i.e. if patients more frequently call for assistance and/or physicians admit patients to hospital due to a short-lived PTH with minimal bleeding, which could also have been managed at home with observation and ice per os. These factors may also play a role in the regional difference observed in rPTH incidences.

Furthermore, our study design did not allow us to control for speculative PTH confounders, like recent upper respiratory diseases, which are more frequent during wintertime in Denmark (significantly more PTHs in the wintertime compared with summertime (Table 1)), regular alcohol consumption, smoking habits, overweight, medicine use, administration of glucocorticoids and post-operative medication. In Denmark, NSAIDs and paracetamol are used routinely as pain relieving medications; no correlation between NSAID use and PTH was found in a large systematic review comprising 36 randomised trials [20]. In Denmark pre-, per- or post-operative antibiotics for patients undergoing tonsillectomy are employed very rarely. Antibiotics may, in certain cases, be administered post-operatively, but this will likely first occur after discharge and after a second assessment by a physician.

## **CONCLUSIONS**

The rate of rPTH has increased from 1991 to 2012 in hospitals and in private ORL offices alike. A significantly higher rate of rPTH was observed in the 20-40-year age group, especially among males. This should be taken into consideration when deciding on tonsillectomy in that age group. A significant and unexplained geographical difference was seen in rPTH. The highest risk of PTH was on the day of surgery and at day six. Further studies are warranted to shed light on why Denmark apparently has a high incidence of post-tonsillectomy haemorrhage and why we observe a significant gender and age

difference.

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**CONFLICTS OF INTEREST:** Disclosure forms provided by the authors are available with the full text of this article at [Ugeskriftet.dk/dmj](https://ugeskriftet.dk/dmj)

## LITERATURE

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