

Retrospective study on risk factors for repeated dental treatment of children under general anaesthesia



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Abstract

Aim This retrospective study aimed to evaluate potential risk factors predicting repeated dental treatment of children under general anaesthesia.

Methods Children below 12 years of age receiving at least one dental treatment under general anaesthesia between 03/2010 and 10/2018 were analysed ($n = 935$, mean age: 4.6 ± 2.4). Dental records were analysed retrospectively for anamnestic, demographic, oral health and treatment factors. Kaplan-Meier statistics was used to estimate the time to second dental treatment under general anaesthesia. Potential risk factors for repeated dental treatment underwent univariate analysis using log-rank tests and were then submitted to a multi-variate Cox-regression analysis ($\alpha = 5\%$).

Results One hundred fifteen children (12.3%) received or were planned to receive repeated dental treatment under general anaesthesia. In children receiving repeated dental treatment, the time intervals between first and second general anaesthesia and second and third general anaesthesia amounted to 22 ± 18 and 23 ± 20 months, respectively. The use of fluoridated toothpaste (HR: 0.28, $p < 0.01$) and attending 2 or more recall appointments per year (HR: 0.6, $p < 0.01$) significantly decreased the risk for repeated dental treatment under general anaesthesia in the multivariate model.

Conclusion Adherence to preventive recall appointments and to oral hygiene recommendations is essential to maintain oral health and avoid repeated dental treatment under general anaesthesia.

KEYWORDS Children, Caries, General anaesthesia, Risk factor.

Introduction

A high number of children still requires dental treatment under general anaesthesia, yet the intervention rate seems increased over the past decades [Rudie et al., 2018; Chen et al., 2017; Klingberg et al., 2010; Jamieson, and Roberts-Thomson, 2006]. Potential risk factors predicting dental treatment under general anaesthesia include—among others—the extent and severity of dental disease (mainly caries), medical history, socioeconomical factors, age/cooperativity and dental anxiety [Ramdaw et al., 2017; Delfiner et al., 2017; Rajavaara et al., 2018].

Dental procedures performed under general anaesthesia comprise preventive measures, restorations, endodontic

treatment and extractions. Especially under general anaesthesia, extractions are often prioritised over endodontic treatment to control the risk of failure and avoid repeated treatment [Rothmaier et al., 2017; Bücher et al., 2016; Savanheimo et al., 2012]. Nevertheless, repeated dental treatment under general anaesthesia becomes often necessary: About 4 to 13% of children below 18 years of age treated under general anaesthesia were reported to receive repeated general anaesthesia [Rudie et al., 2018; Bücher et al., 2016; Savanheimo, and Vehkalahti, 2014; Kakaounaki et al., 2011; El Batawi, 2014; Tahmassebi et al., 2014]. Medically compromised children seem to be at higher risk for repeated general anaesthesia [Rudie et al., 2018; Tahmassebi et al., 2014; Guidry et al., 2017]. Besides, caries severity, nutrition and prevention patterns, treatment measures at primary intervention and irregular attending of recall appointments were associated with repeated general anaesthesia [Kakaounaki et al., 2011; Guidry et al., 2017; Sheller, 2003].

As information on further risk factors predicting repeated treatment under general anaesthesia is limited, this retrospective study aimed to analyse the characteristics of children that were undergoing repeated dental treatment under general anaesthesia and to evaluate potential risk factors for repeated general anaesthesia.

Materials and methods

This retrospective, single-center study was approved by the Ethics Committee (31/07/18) of the University Medical Center, Göttingen (Germany). The dental records of all children below 12 years of age, who received comprehensive dental treatment under general anaesthesia between 03/2010 and 10/2018 at the Department of Preventive Dentistry, Periodontology and Cariology of the University Medical Center Göttingen were identified ($n = 935$).

Demographic information collected included date of general anaesthesia (if applicable: of repeated general anaesthesia), age of patient, gender, type of payment (self-pay, insurance, social welfare), siblings (no, yes/number of siblings) and dental treatment under general anaesthesia of siblings (no, yes). Anamnestic information at first general anaesthesia comprised chief complaint (pain, swelling, caries, preventive care, other), health condition (healthy, medically compromised/ICD 10-classification), previous dental treatment under general anaesthesia as well as fluoridation measures (toothpaste: no/

yes, salt: no/yes, tablet no/yes, other: no/yes). Furthermore, information about oral hygiene (toothbrushing alone or with help) and drinking habits (bottle, cup) were obtained.

Intraoperative data included ASA-classification, operator, the number of decayed (d/D), missed (m/M) and filled (f/F) teeth (dmft/DMFT), ECC-classification, number and type of restorations (composite, stainless steel crowns), number and kind of endodontic treatments (pulpotomy, root canal treatment) and extractions. Data on postoperative treatment included attendance of first follow-up appointment within two weeks after general anaesthesia (no/yes) and attendance and frequency of preventive recall appointments. Data collection was performed by one single examiner (T.K.).

Statistical analysis

Descriptive statistics were calculated for children receiving one or more dental treatments under general anaesthesia during the period under study. Children with at least one follow-up visit were included in the statistical analysis. Therefore, Kaplan-Meier statistics was used to estimate the fraction of children requiring repeated dental treatment under general anaesthesia. Potential predictive factors for repeated dental treatment under general anaesthesia were tested using univariate log-rank tests and were then submitted to a multivariate cox regression. The significance level was set to $\alpha = 5\%$ for all statistical tests. All analyses were performed with the statistic software R (version 3.5.2; R Core Team 2018) using the R-package survival for the time-to-event analyses.

Results

Nine hundred thirty-five children were treated under general anaesthesia from 03/2010 to 10/2018. Patients characteristics are presented in Table 1. One hundred fifteen children (12.3%, mean age: 6.5 ± 3.4 years) received ($n = 104$), were scheduled, but did not show up ($n = 9$) or were planned to receive ($n = 2$) a second dental treatment under general anaesthesia. In 12 children (1.3 %, mean age: 10.3 ± 4.8 years) a third treatment was performed ($n = 8$) or planned ($n = 4$) at the time of data extraction. Time intervals between first and second general anaesthesia and second and third general anaesthesia amounted to 22 ± 18 and 23 ± 20 months, respectively. Three hundred fifty-nine children (mean age: 4.8 ± 2.4 years, females: 42.6%) were included in the Kaplan-Meier statistics. The estimated fraction of children saved from repeated dental treatment under general anaesthesia is presented in Figure 1. Factors with a significant univariate association to the time for second treatment in general anaesthesia are presented in Table 2. The multivariate cox regression revealed the use of fluoridated toothpaste (hazard ratio: 0.28, confidence interval: 0.16 – 0.51, $p < 0.01$) and attending 2 or more recall appointments per year (hazard ratio: 0.6, confidence interval: 0.48 – 0.74, $p < 0.01$) to significantly reduce the risk for repeated dental treatment under general anaesthesia.

Discussion

This study aimed to determine patient and treatment characteristics of children receiving comprehensive dental treatment under general anaesthesia to analyse potential risk factors making repeated dental treatment in general anaesthesia more likely. Patient and treatment characteristics could be

obtained from a large pool of children ($n = 935$) treated under general anaesthesia. Age distribution [Bücher et al., 2016; Takriti et al., 2019] and percentage of children with relevant medical conditions [Takriti et al., 2019] were similar to other specialised centres in Germany. Accordingly, the vast majority of children received dental treatment, mainly fillings and extractions, due to caries. The amount of children receiving a second or a third dental treatment in general anaesthesia corresponds well to data from previous studies [Bücher et al., 2016; Tahmassebi et al., 2014]. However, validity is limited as only about 30% of the children could be followed-up beyond the post-operative appointment, while the majority of patients did not attend further recall appointments. Although it is possible that children have received further treatments under general anaesthesia outside of our department, it seems unlikely as there are very few specialised centres in the near surrounding. Moreover, most of the children requiring repeated general anaesthesia did not attend recalls unless a second or third treatment under general anaesthesia became necessary. This observation confirms that probably most children in need for further dental treatment under general anaesthesia would have attended our clinic.

Although only about 30% of the children could be included in the Kaplan-Meier statistics, age and gender distribution of these children reflects the whole study population, thus it can be considered as an adequate sample. The multivariate Cox-regression model identified only two factors to be relevant for repeated dental treatment: Attending 2 or more recall appointments per year and the use of fluoridated toothpaste. As frequently shown in previous studies, irregular attendance of recall appointments or missing check-ups increase the risk for repeated general anaesthesia [Kakaounaki et al., 2011].

Interestingly, the use of fluoridated toothpaste significantly affected the risk for repeated treatment under general anaesthesia. The overall percentage of children receiving fluoridated toothpaste (65.6%), fluoride tablets (19.4%) and fluoridated salt (20.5%) was low when compared to other studies from Germany (toothpaste: 81 to 95%, tablets: 50 to 90%, salt: 55 to 92%) [Trube, 2004; Buske et al., 2009; Winter et al., 2015; Deichsel et al., 2012; Meyer-Lueckel et al., 2010]. However, the information about fluoridation measures could not be objectively verified as it was obtained from questionnaires in the patients records. A recent study by Martin et al. [2019] presented significant differences between the parent-reported use of fluoridated toothpaste (39.0%) and the actual use of fluoridated toothpaste (71.4%) in low-income families. Many parents were unaware if their child's toothpaste contains fluoride (36.6%), which most often was the case [Martin et al., 2019]. However, even when considering that the use of fluoridated toothpaste might be underestimated in the present study, the relative difference between children with a single treatment under general anaesthesia and repeated treatment was significant.

Parental knowledge and attitudes toward oral hygiene measures often needs to be improved in children requiring dental treatment under general anaesthesia [Karki et al., 2011; Olley et al., 2011], probably also as they are coming disproportionately often from lower socioeconomic and/or educational background [Ramdaw et al., 2017; Harper et al., 2019]. To a lower extent, parents might also refuse fluoridation measures, e.g. due to safety issues [Chi, 2017]. Fluoride refusal depended on age and university degree of caregivers [Chi, 2014]. Interestingly, although all children and parents received oral hygiene education prior to dental treatment and at the recall visits (if attended), the use of fluorides at first treatment

	First general anaesthesia (n = 935)		Second general anaesthesia (n = 115)		Third general anaesthesia (n = 12)	
Age (mean ± standard deviation)	4.6 ± 2.4		6.5 ± 3.4		10.3 ± 4.8	
Gender (%)						
Female/male	43.6/56.4		38.3/61.7		41.7/58.3	
Payment (%)						
Public health insurance/self-payment/social welfare	95.4/1.5/3.1		96.5/1.7/1.7		100/0/0	
Siblings						
Number of siblings (mean ± standard deviation)	1.9 ± 1.4		-		-	
Dental treatment of siblings in general anaesthesia (%)	25.0		-		-	
Chief complaint at first general anaesthesia (%)*						
Pain	53.3		-		-	
Swelling	53.7		-		-	
Caries	97.3		-		-	
Preventive care	6.5		-		-	
Other	10.1		-		-	
Health condition (%)						
Healthy/Medically compromised	71.3/28.7		53.9/46.1		33.3/66.7	
ASA-classification (%)						
1/2/3	87.6/11.9/0.5		70.4/27.8/1.7		33.3/66.7/0	
Previous dental treatment in general anaesthesia (%)	5.6		n.a.		n.a.	
Fluoridation measures (%)*						
- toothpaste	65.6					
- salt	20.5					
- tablet	19.4					
- other	6.6					
Toothbrushing						
Alone	57.0					
With parents	79.1					
Drinking habits						
cup	89.9					
baby bottle (alone or additionally to cup)	42.1					
dmft/DMFT (mean ± standard deviation)	9.1 ± 4.1		10.0 ± 5.0		14.0 ± 3.1	
d/D	before G.A.	after G.A.	before G.A.	after G.A.	before G.A.	after G.A.
m/M	9.0 ± 4.2	0	4.4 ± 3.7	0	3.4 ± 2.0	0
f/F	0.1 ± 0.6	3.8 ± 2.9	2.8 ± 2.0	4.2 ± 3.1	4.1 ± 3.1	5.9 ± 2.4
	0.1 ± 0.5	5.3 ± 2.9	2.9 ± 2.8	5.8 ± 3.3	6.5 ± 3.5	8.1 ± 3.3
ECC-classification (%)						
0/1/2/3	4.3/23.1/60.5/12.1		n.a.		n.a.	
Treatment (mean ± standard deviation)						
direct restorations (composite/compomere)	4.7 ± 3.1		2.4 ± 2.4		1.4 ± 1.3	
stainless steel crowns	0.6 ± 1.1		0.9 ± 1.6		0.3 ± 0.0	
pulpotomy/endodontic treatment	0.1 ± 0.5		0.1 ± 0.0		0	
extractions	3.7 ± 3.2		1.5 ± 2.2		2.1 ± 0.9	
Recall appointments						
- post-operative follow-up (%) (within two weeks after treatment)	50.1		52.2		50.0	
- preventive recall appointments (%) (after postoperative follow-up)	29.5		27.0		41.7	
- frequency of preventive recall appointments per year (mean ± standard deviation)	5.3 ± 5.0		3.5 ± 2.9		2.5 ± 1.4	

TABLE 1 Demographic, anamnestic and treatment factors of children treated once, twice or thrice in general anaesthesia.

n.a. = not applicable - G.A. = general anaesthesia

* more than one answer possible

#preventive recall appointments between second and third treatment in general anaesthesia

Parameter	p-value
ASA classification	0.012
Mental and behavioral disorder	0.029
Diseases of the nervous system	0.019
Swelling	0.001
Insurance status	0.017
Use of fluoridated toothpaste	< 0.001
Use of fluoridated salt	0.009
Use of fluoride tablets	0.039
Operator at first dental treatment under general anaesthesia	< 0.001
Recall (yes/no)	< 0.001
Recall appointments per year (<2 vs ≥2)	< 0.001

TABLE 2 Parameters with a significant univariate association to repeated dental anaesthesia.

Excluded from the multiple model were 'swelling' (due to the number of missing values) and 'insurance status' and 'recall at dentist' (due to the limited number of events in the subgroups). 'Operator' was also dropped due to its many levels. As inclusion of 'recall (yes/no)' and 'recall appointments per year (<2 vs ≥2)' simultaneously leads to results which are hard to interpret, 'recall (yes/no)' was dropped in favour of 'recall appointments per year'.

remained a significant factor to predict repeated treatment.

Unfortunately, only limited information on socioeconomic status (insurance, number of siblings) of parents could be obtained due to the retrospective design of this study. In the univariate analysis, insurance status was significantly associated with repeated treatment, indicating that children receiving monetary support from the social welfare system were at higher risk for repeated treatment than children with public health insurance. Furthermore, operator was significantly associated with repeated treatment in the univariate analysis, which most probably can be explained by an imbalance in the number of children treated by one operator. Some operators treated only few children, partly with relevant medical conditions, while the large majority of children was treated by few operators.

Conclusion

This study underlines that children in need for dental treatment under general anaesthesia need to adhere to preventive recall appointments and to oral hygiene recommendations (especially the use of fluoridated toothpaste) to avoid repeated treatment under general anaesthesia.

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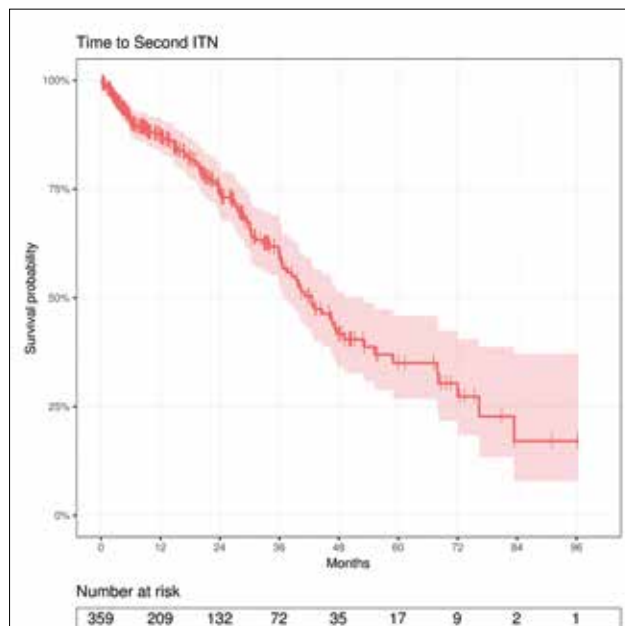


FIG. 1 Kaplan-Meier estimate for time to second dental treatment under general anaesthesia

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