

Prevalence and distribution of deep caries and abscess formation in children who required emergency dental general anaesthesia. A retrospective analysis



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Abstract

Aim The aim of this study was the assessment of prevalence, distribution, and treatment of deep caries and odontogenic abscess formation in children who received emergency dental general anaesthesia (DGA) at the University Hospital of Cranio-Maxillofacial and Oral Surgery of Innsbruck, Austria.

Materials and Methods The study population was composed of 1,184 consecutive cases of emergency DGA from January 2008 to June 2014, in patients ≤ 16 years who had presented with odontogenic pain and/or swelling. Under DGA, the tooth causative for the acute pain, and all teeth with deep caries had been routinely removed. From patient files, demographic data, abscess location and therapy, and the number of teeth extracted under DGA were recorded and analysed by means of descriptive statistics.

Results In 549 cases (46.4%) (mean age 5.29 ± 2.39 years), an abscess formation was recorded; 90.5% of all abscesses were submucous, and 9.5% affected fascial spaces. Decayed primary molars and maxillary primary incisors and canines were most often causative for abscess formation. Drainage was in most cases performed by tooth extraction with/without an intraoral incision under antibiotic therapy. Per case, a mean of 5.91 ± 4.04 primary teeth were extracted. In 77 individuals (mean age 9.83 ± 2.59), a mean of 1.92 ± 1.02 permanent first molars were extracted.

Conclusions In the study population, prevalence of deep caries and abscess formation was alarmingly high. In consideration of the medical risks and high efforts immanent in DGA, educational measures should address parents in order to raise awareness of their responsibility for their children's health.

Introduction

Dental caries may—by toothache, limitation on food intake, sleeplessness, irritability, diffidence, and social impairment—tremendously impact children's quality of life [Rane et al., 2017; Goodwin et al., 2015]. Furthermore, progressive tooth decay may lead to odontogenic infections ranging from periapical inflammation or submucous abscess up to life threatening conditions such as phlegmons in head or neck spaces, airway obstruction, sepsis, osteomyelitis, meningitis, or cavernous sinus thrombosis [Bali et al., 2015; Han et al., 2016]. Even though severe complications rarely occur in children, in case of odontogenic abscess formation, immediate treatment in terms of tooth trepanation or extraction and/or abscess drainage, combined with antibiotic therapy, is required.

In Innsbruck (Austria), admission and emergency treatment of patients presenting with odontogenic pain and abscess formation is performed 24/7 at the University Hospital of Cranio-Maxillofacial and Oral Surgery. In children, due to anxiety or limited cooperation, a surgical intervention is frequently manageable only under general anaesthesia (GA). Especially in an acute setting, GA provides several advantages, such as a rapid onset of action and an optimal titration of anaesthetics [Malamed, 2018]. However, due to anatomic, (patho)physiological, pharmacokinetic and -dynamic specifics to children, a certain risk of complications is inherent in paediatric GA and implicates an obligation to preoperatively obtain their parents' or caretakers' informed consent to the procedure [da Fonseca and Nelson, 2014; Gonzales et al., 2012]. In the course of emergency dental general anaesthesia (DGA) in children at the University Hospital of Cranio-Maxillofacial and Oral Surgery of Innsbruck, after a thorough anamnesis, a clinical examination and—with sufficient cooperation—a radiological assessment by means of an orthopantomogram (OPG), extraction not only of the tooth causative for the acute pain and/or swelling, but of all primary and/or permanent teeth with deep caries considered not worth preserving, is performed. Teeth presenting earlier stages of decay and requiring restorative therapy remain untreated. For these teeth, further management (treatment in a scheduled setting) is necessary.

The general population of the Federal State of Tirol (Austria)

KEYWORDS Childhood caries, Deep caries, Dental general anaesthesia, Dental neglect, Odontogenic abscess.

has been shown to present a high level of education and commitment in general and oral health issues [Gesundheit Österreich GmbH, 2012]. By oral health surveys according to WHO policies, a mean d3mft score (primary teeth decayed within dentin, missing due to caries, and filled) of 0.7 was found in six-year-old children, and absence of any caries was assessed in 74% of all six-year-olds in the year 2011, a percentage already close to the WHO goal of 80% caries-free six-year-olds in 2020 [Gesundheit Österreich GmbH, 2012]. The public health care system has nevertheless been severely challenged by a polarisation of caries in children of high risk groups frequently coming from families with a low educational level or a migratory background [Luckner-Hornischer et al., 2009].

The aim of this study was a breakdown of data on prevalence, distribution, and treatment of odontogenic abscesses and deep caries in the primary or mixed dentition in a selection of children who received acute DGA at the University Hospital of Cranio-Maxillofacial and Oral Surgery of Innsbruck (Austria).

Materials

Subjects

The study population was composed of 1,184 consecutive cases of emergency DGA at the University Hospital of Cranio-Maxillofacial and Oral Surgery, from January 1st 2008 to June 30th 2015, in patients aged ≤ 16 years presenting with toothache and/or odontogenic swelling not manageable under local anaesthesia. DGA was performed either on the day of admission or the following day (in order to ensure an empty stomach or for reasons of capacity). In dependence of their medical condition, the patients underwent pre- and postoperative inpatient care or preoperative out- and postoperative inpatient treatment including a concomitant course of antibiotics (oral or intravenous aminopenicillin plus a beta-lactamase inhibitor or, in case of allergy, erythromycin) and antiphlogistic/antipyretic therapy.

Study design and data acquisition

The study was set up as a retrospective analysis of anonymised data extracted from digital patient files (which were introduced in the Hospital of Cranio-Maxillofacial and Oral Surgery in the year 2008). Ethical approval by the local ethical committee was obtained in advance, study number AN2015-0063 347/4.9.

The following anonymised data were extracted from case files, coded by numbers, and listed in a table (Excel, Microsoft, Redmond, WA, USA).

- a) Date of birth.
- b) Date of DGA.
- c) Gender, male/female.
- d) OPG, yes/no.
- e) Preexisting fillings in primary or permanent teeth, derived from existing OPGs, assigned to tooth numbers.
- f) Preexisting fillings in primary teeth assigned to tooth numbers and previously missing primary canines and molars in six-year-olds, derived from existing OPGs.
- g) Abscess location and therapy, as far as documented in the operative report.
- h) Number and tooth numbers of primary teeth or permanent first molars extracted under DGA.

Only OPGs of good quality, taken shortly before or at the day of DGA, were evaluated with regard to teeth with preexisting fillings and to previously missing primary canines and molars. Fillings were assigned to teeth only, but not to

certain tooth surfaces. In case of multiple treatment, only the OPG at the first assignment was evaluated.

Six-year-olds, presenting a target group of WHO oral health surveys, were evaluated separately.

Data analysis

In this study, data was analysed descriptively. Results of analysis were reported as mean \pm standard deviation (SD) or absolute and relative frequencies, according to the data type.

All computations were performed by means of SPSS software (SPSS Statistics Version 21, IBM, Armonk, NY, USA).

Results

Subjects

Mean age of subjects at the time of DGA was 5.29 ± 2.39 years (range 1 to 16 years). In 167 cases (14.1 %), children were six years old.

As far as gender, 664 cases (56.1%) were male, and 520 (43.9 %) were female.

Orthopantomogram

A preoperative OPG was available in 186 (15.7% of a total of 1,184) cases, and in 31 (18.6 % of 167) cases of six-year-old children at their first DGA.

Multiple treatment

The 1,184 cases of emergency DGA in patients aged ≤ 16 years pertained to 1,141 subjects.

Within the surveyed time span of 7.5 years, 43 subjects required emergency DGA twice, and 78 patients received additional scheduled DGA at the University Hospital of Dental Prosthetics and Restorative Dentistry of Innsbruck.

Preexisting fillings

In all children with OPG at first DGA ($n=186$), the mean number of previously filled primary and permanent teeth was 0.80 ± 1.70 .

In 6-year-old children with OPG at first DGA ($n=31$), the mean number of previously filled primary teeth was 0.94 ± 1.87 (range 0 to 7), and the mean number of missing primary canines or molars was 3.29 ± 2.77 .

In 6-year-olds, permanent first molars were neither missing nor presented fillings in any OPG.

Abscess location and therapy

In 549 (46.4% of a total of 1,184) cases, an abscess location was explicitly documented in the operative report by the surgeon in charge, as shown in Table 1. Decayed primary molars were the most frequent cause for dental abscesses ($n = 384$; 69.9%). While decayed primary maxillary incisors ($n=122$; 22.2%) and canines ($n=25$; 4.6%) were also frequently identified as causative for dental abscesses, only one abscess (0.2%) originated from primary mandibular incisors, and two abscesses (0.4%) originated from primary mandibular canines.

In 15 cases (2.7%), permanent molars were causative for abscess formation. While only one abscess was assigned to a maxillary molar, 14 abscesses were assigned to mandibular molars. In 326 (59.4% of 549) abscess cases, abscess location was in the maxilla, and in 223 (40.6% of 549) cases, abscess location was in the mandible; 497 (90.5% of 549) abscess cases were classified as submucous abscess formation, and 52 (9.5% of 549) cases were assigned to a fascial space. In 43 cases (7.0%) the canine fossa, in 8 cases (1.46%)

	Tooth	Abscesses frequency
1st Quadrant	51	42
	52	21
	53	11
	54	52
	55	36
	16	0
	Total	162
2nd Quadrant	61	28
	62	31
	63	14
	64	58
	65	32
	26	1
	Total	164
3rd Quadrant	71	0
	72	0
	73	0
	74	44
	75	54
	36	5
	Total	103
4th Quadrant	81	0
	82	1
	83	2
	84	48
	85	60
	46	9
	Total	120

TABLE 1 Prevalence of abscess formation in teeth and quadrants.

the submandibular space, and in one case (0.18%) the pterygomandibular space were affected.

In all but two cases of abscess formation, extraction of the causative primary or permanent tooth/teeth, with or without an intraoral abscess incision, effected a sufficient abscess drainage. Whether an enoral incision was made or not, was not consistently documented in the operative reports.

In two cases of submandibular abscess, a percutaneous extraoral drainage was performed.

Extractions under DGA

In the investigated period, a total number of 7,000 primary teeth and 148 permanent teeth were extracted under DGA.

Extraction of primary teeth

The mean number of extracted primary teeth per case was 5.91±4.04 (range 1 to 20). In 9 cases, 20 primary teeth were extracted. The distribution of extracted primary teeth by quadrants and by jaws is depicted in Tables 2 and 3.

Extracted primary molars (n=4,317) represent 61.67% of all extracted primary teeth (n=7,000). The ratio of extracted first primary molars (n=2,379) to extracted second primary molars

	Primary tooth	Extraction frequency
1st Quadrant	51	505
	52	453
	53	229
	54	591
	55	434
	Total	2212
	2nd Quadrant	61
62		463
63		248
64		623
65		444
Total		2265
3rd Quadrant	71	30
	72	36
	73	77
	74	610
	Total	1284
4th Quadrant	81	33
	82	40
	83	82
	84	555
	Total	1239

TABLE 2 Frequencies of extractions assigned to primary teeth and quadrants.

Primary teeth	Maxilla (n1)	Mandible (n2)	Ratio (n1:n2)
Total	4,477	2,523	1.77
Molars	2,092	2,225	0.94
Canines	477	159	3
Incisors	1,908	139	13.73
Canines * incisors	2,385	298	8

TABLE 3 Distribution of extracted primary teeth by jaw. n1, number of extracted maxillary teeth; n2, number of extracted mandibular teeth.

(n=1,938) is 1.23. The ratio of extracted maxillary primary molars (n=2092) to extracted maxillary primary anterior teeth (canines plus incisors) (n=2,385) is 0.88. The ratio of mandibular primary molars (n=2,225) to extracted mandibular primary anterior teeth (canines plus incisors) (n=298) is 7.47.

Extraction of permanent teeth

The mean number of extracted permanent teeth (which were exclusively first molars) was 0.13±0.53.

A total of 148 permanent teeth were extracted in 77 subjects at a mean age of 9.83±2.59 years, which amounts to 1.92±1.02 permanent extracted teeth per individual.

Tooth 36 was extracted in 44 patients (30%), tooth 46 in 39 patients (26%), tooth 26 in 38 patients (26%), and tooth 16 in 27 patients (18%).

Extraction of primary and permanent teeth

The mean number of extracted primary and permanent teeth per case was 6.04 ± 3.96 .

Discussion

Although, within Austria, Tirol is deemed a flagship state in general and oral health concerns [Gesundheit Österreich GmbH, 2012; Bodenwinkler et al., 2012], around 160 cases of emergency DGA in children per year present at the University Hospital of Cranio-Maxillofacial and Oral Surgery of Innsbruck. An extraction rate of 6.04 ± 3.96 teeth per case at a mean age of 5.25 ± 2.39 years points out a high prevalence of profound caries, associated with abscess formation, in the population investigated in this study. The necessity for extraction of the complete primary dentition in some children and for removal of permanent molars in some ten-year-olds, and the demand for multiple emergency DGA in more than 40 subjects within the surveyed period of 7.5 years, poignantly illustrate the failure of the public healthcare system in certain sections of the population. The low number of only 186 preoperative OPGs available in 1,184 cases may be explained by the children's non-cooperation and by the existence of (a neglectable number of) externally taken OPGs brought in by the patients and not integrated in the digital database. While a low number of 0.80 ± 1.70 previously filled teeth per child and of 0.94 ± 1.87 previously filled teeth per six-year-old child reflect a low amount of precedent consultation rates in the investigated groups, a relatively high number of 3.29 ± 2.77 missing primary canines or molars per six-year-old child indicates the previous treatment of profoundly carious teeth (maybe under DGA?) already at a young age. The number of maxillary primary anterior teeth extracted under DGA constituting eightfold the number of extracted mandibular anterior teeth, and a 49 times higher prevalence of odontogenic abscess formation in the anterior regions of the maxilla as compared to the anterior mandible, match a caries distribution typical in the nursing (baby) bottle syndrome [Behrend et al., 2001; Ferro et al., 2004].

Emergency DGA is a challenging task in several aspects. Acute septic surgery in children, at times performed during night shifts, carries the risk of anaesthetic and surgical complications such as airways obstruction (e. g. laryngospasm on extubation), cardiocirculatory events, infection of deep fascial spaces, or sepsis [Gonzales et al., 2012; De Francisci et al., 2013; Adoviča et al. 2017; Ogle, 2017]. However, no severe complications during or after DGA were reported in 1,148 cases surveyed in this study. Nonetheless, with caries being a preventable infectious disease [Balakrishnan et al., 2000], health care programmes should focus on the enhancement of oral and general health standards in high risk groups. Prophylactic approaches should thereby address pregnant women and parents of infants, and emphasise (oral) health consciousness by education in nutrition, life style and domestic oral hygiene [Wagner and Heinrich-Weltzien, 2017; 2017]. The amendment of a mandatory dental examination of the expectant mother (eventually followed by consultation and dental treatment) to the maternity passport (a document regulating medical care during pregnancy and infancy up to the child's fifth birthday, and required for the claim for public child-care allowance in Austria) should be considered. Furthermore, parents should be enjoined to adhere to regular dental attendance for their children. Parents' failure in providing oral care to their children, in seeking dental treatment, or in complying with treatment, has been associated with child neglect and abuse [Lourenço et al., 2013; Costacurta et al., 2015; da

Silva-Júnior et al., 2017; Kvist et al., 2017; Sillevs Smith et al., 2017], grievances certainly not to be connived at in a state with a highly developed health care system.

Conclusion

An alarmingly high prevalence of deep caries and abscess formation in a population of children requiring emergency DGA indicates a severe caries polarisation and a need for improvement of preventive measures in some social groups within a mid-European state of high health standards. In these groups, the parents' awareness of the responsibility for their children's health and quality of life should be raised in consideration of the medical risks and high efforts immanent in DGA.

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Conflicts of interest

The authors declare that there are no conflicts of interest in this study.

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