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Original Article

Predictors of Dental General Anesthesia Receipt among Children Attending a Tertiary Hospital in Saudi Arabia

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Abstract

Aim: Children are normally treated in a dental chair, despite that some may have their treatment done under dental general anesthesia (DGA). Factors affecting the decision on DGA include the quality and quantity of treatment needed and child's age and cooperation. This study aimed to estimate the prevalence of DGA among children with dental caries and to identify the associated factors in a tertiary care setting in Saudi Arabia. **Methods:** A cross-sectional study of 400 children with dental caries was conducted. Data were collected from the patients' records including demographic, behavioral, and clinical information, diagnosis using caries indexes (Decayed, Missing, Filled Teeth/decayed filled teeth [dft]), and number of DGA and its indications. Logistic regression analysis was applied to identify the predictors of DGA, and significance was considered at $P \leq 0.05$. **Results:** The study included 400 children; 55% of them were below the age of 6 years, with a mean age of 6.4 ± 2.3 years. About one-half of children were males (51.7%) and unhealthy (48.2%). The majority were of negative behavior (70.7%) and noncomplaint to dental appointments (70.3%). More than three-fourth of children (78.5%) experienced one or more DGA. GA use was significantly associated with gender ($\chi^2 = 4.30$, $P < 0.04$), age ($t = 12.37$, $P < 0.0001$), health status ($\chi^2 = 16.02$, $P < 0.0001$), dft index ($z = 11.44$, $P < 0.0001$), child behavior ($\chi^2 = 48.54$, $P < 0.0001$), age at the first dental visit ($t = 11.73$, $P < 0.0001$), number of dental treatment visits ($z = 11.14$, $P < 0.0001$) and dental preventive visits ($z = 7.21$, $P < 0.0001$) before the index dental visit, and compliance with dental appointments ($\chi^2 = 39.50$, $P < 0.001$). However, after adjusting for confounders, using the logistic regression analysis, DGA use was predicted by unhealthy children (odds ratio [OR] = 27.35, $P = 0.002$), those with a negative behavior (OR = 18.28, $P = 0.003$),

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and those with higher dft index (OR = 1.68, $P < 0.001$). **Conclusions:** Noncooperation, general health status, and dental caries level (dft) were the main factors for the decision of DGA. High caries-risk children must be the target for behavioral management to minimize their need for treatment under DGA. Post-DGA appointment to guide the child back to normal dental care is recommended.

Keywords: Caries index, child behavior, dental, dental caries, general anesthesia, oral health, Saudi, uncooperative

Introduction

Dental caries is a preventable, chronic disease that affects around 621 million worldwide.[1] In a study that has been conducted in Saudi Arabia, 65% of caries prevalence was reported in children.[2] In the United Kingdom, the caries prevalence reached 49% in children aged 5 years, and in Jordan, in preschool children, it ranged from 48% to 67%.[3,4] The American Academy of Pediatric Dentistry (AAPD) recommended that the child first dental visit be on the time of eruption of the first tooth; therefore, the dentist would be able to assess the child oral health and craniofacial development and also to educate the parents or caregivers on prevention measures.[5] In Saudi Arabia and other countries, it was reported that children are brought to a dentist later than the recommended and mostly due to pain.[6-10]

Treating young children can become very challenging, and not all children can be approached by behavioral management techniques as tell-show-do and positive reinforcement.[11] Thus, if the behavior of the child cannot be managed, other techniques are necessary to treat those uncooperative and emotional children, such as conscious sedation and dental general anesthesia (DGA).[3]

The AAPD defined DGA as "a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation."[12] Demand for DGA is increasing worldwide.[13-15] Nowadays, DGA is frequently used because of dental fear, lack of cooperation, medical condition, ineffective local anesthetics, and extensive treatment need.[16-19] Besides, DGA provides a single treatment visit, better moisture control, and little or no need for cooperation from the child, and it improves the child quality of life.[1,13,20-23]

Although DGA is safe, it is still unpredictable procedure, and it may lead to morbidity and mortality in unfortunate cases.[19,24] Hence, to reduce the incidence of DGA, early recognition of high-risk patients should be the goal.[25] It is important to identify the risk factors that contribute to DGA administration in children; as such, knowledge will help to reduce its use and also to plan for preventive programs targeting higher-risk groups. Therefore, it seemed appropriate to carry out a study to assess the factors influencing the administration of general among the pediatric population.

Methods

Study design

A cross-sectional study was conducted.

Study setting and study subjects

This study was conducted at King Abdullah Specialized Children's Hospital (KASCH), a tertiary pediatric hospital in Riyadh, Saudi Arabia, with a total capacity of 552 beds, after granting the ethical approval from the IRB of the Ministry of National Guard-Health Affairs, Riyadh, Saudi Arabia, (Ref.# IRB/RSS18/002/R). All children diagnosed with dental caries in KASCH, from April 2016 to April 2017, made the target of the study ($n = 400$ children).

Data collection

Medical records were examined for 400 children with dental caries to collect data on the following:

1. Demographic characteristics including gender, age, health status (healthy and unhealthy), and child behavior at the index visit according to Frankl's scale, which classifies the child behavior into four categories: definitely positive, positive, negative, and definitely negative.[26] Children were categorized to either cooperative (definitely positive and positive) or

uncooperative (negative and definitely negative) based on the information registered in the records by their treating dentists. The child was considered unhealthy when he/she had a diagnosis of any medical disorder, such as asthma, blood diseases, or a developmental/mental disorder

2. Disease characteristics: Caries index (decayed filled teeth [dft] and Decayed, Missing, Filled Teeth [DMFT]), oral health status to (poor, fair, good, and excellent), age at which the child first visited the dentist, number of treatment visits, number of preventive visits, number of missed visits, and noncompliance to dental visits (those who attended <70% of the scheduled appointments were considered noncompliant)
3. GA: The prevalence of GA was estimated for all children diagnosed with dental caries.

Data analysis

Data were entered and analyzed using Statistical Package for the Social Sciences software (SPSS version 26.0;IBM Corporation, Armonk, NY, USA). Mean and standard deviation were used for continuous parametric variables, the median and interquartile range for continuous nonparametric variables, and the numbers and percentages for categorical variables. Chi-square test and Fisher's exact test were used to compare categorical variables, and Student's *t*-test and the Mann–Whitney test were used to compare continuous variables. Logistic regression analysis was applied to identify the significant predictors of DGA use. Significance was considered at $P \leq 0.05$.

Results

The study included 400 children; 55% of them were below the age of 6 years, with a mean age of 6.4 ± 2.3 years. About one-half of children were males (51.7%) and unhealthy (48.2%). The majority were of negative behavior before the index dental visit (70.7%) and noncomplaint to dental appointments (70.3%). The median age of first dental visits was 5 years (interquartile range [IQR], 3 rears) It was 1 year (IQR, 1 year), for the number of dental treatment visits, 1 year (IQR, 1 year) for dental preventive visits, 10 years (IQR, 7 years) for dft index, and 1year (IQR, 4 year) for DMFT index [Table 1].

More than three-fourth of children (78.5%) experienced one or more DGAs. GA use was significantly associated with gender (χ^2=4.30, P<0.04), age (t=12.37, P<0.0001), health status (χ^2 = 16.02, P < 0.0001), dft index (z = 11.44, P < 0001), child behavior (χ^2 = 48.54, P < 0001), age at the first dental visit (t = 11.73, P < 0.0001), number of dental treatment visits (z = 11.14, P < 0001) and dental preventive visits (z = 7.21, P < 0001) before the index dental visit, and compliance with dental appointments (χ^2 = 39.50, P < 0.001). Nearly, all children (98.5%) were presented with poor or fair oral health status, with no significant association with GA use (P = 0.14) [Table 1]. After adjusting for confounders, using the logistic regression analysis, DGA use was predicted by unhealthy children (odds ratio [OR]=27.35, P=0.002), those with a negative behavior (OR = 18.28, P=0.003), and those with higher dft index (OR = 1.68, P<0.001) [Table 2].

Discussion

Based on the results of this study, the prevalence of GA among pediatric patients who were treated in King Abdullah Specialist Children Hospital was subjectively high (78.5%). A study conducted by Noura *et al*.,[3] in all of Dubai health sectors, reported prevalence that reached only 6.1% for 3 years. However, this high prevalence can be explained by the excessive need for treatment in those children, caused by fear making disease progression faster and much extensive. Furthermore, it is a tertiary referral hospital that provides free of charge treatment, thus explaining the high demands.

Factors affecting the decision on DGA include the quality and quantity of treatment needed and a child's age and cooperation.[27] In the present study, child's health, cooperation, and severity of dental caries were the significant predictors of DGA.

Dental clinics can be a very threatening environment for young children, leading them to show negative behavior and lack of cooperation. In our study, 70.7% showed uncooperative behavior at the first visit. Lack

Table 1: Prevalence of dental general anesthesia and association with demographic, behavioral, and clinical characteristics of the study population (*n*=400)

Variables	Used DGA (*n*=314; 78.5%), *n* (%)	Haven't used DGA (*n*=86; 21.5%), *n* (%)	Total (*n*=400; 100%), *n* (%)	*P*
Gender				
Male	171 (82.6)	36 (17.4)	207 (51.7)	χ^2=4.30, *P*<0.04
Female	143 (74.1)	50 (26)	193 (48.3)	
Age				
Up to 6 years	216 (98.2)	4 (1.8)	220 (55.0)	χ^2=112.21, *P*<0.0001*
>6-12 years	98 (54.4)	82 (45.6)	180 (45.0)	
Mean±SD	5.8±2.0	8.8±1.7	6.5±2.3	*t*=12.37, *P*<0.0001*
Health status *n* (%)				
Healthy	144 (76.6)	44 (23.4)	188 (51.8)	χ^2=16.02, *P*<0.0001*
Nonhealthy	161 (92.0)	14 (8.0)	175 (48.2)	
Oral health status				
Poor/fair	149 (77.2)	44 (22.8)	193 (98.5)	FET, 0.14
Good/excellent	1 (33.3)	2 (66.7)	3 (1.5)	
dft index, mean±SD	10.9±4.1	3.3±3.1	9.4±4.9	*Z*=11.44, *P*<0.0001*
DMFT index, mean±SD	1.8±2.4	1.9±2.0	1.8±2.3	*Z*=1.07, *P*=0.90
Behavior at visits				
Cooperative	32 (42.1)	44 (57.9)	76 (29.3)	χ^2=48.54, *P*<0.0001*
Uncooperative	155 (84.7)	28 (15.3)	183 (70.7)	
Age at first visit (years), mean±SD	4.9±2.0	7.8±2.0	5.6±2.3	*t*=11.73, *P*<0.0001*
Dental treatment visits, mean±SD	0.7±0.9	4.1±3.6	1.4±2.3	*Z*=11.19, *P*<0.0001*
Preventive dental visits, mean±SD	0.4±0.7	1.3±1.4	0.6±1.0	*Z*=7.21, *P*<0.0001*
Compliance				
Compliant (≥70%)	114 (98.3)	2 (1.7)	116 (29.7)	χ^2=39.50, *P*<0.001*
Noncompliant (<70%)	191 (69.5)	89 (30.5)	275 (70.3)	
Percentage compliance	70.1±23.2	52.5±7.1	66.2±22.0	*t*=11.42, *P*<0.001*

Z=Mann–Whitney test, χ^2=Pearson's Chi-square test, *t*=Student's *t*-test, *Statistically significant. DGA: Dental general anesthesia, dft: Decayed filled tooth, FET: Fisher's exact test, SD: Standard deviation, DMFT: Decayed, Missing, Filled Teeth

Table 2: Logistic regression analysis of dental general anesthesia receipt and some demographic and disease characteristics

	B	SE	*P*	OR	95% CI	
					Lower	Upper
Age: 0-6 versus >6 years (>6=1)	−2.27	1.54	0.14	0.10	0.01	2.10
Gender (male=1)	1.23	0.98	0.21	3.41	0.50	23.48
Health status (unhealthy=1)	3.31	1.04	0.002*	27.35	3.54	211.42
Age at 1st dental visit	−0.54	0.30	0.07	0.58	0.33	1.05
Behavior before DGA (negative=1)	2.91	0.97	0.003*	18.28	2.75	121.37
Number of dental treatment visits	−0.58	0.30	0.051	0.56	0.32	1.00
Number of preventive dental visits	−0.76	0.46	0.10	0.47	0.19	1.16
dft index	0.52	0.14	<0.001*	1.68	1.26	2.22
Compliance (noncompliant=1)	−0.10	1.50	0.95	0.91	0.05	17.15
Constant	1.45	2.31	0.53	4.27		

*Statistically significant. SE: Standard deviation, OR: Odds ratio, CI: Confidence interval, DGA: Dental general anesthesia, dft: Decayed filled tooth

of cooperation of children was the main indication for having dental treatment under GA.[3] Several other studies reported that noncooperative behavior was the most common reason for receiving DGA.[17,21,27-29] These findings were in agreement with the finding of the present study, where uncooperative behavior was a significant predictor of DGA in the present study, after adjusting for all other confounders.

Early childhood caries has been noted to be the most common cause of DGA in young children.[30] In the present study, children who received DGA showed higher severity of caries in primary

teeth (dft, 10.9 ± 4.1) as compared to those who did not use DGA (dft, 3.3 ± 3.1). This finding was in agreement with the finding of Bücher *et al*.[31] Dental health status was a significant predictor of DGA in our study.

The general child health status could be one of the factors associated with DGA use. In previous studies, healthy children received DGA in higher proportions than those among unhealthy children.[13,32,33] In a study of DGA among healthy and medically compromised children in Finland,[27] healthy children showed an increasing trend of DGA use during the study period, while medically compromised children had been treated more frequently under DGA in the past. The lower DGA use among unhealthy children might be attributed to the lack of communication between medical and dental physicians and poor dental consideration of parents of the medically compromised children as well difficult and late referral of those unhealthy children.[33] However, in our study, nearly all unhealthy children were subjected to DGA, and the unhealthy status of the child was a significant predictor of DGA. This might be due to the free of charge dental care in our tertiary care hospital with its well-organized referral system. Further study is necessary to investigate this issue.

In our study, nearly all preschool children were treated under DGA, as compared to one-half of school-aged children. A higher prevalence of DGA in preschool children reaching around two-thirds of the sample was reported in the literature.[13,15,29,34],while a lower prevalence was reported by Kakaounaki *et al.* Preschool kids are difficult to reach, unlike the school-age child who can be reached and given preventive programs in schools. Dental fear and lack of cooperation are common among toddlers and preschool children, and nowadays, DGA is frequently used to treat children with dental anxiety.[35] After adjusting for possible confounders, child's age was not a significant predictor of DGA use. Gender plays an important role, with higher levels of dental fear expressed by females,[36-38] which may lead to more likelihood of treatment under DGA. However, in our study, DGA was significantly associated with male gender; however, after adjusting for other confounders, gender was not a significant predictor of DGA.

The age at which children receive dental care for the first time varies and depends on many factors such as parents' socioeconomic status, previous dental experience, type of dental services (governmental versus private), dental health status, and other factors. In Murshid's study,[6] most children had their first dental visit between 3 and 5 years, and the majority showed positive behavior at their first visit. In the present study, the mean age at first dental visit for children, who attended KASCH for free dental service, was 5.6 years, which is considered as a delayed time for dental exposure if compared with the recommended age of 6 months to 1 year.[5] However, the mean age at the first dental visit was significantly lower for those who received DGA than its corresponding age among those who did not use DGA. This might reflect the severity of dental health among those children. However, age at the first dental visit was not a significant predictor of DGA use.

Early identification of high caries-risk patients and intensive preventive care and regular dental visits were the keys to reduce the number of children receiving treatment under DGA, due to severe dental caries.[39] This would explain the finding that DGA was significantly associated with smaller numbers of dental treatment and preventive visits, in the present study. This finding was in agreement with the finding reported by Grindefjord *et al*.[25] However, compliance was significantly associated with DGA in the present study. This may reflect the child's dental caries severity that forces parents to comply with dental appointment. However, after adjusting for other confounders, the number of visits and compliance were not significant predictors of DGA use.

This study has some limitations. It was done in one tertiary hospital that would not allow for generalization of conclusion. It is a retrospective study, using hospital records, and this would limit the amount of information available, due to missing data, that would restrict data analysis to a few specific variables. However, this study may highlight some necessary information to characterize children who are more prone to DGA. Conduction of population-based studies is recommended.

Conclusions

The results of this study showed that DGA was prevalent in Saudi Arabia, and children at high risk of DGA were unhealthy children, those with a high level of dental caries, and those with uncooperative behavior. These children need to be identified early and managed properly. Parents and caregivers of preschool children need to be accessed and educated to treat their kids early on before there dental condition worsen and effective management can be done. High caries-risk children must be the target for behavior management to minimize their need for treatment under GA. Post-DGA appointment to guide the child back to normal dental care is recommended.

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Authors contribution

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

This study was approved by the IRB of the Saudi Ministry of National Guard-Health Affairs (Ref.# RSS18/006/R). Consenting by children's parents was waived by the IRB, as the study was done by retrieving data from the medical records with no personal identifiers.

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