The Use of General Anesthesia in Pediatric Dental Care of Children at Multi-Dental Centers in Saudi Arabia

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Objective: *High caries reports in young Saudi children strongly suggest the need occasionally for general anesthesia to provide quality dental work. The purpose of this study was to investigate the characteristics of patients, dental procedures and hospital protocols for Pediatric Dental General Anesthesia (PDGA) procedure at multi-dental centers in Jeddah, Saudi Arabia.* ***Study Design:*** *Study sample included 90 children attending PDGA treatment at three governmental hospitals in Jeddah. Collected data included patient's demographics, medical condition, admission type, intra-operative protocols, and dental procedures.* ***Results:*** *Results showed the mean age of treated children was 5±2 years and the majority of them (93%) were treated for the first time under general anesthesia (GA). Long waiting duration for PDGA procedure was reported regardless of the patient age and medical status. Being very young with extensive caries was the major indication for GA (58%). Children mean preoperative fasting times were 10 ± 2 hours. Hospitals were significantly different in some protocols for PDGA procedures. Child behavior during GA induction was significantly related to child's age, premedication use, and hospital admission type. The mean number of treated teeth per child was 14±3.8 and the treatment mostly included restorations. Age was found to significantly affect the type of dental treatment, while gender and medical status did not.* ***Conclusions:*** *PDGA procedure is used mostly for young children with extensive dental caries. Children treated under GA received a comprehensive dental care in Saudi hospitals. Efforts should be directed to improve some of the existing hospitals protocols with PDGA procedure. The long waiting period for PDGA operation indicated the need to improve available facilities in the three hospitals.*

Keywords: *General anesthesia, hospital dentistry, dental treatment, children*
J Clin Pediatr Dent 33(2): 61–68, 2008

INTRODUCTION

One of the major health problems of children in Saudi Arabia is the high caries rate.[1-3] Almost eighty percent of the children accepted dental treatment with different routine behavior techniques, the remaining 20% of children expressed some degree of fear or anxiety, requiring pharmacological intervention to provide quality dental care.[4,5] Some dentists preferred to exhaust the behavioral methods and sedation before the use of general anesthesia (GA), while others decided to use GA with some children without wasting time and effort in behavior modification. According to American Academy of Pediatric Dentistry (AAPD) "the decision to use general anesthesia must take into consideration the alternative behavioral guidance modalities, dental needs of the patient, the effects on the quality of dental care, the patient's emotional development, and the patient's medical status."[6] In a survey about behavior techniques used by dentist in Saudi Arabia, sixty percent of them reported using GA to treat their patients.[7] The use of GA for pediatric patients to provide comprehensive dental care has increased all over the world.[8-9] However, long waiting time for PDGA procedures has been reported and its disruption of the children's life has been described.[8,10,11]

Extensive caries among children is the most common indication for PDGA treatment.[8] Behavior setbacks and medical condition are also considered a major indication for PDGA[10,12] as well as, trauma, acute infection, allergy, dental anomalies and surgery.[8, 13,14]

Under GA, pediatric dentists may not follow the same protocol of treatment used in the dental clinic. Child age and

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medical status are considered important factors in influencing dental procedures under GA.[13-15] Most of the children receive both restorations and extractions under GA,[13,16] however, a greater amount of extractions have been reported in other countries compared to treated cases under GA in Saudi Arabia.[12,16-18]

For dental GA, children can be admitted as in-patient (hospital stay) or out-patient (day stay). The medical condition of these children is the major determinant of their admission type. Basic monitoring methods were recommended to be used with PDGA by the AAPD for patient safety which include physical examination, temperature assessment, stethoscopes, sphygmomanometer, pulse oxymetry or capnography, electrocardiography.[19-21]

Dental General Anesthesia use in children has a tendency to increase due to the high reported caries prevalence among Saudi children. Few studies are available to describe the patient's demographics and dental treatment provided under GA in Saudi Arabia (SA) but no report is available to describe the protocols for PDGA procedures in SA hospitals. The purpose of this report is to provide an overview of current PDGA procedure with regards to patient demographics, hospital protocols and dental treatments at three hospitals representing three different governmental sectors in Jeddah, SA.

MATERIAL AND METHODS

The study was designed to be a prospective study. It included three governmental hospitals in Jeddah offering free dental rehabilitation under GA for pediatric patients: University Hospital (UH), Ministry of Health Hospital (MH), and National Guard Hospital (NGH). Ninety children who attended for dental rehabilitation under GA (30 from each hospital) were included in the study after parental consent.

General physicians and/or anesthesiologists cleared all children for GA pre-operatively. The operator completed dental examination and radiographs either at the pre-anesthetic appointment or in the operating room (OR) if the child was uncooperative. All parents signed the prepared informed consents described for them by their dentist. Dentists also told the parents about the proposed treatment, taking into consideration the possible needs to modify it at the OR. Also, verbal instructions were given to the parents about the pre-operative fasting hours required for their child. All data were collected in a pre-designed form by a single investigator.

Pre-operatively, the following data were recorded: age, weight, gender, medical condition, indication for GA (severe caries in a very young child, behavior problem, medical problems, others), information on previous Dental General Anesthesia (DGA), waiting time for DGA from the screening date until date of treatment, admission type (in-patient, out-patient), pre-operative fasting hours, and pre-medication used (type, route).

Intra-operatively the following data were recorded:

1. Monitoring techniques.
2. Children behavior during induction on a three-point scale (calm, uncooperative, very uncooperative).[16]
3. Dental data (teeth present/absent, type of treatment performed) as well as the other dental procedures such as prophylaxis, rubber dam use, space management, surgery, suture, and the use of local anesthesia.
4. Total dental time from the start of dental treatment to the end.
5. Total anesthesia time from induction to extubation.

DATA ANALYSIS

For analysis, some of the data were categorized into groups. Age was divided into young and older age groups (5 years, >5 years). Weight was plotted on an age-weight percentile chart[22] and categorized into three groups (underweight =below50% line, normal weight = at 50% line, over weight = above 50% line). The variable of "treated teeth" was calculated as the sum of filled and extracted primary and permanent teeth. Chi Square test, independent T test were used to compare between groups. A P-value of less than 0.05 was considered statistically significant.

RESULTS

1. Demographic variables

Participant's demographic data are presented in Table 1. The children's age range was from 1 to 13 years with the

Table1. Frequency distribution of demographic data for PDGA participants at different hospitals

Demographic Variables	Total	Hospital		
		UH	MH	NGH
	N=90 n (%)	N=30 n (%)	N=30 n (%)	N=30 n (%)
Age group				
⩽5 years	56 (62.2)	24 (80)	17 (56.7)	15 (50)
⩾5 years	34 (37.8)	6 (20)	13 (43.3)	15 (50)
Gender				
Male	46 (51.1)	15 (50)	16 (53.3)	15 (50)
Female	44 (48.9)	15 (50)	14 (46.7)	15 (50)
Indication for GA				
Very Young	52 (57.8)	17 (56.7)	18 (60)	17 (56.7)
Behaviour problem	18 (20)	2 (6.7)	7 (23.3)	9 (30)
Medical problem	18 (20)	9 (30)	5 (16.7)	4 (13.3)
Others	2 (2.2)	2 (6.7)	0	0
DGA history				
First time	84 (93.3)	27 (90)	28 (93.3)	29 (96.7)
Second time	6 (6.7)	3 (10)	2 (6.7)	1 (3.3)
Weight groups				
Under-weight	54 (60)	10 (33.3)	26 (86.7)	18 (60)
Normal weight	23 (25.6)	15 (50)	2 (6.7)	6 (20)
Over-weight	13 (14.4)	5 (16.7)	2 (6.7)	6 (20)
Medical condition				
Healthy	69 (76.7)	21 (70)	23 (76.7)	25 (83.3)
Medically compromised	21 (23.3)	9 (30)	7 (23.3)	5 (16.7)

UH: University Hospital
MH: Ministry of Health Hospital
NGH: National Guard Hospital

Table 2. Hospitals protocols with PDGA procedure.

Protocols and policy	Total	hospital			P-Value
		UH	MH	NGH	
	N=90 n (%)	N=30 n (%)	N=30 n (%)	N=30 n (%)	
Mean fasting hours					0.003
Less than 4 hours	0	0	0	0	
4-8 hours	17 (18.9)	7 (23.3)	0	10 (33.3)	
More than 8 hours	73 (81.1)	23 (76.7)	30 (100)	20 (66.7)	
Pre-medication use					0.000
Yes	43 (47.8)	15 (50)	0	28 (93.3)	
No	47 (52.2)	15 (50)	30 (100)	2 (6.7)	
Pre-medication type					0.000
Midazolam	38 (42.4)	10 (33.3)	0	28 (93.3)	
Ketamine	5 (5.6)	5 (16.7)	0	0	
Pre-medication route					0.000
Oral	36 (40)	8 (26.7)	0	28 (93.3)	
IV	5 (5.6)	5 (16.7)	0	0	
IM	2 (2.2)	2 (6.7)	0	0	
Hospital admission					0.000
In-patient	46 (51.1)	2(6.7)	29 (96.7)	15 (50)	
Out-patient	44 (48.9)	28 (93.3)	1 (3.3)	15 (50)	
Monitors					0.063
All monitors	70 (77.8)	26 (86.7)	19 (63.3)	25 (83.3)	
No temperature probe	17 (18.9)	4 (13.3)	8 (26.7)	5 (16.7)	
No capnography	3 (3.3)	0	3 (16.7)	0	

UH: University Hospital
MH: Ministry of Health Hospital
NGH: National Guard Hospital
P-value using Chi-Square test

mean 5.3 ±2.1 years. 62% of the treated children were under the age of 5. Males and females were operated evenly under GA at different hospitals. The majority of participants (93%) were treated for the first time under DGA and only six patients for the second time. The mean age of the children with second DGA was 8.2 ±3.7 years, which was higher than the mean age with the first DGA (5.1 ±1.8). In addition, the majority of the children were underweight (60%), while 25% of the patients were within the normal weight, and only 14.4% were overweight. Being very young with extensive caries was the major indication for DGA (58%); however, behavior problems and medical problems were evenly distributed between treated children (20%). Other reasons were reported for two patients, one with amelogenesis imperfecta and the other with facial cellulites. Most of the treated children were healthy (77%) and 23% were medically compromised. Neurological/mental problems were the most common medical reasons for patient's treatments under GA.

2. Hospitals policy and protocols

The mean time elapsed from patient screened for DGA treatment and the actual treatment date was 8.9 months. Among hospitals the mean patient waiting time for PDGA was 7.2 ± 6.2, 11.6 ± 9, 7.9 ± 6 months at UH, MH, and NGH respectively. The difference between the hospitals in this regard was slightly significant (P=0.047).

Table 2 shows the hospitals protocol and policy followed with PDGA procedures. Hospitals were significantly different in their protocols.

Verbal pre-operative instructions were given to all patients/parents about the recommended pre-operative fasting hours. The results showed that children mean pre-operative fasting time was 10 ±2.3 hours (range=4-16 hours). Most of the children (81%) were fasting more than 8 hours, and none were fasting less than 4 hours.

Premedication was used for approximately half of the sample (48%). Hospitals used different premedication protocols. Midazolam was the most common premedication oral agent used. At MH, no premedication was employed, while at NGH, oral midazolam was almost routine.

Results showed that children admission for DGA procedures was approximately equal between in and outpatient among the three hospitals. However, some hospitals had a universal admission protocol such as MH, which admitted almost all children as in-patients, while UH admitted them mostly as out-patient. To avoid bias of in-patients being more medically compromised than outpatients, a Chi-Square test was used to see the relationship between admission type and medical status (Figure 1). Although most of the medically compromised patients were admitted as in-patients, results showed no significant difference between in and out-patient groups.

Children's behavior during induction was significantly affected by age, premedication use and admission type (Figure 2). Premedicated, older out patient groups were significantly calmer than the rest of the children.

In all three hospitals, qualified anesthesia, dental, and nursing staffs were available in the OR. As recommended by the AAPD, all standard monitors for patient's safety were used in 78% of the cases. In 22% of the cases temperature

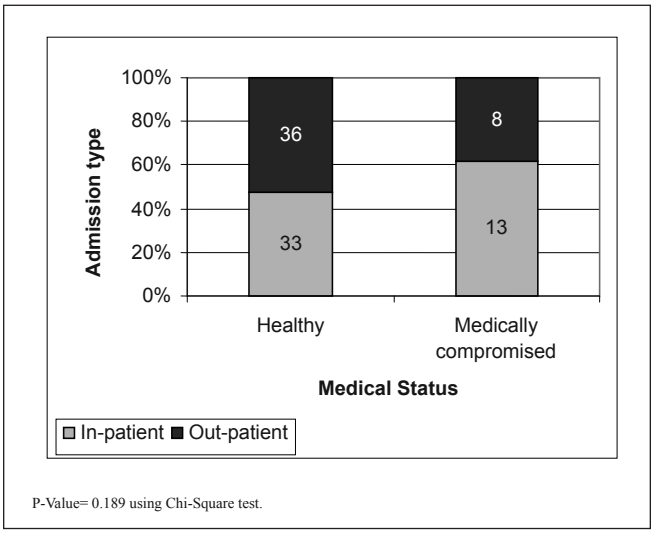

Figure 1. Relationship between medical condition and admission type for PDGA participants.

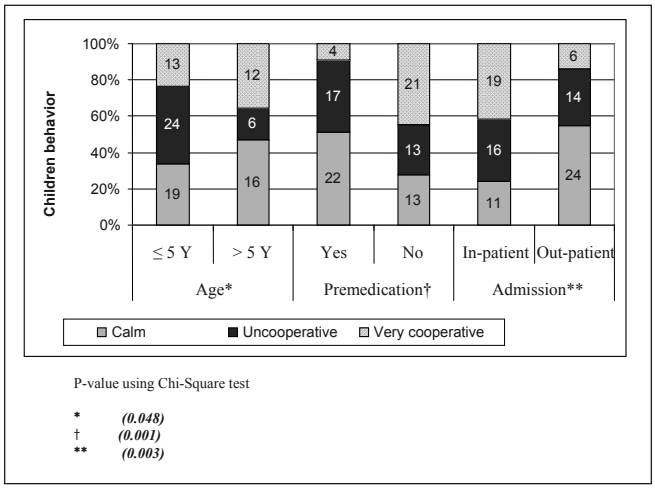

Figure 2. Relationship between children behaviour during induction and age, pre-medication use, and admission type.

probe was not used in 19% and capnography monitoring in 3% of the patients.

The mean anesthesia time for PDGA procedures was 124.6 min (range = 10-295 min). The mean anesthesia time *per* hospital was 157 ± 54, 70 ± 18.5, 146 ± 49 min at UH, MH, and NGH respectively.

3. Dental procedure

The mean number of present teeth was 20 ± 2.15 teeth, while the mean number of treated teeth 14 ± 3.8. This meant that more than two thirds (70%) of the teeth needed treatment under GA. Dental treatment under GA included primarily restorations and extractions (77%). However, some patients received restorations (19%) or extractions only (4%). The mean dental treatment duration under GA was 97.9 ± 49.9 min and ranged from 5 min to 224 min. Dental treatment time was lower at MH (51.4 ± 17.4) than UH (124.9 ± 45.4) and NGH (117.4 ± 43.6), and the difference between hospitals was greatly significant (P=000).

Table 3 presents the frequency of dental treatments performed under GA. The majority of patients (97%) had fillings, 81% had one or more teeth extracted, 69% had pulp therapy treatment, and (21%) fissure sealants. Surgery was needed on three patients; one for root removal and two for incision and drainage. The types of dental treatment used under GA were statistically different among hospitals. Sealant use was significantly low at MH and extraction was slightly lower at NGH. The use of other dental procedures under GA was significantly different among hospitals. The results showed that MH used less the rubber dam and per-

Table 3. Frequency distribution of dental procedures usage for PDGA participants at different hospitals.

Dental Procedures	Total	Hospital			P-Value
		UH	MH	NGH	
	N=90	N=30	N=30	N=30	
	n (%)	n (%)	n (%)	n (%)	
Filling	87 (96.7)	29 (96.7)	29 (96.7)	29 (96.7)	1.0
Extraction	73(81.1)	26 (86.7)	27 (90)	20 (66.7)	0.044
Pulp therapy	62 (68.9)	22 (73.3)	20 (66.7)	20 (66.7)	0.813
Sealant	19 (21.1)	10 (33.3)	1 (3.3)	8 (26.7)	0.011
Surgery	3 (3.3)	1 (3.3)	0	2 (6.7)	0.355
Prophylaxis	57 (63.3)	28 (93.3)	0	29 (96.7)	0.000
Rubber dam	51 (56.7)	25 (83.3)	0	26 (86.7)	0.000
Local Anesthesia	21 (23.3)	2 (6.7)	0	19 (63.3)	0.000
Suture	30 (33.3)	5 (16.7)	23 (76.7)	2 (6.7)	0.000
Haemostatic	15 (16.7)	1 (3.3)	0	14 (46.7)	0.000
Space management	4 (4.4)	1 (3.3)	0	3 (10)	0.160
Fluoride application	56 (62.2)	27 (90)	0	29 (96.7)	0.000

UH: University Hospital
MH: Ministry of Health Hospital
NGH: National Guard Hospital
P-value using Chi-Square test

Table 4. Relationship between dental procedures and age, gender and medical condition for PDGA participants.

Dental procedure	Age (year)	Mean	SD	P-value	Gender	Mean	SD	P-value	Medical condition	Mean	SD	P-value
Number of treated teeth	⩽5	13.6	3.86	0.25	M	14.2	3.06	0.549	H	13.7	3.87	0.215
	>5	14.59	3.69		F	13.75	1.18		MC	14.9	3.52	
Extraction	⩽5	4.02	4.12	0.009	M	4.7	3.59	0.56	H	4.7	4.66	0.26
	>5	6.62	5.01		F	5.3	5.5		MC	6	4.49	
Colored restoration	⩽5	4.48	3.34	0.311	M	4.6	3.29	0.236	H	4.16	3.26	0.786
	>5	3.76	3.08		F	3.8	3.17		MC	4.38	3.26	
SSC	⩽5	4.43	3.04	0.017	M	4.3	3.1	0.118	H	4.01	3.12	0.311
	>5	2.85	2.85		F	3.3	2.9		MC	3.24	2.81	
Pulpotomy	⩽5	3.04	2.83	0.039	M	2.59	2.47	0.974	H	2.62	2.71	0.775
	>5	1.82	2.35		F	2.57	2.98		MC	2.43	2.8	
Sealant	⩽5	0.55	1.25	0.927	M	0.59	1.4	0.735	H	0.55	1.23	0.929
	>5	0.53	1.16		F	0.5	0.95		MC	0.52	1.17	

P-value using Independent Sample T-test.
M=male, F=female, H= healthy, MC= medically compromised

formed less prophylaxis, and topical fluoride applications.

Table 4 shows the relationship between dental procedures and age, gender, and medical conditions of the PDGA participants. The number of treated teeth was not affected by patient age, gender, or medical condition. However, age was found to be significantly affecting the type of dental treatment, while gender and medical status did not. Younger patients had a significantly higher number of stainless steel crowns (SSC) and pulpotomy treatments; however, older children had a significantly higher number of extracted teeth.

DISCUSSION

Patients demographic

Comparing previous retrospective studies on PDGA in SA, the present study showed that younger children (5 years) were treated more often with GA than older children.[10,12] This could be explained by the children inability to cooperate to receive the required treatment under local anesthesia. Not surprisingly, lack of maturity in young children with extensive caries was the most common reason for pediatric dental treatment under GA.[1,3] The mean age of children treated under GA (5.3 ±2 years). Only 7% of the study participants were treated for the second time in the OR. Our report of children's re-treatment under GA in the three hospitals was low compared to 11.9% in the UK.[24] This difference could be due to a greater number of younger aged children included in our study and the efforts of dentists in SA to manage older, mature children in dental clinics.

In the present study, more healthy children were treated under GA than medically compromised children.[12,17] The prevalence of DGA use among medically compromised children (23%) was lower than in other developed countries.[14,25] This could be explained by the significant PDGA need among healthy young children with extensive dental caries, difficult and late referral of medically compromised children for dental care, lack of communication between medical and dental physicians, and poor dental consideration of parents of the medically compromised children.

The age of medically compromised children was higher than healthy ones which is similar to other studies.[10,15] Probably, parents of chronically sick children are aware of their need for dental treatment, but concerns with immediate medical needs frequently causes considerable delay in seeking dental treatment. Patients with mental/neurological problems were found, as previously reported[10] the most frequently treated among the medically compromised children, which may be either a reflection of the pediatric neurologist awareness of their patient's needs or presence of a large number of children with neurologic/mental problems with greater dental disease.

Hospital policy and protocols

To our knowledge, this is the first report that summarizes the policy and protocols of PDGA procedures in different governmental hospitals in Jeddah. Our study showed that the included hospitals provided the recommended monitors and qualified personnel to facilitate safe practice under GA. However, the significant difference in protocols among the hospitals suggested the need for some standardization by health authorities for improved services with PDGA procedures.

The American Society of Anesthesiologists (ASA) recommended a guideline for the pre-operative fasting time ranging from 2 hours for clear liquid to 6 hours for a light meal, which should be clearly explained to the parents to reduce the risk of pulmonary aspiration.[26,27] Participants in the present study followed the given verbal pre-operative fasting instructions in which none of them fasted for less than 4 hours. Eighty one percent (81%) of the children fasted for more than 8 hours (mean = 10 hours), which represented a long fasting period for the children in comparison to a previous report (6.3 hours).[28] Hunger and thirst could be a factor for child's anxiety, as reported previously.[29,30] Only verbal mean of pre-operative instructions was used in the three hospitals, suggesting the usage of clear written instructions for better parent understanding to avoid over/under fasting among the children.

No standard protocol exists by the AAPD for premedicating children before DGA procedures. Our study showed differences in children premedication protocols. A significant relationship was found in children's premedication and their behavior during induction. To facilitate easy induction, our study encouraged pre-medicating young children.

Day surgery for PDGA procedures was greatly recommended because it showed sizeable safety levels for both healthy and medically compromised patients with a high level of acceptability and less cost.[16,32] In-patient admission was recommended by AAPD for high-risk patients. In the present study, the admission protocol significantly varied among the three hospitals and half of the children were admitted as in-patient with no significant relationship to their medical conditions. Additionally, our study found in-patient admitted children were highly uncooperative during induction in comparison to outpatient children, which may be due to the alteration of the children's and family environments. In-patient admission was recommended in some studies[16,30] for long dental treatment duration (more than 2 hours). Although at the University Hospital longer anesthesia durations were reported in comparison to Ministry of Health Hospital. The majority of patients at University hospital were discharged in the same day. Our findings suggest increase usage of day care admission for PDGA procedure in SA hospitals unless admission is indicated.

Dental Procedures

Our study showed that, extensive dental care was performed for children under GA, in which the mean number of treated teeth under GA (14 teeth) was higher than previous reports.[16,30,33] Delaying dental treatment may bring a subsequent risk of the development of anxiety and deterioration of the dental status. The present study found children with extensive caries waiting for a long time to be treated under

GA (9 months). This waiting time was longer than DGA previous reports.[8,13,34] This could be explained by the shortage in pediatric dentists, the high number of children needing restorative treatment, limited operating time for dental procedures *per* hospital, and limited admission facility for dental patients. Recent report indicated that a well equipped dental clinic with appropriately trained personnel within the confines of a hospital or ambulatory surgery facility allowed for more efficient use of time and space as well as reduced cost and waiting duration.[35] The authority efforts should be directed to improve the hospitals facilities for PDGA procedure and the use of day care admission in order to reduce PDGA waiting periods.

A variety of dental procedures were performed under GA for pediatric patients. More than two thirds of the patients received both restorations and extractions, which was higher than previous PDGA reports in SA.[12,17] The significant quantity of treated teeth *per* patient in our study represented the elevated severity of cases treated under GA in comparison to previous DGA reports.[10,12,16] Although comprehensive dental treatment was performed for patients, sealant was infrequently applied in children under GA which may be due to their high caries incidence. Only 4 cases were treated solely by extractions, which suggests the low use of DGA for exodontias parallel to previous SA reports,[10,12,16] but in contradiction to others.[11,16,18] This could represent the aggressiveness of dental treatment provided for children under GA in those countries compared to the conservative approach in the tested three hospitals. This conservative treatment protocol might be explained by the fact that the treatment was carried out by pediatric dentists.

The dental treatment decision under GA seemed to be affected by the children's age in which younger age children had more pulpotomies and stainless steel crowns (SSC) while older children had more extractions. This could be due to the timing of primary teeth exfoliation with the older age group and younger children susceptibility to future recurrent caries.[13] In our study, medical status did not affect the dental treatment under GA contradicting previous reports.[10,36] This difference could be due to the mild medical condition of the sample.

The use of rubber dam under GA was reported by 49% of the pediatric dentists registered in the UK General Dental Council.[37] Our study supported the difference among pediatric dentists using rubber dam under GA in which none of the patients at MH were treated with rubber dams compared to more than 80% of the patients at UH and NGH. The lack of Rubber dam showed a poor success rate.[38,41]

Longer treatment durations were reported at UH and NGH compared to MH. This is due to the lack of dental prophylaxis, rubber dam placement, fluoride application, sealant, and eshetic filling materials at MH. This additionally could demonstrate the difference in dental treatment protocols among pediatric dentists in the three hospitals, which could be due to the conflict among the dentists about the need for such procedures under GA.

CONCLUSIONS

1. In Saudi Arabia a PDGA procedure is used mostly for young children with extensive dental caries.
2. The long waiting period for PDGA operation indicated the need to improve available facilities within the three governmental hospitals in Jeddah.
3. The high mean of untreated teeth among children suggested the need for collaborated efforts to reduce children caries prevalence by implementing of an early preventive program and treatment of the existing caries as early as possible in the dental clinic or under GA.
4. Some of the existing hospitals protocols with PDGA procedure should be standardized.
5. Day care admission and clear written pre-operative fasting instructions should be encouraged in SA hospitals.

ACKNOWLEDGEMENT

The authors would like to acknowledge King Abdulaziz Deanship of Scientific Research for granting the research # (426/052).

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