ORIGINAL RESEARCH

Characteristics of Pediatric and Medically Compromised Patients Treated under General Anesthesia in a Middle Eastern Country

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Abstract

Aim: This study aims to describe dental treatment provided to healthy and medically compromised patients treated under general anesthesia (GA) over a four-year period.

Materials and methods: A total of 97 patients who received dental treatment under GA at the Saint Joseph University, Lebanon, from 2016 to 2019 were included in the study. The study population was analyzed according to the patient's age, medical status, and type of treatment done accordingly.

Results: The mean age of the patients was 9.15 ± 8.84 years. About 58.8% were aged below 6 years (primary dentition) and 48.5% had medical problems. Dental procedures performed were mostly extractions (4.00 ± 4.15 per patient) followed by resin composite restorations (3.66 ± 3.02 per patient). The mean number of pulpotomies per patient (p <0.001) and stainless steel crowns (p <0.001) were significantly higher in primary dentition, whereas in permanent dentition, the mean number of endodontic treatments per patient (p = 0.016) was significantly larger. Also, there was a significant difference between the type of treatment done on healthy and medically compromised patients (p <0.001).

Conclusion: Better emphasis on oral health education and preventive strategies for children and special need patients is essential.

Clinical significance: Dental GA is a reliable treatment for young uncooperative children and medically compromised patients. A multidisciplinary treatment plan must be conducted to ensure optimal oral healthcare and avoid unnecessary extractions.

Keywords: Dental care for children, General anesthesia, Medically compromised patient, Retrospective study.

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Introduction

Despite recent advances in the medical field, dental caries is still considered one of the most prevalent health problems in childhood.[1] In underprivileged families, children are increasingly affected by early childhood caries (ECC), and they often seek professional healthcare either at a very young age or upon pain and infection, which makes their cooperation limited.[2]

Another category of challenging patients is medically compromised patients. A medically compromised patient is defined as an individual with any physical, developmental, mental, sensory, behavioral, cognitive, or emotional deficiency, which renders the cooperation on a dental chair very limited or inexistent.[3] Owing to several factors including the difficulty of maintaining good oral hygiene, a soft and high sugar-containing diet, problems in chewing and swallowing, and medication; they have an increased risk of oral diseases throughout their lifetime. The improvement of their oral health status is important for their general health and long-term well-being.[4]

When dealing with these categories of patients, the use of pharmacological and non-pharmacological behavior management techniques and different types of sedation are often efficient in reducing anxiety and fostering a positive attitude.[5] Nevertheless, some patients are unable to cooperate and therefore require alternative procedures, such as dental treatment under general anesthesia (GA).[6]

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GA is a safe and reliable tool allowing for the provision of high-quality comprehensive dental care and complete rehabilitation of the oral cavity in a short amount of time in one session.[7] Dental treatment under GA had the best success rates compared to both behavioral management techniques and pharmacologic sedation.[8]

The modality of the treatment depends on several factors including the patient's age, medical status, minimal future ability to cooperate on the dental chair, the possibility of regular follow-up, and home maintenance.[9]

The objective of this study was to describe the characteristics of pediatric dentistry patients and medically compromised patients attending a private dental school in Lebanon and treated under general anesthesia and to determine the factors associated with the type of dental treatment administered.

Materials and Methods

Design of the Study and Data Collection

This was an observational retrospective study. The protocol was approved by the ethical committee of the Saint Joseph University (USJ-2020-151), Beirut, Lebanon.

Pediatric and medically compromised patients who attended the Department of Pediatric and Community Dentistry at the School of Dental Medicine at Saint Joseph University for dental treatment and were treated under general anesthesia in a hospital setting from September 1, 2016 to September 1, 2019 were included in this study. Patients with incomplete records were excluded.

The data for this study was collected from the records of healthy and medically compromised patients in need of dental treatment under general anesthesia. The data included for each patient, sex, age, medical status, the reason of admission for dental GA, number of treated teeth, type of treatment done under GA, and the presence of follow-up in the office after GA.

Statistical Analyses

IBM SPSS Statistics (version 25, USA) was used for statistical analyses. The level of significance was set at $p \leq 0.05$. Kolmogorov–Smirnov tests were used to assess the normality distribution of continuous variables. Analysis of variance followed by Tukey's post hoc test (HSD) was performed to compare continuous variables between the three groups. Student's t-tests were performed to compare continuous variables between the two groups. Chi-square tests and Fisher exact tests were used for the comparison of categorical variables.

Results

Description of the Study Population

A total of 97 children aged 9.15 ± 8.84 years (54 boys: 9.51 ± 8.92 years; 43 girls: 8.70 ± 8.82 years) were included in the study. About 58.8% were aged below 6 years (primary dentition) and 48.5% had medical problems. The main reason for dental treatment under general anesthesia in this population was the lack of cooperation (41.2%) (Table 1).

The mean total number of treated teeth per patient during general anesthesia was 10.98 ± 4.090. The mean number of extracted teeth and the mean number of composite restorations per patient were 4.00 ± 4.151 and 3.66 ± 3.027, respectively (Table 2).

Association between Treatment Type and Age of the Participant

The mean number of pulpotomies (p <0.001), SSC (p <0.001), and follow-up visits (p =0.021) was significantly higher in participants aged less than six years.

However, the mean number of endodontic treatments on a permanent tooth (p = 0.016), direct and indirect pulp capping (p = 0.007), amalgam restorations (p = 0.040), and ultrasonic scaling (p < 0.001) were significantly greater in participants aged 6 years or more (Table 3).

Association between the Type of Dental Treatment and Medical Problems

The mean number of pulpotomies (p <0.001), SSC (p <0.001), and follow-up visits (p = 0.024) was significantly elevated in healthy participants. On the contrary, the mean number of direct and indirect pulp capping (p = 0.021) and ultrasonic scaling (p < 0.001) were significantly greater in participants with medical problems (Table 4).

Table 1: Description of the study population

	Frequency	*Percentage*
Age of the participants		
<6 years	57	58.8
≥6 years	40	41.2
Presence of medical problem	47	48.5
Reasons for general anesthesia		
Lack of cooperation	40	41.2
Medical status	35	36.1
Young age	19	19.6
Missing values	3	3.1
Year of admission		
2016	29	29.9
2017	27	27.8
2018	26	26.8
2019	15	15.5

Table 2: Type of dental treatment during GA

Mean number of treatment modality per patient	
Number of treated teeth	10.98 ± 4.090
Pulpotomy	2.78 ± 2.455
Resin composite restoration	3.66 ± 3.027
Stainless steel crown (SSC)	2.54 ± 2.250
Endodontic treatment on permanent tooth	0.24 ± 0.910
Tooth extraction	4.00 ± 4.151
Esthetic zirconia crown	0.14 ± 0.661
Pit and fissure sealant	0.61 ± 1.656
Direct and indirect pulp capping	0.09 ± 0.410
Amalgam restoration	0.07 ± 0.415
Prevalence of dental treatment	
Ultrasonic scaling	40 (41.2%)
Impression for a fixed or a removable appliance	8 (8.2%)
Cementation of a space maintainer	2 (2.1%)
Stripping on anterior primary mandibular teeth	28 (28.9%)
Follow-up in the office after GA	69 (71.1%)

Table 3: Association between the type of dental treatment and age of the participants

	<6 years	*≥6 years*	*p*
Number of teeth treated/patients	11.28 ± 3.534	10.55 ± 4.788	0.389
Number of resin composite restorations/patients	3.21 ± 2.534	4.30 ± 3.553	0.081
Number of pulpotomies/patients	4.04 ± 2.113	1.00 ± 1.695	0.000
Number of SSC/patients	3.65 ± 1.959	0.95 ± 1.600	0.000
Number of endodontic treatments of permanent tooth/patients	0.05 ± 0.397	0.50 ± 1.301	0.016
Number of teeth extracted/patients	3.56 ± 3.645	4.63 ± 4.759	0.216
Number of esthetic zirconia crown/patients	0.21 ± 0.818	0.05 ± 0.316	0.241
Number of pits and fissures sealants/patients	0.37 ± 0.899	0.95 ± 2.320	0.089
Number of direct and indirect pulp cappings/patients	0.00 ± 0.000	0.23 ± 0.620	0.007
Number of amalgams restorations/patients	0.00 ± 0.000	0.18 ± 0.636	0.040
Ultrasonic scaling	13 (22.8%)	27 (67.5%)	<0.001
Impression for a fixed or removable appliance	5 (8.8%)	3 (7.5%)	1.000
Cementation of a space maintainer	2 (3.5%)	0 (0.0%)	0.510
Stripping on anterior primary mandibular teeth	28 (50.0%)	0 (0.0%)	<0.001
Follow-up in the office after GA	46 (80.7%)	23 (57.5%)	0.022

Table 4: Association between the type of dental treatment and medical problems

	Presence of medical problem	*Absence*	*p*
Number of teeth treated/patients	10.70 ± 4.832	11.24 ± 3.274	0.520
Number of resin composite restorations/patients	4.02 ± 3.480	3.32 ± 2.519	0.256
Number of pulpotomies/patients	1.70 ± 2.293	3.80 ± 2.167	<0.001
Number of SSC/patients	1.55 ± 2.124	3.46 ± 1.971	<0.001
Number of endodontic treatments of permanent tooth/patients	0.40 ± 1.210	0.08 ± 0.444	0.079
Number of teeth extracted/patients	4.23 ± 4.635	3.78 ± 3.672	0.593
Number of esthetic zirconia crowns/patients	0.09 ± 0.408	0.20 ± 0.833	0.395
Number of pit and fissure sealants/patients	0.81 ± 2.163	0.42 ± 0.950	0.250
Number of pulp cappings/patients	0.19 ± 0.576	0.00 ± 0.000	0.021
Number of amalgam restorations/patients	0.15 ± 0.589	0.00 ± 0.000	0.077
Ultrasonic scaling	28 (59.6%)	12 (24.0%)	<0.001
Impression for a fixed or removable appliance	2 (4.3%)	6 (12.0%)	0.270
Cementation of a space maintainer	0 (0.0%)	2 (4.0%)	0.495
Stripping on anterior primary mandibular teeth	5 (10.6%)	23 (47.9%)	<0.001
Follow-up in the office after GA	28 (59.6%)	41 (82.0%)	0.024

Association between the Type of Dental Treatment and Indication of GA

The number of pulpotomies (p <0.001), number of SSC per patient (p <0.001), and follow-up visits (p = 0.003) was greater in a non-cooperative or young patient while stripping was frequent in young age patients (p <0.001).

On the other hand, the number of endodontic treatments on a permanent tooth (p = 0.046), number of direct and indirect pulp capping (p = 0.014), and scaling (p <0.001) were greater in medically compromised patients (Table 5).

Comparison of Dental Treatment according to Year

The modality dental treatment did not change significantly within years (p >0.05). However, cleaning was the most frequent dental act in 2018 and 2019 compared to other years (p = 0.006) (Table 6).

Discussion

Dental treatment under GA leads to improvement in the quality of life and body growth of young children with ECC and significant changes in oral health and psychological, social, and overall wellbeing as well as a positive impact on the family.[10] There is also a significant improvement in the oral health-related quality of life of patients with disabilities concerning pain, eating, sleeping, and behavioral problems.[11] In special need patients, the importance of conserving functional teeth is increasingly recognized in terms of preventing dysphagia and preserving masticatory capacity.[12]

In this retrospective study, we analyzed the records of healthy and medically compromised patients treated under GA. Of the 97 patients, 41.2% were admitted for a lack of cooperation, and 36.1% were medically compromised. This was similar to the study of Savanheimo and Vehkalahti, in which the most common reason for dental GA was lack of cooperation (82%).[13]

Overall, the most frequent act was dental extraction (4.00 ± 4.151 per patient) followed by resin composite restorations (3.66 ± 3.027 per patient). This was as per other studies that reported an abundance of extractions and restorative procedures.[14,15] Stanková et al. also reported more extractions (7.5) than restorative procedures (1.52) being performed in 281 patients aged 5 years.[16] This radical approach could explain the fact that none of the 97 patients included in this study needed a second intervention under GA. Previous studies have reported rates of 11% for a second and 2% for a third GA visit in Germany, 9% in England after 6 years.[17,18] Rudie et al. concluded that about 10% of patients were treated more than once (range: 2–7 times) under GA during the 13-year study period.[19]

The results of this study showed a significant difference between the type of treatment and the patient's age. Therefore, in patients with primary dentition, a pulpotomy (p <0.001) followed by an SSC

Table 5: Association between the type of dental treatment and indication of GA

	Lack of cooperation	*Medically compromised*	*Young age*	*p*
Teeth treated/patients	11.63 ± 3.801	10.09 ± 4.604	11.95 ± 3.341	0.162
Resin composite restorations/patients	3.23 ± 2.423	4.54 ± 3.705	3.47 ± 2.525	0.150
Pulpotomies/patients	3.08 ± 1.845	1.34 ± 2.169	4.79 ± 2.529	0.000
SSC/patients	2.78 ± 1.747	1.34 ± 2.141	4.16 ± 2.243	0.000
Endodontic treatments permanent tooth/patients	0.03 ± 0.158	0.54 ± 1.379	0.16 ± 0.688	0.046
Number of teeth extracted/patients	4.65 ± 4.538	3.77 ± 4.440	3.37 ± 2.813	0.485
Number of esthetic zirconia crowns/patients	0.18 ± 0.594	0.06 ± 0.338	0.26 ± 1.147	0.536
Number of pit and fissure sealants/patients	0.43 ± 1.010	0.86 ± 2.353	0.37 ± 1.012	0.439
Number of direct and indirect pulp capping/patients	0.00 ± 0.000	0.26 ± 0.657	0.00 ± 0.000	0.014
Number of amalgams restorations/patients	0.00 ± 0.000	0.20 ± 0.677	0.00 ± 0.000	0.083
Ultrasonic scaling	8 (20.0%)	26 (74.3%)	5 (26.3%)	<0.001
Impression for a fixed or removable appliance	7 (17.5%)	0 (0.0%)	1 (5.3%)	0.026
Cementation of a space maintainer	1 (2.5%)	0 (0.0%)	1 (5.3%)	0.501
Stripping on anterior primary mandibular teeth	13 (33.3%)	3 (8.6%)	12 (66.7%)	<0.001
Follow-up in the office after GA	35 (87.5%)	18 (51.4%)	14 (73.7%)	0.003

Table 6: Type of dental treatments within years

	2016	*2017*	*2018*	*2019*	*p*
Teeth treated	11.72 ± 4.292	10.89 ± 4.228	10.85 ± 3.738	9.93 ± 4.166	0.582
Resin composite restorations	3.52 ± 2.760	3.26 ± 2.229	4.73 ± 3.853	2.80 ± 2.933	0.172
Pulpotomies	2.69 ± 2.606	2.96 ± 2.377	2.19 ± 1.939	3.67 ± 2.992	0.307
SSC	2.28 ± 2.051	2.59 ± 2.099	2.04 ± 1.990	3.80 ± 2.957	0.091
Endodontic treatment permanent tooth	0.07 ± 0.258	0.37 ± 1.079	0.42 ± 1.332	0.00 ± 0.000	0.302
Teeth extracted	5.10 ± 4.655	4.33 ± 3.833	2.85 ± 3.120	3.27 ± 4.935	0.196
Esthetic zirconia crowns	0.34 ± 1.111	0.15 ± 0.456	0.00 ± 0.000	0.00 ± .000	0.203
Pits and fissures sealants	0.52 ± 2.246	0.33 ± 0.920	1.08 ± 1.719	0.47 ± 1.125	0.393
Direct and indirect pulp capping	0.00 ± 0.000	0.15 ± 0.602	0.08 ± 0.272	0.20 ± 0.561	0.391
Amalgam restorations	0.07 ± 0.371	0.19 ± 0.681	0.00 ± 0.000	0.00 ± 0.000	0.359
Ultrasonic scaling	6 (20.7%)	9 (33.3%)	16 (61.5%)	9 (60.0%)	0.006
Impression for a fixed or removable appliance	5 (17.2%)	2 (7.4%)	1 (3.8%)	0 (0.0%)	0.253
Cementation of a space maintainer	1 (3.4%)	1 (3.7%)	0 (0.0%)	0 (0.0%)	1.000
Stripping on anterior primary mandibular teeth	11 (39.3%)	5 (19.2%)	8 (30.8%)	4 (26.7%)	0.461
Follow-up in the office after GA	23 (79.3%)	22 (81.5%)	17 (65.4%)	7 (46.7%)	0.077

(p <0.001) was the most frequent act. Tate et al. showed in their study that the highest failure rates for restorative procedures done under GA were seen in composites and composite strip crowns.[20] They concluded that SSCs are the most reliable restorations, while composite restorations are the least durable. Khodadadi et al. indicated that pulp therapies had the lowest failure rate (3.03%) and resin composite restorations had the highest (9.63%).[21] The records obtained showed that no pulpectomy was performed on primary teeth under GA to avoid any risk of reinfection and relapse. This option was chosen firstly for an economical reason since dental GA is not covered in Lebanon by any insurance company and patients attending the Saint Joseph University are from poor socio-economic backgrounds. Therefore, any primary tooth with a diagnosis of partial or complete pulpal necrosis, irreversible pulpitis, and signs of radiolucency on preoperative panoramic radiography was extracted. Furthermore, in a recent study, Chen et al. analyzed the survival rate and factors associated with the failure of pulpectomy performed under GA. They concluded that the prognosis of pulpectomy can be influenced by both treatment-related variables and patient factors, and the five-year survival rate is lower than expected. By the end of the fourth year, 45% of teeth with pulpitis and 46% of teeth with periapical periodontitis were estimated to relapse.[22]

In patients with mixed or permanent dentition, endodontic treatment on a permanent tooth (p = 0.016), direct and indirect pulp capping (p = 0.007) amalgam restorations (p = 0.040), pit and fissure sealants (p = 0.089), and ultrasonic scaling (p < 0.001) were more frequent.

Ultrasonic scaling was systematically performed at the beginning of the GA to eliminate as much plaque as possible since the persistence of plaque is a risk factor for caries recurrence in the future.[23] This was also supported by Kalhan et al. who found that individuals with low resting plaque pH at 6 and 12 months after GA were shown to be at high risk of 1-year caries incidence at 12

months.[24] The material used for pit and fissure sealant in this study was resin-based. This was also valid in the study of Ulusu et al., while Mickenautsch and Yengopaland, and Molina et al. suggested that in the context of general anesthesia, when a lot of treatment often has to be undertaken in a restricted amount of time, it is preferred to provide glass ionomer sealants for patients with high caries risk since the release of fluoride is a useful property.[25–27]

For all endodontic procedures as well as direct and indirect pulp capping, a trained endodontist performed the interventions fully equipped (digital portable X-ray machine, apex locator, and endodontic loops) and always using the rubber dam in an attempt to increase the prognosis. Chung et al. showed complete clinical and periapical healing in single visit endodontics under GA for 221 teeth over 56 months.[28] The authors showed that single-visit endodontic and restorative treatments under GA provided sustainable functionality of treated teeth by an estimated 5-year survival rate of 89.8%.[28] All authors focused on the importance of standardizing the root canal treatment to avoid excessive dental extractions.

The proportion of medically compromised patients and those with developmental disabilities who survive are increasing, and these children remain at high risk of developing dental caries and periodontal disease. It has become a common practice to provide dental treatment for special need patients to improve their oral health status, which is also important for their general health and long-term welfare.[12] Reported literature from January 1966 to May 2012 were analyzed, and the demand for dental treatment for special-need patients under general anesthesia continues to increase.[3] Currently, there are no certain accepted protocols for the provision of dental treatment under general anesthesia for medically compromised patients. In this study, there was a significant difference between the type of treatment provided and the medical status of the patient. Interestingly, the mean number of extracted teeth was not statistically different between healthy and special needs patients ($p = 0.52$). A conservative approach was preferred for extraction whenever possible. Over the past few years, advances in technology have allowed practitioners to provide advanced dental treatment under GA.[6] Equity in health implies that patients with disabilities should have equal access, equal care, and equal treatment outcome as any other patient, always keeping in mind that the premise is to be as time-efficient as possible and to avoid relapse.[6] Ayuse et al. analyzed in 16 disabled patients treated under GA the changes in all the variables of sleep cycles in comparison to the values in the preoperative period and observed major behavioral changes like a complete loss of appetite, ongoing insomnia, and daytime somnolence, especially after extraction of teeth.[29] It is therefore essential to conduct a multidisciplinary treatment plan based on a prior intra-oral examination to provide more restorative treatments and avoid extractions as much as possible.

In this study, the trend of dental treatments performed under GA was not statistically significant over 4 years ($p > 0.05$). Chen et al. analyzed the trend for dental treatment under GA for 10 years and concluded that there was an increase in the demand for GA, especially for the extraction of primary teeth.[22]

The follow-up visits, parent's motivation, and home maintenance are essential in the success of dental treatment under GA. In this study, a significant difference was noticed in follow-up visits between healthy patients (82%) and medically compromised patients (59.6%). This could be due to the cumulative responsibilities lying upon parents of special need patients who are often scheduling multiple medical visits to different specialists to attend to their children's complicated medical status and forget about the need for regular dental follow-ups. Savanheimo and Vehkalahti concluded in their 5-year follow-up study that familiarization with dental care must be strongly prioritized after GA to reduce dental fear and lack of cooperation.[13] Oubenyehya and Bouhabba confirmed that without proper long-term follow-up, any positive results might be lost over time.[30]

This study was subject to the inherent limitations of retrospective chart reviews and small sample size. This is because dental GA comes as a last resort when all other attempts using pharmacological and non-pharmacological management techniques are exhausted.

In conclusion, GA is useful in providing optimal oral health in a single session in young uncooperative children with early childhood caries and medically compromised patients. The type of treatment depends on the patient's age and medical status. However, the success of any type of treatment relies on regular follow-ups and the education and motivation of the caregivers.

It is therefore mandatory to design individual preventive approaches and emphasis more on continuing oral health education independently of whether the child is healthy or medically compromised to reduce preventable hospitalization.

Clinical Significance

Dental GA is a reliable treatment for young uncooperative children and medically compromised patients**.** A multidisciplinary treatment plan must be conducted to ensure optimal oral healthcare and avoid unnecessary extractions.

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Ethical Approval

The protocol of this study was approved by the ethical committee of the Saint Joseph University of Beirut, Lebanon (USJ-2020-151).

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