Original Article

A retrospective comparison of dental treatment under general anesthesia *versus* non-pharmacological approach in patient with special health care needs

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Abstract *Background/purpose:* The unmet dental needs are still at the highest rate in patients with special health care needs (SHCN) owing to their physical conditions, lack of cooperation, anxiety and dental fear. This study was aimed to investigate the differences in characteristics and outcomes of dental treatment between general anesthesia (GA) and non-pharmacological approach (NP) in patients with SHCN.
Materials and methods: This study reviewed the dental chart records of SHCN patients from 2005 to 2019. The dental chart records were divided into two subgroups: GA and NP groups. The demographic data, recall behavior and treatment outcomes were analyzed and compared between groups. The comparisons between groups were analyzed by Pearson's chi-squared test, Fisher's exact test and Mann—Whitney U test at a significant level of 0.05.
Results: Two hundred and sixty-one patients aged 2.2—43.1 years with mean age 14.22 ± 8.64 years old were included. The proportion of cases treated under GA (62%) and NP (38%) was 1.6:1. General anesthesia group had significantly higher in mean ages, caries experience, definitely negative behavior and treatment needs than NP group ($P < 0.001$). Moreover, recall rates in GA group were significantly lower than NP group ($P < 0.001$) without a significant difference in regularity. New caries occurrence ($P = 0.015$) with faster rate ($P = 0.035$), and behavior changes was significantly found in GA group ($P = 0.007$) after 24 months of recall.
Conclusion: Patients with SHCN who were at older age and had high caries experience with definitely negative behavior and numerous treatment needs were more justifiably for GA. A

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significant new caries occurrence with faster rate tended towards SHCN patients who underwent GA.

Introduction

Special health care needs (SHCN) are people that live with some form of disability; physical, developmental, behavioral, sensory, and intellectual disabilities, or any limiting conditions that could be barriers in performing daily life routines and most of activities in a normal way.[1] According to those limitations, patients with SHCN have undeniably faced with some medical and oral health problems throughout their lifetime and that exceedingly affects the quality of life.

Patients with SHCN are more at increased risk of caries, likely to have poorer oral hygiene and periodontal status in consequence of inadequate oral health care, diet problems, insufficient fluoride exposure, malocclusion, enamel defect and so on.[2,3] However, the unmet dental needs are still at the highest rate in this group of patients owing to their limitations in cooperation, higher level of anxiety and dental fear.[4,5] Therefore, using the appropriate behavior management techniques in dental treatment has played an important role for pediatric dentist in order to perform the procedures with effective treatment outcomes.

Generally, there are two alternative behavior management approaches in treating SHCN patients. In routine dental setting, non-pharmacological approach (NP) such as Tell-show-do, positive reinforcement and desensitization can be used in patients who have quite high cognitive functions, whereas physical restraint is more effective for patients who have resistant behavior, despite the use will be limited when patients physically grow bigger and/or have extremely resistant behavior. The alternative behavior management is pharmacological approach that have been used when patients cannot undergo the dental treatment under routine dental setting. General anesthesia (GA) is the most frequently used technique because it can provide reliable and effective outcomes as it could allow all required treatments done in one visit.[6,7] Nonetheless, GA requires carefully concerns in pre-operative assessments and reveals some disadvantages such as high cost, intra- and post-operative complications, and hospital-based setting is required.

Most of the previous studies have focused on differences in comprehensive dental treatment under GA between SHCN patients and healthy uncooperative children.[8−10] To our knowledge, there is limited study focusing on SHCN patients with different behavior management approaches. Thus, this study is aimed to investigate the differences in characteristics and outcomes of dental treatment under GA and NP approach in patients with SHCN.

Materials and methods

Ethical considerations

The retrospective analysis of dental chart records of SHCN patients at Pediatric dental clinic, Faculty of Dentistry, Mahidol University between January 2005 and December 2019 (14 years) was approved by The Ethics Committee of Mahidol University, Thailand (MU-DT/PY-IRB 2021/DT002).

Data collection

The data were reviewed and collected by a single pediatric dentist. Before the assessment of all dental chart records, 10% of the dental chart records were randomly reviewed to evaluate the intra-examiner reliability which was considered as good (Kappa values was 0.77) before the study began.

Patients with SHCN who were at any ages and had at least one disability from these categories; behavioral, developmental, intellectual, physical and sensory, were included as the study population. Moreover, they had to complete comprehensive treatment either under GA or NP approach by pediatric dental residents. The records clearly revealed demographic data; age, gender, residency area, type of disability, dental conditions; the simplified oral hygiene index (OHI−S) using Greene−Vermillion index,[11] the decayed-missing-filled teeth in both primary and permanent dentitions (dmft/DMFT), behavior level (Frankl scores),[12] treatment needs, recall behavior and treatment outcomes. Patients with SHCN who had incomplete comprehensive dental treatment were excluded. The subjects were divided into two groups according to behavior management approach; GA *versus* NP.

In GA group, the preoperative assessments were carefully and individually considered for both physical and mental status to be assured that patients met the GA indication criteria. The standard comprehensive dental treatment under GA were performed by the anesthesiologist and pediatric dental residents in one visit under supervision of highly experienced pediatric dentist of Faculty of Dentistry, Mahidol University, Bangkok, Thailand. All GA patients were arranged an appointment for a week later for close follow-up after GA and also made routine recalls in accordance to their caries risk level.

In NP group, the standard oral examination, preoperative assessment of physical and mental status was also performed by pediatric dental resident under supervision of

highly experienced pediatric dentist of Faculty of Dentistry, Mahidol University, Bangkok, Thailand to assure that the patients were appropriate to have comprehensive dental treatment in routine dental setting using NP approach; both basic (tell-show-do, positive reinforcement, distraction and desensitization) and advanced (protective stabilization) behavior guidance. Patients were recalled according to their caries risk level after completed the comprehensive treatment.

Subjects in both groups received a caries risk-based preventive program individually; oral hygiene instructions, diet counseling and professional fluoride since in the first visit, then remotivated and emphasized in every single visit. Recall behavior; number and regularity of recalls (≤ 6 months = regular and >6 months = irregular) as well as treatment outcomes; failure of treatments, new caries detected, and changes (last recall visit - baseline) in OHI–S and Frankl behavior level were collected in both groups.

Statistical analysis

Descriptive statistics were calculated and reported as frequencies and mean $\pm$ standard deviation. Comparisons between GA and NP group were analyzed by Pearson's chi-squared test, Fisher's exact test and Mann–Whitney U test (non-normal data distribution) at a significant level of 0.05. All data analyzed using SPSS (version 23.0. IBM, Armonk, NY, USA).

Results

Four hundred and seven dental chart records were reviewed and 146 of them were excluded due to incomplete comprehensive treatment. Thus, a total of 261 cases were included in this study. There were 162 cases (62%) in GA group and 99 cases (38%) in NP group. The flow chart of subject recruitment in the study is shown in Fig. 1. The mean age of GA group was significantly greater than NP group ($P = 0.027$); 15.51 $\pm$ 9.57 and 12.11 $\pm$ 6.35 with a range from 3 to 43.1 and 2.2 to 31.2 years respectively. The

number of male patients was almost two times higher than female patients and the gender ratios were similar in both groups as shown in Table 1. The data showed the highest number of cases with developmental disability (80.1%) without significant difference in type of disability between two groups ($P > 0.05$). The mean decayed, missing, filled teeth of both primary and permanent dentition (dmft/dMFT) or caries experience were significantly higher in GA group ($P < 0.001$). Poor level of OHI–S index was found the most in both groups but there was no significant difference in percent ratio of OHI–S index level among groups ($P > 0.05$). There were significantly higher number of cases with definitely negative behavior in GA group, whereas NP group had higher number of cases with definitely positive behavior ($P < 0.001$). All performed treatment procedures were significantly higher in GA group ($P < 0.001$) except for pulp therapy.

In GA group, there were 136 cases (84%) that presented at 1-week recall after treatment then 121 cases (74.7%) continued their recalls in routine dental setting (Fig. 1), which were significantly lower than 96 cases (97%) of NP group ($P < 0.001$). When categorized recall behavior as regularity, there was no significant difference between two groups ($P > 0.05$) as shown in Table 2.

Treatment outcomes after 24 months of recall were presented in Table 3. The number of stainless steel crown dislodgement significantly higher in GA group ($P = 0.014$). A significant occurrence of new caries ($P = 0.015$) and the mean elapsed time that caries had been first detected after completed the comprehensive treatment were shorter in GA group ($P = 0.035$) without association in regularity of recall ($P > 0.05$). The OHI–S index improvement showed no differences between two groups, while improvement in behavior was observed in GA group significantly ($P = 0.007$).

Discussion

This is the first study that revealed the information about characteristics and outcomes of dental treatment in patients with SHCN between general anesthesia and non-
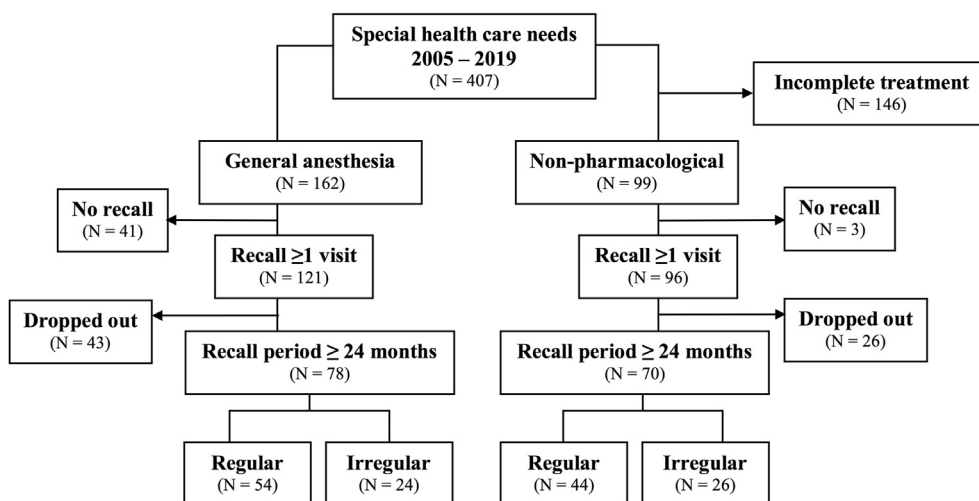

Figure 1 Flow of case recruitment.

Table 1 Demographic data.

	Total (N = 261)	General anesthesia (N = 162)		Non-pharmacological (N = 99)		P-value
[a]Age (Mean ± SD years)	14.22 ± 8.64	15.51 ± 9.57		12.11 ± 6.35		0.027[b]
Gender N (%)						
Male	169 (64.8)	107 (66.0)		62 (62.6)		0.574
Female	92 (35.2)	55 (34.0)		37 (37.4)		
Residency area N (%)						
Bangkok & vicinity	232 (88.9)	140 (86.4)		92 (92.9)		0.104
Up-country	29 (11.1)	22 (13.6)		7 (7.1)		
Type of disability N (%)						
Physical disability	54 (20.7)	36 (22.2)		18 (18.2)		0.434
Developmental disability	209 (80.1)	129 (79.6)		80 (80.8)		0.817
Intellectual disability	34 (13.0)	25 (15.4)		9 (9.1)		0.140
Sensory disability	13 (5.0)	8 (4.9)		5 (5.1)		1.000
Behavioral disability	20 (7.7)	10 (6.2)		10 (10.1)		0.247
[a]Caries experience (Mean ± SD case)						
Primary dentition	9.21 ± 5.85	11.9 ± 4.72		5.75 ± 5.33		<0.001[b]
Permanent dentition	6.57 ± 6.17	8.3 ± 6.49		3.41 ± 3.93		<0.001[b]
OHI–S index N (%)						
Good	21 (8.0)	11 (6.8)		10 (10.1)		0.619
Fair	83 (31.8)	53 (32.7)		30 (30.3)		
Poor	157 (60.2)	98 (60.5)		59 (59.6)		
Frankl behavior scores N (%)						
Definitely negative (1)	130 (49.8)	107 (66)		23 (23.2)		<0.001[b]
Negative (2)	76 (29.1)	39 (24.1)		37 (37.4)		
Positive (3)	25 (9.6)	11 (6.8)		14 (14.1)		
Definitely positive (4)	30 (11.5)	5 (3.1)		25 (25.3)		
Treatment needs	case(%)	case(%)	n/case	case(%)	n/case	
Sealant	165 (63.2)	118 (72.8)	6.8 ± 4.4	47 (47.5)	5.7 ± 4.1	<0.001[b]
Filling	179 (68.6)	131 (80.9)	4.8 ± 3.4	48 (48.5)	2.9 ± 1.7	<0.001[b]
Stainless steel crown	80 (30.7)	66 (40.7)	4.4 ± 3.1	14 (14.1)	2.2 ± 1.3	<0.001[b]
Pulp therapy	38 (14.6)	28 (17.3)	1.8 ± 1.1	10 (10.1)	1.5 ± 0.7	0.110
Extraction (caries)	122 (46.7)	99 (61.1)	4.5 ± 4.0	23 (23.2)	2.9 ± 2.3	<0.001[b]
Minor Surgery	53 (20.3)	50 (30.9)	3.5 ± 1.2	3 (3.0)	3.3 ± 1.2	<0.001[b]

SD: standard deviation; OHI–S: simplified oral hygiene index.

[a] The differences in mean age and caries experience were analyzed by the Mann–Whitney U test, whereas other demographic data were analyzed by the Pearson's chi-squared and the Fisher's exact test.

[b] Statistical significance (P < 0.05).

Table 2 Recall behavior.

	General anesthesia (N = 162) n (%)	Non-Pharmacologica (N = 99) n (%)	P-value
Recall 1-week after GA	136 (84)		
Continued recall	121 (74.7)	96 (97)	<0.001[a]
Regularity of recall			
Regular (≤6 months)	94 (77.7)	68 (70.8)	
Irregular (>6 months)	27 (22.3)	28 (29.2)	0.249

[a] Statistical significance (P < 0.05).

pharmacological behavior management approaches. It was found that almost two third of our study population (62%) received dental treatment under GA, while only 38% were able to undergo the routine dental setting with NP approach. The reason could be that our dental hospital is one of the main referral center due to the full facilities with multidisciplinary team, thus most SHCN cases that has been referred are purposefully referred for GA. Referring to the significantly higher mean ages, higher number of cases that presented with definitely negative behavior and distinctly high dmft/DMFT of both primary and permanent dentitions in GA group, it may imply that patients who have sought for their dental treatment at older age tend to have more severe caries experience and negative behavior, which lead them to more invasive behavior approach as GA. In other words, the reasons for dental treatment under GA were based on the level of the patient's cooperation and

Table 3 Outcomes of dental treatments at ≥ 24 months of recall.

	General anesthesia (N = 78) n (%)	Non-Pharmacologica (N = 70) n (%)	P-value
Failure of treatments			
Sealant loss	28 (35.9)	15 (21.4)	0.053
Defective Filling	14 (17.9)	5 (7.1)	0.050
SSC dislodgement	7 (9.0)	0	0.014[b]
New caries			
New caries (case)	49 (62.8)	30 (42.9)	0.015[b]
[a]Mean elapsed time ± SD (years)	2.5 ± 2.4	3.1 ± 2.3	0.035[b]
OHI−S change			
Improved	34 (43.6)	33 (47.1)	0.665
No change & worse	44 (56.4)	37 (52.9)	
Frankl behavior change			
Improved	29 (37.2)	12 (17.1)	0.007[b]
No change & worse	49 (62.8)	58 (82.9)	

SD: standard deviation; SSC: stainless steel crown; OHI−S: simplified oral hygiene index.

[a] The differences in mean elapsed time of new caries occurrence were analyzed by the Mann−Whitney U test, whereas other treatment outcomes were analyzed by the Pearson's chi-squared and the Fisher's exact test.

[b] Statistical significance (P < 0.05).

caries experience and this finding was in agreement with previous studies.[13,14] The distributions among types of disability were not different in both groups. It was found that autism spectrum disorder (ASD) followed by intellectual disability, epilepsy and Down syndrome were treated the most in the present study. Furthermore, the disproportion of gender in this study was similar to previous studies that found higher number of male than female cases.[8,15,16] It is possible that the general prevalence of SCHN was higher among male, particularly in the region that this study was conducted.[17,18] Nonetheless, the gender distribution between two groups was not different.

Treatment needs were significantly higher in GA group except pulp therapy. The number of cases for restorative procedures; filling and stainless steel crown, were higher than extraction which correspond to Al-Ogayyel et al.[9] and Mallineni et a1[15] despite our extraction rate was relatively higher than both of them (4.5 vs.4.32 vs.2.94 respectively), yet lower than Ciftci et al.[8] (5.7). The difference might base on the caries experience (dmft/DMFT) and severity in each study population which was in agreement of the earlier study.[19] Pulp therapy was performed less in both group because of the uncertain outcomes when treating questionable or poor prognosis teeth, lead to increasing risk for repeat treatment and thus, extraction becomes superior option in that case.

One-week after GA recall rate was quite high (84%) when compared to previous study (68.68%).[20] It was observed that 79.4% of patients in this current study who came for 1-week recall after GA, continued their following recalls and this finding was consistent with Kakaounaki et al.[21] that found patients who disappeared at 1-week recall visit

tended to disappear at the following recall and ended up with repeat GA. Nevertheless, continued recall rates in GA group were significant lower than NP group. The possible reason was that patients in GA group might have more complex condition and worse behavior than NP group which is the great obstacle for routine check-up. The other reason would be most cases in GA group were referred from dental clinic or hospital that was still able to treat patients conventionally. Thus, their routine recalls were mostly taken place at where they were from. However, the socioeconomic status of major caretaker is still a crucial factor that is needed to take into account in recall behavior for the fact that the oral health was not taken as seriously as earning their living. As a result, they could not bring their children for recall visit routinely particularly in low-income families.[22] Unfortunately, the present study could not analyzed the relationship between this factor and the recall behavior due to the limitation of secondary data retrieval.

Treatment outcomes showed only stainless steel crown dislodgement was significantly higher in GA group (9%) when none of NP group was detected. This could be due to the higher number of crown performed in GA group and other specific factor such as parafunctional habits which mostly found in more severe SHCN patients that required GA.

The improvement of behavior (Fig. 2) could be seen significantly higher in GA group, possibly due to a greater number of GA cases had negative baseline behavior (Frankl score 1−2) than NP group. This result showed that the negative behavior of children with SHCN could be adjusted and improved by many techniques of NP approaches in the subsequent recall visits, not unless ones who had been through GA before.

Although oral hygiene is one of the predictor for caries occurrence, a significant caries occurrence with faster rate was detected in GA group although there were no significant OHI−S change, and any associations in regularity of recall in the present study. Conversely, focusing on OHI−S change in Fig. 3, there was a trend of great improvement in GA group at ≥ 24 months of recall. Thus, it could be implied that effective and individual prevention strategy is beneficial to improve oral hygiene beside the regularity of
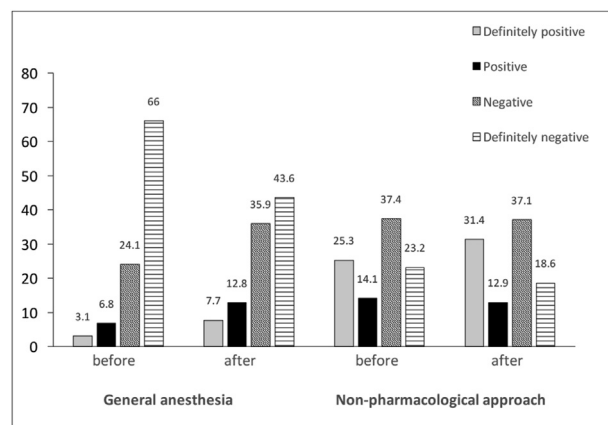

Figure 2 Percentage of Frankl behavior change at before and after 24 months of recall.
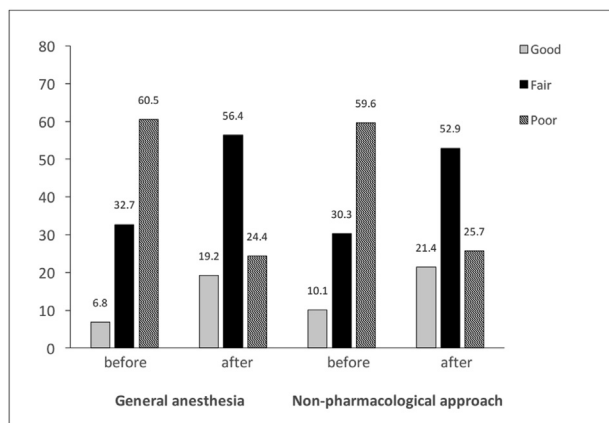
Figure 3 Percentage of OHI—S change at before and after 24 months of recall (footnote- OHI—S: simplified oral hygiene index).

recalls, particularly in patients treated under GA who had more complex physical and mental status as a great obstacle for having frequent recall visits. In addition, another preventive approach such as teledentistry should be more studied and apply into this context to improve the quality of life in SHCN patients especially in the Covid 19 pandemic.

Based on the result of this retrospective study, there were some differences in characteristics of dental treatment under GA *versus* NP approach in SHCN patients. It can be concluded that patients who were at older age and had high caries experience with definitely negative behavior and numerous treatment needs were more justifiably for GA, nonetheless the behavior could be significantly improved on subsequent visits. A significant new caries occurrence with faster rate tended towards SHCN patients who underwent GA. The limitation of this retrospective study was that some information could not be obtained from the dental chart record such as socioeconomic status of caretakers. Moreover, some correlations between various factors could not be answered due to the limited samples. Further studies regarding the related factors that might affect the failure of treatments including recall behavior, and long-term outcomes involving repeated GA rate should be of interest.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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