The influence of obesity on pediatric conscious sedation

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Abstract

Objective: This study was conducted to investigate as to whether obesity have any effects on conscious sedation outcomes.

Methods: Forty children (mean age 30.5 months, mean height and weight were 91.3 cm, 14.3 kg respectively) were sedated with chloral hydrate (60 mg/kg) and hydroxyzine (25 mg). The relative obesity rate of the patients was obtained by the proportion of height to weight and the tonsil size of the patients was classified by Brodsky's scale. The overall sedation outcomes were evaluated by Houpt's scale. The pulse and respiratory rates during sedation were also evaluated.

Results: The obesity of the patients had no statistically significant effects on movement, crying during sedation. However, an increase in obesity had negative effects on the overall conscious sedation outcomes.

Conclusion: This investigation demonstrated that increased obesity may cause detrimental effects on pediatric conscious sedation outcomes.

Key words : Conscious sedation, Obesity, Sedation rating scale

I. INTRODUCTION

While most pediatric dental patients can be treated with non-pharmacologic management techniques, some of the uncooperative patients require pharmacologic management techniques such as conscious sedation or general anesthesia. From these two pharmacologic treatment options, conscious sedation is more widely utilized due to its convenience. The primary goal of pediatric conscious sedation is to facilitate the quality of dental care by minimizing obstructive behavior and at the same time to promote a positive response to dental treatment. The profession of pediatric dentistry has long searched for the ideal agent or regimen that will allow these goals to be met. Despite the fact that dozens of drugs have been utilized for conscious sedation either alone or in combination with varying routes of administration, the drug regimen that consistently and effectively meets the goals for conscious sedation has yet to be found.

Obesity is a major pediatric health problem. The prevalence of obesity in children is rising, and estimates suggest that 27.1% of 6-to 11-year-old children and 21.9% of 12-to 18-year-old children are obese[1]. This represents a problem in part because of the immediate consequences of obesity in youth, which includes changes in health risk or health status, such as lowered fitness[2], increased blood pres-

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sure, increased total cholesterol and decreased high-density lipoprotein concentrations. In addition, obesity in childhood is predictive of adult obesity[3-5].

Anesthetic management of obese patients does not engender enthusiasm from most anesthesiologists, because of increased oxygen consumption, carbon dioxide production and other related clinical problems (hypertension, abnormal liver function and so on). For the same reasons, such reluctance can be applied to pediatric conscious sedation.

Clinicians and investigators agree that the most common cause of respiratory problems in children sedated for dental care is upper airway obstruction[6]. Soft tissue obstruction of the airway by the tongue is common, and increased tonsil size is also one of the risk factors. Decreased tone of the upper airway and the musculature of the tongue during sedation are evident in a sleeping child,[7] and supine patient position during sedation can magnify the effect of tonsil size.

In this study, we investigated to determine whether obesity may have any effects on pediatric conscious sedation outcomes.

Ⅱ. MATERIALS AND METHODS

Subjects and procedures

Forty ASA Class I children, ages 19-42 months were included in this study (Table 1). All of the children exhibited definite negative behavior preoperatively in accordance with the Frankl Scale[8]. The children's average weight was 14.4 kg, ranging from 10.5 kg to 17.3 kg. Their average height was 91.3 cm, with a minimum height of 85 cm and a maximum of 99 cm (Fig. 1).

After measuring the patients' height, weight and obesity, the patients received 60 mg/kg chloral hydrate (with a maximum dose of 1000 mg) and 25 mg hydroxyzine and remained in a quiet room for approximately 60 minutes after drug administration. Onset time (the time when patients fell asleep) was recorded by their parents or guardians. All of the patients were placed in a Papoose Board (Olympic Medical Corp., Seattle, WA), received local anesthesia, and were monitored for physiologic vital signs. Fifty percent of concentration nitrous oxide was administered. Vital signs (pulse rate, respiration and oxygen saturation) were recorded every 5 minutes throughout the whole treatment procedures.

(1) Evaluation of obesity

Kaup index was used to classify child obesity and they were categorized into 3 groups by their obesity (Table 2). Kaup index calculates the obesity by dividing the children's weight by height squared and multiplying it by 10.

(2) Classification of tonsil size

An evaluation of tonsil size was recorded using the

Table 1. Distribution of cases by age (Average 30.5±5.8 months)

Age (Months)	Number	Percentage
≤20	1	2.5
21-25	5	12.5
26-30	16	40
31-35	12	30
36-40	5	12.5
41≤	1	2.5

Table 2. Distribution of cases by Kaup index (N=40)

	Group I (<15)	Group II (15~19)	Group III (≥19)	Mean
Male	6	8	8	17.4±3.2
Female	5	8	5	17.1±2.9

Brodsky's classification system[9]. This system classifies Type 0 tonsils as not present or atrophied, through a continuum to Type 4 tonsils, which are hypertrophied and in contact with each other. The dental operator and the sedation assistant reached a consensus for each patient's tonsil size at the beginning of each sedation appointment.

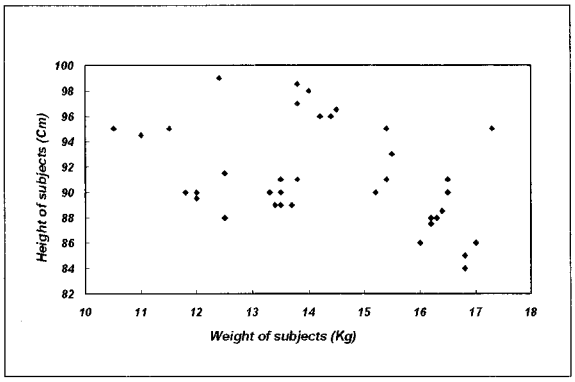

Fig. 1. Distribution of cases by height and weight. (Mean height and weight: 91.3±3.8, 14.4±1.9)

(3) Behavioral assessment during sedation

The Houpt Sedation Rating Scale[10] was utilized for behavioral assessment (Table 3). Combined ratings of sedation effectiveness were made by the operator and the sedation-assisting dentist at the end of each visit.

(4) Evaluation of apnea events

SpO_2 and pulse rate were continuously monitored using pulse oximeter. When SpO_2 remains below 95 for more than 5 seconds, it was defined as true apnea.

Data analysis

The ANOVA with multiple comparisons and Spearman's correlation were used for statistical analysis in this study. Findings were considered statistically significant if a P-value of ≤ 0.05 was attained.

Table 4. Houpt Sedation Rating Scale[10]

Sleep	Score
Fully awake	1
Drowsy, disoriented	2
Asleep	3
Movement	
Violent movement interrupting treatment	1
Continuous movement making treatment difficult	2
Controllable movement that does not interfere with treatment	3
No movement	4
Crying	
Hysterical crying that demands attention	1
Continuous, persistent crying that makes treatment difficult	2
Intermittent crying that does not interfere with treatment	3
No crying	4
Overall behavior	
Aborted	1
Poor : treatment interrupted, only partially completed	2
Fair : treatment interrupted, but eventually all completed	3
Good : difficult, but all treatment performed	4
Very good : some limited crying or movement	5
Excellent : no crying or movement	6

Ⅲ. RESULTS

1. Behavioral assessment by obesity

(1) Sleep and movement

Fig. 2 shows the ratings in sleep and movement by obesity. There was no statistically significant difference (p=0.132, 0.216), but in general, children with a higher level of obesity showed a tendency of worse behavior.

(2) Crying and overall behavior

There was no statistically significant difference in crying among the groups (p=0.098). However, in the case of overall behavior, groups I and II showed better results than group III, and the difference was statistically significant (p=0.038, 0.031) (Fig. 3).

2. Onset time by obesity

Each group showed a different onset time and group I showed a statistically significant faster onset time than groups II and III (p=0.002, 0.001) (Fig. 4). Group II showed a statistically significant faster onset time than group III (p=0.019).

3. Apnea events by obesity

There were no statistically significant differences among the groups in terms of apnea events (p=0.082) (Fig. 5).

4. Tonsil size by obesity

There was no statistically significant difference in tonsil size by obesity (p=0.105) (Fig. 3).

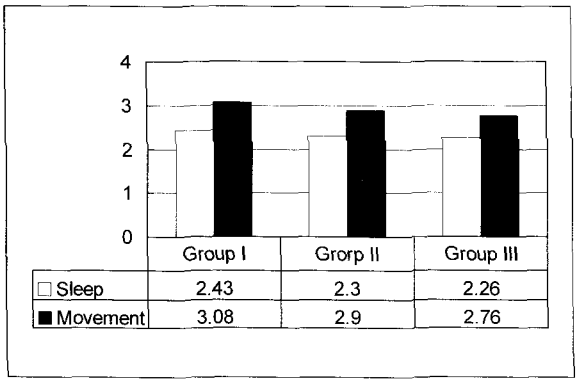

Fig. 2. Evaluation of sleep and movement by obesity.

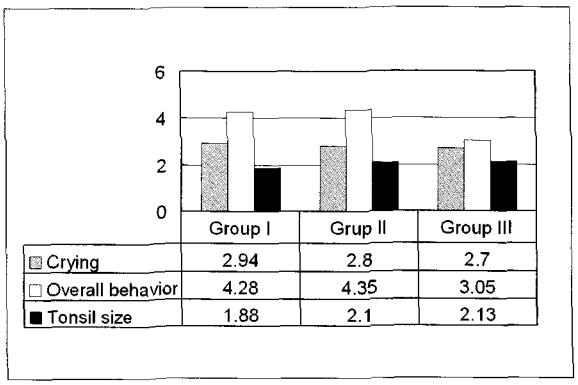

Fig. 3. Evaluation of crying, tonsil size and overall behavior by the obesity rate.

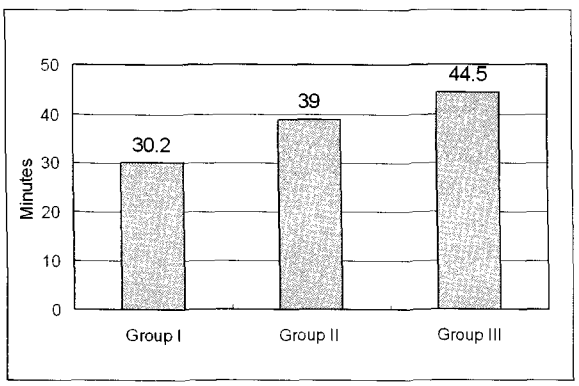

Fig. 4. Evaluation of onset time by the obesity rate.

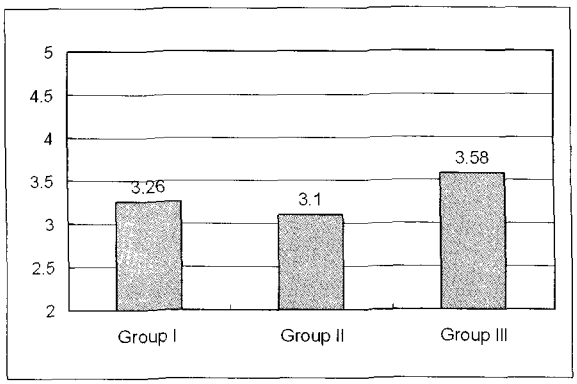

Fig. 5. Evaluation of true apnea events.

Ⅳ. DISCUSSION

Chloral hydrate is a sedative-hypnotic agent that was first synthesized in 1832 and is widely used in both pediatric medicine and dentistry[11,12]. Used alone or with a co-medication such as hydroxyzine or promethazine, chloral hydrate is the most frequently used oral agent for conscious sedation in pediatric dentistry[13,14]. Despite its popularity, the use of chloral hydrate for conscious sedation in pediatric dentistry is less than ideal. Oral chloral hydrate has variable absorption rate, has a bitter taste and causes gastric irritation[15,16]. Chloral hydrate may cause respiratory depression and has a wide range of effectiveness[15,17,18]. In general, the dose of chloral hydrate is prescribed by the body weight, but there are great differences in their effectiveness individually. Obesity can be considered as a factor that makes such a difference.

The measurement of body fat, which is composed mainly of adipose in the form of triglyceride, represents a challenge to researchers and clinicians. The main stores of body fat are subcutaneous and intra-abdominal, and considerable amounts of fat can also reside within muscles. Because fat is diffuse and inaccessible, it is impossible to measure total adipose directly. Traditionally, the gold standard for estimating body fat has been hydrodensitometry (underwater weighing), which is based on the principle that fat tissue is less dense than muscle and bone. Dual-energy x-ray absorptiometry is now replacing densitometry as a standard because of its high precision and its simplicity for the subject. Both of these methods are used primarily for research purposes and are not available for routine clinical care, but they can be used to validate other methods of measuring body fat. In the clinical practice and in large epidemiologic studies, body fat is most commonly estimated by using a formula that combines weight and height. The underlying assumption is that most of the variation in weight for persons of the same height is due to fat mass. The formula used most frequently in epidemiologic studies is the body-mass index (BMI), also called the Quetelet index, which is the weight in kilograms divided by the square of the height in meters[19]. In this study, Kaup index is used instead of BMI. Kaup index is also a measure of the obesity based on height and weight. However, Kaup index is clinically more effective when applied to children than BMI which uses metric measures as kilograms and meters, since weight and height are indicated in grams and centimeters.

Another method used for assessing fatness is bioimpedance. The measurement of bioimpedance is based on the principle that lean mass, because it is primarily an electrolyte solution, conducts current better than fat mass. Thus, a measurement of the resistance to a weak current (impedance) applied across the extremities, when combined with height and weight and an empirically derived equation, provides an estimate of body fat. Devices to measure bioimpedance are simple and moderately priced and impose a minimal burden on patients, but they do not measure fat better or predict biologic outcomes more accurately than simple anthropometric measurements. There are many methods used for assessing fatness of body like those mentioned above, but the most clinically effective and easier method for children is thought to be BMI or Kaup index. Therefore, Kaup index was used in this study to evaluate the obesity.

Most of previous researches on the sedation outcomes adopted Houpt's sedation rating scale to evaluate the effectiveness of sedation regimens. Therefore, the same rating scale was used in this study in order to allow to make more objective comparision possible between the results of this study and the previous ones.

In this study, there were no statistically significant differences among the groups in measurements of sleep, movement and crying by the obesity, but a slight tendency towards worse behavior in obese children was noted. This trend could be substantiated by statistically significant differences in overall behavior.

In onset time and overall behavior, there were statistically significant differences among groups. These results can be explained in two ways.

The first one is the affinity of chloral hydrate for lipid cells. When chloral hydrate is absorbed into the body, it gets activated in a form of trichloroethanol, which has the same chemical structure like ethanol, but with 3 chloride ions attached. Similar to ethanol, trichloroethnol has a high affinity for lipid cells. Due

to a high affinity of trichloroethnol for lipid cells, it is considered that the absorption rate of chloral hydrate can be affected by the degree of the individual obesity.

The second one is the concept of "volume of distribution." Suppose a drug has been completely absorbed from its site of application and has reached equilibrium in its distribution among several tissues of the body, no biotransformation or excretion of the drug has occurred. If one knew the mass of drug administered and the average concentration of the drug in the body, the apparent volume into which the drug had been dissolved could be determined from the relationship: concentration = mass/volume. Simply, when a person's body surface area is larger, less amount of medication is actually going to the acting site. This is called "volume of distribution."

Based on a high affinity of trichloroethanol for lipid cells and volume of distribution, it is considered that sedation outcomes were different by the obesity. However, in order to get a more reliable conclusion, it is recommended to conduct further more detailed study including pharmacokinetics and affinity for lipid tissue of chloral hydrate.

There were several studies about the relationship between tonsil size or obesity and obstructive sleep apnea, but there were only a few exact reports for that relationship. Marcus and Koemer[20] showed that the degree of obesity correlated with the severity of upper airway obstruction, and obese children have a high prevalence of obstructive sleep apnea. However, Mallory and Figer[21] did not find any correlations between obesity and tonsil size or obstructive sleep apnea in their study.

In this study, no correlation could be noted between obesity and true apnea events. This result can be explained by the fact that apnea events in conscious sedation is more affected by such factors as jaw position, duration of treatment and the dose of sedative agents[22].

Tonsil size has also been considered another factor that affects apnea events during dental conscious sedation. In this study, there was no statistically significant correlation between patients' tonsil size and obesity even though there was a trend that more obese children had larger tonsils. In addition, patients with relatively small tonsil size were usually selected for conscious sedation to minimize sedation risk. Thus, no statistical evaluation of apnea events could be made by the tonsil size in this study.

Ⅴ. CONCLUSION

This study was conducted to investigate as to whether obesity may have any effects on conscious sedation outcomes. Based on the results of this study, the following conclusion could be made.

1. In the case of sleep, movement and crying, there was no statistically significant difference by obesity.
2. In the case of overall behavior, lean children and those with normal obesity rate showed better results compared to obese children.
3. The higher the obesity rate was, the faster the onset time became.
4. In the case of apnea events, there was no statistically significant difference by obesity.
5. There was no significant correlation between tonsil size and obesity.

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Abstract

아동의 비만도가 진정요법의 효과에 미치는 영향

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본 연구의 목적은 소아의 비만도가 진정요법의 효과에 미치는 영향을 알아보는 것이다. 삼성서울병원 소아치과에 내원한 환자 중 ASA I 또는 II에 해당하는 40명의 환아 (평균연령 30.5개월, 평균신장 91.3cm, 평균체중 14.3kg)를 대상으로 chloral hydrate(60mg/kg) 및 hydroxyzine(25mg)을 사용하여 진정요법을 시행하였다. 환아의 체중과 신장을 이용하여 환아 각각의 비만도를 계산하였고 Broadsky's scale을 이용하여 편도선의 크기를 측정하였다. 진정요법에 대한 결과는 Houpt's scale(수면, 움직임, 울음, 전반적인 행동지수)을 이용하여 평가하였다.

환아의 비만도는 진정효과중 움직임과 울음에 대하여는 통계학적으로 유의한 차이를 만들지 않았으나 비만도가 증가할수록 전반적인 행동지수가 유의하게 나빠지는 결과를 보였다.

주요어 : 진정요법, 비만도, 진정평가지수