Original Article

pISSN 2383-9309 ▮ eISSN 2383-9317
J Dent Anesth Pain Med 2016;16(4):283-288 ▮ https://doi.org/10.17245/jdapm.2016.16.4.283

Survey of the sevoflurane sedation status in one provincial dental clinic center for the disabled

Chang-hyun Park[1], Seungoh Kim[2]

[1]Department of Pediatric Department, School of Dentistry, Dankook University, Cheonan, Korea
[2]Department of Anesthesiology, School of Dentistry, Dankook University, Cheonan, Korea

Background: Sevoflurane sedation in pediatric and disabled patients has the advantage of faster induction and recovery compared to general anesthesia, as well as minimum influence on the respiratory and cardiovascular functions, and airway protective reflexes. This study aimed to evaluate the clinical efficacy of sevoflurane sedation used in dental treatment at one provincial dental clinic center for the disabled.
Methods: We investigated patients' gender, age, reasons for undergoing sedation, medication history prior to treatment, duration of anesthesia, treatment length, type of treatment, and yearly patterns, for 387 cases of dental treatment performed using sevoflurane sedation from January 2013 to October 2016.
Results: We analyzed 387 cases (215 male patients, 172 female patients). Male patients aged 20 year or older accounted for 39.0% of all patients, marking the highest proportion. Patient's lack of cooperation was the most common reason for performing dental sedation. Prosthetic treatment was the most frequently practiced, accounting for 174 treatment cases. The mean lengths of the entire treatment and of the dental procedure were 55.2 min and 39.8 min, respectively.
Conclusions: Sevoflurane sedation has the advantage of fast anesthesia induction and recovery compared to general anesthesia; therefore, it can be used efficiently to induce anesthesia in pediatric and disabled patients during short dental procedures, enabling stable treatment of these patients.

Keywords: Handicapped patients; Pediatric; Sedation; Sevoflurane.

INTRODUCTION

Behavioral control of pediatric or disabled patients is one of the most important factors to consider during dental treatment. When it is difficult to obtain cooperation from patients using conventional methods of behavior management, appropriate sedation must be performed. Sevoflurane inhalation has fast induction and recovery times because of low solubility in blood [1], and minimally affects patients' respiratory and cardiovascular functions and airway protective reflexes [2,3]. Moreover, since sevoflurane sedation does not require intravenous injections, thus allowing pediatric and disabled patients to avoid the fear of shots, it makes behavior management of these patients much easier [4]. Owing to these advantages, sevoflurane sedation has become a common alternative to general anesthesia for pediatric and disabled patients who are to undergo dental treatment, especially when performing short dental procedures.

The present study aimed to retrospectively evaluate the clinical effectiveness of sevoflurane sedation at one

Received: 2016. December. 1. • Revised: 2016. December. 10. • Accepted: 2016. December. 12.
Corresponding Author: Seungoh Kim, Department of Anesthesiology, School of Dentistry, Dankook University, 119 Dandaero, Dongnam-gu, Cheonan, 31116, Korea
Tel: +82-41-550-1863 Fax: +82-41-550-1863 E-mail: ksomd@naver.com

provincial dental clinic center for the disabled between January 2013 and October 2016.

MATERIAL AND METHODS

The research protocol was established according to a guideline published by the Institutional Review Board (IRB) of Dankook University Dental Hospital, and was approved by the IRB (IRB No. DKUDH IRB 2016-12-01).

1. Study subjects

We reviewed 387 cases of dental treatments using sevoflurane sedation performed between January 2013 and October 2016 on pediatric and disabled patients at one provincial dental clinic center for the disabled. The clinic has been providing the community with dental treatments for disabled patients and those who require general anesthesia or sedation.

2. Method

We reviewed patients' gender, age, reasons for undergoing sedation, medication history prior to the treatment, duration of anesthesia, treatment length, type of treatment performed, and yearly patterns on their medical records.

3. Method of sedation

Indications for using sevoflurane sedation were the following: (1) failure to control the behavior of the patient using conscious sedation; (2) the patient requires short procedures that last less than an hour; and (3) the patient can breathe through the nasal cavity and there is no condition posing difficulty in airway management. Dental procedures were performed after receiving consent forms from the legal guardians of the patients.

Sevoflurane 8 vol % was delivered to the patients through a full facial mask. The facial mask was replaced with a nasal cannula (Softech BI-FLO® Cannula #1844; TELEFLEX Inc., Pennsylvania, USA) when patients lost consciousness. During the procedure, the flow rate of 100% oxygen was maintained at 2 L/min, and the patients' respiration was continuously monitored through the end-tidal sevoflurane concentration (ETS) and capnography line of the nasal cannula. The ETS was maintained within a 1-1.5 vol % range. The depth of sedation was measured during the procedure using S/5 Entropy™ Module (Datex-Ohmeda Division, Instrumentarium Corporation, Helsinki, Finland). In addition, spontaneous breathing, oxygen saturation, breathing rate, heart rate, and blood pressure were continuously monitored. Once the procedure was completed, administration of sevoflurane was interrupted, after which the patient recovered from anesthesia within 5 min to 10 min. Patients were moved to a recovery room after they fully regained consciousness and were discharged on the same day as the procedure.

RESULTS

1. Annual patterns of the number of patients (Fig. 1)

The number of patients who underwent sevoflurane sedation was the highest in 2013 (146 patients), and decreased in the following years.

2. Gender distribution (Fig. 2)

Of the 387 patients, 215 were male (55.6%), and 172 were female (44.4%); thus, the proportion of male patients was higher than that of female patients.

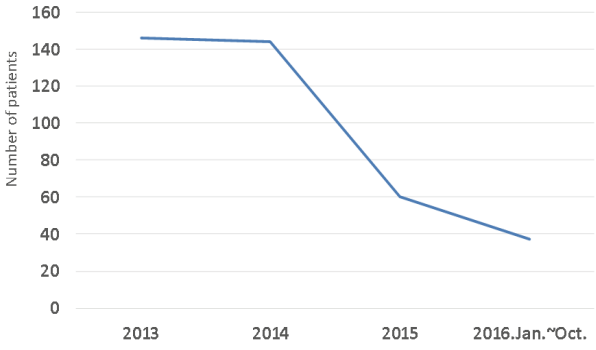

Fig. 1. Annual patterns of the number of patients.

3. Age distribution (Table 1)

The patients' age ranged from 0 years to 83 years: 83 patients (21.4%) were 0-4 years old, 104 patients (26.9%) were 5-9 years old, 17 patients (4.4%) were 10-14 years old, 32 patients (8.3%) were 15-19 years old, and 151 patients (39.0%) were 20 years old or older.

4. Main reasons for undergoing sedation (Table 2)

Dental phobia (lack of cooperation, anxiety) accounted for 158 treatment cases and was the most common reason for administering sevoflurane sedation. Other reasons included intellectual developmental disorder (mental retardation, intellectual disability), accounting for 96 cases, and autism, accounting for 27 cases.

5. Distribution of dental treatment types (Fig. 3)

Prosthetic treatment was the most commonly performed procedure, accounting for 174 treatment cases. It was followed by tooth extraction (74 cases), dental restoration (64 cases), and pulp treatment (32 cases).

6. Distribution of medical clinics department (Table 3)

The pediatric dental clinic and the advanced general dental clinic managed the highest proportions of treatments: 188 cases (48.6%) in the pediatric dental clinic and 164 cases (42.4%) in the advanced general

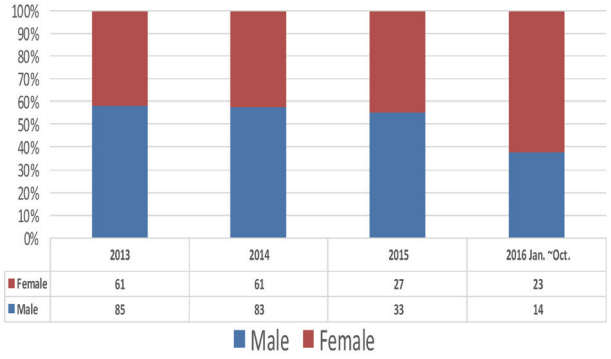

Fig. 2. Gender distribution.

Table 1. Age distribution

Age	Patient No
0-4	83
5-9	104
10-14	17
15-19	32
20-29	74
30-39	30
40-49	24
over 50	23

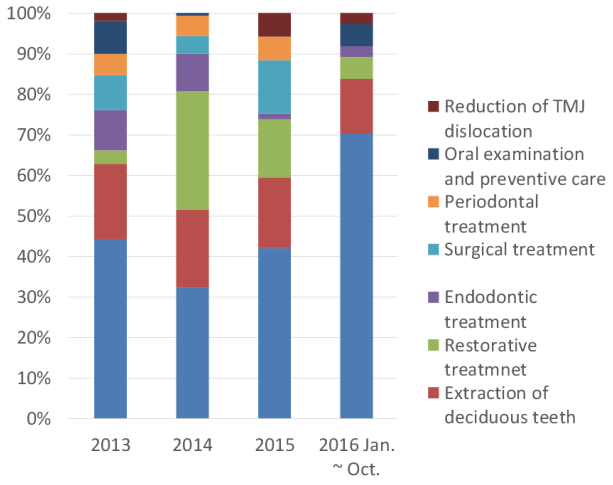

Fig. 3. Distribution of dental treatment types.

Table 2. Main reasons for undergoing sedation

Main Reason	2013	2014	2015	2016 (Jan-Oct)	Total
Dental phobia	64	66	18	10	158
Intellectual developmental disorder	31	28	20	17	96
Multi-compromised reason	21	24	8	0	53
Autism	9	10	5	3	27
Physical disability	5	6	4	4	19
Various (Congenital diaphragmatic defect, Mitochondrial disease, Allergy, Heart disease)	8	7	2	0	17
Alzheimer disease	2	0	3	1	6
Epilepsy	2	2	0	0	4
Gagging	1	0	0	2	3
Parkinson's disease	2	0	0	0	2
Blindness, Deafness	1	1	0	0	2

Table 3. Distribution of medical clinics department

Department	2013	2014	2015	2016 (Jan-Oct)	Total
Pediatric dental clinic	75	86	19	8	188
Advanced general dental clinic	64	51	27	22	164
Prosthetic dental clinic	0	4	8	6	18
Oral maxillofacial surgical dental clinic	6	1	2	0	9
Oral medicine dental clinic	0	2	4	1	7
Preservative dental clinic	1	0	0	0	1

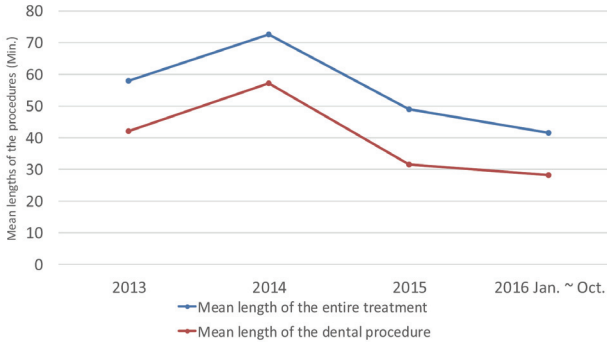

Fig. 4. Mean lengths of the entire treatment and of the dental procedures (min).

dental clinic. The proportion of treatments handled in the advanced general dental clinic increased over time.

7. Mean lengths of the entire treatment and of the dental procedures (Fig. 4)

The mean length of sevoflurane sedation procedure was 55.2 min. The mean length of the dental procedure was 39.8 minutes. Both parameters were the highest in 2014, and they decreased in the following years.

DISCUSSION

Use of sedation is very important during the treatment of pediatric and disabled patients whose behaviors may be difficult to control. Specific psychological traits characteristic of pediatric and disabled patients make their behavioral management challenging, interfere with the treatment, and give rise to serious problems in the treatment environment. For these patients, sedation is necessary to achieve successful treatment outcomes [5]. Oral sedation, which is common in clinical use, sedates individuals to different degrees. While general anesthesia successfully induces complete loss of consciousness, it is invasive, has a long recovery time, and may induce post discharge adverse effects such as apnea and bradycardia, as well as arousal reactions such as delirium and agitation during recovery [5]. Deep sedation accompanied by local anesthesia has been used as a safer alternative for general anesthesia as it minimally affects respiratory and cardiovascular functions and protective reflexes, and has a short recovery time.

Sevoflurane sedation can be useful in dental treatment of pediatric and disabled patients, whose behaviors are usually difficult to control. The observed decrease in the number of patients who underwent sevoflurane sedation in 2015 and 2016 compared to 2013 and 2014 can be attributed to a change in indications for sevoflurane sedation in 2015 and 2016. Whereas sevoflurane sedation was indicated for dental procedures that took less than 2 h in year 2013 and 2014, the indication was changed to 1 h in 2015. This change is reflected in the mean lengths of treatment listed in Fig. 4. The range may have been reduced because (1) the sevoflurane gas may be diluted by the air in the cannula or by the patient's breathing prior to administration, and (2) airway management may have to be performed in case of excessive sedation induction, making sevoflurane sedation less advantageous for long procedures.

According to a statistical report published by the Korean Employment Agency for the Disabled, the proportions of disabled men and women were 58.1% and 41.9%, respectively, in 2014, and the proportion of disabled women steadily increased from 2000 to 2014 [6]. In our study, the proportion of male patients (215 patients, 55.6%) was higher than that of female patients (172 patients, 44.4%). However, when compared with

previous studies, the proportion of female patients has increased. In 1997, the proportion of female patients among the total disabled patients was 35.7% at Yonsei University [7]. In 2009, a similar study at Seoul National University College of Dentistry showed that the ratio of female patients was 41.7% [8]. The steady increase seems to reflect the increase in the female disabled population.

Patients aged 0-9 year accounted for nearly half of the patient population (187 patients, 48.3%). This may be because emergency treatments are in higher demand among pediatric patients compared to older and adult patients. Not only is behavioral management of pediatric patients challenging, but also these patients fail to cooperate during emergency treatment due to the fear caused by their injuries [9].

Sedation using nitrous oxide often fails to sedate a patient to the degree required for emergency treatment, and in many cases, it needs to be administered together with oral sedation. General anesthesia also proves inadequate as it lasts too long, and requires a long recovery time. As an attempt to overcome these limitations, a research has been conducted on application of sevoflurane sedation in emergency treatments, and higher levels of satisfaction with the procedure were reported among pediatric patients in previous studies [5].

In this study, instead of a nasal hood, a nasal cannula through a facial mask, was used following the sedation induction. Although nasal hoods have excellent sealing effects, they may cause poor visibility and interfere with the instrumentation when treating the maxillary anterior teeth, which are prone to injuries. These limitations are less evident when using nasal cannulas; therefore, nasal cannulas are useful for the treatment of pediatric patients [10].

When different types of dental procedures were grouped by year, it was found that the rate of prosthetic treatment greatly increased, while those of restorative dental treatment and pulp treatment decreased. During relatively short prosthetic treatments, whose procedures may include taking teeth impressions and fixing dental prostheses, sevoflurane sedation was continuously conducted owing to the relatively short duration of the anesthesia, the short recovery time, and its ability to sufficiently induce sedation. This pattern of preference for inhalation sedation using sevoflurane during short procedures, in which airway management is relatively easy, is reflected in the decrease of both the entire treatment length and the length the dental procedure starting from 2014.

The proportions of treatments managed in the pediatric dental clinic and in the advanced general dental clinic were 48.6% and 42.4%, respectively, thus exceeding those managed in other medical clinics. This may be caused by characteristics of the aforementioned clinics that mainly manage pediatric or disabled patients. In addition, the proportion of treatments managed in the advanced general dental clinic was found to increase over time. This may be attributed to a decrease in the number of restorative dental treatments performed at the pediatric dental clinic, and to the nature of the treatments performed at the advanced general dental clinic, a huge proportion of which is in fact restorative dental treatments.

The difference between the entire treatment time and the dental procedure time was 15.6 min, shorter than the 32 min difference when using general anesthesia calculated in the previous study [5]. This means that the sum of the induction time and the time required to restore consciousness is shorter in the sevoflurane sedation than in general anesthesia; it is inadvisable to perform general anesthesia during short dental procedures because of the extra time that would be required. Sevoflurane sedation can be used as a good alternative for general anesthesia as it overcomes these limitations.

Sevoflurane induces deep sedation at a higher success rate compared to other methods, and is highly potent. Therefore, medical staff should be provided with appropriate general anesthetic monitoring devices. Moreover, the medical staff should be skilled at handling emergencies and performing high-level airway management techniques such as bag-mask ventilation [11,12].

Treatment length is important in sevoflurane sedation.

Sevoflurane sedation has the advantage of faster sedation induction and recovery times compared to general anesthesia under the condition that it is performed during emergency treatment or simple procedures, and airway management is easy during sedation. Sevoflurane sedation enables stable treatment of these patients.

When performing short dental procedures on pediatric or disabled patients, sevoflurane sedation is more economical than general anesthesia due to its faster anesthesia induction and recovery times.

ACKNOWLEDGMENTS: This present study was conducted by the research fund of Dankook University in 2015.

REFERENCES

1. Jones RM. Desflurane and sevoflurane: inhalation anaesthetics for this decade?. Br J Anaesth 1990; 65: 527-36.
2. TerRiet MF, DeSouza GJA, Jacobs JS, Young D, Lewis MC, Herrington C, et al. Which is most pungent: isoflurane, sevoflurane or desflurane? Br J Anaesth 2000; 85: 305-7.
3. Kanaya N, Hirata N, Kurosawa S, Nakayama M, Namiki A. Differential effects of propofol and sevoflurane on heart rate variability. Anesthesiology 2003; 98: 34-40.
4. Röhm KD, Wolf MW, Schöllhorn T, Schellhaass A, Boldt J, Piper SN. Short-term sevoflurane sedation using the Anaesthetic Conserving Device after cardiothoracic surgery. Intensive Care Med 2008; 34: 1683-9.
5. Kim SO. A survey of general anesthesia, sevoflurane sedation and intravenous sedation in chungnam dental clinic for the disabled. J Korean Academy of Pedi Dent 2013; 40: 28-39.
6. Korea Employment Promotion Agency for the Disabled Employment Development Institute. 2015 Disability Statistics. Korea Employment Promotion Agency for the Disabled Employment Development Institute. 2015. [2015 Dec 16].
7. Lee JH, Shon HK, Kim JH. A study on the treatment of dentally handicapped patients under outpatient general anesthesia. J Korean Academy of Pedi Dent 1997; 24: 581-9.
8. Seo KS, Shin TJ, Kim HJ, Han HJ, Han JH, Kim HJ, et al. Clinico-statistical analysis of cooperation and anesthetic induction method of dental patients with special needs. J Korean Dent Soc Anesthesiol 2009; 9: 9-16.
9. Kim SO, Kim YJ, Hyun HK, Koo YS, Shin TJ. Deep sedation with sevoflurane inhalation via a nasal hood for brief dental procedures in pediatric patients. Pediatr Emerg Care 2013; 29: 926-8.
10. Kim SO, Kim YJ, Koo YS, Shin TJ. Deep sedation with sevoflurane insufflated via a nasal cannula in uncooperative child undergoing the repair of dental injury. Am J Emerg Med 2013; 31: 894. e1-3.
11. Hosey MT, UK National Clinical Guidelines in Pediatric Dentistry. Managing anxious children: the use of conscious sedation in paediatric dentistry. Int J Paediatr Dent 2002; 12: 359-72.
12. Clinical ACS, General AS, American Academy of Pediatric Dentistry. Guideline on use of anesthesia personnel in the administration of office-based deep sedation/general anesthesia to the pediatric dental patient. Pediatr Dent 2012; 34: 170.