Intravenous sedation for dentistry in Japan—current clinical features of our department

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There are 1,800 certified dental anesthesiologists in Japan. Anesthesia can be provided to dental patient, if the provider is certified as a dentist in principle, however, most anesthesia presumably is provided by the certified dental anesthesiologists. Thus, the certified dental anesthesiologists should provide anesthesia to dental patients, either, adults and children, who requires anesthesia. Many outpatients are managed under intravenous sedation because of its feasibility. The Japanese Dental Society of Anesthesiologists is an organization that was founded 50 years ago and is responsible for the certification of dental anesthesiologists. Our department of anesthesiology is certified by this society and is contributing to the education of dental anesthesiologists. Our department treats approximately 2,000 sedation cases and 1,200 general anesthesia cases annually. Here, we would like to introduce the clinical features of dental anesthesia performed in our department, including our clinical research, as an example of dental anesthesia in Japan.

Optimal sedation level for dentistry

Anesthesia for dental treatment and oral surgery is a specialized field of anesthesia. Since oral surgery and respiratory management share the orofacial field, one of the challenges faced by anesthetists is assuring safe respiration while sedating the patient to enable surgical intervention. Endotracheal intubation can be used to secure the respiratory tract safely, but this approach can only be used in patients receiving general anesthesia. During intravenous sedation, the airway is not secured by an artificial tract, such as the endotracheal tubing. The airway is also prone to obstruction because the use of sedatives can lead to a loss of consciousness and can reduce the sensitivity to hypercapnia. Anesthesiologist must find the optimal sedation level allowing both requirements—a sufficient sedative state and a secure airway—to be met. However, the required sedative dose can vary among individuals. The sedative dose can be titrated by watching the respiratory status and the sedated status. The final goals of optimal sedation should be a patient who is satisfied with a slight level of unconsciousness and is able to accept the procedure and a surgeon or dentist who is satisfied with the ease of treating the patient and a controllable surgical field.

Factors for achieving optimal sedation

One may wonder whether an optimal sedative dose to achieve an optimal sedation level for dental treatment could be defined. Sedation level for gastrointestinal endoscopy has been discussed, and relatively larger dose is suggested (1). However, the optimal sedative level depends on the procedure. Since the upper airway cannot be easily manipulate during dental treatment, the controllable range

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for dental sedation is limited. A previous study explored the optimal sedation level for dental treatment by analyzing the results of postoperative questionnaires completed by both the patient and the surgeon or dentist (2). In this study, the surgeries mainly consisted of tooth extraction and/or minor dental surgery. The sedation method that was used was a combination of midazolam and propofol. The authors found that patient satisfaction depended on a loss of memory/amnesia and a surgical time of less than 90 min, ideally less than 40 min. Meanwhile, dentist satisfaction depended on the minimization of patient movement. To achieve both patient and dentist satisfaction, the dose of midazolam was important, since amnesia can be efficiently obtained using this benzodiazepine sedative, but not by using propofol. This study demonstrated that a midazolam dose of 3 mg was most effective for achieving amnesia that was not accompanied by unintentional patient movement. This dose has been doses of greater than 3 mg seemed to trigger unintentional patient movement. Unconsciousness might be disadvantageous to maintaining an optimal sedation status because a forced body position can be uncomfortable if it is maintained for a long time, and even though a patient is unconsciousness, they are still aware of discomfort. This study demonstrated that patients cannot stand forced body positioning for periods of longer than 90 min. This time period might represent a threshold between choosing sedation or general anesthesia. The combination of midazolam and propofol is advantageous to avoid cardiovascular and respiratory adverse effect (3) as this study demonstrated.

Current monitoring of intravenous sedation

Processed electroencephalogram (EEG)

Sedation is an incomplete anesthesia. Once the anesthesia level becomes deeper closely to general anesthesia, respiration becomes crucially depressed. Thus, the monitoring of respiration has to be mandatory during sedation. Pules-oximetry is a reliable monitoring for oxygenation. However, impending crucial airway obstruction and respiratory depression has to be predicted before desaturation occurs. Such respiratory depression largely depends on the level of consciousness. The consciousness level depends on the balance between the strength of the stimuli and the level of the pharmacological suppression of neuron activity. If a stimulus increases, the level of consciousness will also increase. If the pharmacological suppression increases, the level of consciousness decreases. During intravenous sedation for dental treatment, the level of stimuli fluctuates, and multimodal stimuli, such as forced opening of the mouth, drilling sounds, and cold-water injections, cannot be suppressed by local anesthesia alone. Thus, the sedation level should be deeper than the minimum sedation level to prevent clear awareness. In contrast, to prevent adverse events brought on by deeper sedation, such as desaturation or hypotension in circulatory-compromised patients, the sedation level should be as light as possible. The titration of the sedation level relative to fluctuations in the intensity of stimuli should be considered to maintain a stable sedation status. The level of neuronal suppression can be monitored using processed EEG monitoring (for example, Sedline™, Masimo Co., Ltd., Irvine, CA, USA). Recent advancements in EEG monitoring have demonstrated the ability of this technique to show the balance of each band activity more evenly than that possible using power spectral analysis. Thus, qualitative analysis of the sedation level is now possible (*Figure 1*). The continuous infusion of short-acting sedatives can be instantly controlled. These two advanced techniques can, theoretically, be used to achieve a stable sedation level. We are now attempting to titrate the sedative dose under the guidance of processed EEG monitoring using the patient state index (PSi) value (Sedline™, Masimo Co., Ltd.). This system works well in most cases because healthy dental patients have a large sedative dose range within which safe management is possible. However, some circulatory and respiratory-compromised patients have a very narrow range of tolerable sedative dose. Sudden changes in circulation and respiration cannot be accounted for when the processed EEG value is used to guide sedation. Further research is needed for the application of this technique in cases with difficult sedation.

Respiratory monitoring

Respiratory monitoring is another issue for the advancement of intravenous sedation. We presently have several approaches for monitoring respiration. Pulse oximetry, capnometry, ECG impedance to detect respiratory chest movement, acoustic tracheal sounds, and respiratory flow at the nostril can all be used to monitor and evaluate respiration. When oxygen is administered to a sedated patient, the detection of desaturation using pulse-oximetry is less sensitive to respiratory depression, such as non-hypoxemic obstructive apnea, than other

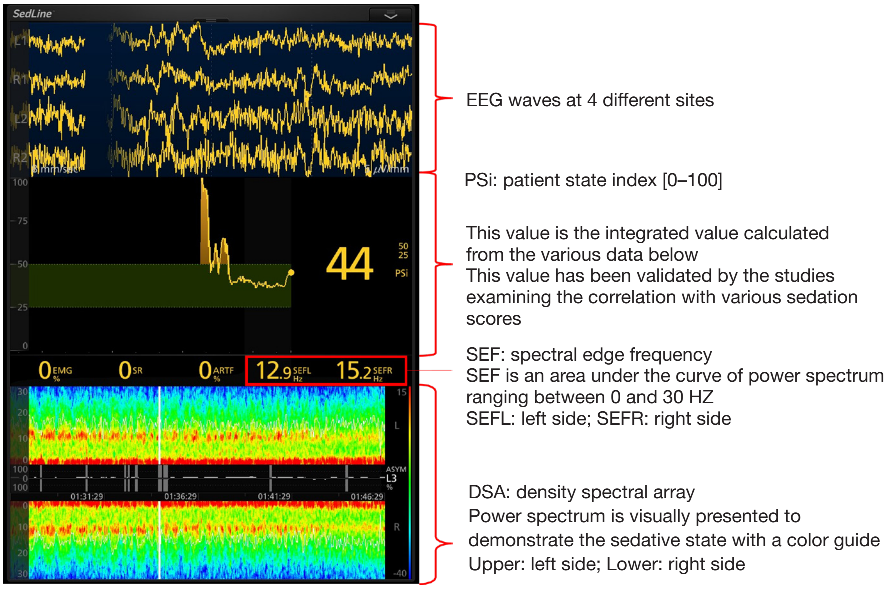

Figure 1 Display of Sedline™ (Masimo Co., Ltd.). The crude EEG from the four channels is shown on the upper screen. The PSi represents an integrated value calculated from the processed EEG parameters and is shown in the middle. The DSA intuitively shows the level of sedation using a color indicator. Simply summarized, the color shifts towards blue when slower bands increase, indicating deeper sedation. Red indicates the direction of awareness. EEG, electroencephalogram; PSi, patient state index; DSA, density spectral array.

modalities. Airway stenosis and obstruction can be initial adverse steps in respiratory depression. These events can be detected by disturbances in smooth airflow in the upper airway. Acoustic monitoring of the larynx can theoretically be used to detect airflow disturbances. Noises accompanying dental treatment, however, can interrupt the stable monitoring of tracheal sounds. External noises and specific tracheal sounds need to be distinguishable. Capnometry may be another option for detecting airway stenosis or obstruction. Capnogram monitoring in a closed anesthesia circuit enables quantitative (hyperventilation or hypoventilation) and qualitative evaluations of the airway (airway stenosis). However, the airway is open in sedated patients. Consequently, respiration cannot be evaluated quantitatively, and qualitive evaluations might be unreliable because the patient may sometimes respirate orally, meaning that the capnogram results might not be able to detect airway obstruction specifically. Recently, another option has been proposed (4). Nasal pressure measured at the nostril can detect abnormal breathing patterns at the nostril. Trends in nasal pressure can distinguish between hypopnea and apnea, and hypopnea and apnea precede desaturation during intravenous sedation (*Figure 2*). Thus, initial abnormal respiratory changes can be sensitively detected by nasal pressure monitoring during sedation. Further developments are expected in the monitoring of specific respiratory changes during sedation.

The Japanese Society of Dental Anesthesiology disclosed the statistical data for the safety of dental anesthesia between 2014 and 2018 (5). In this report, the incidence rate of the overall life-threating events related to sedation provided by the certified dental hospital was 0.31/100,000 cases. Thus, the sedation provided by the specialized facility for dental anesthesia is safe in Japan.

Anesthesia for pediatric dentistry

Uncooperative pediatric dental patients often require anesthesia management to provide a stable field for dental treatment. Sedation could be an alternative to general anesthesia for pediatric patients. Applying general anesthesia instead of sedation would not be appropriate for a certain dental treatment which needs repetitive treatment, for example, dental root canal treatment. However, sedation for pediatric patients involves a higher risk of respiratory failure than in adults (6-8). Higher skill levels and training are required to provide safe sedation care in pediatric patients (9) because critical events are more likely to occur incidentally when non-specialists provide sedation. Even if exclusive monitoring by the certified anesthesiologists may

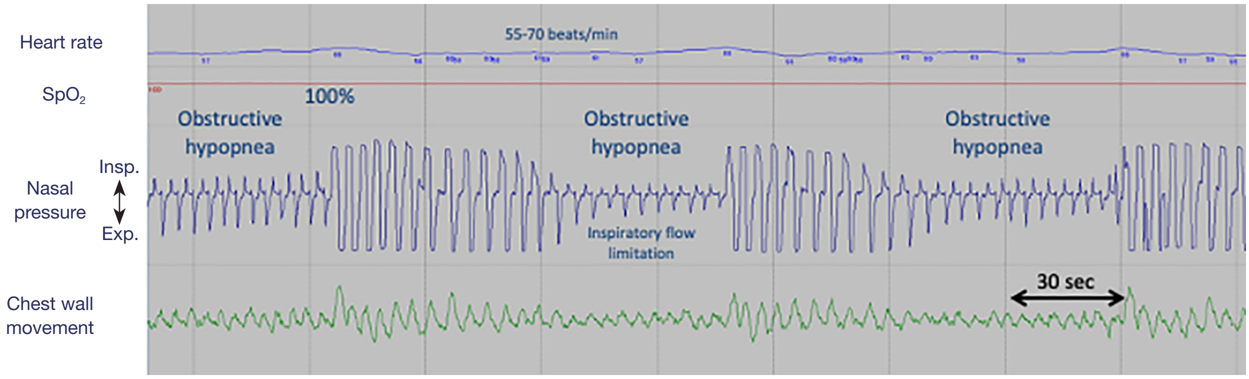

Figure 2 An example of typical adverse respiratory events observed during dental sedation in a 57-year-old patient with a body mass index of 24.3 kg/m^2. Repetitive periodic obstructive hypopnea, similar to that seen in patients with disordered breathing during sleep, were also observed. Cited from reference (4). SpO_2, oxygen saturation measured using pulse oximetry; insp., inspiratory; exp., expiratory.

not help rapid failure of respiration caused by anesthesia-related airway obstruction. Our hospital does not provide intravenous sedation to pediatric patients under the age of 12 years even though it could be provided by the certified anesthesiologists (10). In this patient group, general anesthesia provides a better field of dental treatment and results in a better prognosis. Knapp reported that child-reported measures of quality of life (QoL) and oral health-related QoL (OHRQoL) were significantly higher in general anesthesia groups than in others (11). However, Japan has fewer pediatric general anesthesia cases than North America because general anesthesia for pediatric dentistry is not common. Parents may not know of the availability of anesthesia management for dentistry. In the United Kingdom (UK), where general anesthesia is common for pediatric dental treatment, approximately 59,000 children and adolescents (aged, 0–19 years) per year in 2017 and 2018 were admitted for dental extractions under general anesthesia (12). Although general anesthesia is common in the UK, tooth extraction, rather than tooth treatment, is more likely to be chosen because frequent, repeated general anesthesia is not feasible for patients or their parents (13). Moreover, the risk of repeated anesthesia for pediatric patients remains uncertain because of undetermined adverse effects on the developing brain (13). Thus, the risk of general anesthesia to the developing brain and the feasibility of performing general anesthesia on an outpatient basis are important reasons for the reluctance to perform general anesthesia in pediatric dental patients. We have to focus on the benefits of dental treatment on dental health for children and consider the choice of anesthetic technique, tailoring the method to individual cases. This issue is an important point for the further development of the field of dental anesthesia.

Closing remarks

We have introduced our activity in the field of dental anesthesia in Japan. The demand for anesthetic management in dentistry is increasing. Although the Japanese population continues to be unfamiliar with anesthetic management in dentistry, we must continue to provide safe management to individuals who require anesthesia for dental treatment. We recognize the risk of sedation if it is applied incorrectly, and we are continuing to further the development of optimized sedation techniques.

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References

1. Kiriyama S, Gotoda T, Sano H, et al. Safe and effective sedation in endoscopic submucosal dissection for early gastric cancer: a randomized comparison between propofol continuous infusion and intermittent midazolam injection. J Gastroenterol 2010;45:831-7.
2. Masuda R, Nonaka M, Nishimura A, et al. Optimal and safe standard doses of midazolam and propofol to achieve patient and doctor satisfaction with dental treatment: A prospective cohort study. PLoS One 2017;12:e0171627.
3. Yamamoto T, Fujii-Abe K, Fukayama H, et al. The Effect of Adding Midazolam to Propofol Intravenous Sedation to Suppress Gag Reflex During Dental Treatment. Anesth Prog 2018;65:76-81.
4. Kohzuka Y, Isono S, Ohara S, et al. Nasopharyngeal Tube Effects on Breathing during Sedation for Dental Procedures: A Randomized Controlled Trial. Anesthesiology 2019;130:946-57.
5. Sanuki T, Miyawaki T, Iijima T. A survey on the safety of anesthesia management provided by dental anesthesiologists in Japan: a 5-year survey by the Japanese Dental Society of Anesthesiology. Clin Oral Investig 2023;27:5475-83.
6. Rodgers SF. Safety of intravenous sedation administered by the operating oral surgeon: the first 7 years of office practice. J Oral Maxillofac Surg 2005;63:1478-83.
7. Rodgers SF, Rodgers MS. Safety of intravenous sedation administered by the operating oral surgeon: the second 7 years of office practice. J Oral Maxillofac Surg 2011;69:2525-9.
8. Lee HH, Milgrom P, Starks H, et al. Trends in death associated with pediatric dental sedation and general anesthesia. Paediatr Anaesth 2013;23:741-6.
9. Coté CJ, Wilson S. Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures. Pediatr Dent 2019;41:26E-52E.
10. Nishimura A, Iijima T. Risk of intravenous sedation for pediatric outpatients in dentistry (in Japanese). Japanese Journal of Pediatric Anesthesia 2021;27:64-7.
11. Knapp R, Marshman Z, Gilchrist F, et al. The impact of dental caries and its treatment under general anaesthetic on children and their families. Eur Arch Paediatr Dent 2021;22:567-74.
12. Government UK. Hospital tooth extractions in 0 to 19 year olds 2022. 2023. Available online: https://www.gov.uk/government/statistics/hospital-tooth-extractions-in-0-to-19-year-olds-2022/
13. Tahmassebi JF, Achol LT, Fayle SA. Analysis of dental care of children receiving comprehensive care under general anaesthesia at a teaching hospital in England. Eur Arch Paediatr Dent 2014;15:353-60.

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