



Current status and recent topics in intravenous sedation in Japanese dental practice: a narrative review

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Background and Objective: Sedation in dentistry is practiced worldwide as it alleviates patient anxiety and facilitates treatment. Japan has a dental anesthesiologist system for dentists, and intravenous sedation (IVS) is often administered by dental anesthesiologists. The first objective of this narrative review is to summarize dental IVS in Japan based on the two sedation guidelines. The second objective is to identify trends and perspectives by summarizing the latest literature on IVS in Japan over the past 5 years.

Methods: This review referred to the “Guidelines for Intravenous Sedation in Dental Practice (Revised Second Edition, 2017)” and the “Practical Guide to Deep Sedation in Dental Practice—Concept of Anesthetic Management of Deep Sedation” developed by the Japanese Society of Dental Anesthesia. Additionally, we included original papers and case reports from the past 5 years that were searched using keywords (dental anesthesia, intravenous sedation) in a Japanese database (Ichushi-Web). Exclusion criteria were: subjects were children, locations were outside Japan, and articles for which the complete publication format was not available. We identified 58 articles, and 51 were included in this review.

Key Content and Findings: Established sedation using midazolam and propofol is widely used in various dental specialties in Japan. The main targets are patients with high dental anxiety, strong gag reflexes, patients undergoing oral surgery, and patients with disabilities. The main sites are university hospitals and core regional hospitals. Recent trends have shown an increasing need for IVS, particularly in special needs dentistry, and there are increasing attempts to adapt sedation to high-risk patients, such as by using new drugs and monitoring techniques. However, it is necessary to consider study design with a high level of evidence and from a broader perspective, such as needs assessment and long-term impact.

Conclusions: The need for IVS in dentistry is increasing in Japan, and it has been standardized in two guidelines. Further accumulation of high-quality evidence and studies from a broader perspective are needed to provide safer sedation to a wider range of patients.

Keywords: Dental anesthesia; intravenous sedation (IVS); midazolam; propofol; special needs dentistry

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Introduction

Background

Sedation is widely used in dentistry worldwide to alleviate patient anxiety and facilitate treatment (1-4).

Compared to oral sedation, intravenous sedation (IVS), which involves administering anesthetic intravenously, allows for easier adjustment of the depth and duration of anesthesia and better management of complications.

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Table 1 Summary of the methods employed in the narrative review

Items	Specification
Date of search	Mar 26, 2023
Databases and other information sources searched	Ichushi-Web
Search terms used	IVS/AL and (dental anesthesia/TH or dental anesthesia/AL) and (DT=2018:2023 PT=original paper CK=human)
Timeframe	2018/03/26–2023/03/26
Inclusion and exclusion criteria	Inclusion criteria: original papers, case reports, language: Japanese or English; exclusion criteria: subjects were children, locations were outside Japan, and articles for which the complete publication format was not available
Selection process	The author made his own selection

Rationale and knowledge gap

However, the availability of intravenous anesthesia administration by dentists varies depending on the system in each country, and in some countries, oral sedation is preferred (4). In Japan, a dental anesthesiologist system exists for dentists, and dental anesthesiologists often perform IVS.

Objective

The first objective of this narrative review is to provide an overview of dental IVS in Japan according to the two sedation guidelines established by the Japanese Society of Dental Anesthesiologists. The second objective is to summarize the latest 5 years of literature on IVS in Japan by searching the Japanese Central Journal of Medicine to identify trends and perspectives. We present this article in accordance with the Narrative Review reporting checklist (available at <https://joma.amegroups.com/article/view/10.21037/joma-23-13/rc>).

Methods

In March 2023, a 5-year search of Japanese literature was conducted using the following search method on the Ichushi-Web provided by the Japan Medical Abstracts Society, Japan’s largest medical database. It contains information on about 15 million articles collected from academic and specialized journals in related fields, including dentistry, medicine, nursing, and psychology. The search procedure was as follows: “IVS/AL and (dental anesthesia/TH or dental anesthesia/AL) and (DT=2018:2023

PT=original paper CK=human)”. The details of the search are shown in *Table 1*.

For many years in Japan, IVS has been used during dental procedures by dental anesthesiologists (5–7). IVS is a method of sedation in which a specific drug is administered intravenously to relieve mental tension during dental treatment (8). While it has been a sought-after procedure for both operators and patients, the depth of anesthesia, indications, and methods of administration have not been common among dental anesthesiologists. To develop the concept of IVS and standardize its management, the “Guidelines for Intravenous Sedation in Dental Practice” were formulated in 2009 and revised in 2017 by the Japan Society of Anesthesiologists Guidelines Development Committee based on evidence from Japan and abroad. First, an overview of IVS in Japan will be presented according to the guideline (8).

Psychosedation is defined as the use of medication to control fear, anxiety, and nervousness during dental treatment and to safely administer treatment. Psychosedation is mainly divided into inhalation sedation, in which nitrous oxide is inhaled, and IVS, in which sedative drugs are administered intravenously, depending on the route of drug administration. IVS is divided into conscious sedation and deep sedation, depending on the target sedation level (8).

Conscious sedation aims to achieve mental sedation without loss of consciousness through the anxiolytic and amnesic effects of the administered drug. This level of sedation is sufficiently protective of the organism, allowing the airway to remain voluntary and preventing significant circulatory depression. This method is useful for patients with severe dental anxiety or complicated underlying diseases. On the other hand, in actual dental practice, deep

Table 2 Major indications, contraindications, and diseases requiring caution for intravenous sedation in Japan

Indications
Patients with strong dental fear
Patients prone to vasovagal reflex, hyperventilation syndrome, or panic disorder due to dental treatment
Patients with a strong vomiting reflex
Patients requiring intraoperative circulatory stability
Disabled persons requiring sedation
Contraindications
Patients in early pregnancy
Patients for whom the drug used is contraindicated
Patients who need to be especially careful
Diseases associated with upper airway obstruction (e.g., severe obesity, microtia, tonsillar hypertrophy, sleep apnea)
Patients suspected of having residual gastric contents
Patients with reduced respiratory and circulatory reserve

sedation to the point of unconsciousness is sometimes used, which is called deep sedation and is distinguished from subconscious sedation (8).

Deep sedation may be necessary for patients who are unable to accept dental treatment due to disabilities such as intellectual disability or autism spectrum disorder. Hypnotic effects may also be expected in highly invasive oral surgery and implant procedures. Anesthesia levels resulting in loss of consciousness can compromise vital defenses, impair upper airway patency, and cause circulatory depression. Therefore, deep sedation carries a higher risk of complications than conscious sedation (9). In 2021, the Japanese Society of Dental Anaesthesia Guideline Formulation Committee issued a guideline for deep sedation, which had to be performed due to clinical needs, presenting case selection, management methods including monitoring methods, accidental injuries and their prevention, and the skills that anaesthetists should possess (9).

Table 2 lists the indications, contraindications, and diseases that should be considered for IVS in Japan.

The primary sedatives utilized for IVS in Japan are the benzodiazepines midazolam and propofol (8). Midazolam is advantageous among benzodiazepines due to its short half-life and lack of vascular pain, which makes circulatory depression unlikely. However, caution must be exercised in elderly patients and those with underlying respiratory disease as respiratory depression may occur. Propofol has a rapid onset of action and is not cumulative, allowing it

to be administered continuously via a syringe pump for a stable depth of anesthesia and rapid recovery. It is suitable for patients with euphoria, antiemetic effects, and a strong strangulation reflex, but dose-dependent respiratory and circulatory depression is observed, and it is also associated with vascular pain.

Respiratory complications are the most frequent complications that may occur during IVS, including hypoxia, tongue depressions, airway obstruction, gasping, and aspiration pneumonia. Cardiovascular complications include blood pressure fluctuations and arrhythmias. Other potential complications include inability to perform scheduled procedures with IVS due to restlessness or agitation, vasculitis, and anaphylaxis (8). To enhance the safety of IVS, monitoring as shown in *Table 3* is required. Measurement of EtCO₂ has been shown to facilitate detection of respiratory depression and airway obstruction and prevent hypoxia during sedation. However, a preliminary survey conducted by the committee showed that only 36.5% of patients used the system (9). Sedation does not monitor EtCO₂ in the closed breathing circuit, so exhalations may not be reliably detected. Therefore, visual observations such as thoracic movements may be used instead of the use of capnography. Monitoring of EtCO₂ should be promoted to establish safe deep sedation.

After providing an overview of IVS in Japan, this paper presents a review of recent topics and knowledge gaps from relevant studies published in the last 5 years. The search

Table 3 Monitoring required for intravenous sedation based on the two sedation guidelines established by the Japanese Dental Society of Anesthesiology

Awareness
Use of BIS monitor
Responding to the call
Ventilation
Use of EtCO ₂ monitor
Monitoring of thoracic cage movement
Auscultation of breath sounds
Oxygenation
Continuous measurement of SpO ₂
Evaluation of mucous membrane and skin color
Cycle
Assessment of pulse rate and blood pressure
Use of Electrocardiogram if necessary
BIS, Bispectral Index.

yielded 58 references, of which 7 were excluded based on exclusion criteria, and 51 were included in this narrative review. Among the included articles, 18 were original papers and 33 were case reports, including case series. Twenty articles were published in the *Journal of Japanese Dental Society of Anesthesiology*, 8 in the *Journal of Dentistry for the Disabled*, 4 in *Journal of Japanese Society of Dentistry for Medically Compromised Patient*, 3 in *The Journal of Japan Society for Clinical Anesthesia*, and 16 in other journals primarily published by institutions.

Retrospective studies have revealed areas of need for IVS in Japan. IVS is mainly used in the departments of dental anesthesiology (7), oral surgery, and dentistry for the disabled at university hospitals (10). It is also used in oral surgery or dental treatment at city general hospitals (11-13). There is also a great need for IVS in the field of dentistry for the handicapped, where it is used as a behavioral modification method along with dental treatment under general anesthesia in public and private dental facilities for the handicapped (5,14).

In the field of dentistry for the disabled, IVS is selected “because the patient is uncooperative and cannot safely undergo dental treatment” and “because the patient experiences difficulty undergoing dentistry and treatment due to hypertonia and involuntary movements caused by cerebral palsy”. IVS is also used “to continue dental treatment after dental treatment under

general anesthesia” (5).

Case series and case reports have shown attempts to extend IVS to patients with diseases that are difficult to manage systemically. In the sedation of a patient with Down’s syndrome complicated by Eisenmenger’s syndrome who was diagnosed as being unable to undergo general anesthetic procedures, midazolam was the sedative of choice because of its low circulatory variability (15). Implant surgery in patients with pre-existing fulminant myocarditis with complete atrioventricular block was also performed with IVS using midazolam after the preparation of a defibrillator with percutaneous pacing function (16). While IVS with propofol has the advantage of easily adjustable anesthetic depth, its disadvantage is respiratory depression. To overcome this disadvantage, IVS with nasal high-flow therapy is becoming the method of choice (17).

The most used monitors in IVS are pulse oximeters, blood pressure monitors, and electrocardiographs and the use of EtCO₂ monitoring and Bispectral Index (BIS) monitoring is recommended (8,9). In addition, there have been reported cases of IVS with advanced monitoring in patients with complications as described above. IVS with midazolam and propofol was performed in a patient with dilated cardiomyopathy while the ClearSight system, a non-invasive cardiac output measurement device, and transthoracic echocardiography evaluated cardiac function (18). There are also reports of IVS being used for oral management, including tooth extraction, in patients prior to cardiac surgery (18). These findings suggest that IVS may be a useful approach to reduce the burden of invasive dental treatment in patients with severe cardiac disease.

Newer agents are being applied for wider and safer indications for IVS. Dexmedetomidine is a sedative agent with minimal respiratory depression and is considered effective for sedation during surgery under regional anesthesia in the maxillofacial region (19-23). However, its adverse effects on circulation, such as bradycardia and hypotension, as well as hypertension, are problematic (22). Remimazolam, an ultra-short-acting benzodiazepine intravenous anesthetic that was not included in this review, is also expected to be used for IVS because it causes less respiratory and circulatory depression.

As previously mentioned, the indications for IVS are expanding, and efforts to enhance safety with new drugs and monitoring methods are ongoing. However, it is unclear whether IVS is sufficiently recognized or in demand in Japan. A survey of internet users revealed that IVS is largely unknown to the general public, but the demand for it is high.

IVS is covered by insurance for dental treatment and oral surgery in Japan. Ishida reported the five-fold increase in insurance points for IVS in 2020 had improved the balance of payments and positive income and expenditure for hospital dentistry up to 56 minutes of anesthesia time (13). In order to provide a stable supply of safe IVS, it is important to revise reimbursement prices in line with costs, and the accumulation of data to provide evidence is considered necessary.

Japanese research on IVS lacks a perspective on its long-term prognosis. Although IVS is associated with patient satisfaction for dental anxiety, its long-term effects on patients' oral-related quality of life have not been examined. Prospective studies abroad have reported that IVS does not lower patients' dental anxiety one year later (24), and adequate midazolam sedation is associated with higher patient satisfaction and a desire for the next sedated dental treatment (25). However, the dependence and tolerance of sedation over multiple sessions and methods have not been adequately studied, and there are no established guidelines for whether sedation should be administered. Clinicians must rely on their own judgment and the patient's wishes, but criteria are needed to aid their decision-making, such as the Indicator of Sedation Need (26-28).

We need to be prepared for the increasing demand for dental treatment under anesthesia control. With Japan's aging population, more patients will have complications and require safe dental treatment. Additionally, there is a growing awareness of the importance of human rights, which will result in a greater demand for anesthesia control instead of suppressive treatment for individuals with disabilities. Moreover, patients who avoid dental treatment due to fear will also benefit from IVS. To address these needs, it is important to identify the indications for dental anesthesia management, including IVS, and standardize safe methods for its administration. However, the literature on advanced IVS indications is still dominated by case reports, and there are few studies with a high level of evidence such as cohort studies and randomized controlled trials, which are necessary for further standardization of IVS. Furthermore, studies from a societal perspective, including the needs of IVS and the establishment of indication criteria, are also necessary.

Conclusions

IVS provided by dental anesthetists in Japan is standardized and is considered a growing necessity. However, in order to

provide appropriate IVS to patients who need it, long-term studies on its effects, needs assessments, and other broad perspectives, as well as the accumulation of studies with a high level of evidence, are necessary.

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Footnote

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