

Successful Premedication With Sublingual Midazolam Using a Suction Toothbrush

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Premedication is often used to reduce the stress associated with anesthesia-related procedures. However, in some cases, patients may not cooperate with medication delivery because of significant fear and anxiety. We report a case of an uncooperative patient with severe intellectual disabilities who was successfully premedicated with the unique technique of sublingual midazolam administration using a suction toothbrush. The 38-year-old male patient was planned to receive dental treatment under deep intravenous sedation (IVS), but he refused both intravenous cannulation and mask induction. Preanesthetic medication delivery using other routes was attempted but not accepted. As the patient tolerated toothbrushing, we used repeated practice with sublingual water administration through the toothbrush's suction hole to gradually desensitize the patient. Using that same method, sublingual midazolam was administered as a successful premedication to allow placement of a face mask for inhalational induction without distress and completion of the dental treatment under IVS. For patients who refuse other premedication routes, sublingual administration during toothbrushing with a suction toothbrush may provide a successful alternative.

Key Words: Intellectual disability; Developmental disorder; Sublingual administration; Suction toothbrush.

Patients with intellectual disabilities, including developmental disorders and autism, often have difficulty undergoing dental treatment because of poor compliance. Attempts to promote treatment acceptance through desensitization and other means can be made but in many instances are unsuccessful, prompting the use of sedation or general anesthesia for the safe completion of treatment.¹ However, the procedures commonly involved with the delivery of anesthesia services, such as intravenous (IV) cannulation or mask fitting for anesthetic inhalation, can be very stressful. If the patient is unable to cooperate, physical restraint may be necessary, potentially leading to problematic psychological and/or physical insult. Efforts to mitigate these adverse effects can include preanesthetic medications,² which can be administered via several methods depending on the degree of patient cooperation and acceptance. Patients who are fearful or overly alert may have difficulty accepting premedication.

Received August 11, 2022; accepted for publication January 16, 2023.

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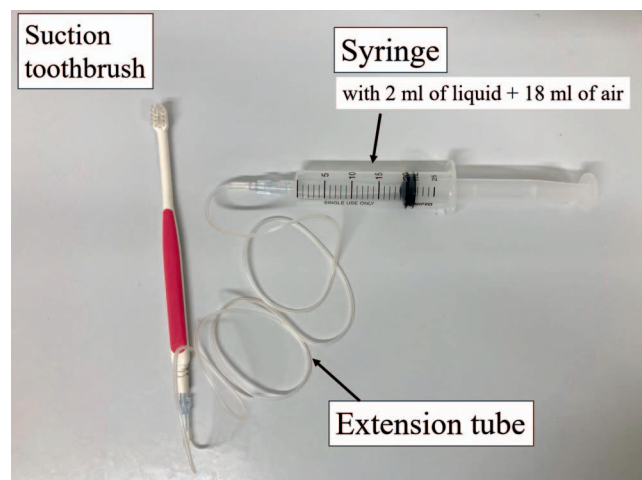
Anesth Prog 70:80–84 2023 | DOI 10.2344/anpr-70-01-05
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In the present case, we initially planned to use deep IV sedation (IVS) to treat a patient with severe intellectual disability who had difficulty undergoing dental treatment because of noncompliance. However, this was not readily achieved because the patient strongly refused IV cannulation and a face mask for inhalational induction. We attempted premedication administration by intramuscular injection and by the oral route to sedate the patient sufficiently to permit the aforementioned procedures, but neither was successful because of his significant fear and anxiety. Therefore, we administered sublingual midazolam as premedication using a suction toothbrush while brushing the patient's teeth. This approach was successful, as he became sufficiently sedated to accept the face mask for inhalational induction without discomfort, allowing the dental treatment to be successfully completed under IVS.

CASE PRESENTATION

The patient was a 38-year-old male (height 160 cm; weight 38.5 kg; body mass index 15.0 kg/m²) with severe intellectual disability and dental phobia but no other medical comorbidities, medications, or allergies. He had difficulty speaking, and conversational communication was impossible. At 28 years of age, he made his first visit

Figure 1. Suction toothbrush used for sublingual administration.



Suction toothbrush (Cutect, Always Co, LTD) with an extension tube and injection syringe connected.

to our dental clinic and was diagnosed after oral examination with chronic periodontitis, necessitating periodontal treatment. The patient demonstrated marked fear and anxiety and was unable to lie supine in the dental chair. He was extremely uncooperative during treatment and only tolerated toothbrushing while sitting upright. Desensitization for treatment was attempted but did not produce adequate results.

Periodontal treatment was then performed under deep IVS; however, the patient had to be restrained by several people while mask induction was performed, which caused significant emotional trauma. Afterwards, he would run out of the room during subsequent dental visits whenever he found the anesthesia mask.

Six years after the initial visit, dental caries requiring treatment were identified. The patient remained remarkably uncooperative and again required IVS with the use of physical restraint during inhalational induction. Subsequently, his cooperation during dental treatment was even lower, and he was no longer able to even enter the anesthesia procedure room and only permitted toothbrushing in the sitting position. Desensitization for dental treatment was continued, but little progress was made.

Nine years after the initial visit, exacerbation of chronic periodontitis was observed, requiring additional periodontal treatment. Because of the patient's uncooperative nature, IVS was once again required. However, the patient became extremely agitated and ran out of the room after seeing the syringe and the anesthesia machine. We were unable to perform IV cannulation while the patient was conscious and could not calm him enough to safely perform mask induction. Oral and

Figure 2. Sublingual administration on a mannequin.



While the teeth were brushed, the tip of the toothbrush was set sublingually, and a sedative was injected.

intramuscular premedication were attempted, but neither was possible because of poor patient compliance. Because the only procedure the patient would accept was toothbrushing, we planned to administer sublingual midazolam for premedication by injecting the drug through the suction hole of a suction toothbrush while brushing his teeth.

The first step was to change the toothbrush used for his oral care to a suction toothbrush (Cutect, Always Co, LTD; Figure 1). The brushing was also performed on a stretcher in the anesthesia recovery room rather than in the dental chair, with the assumption that he would be transferred to the anesthesia treatment room after premedication. After the patient grew to accept the suction toothbrush, brushing was then performed with an extension tube connected to its suction hole. Once that was accepted, brushing was then performed with the suction toothbrush connected to an extension tube and an injectable syringe (filled with 2 mL of water and 18 mL of air) used to eject water sublingually during brushing (Figures 1 and 2). A separate staff member operated the syringe as it was hidden in her pocket (Figure 3). The desensitization steps described above were carried out once a month over approximately 3 months.

On the day of treatment, the patient was instructed not to eat or drink for at least 6 hours. Toothbrushing was initiated using the suction toothbrush with the patient sitting on a stretcher in the anesthesia recovery room as described previously. While his response was monitored, a syringe filled with 2 mL of midazolam (10

Figure 3. Simulated sublingual administration while toothbrushing.



The syringe was concealed in the staff member's pocket and manipulated without being seen by the patient.

mg) and 18 mL of air was used to deliver the premedication sublingually via the suction toothbrush. Minimal amounts of the ejected medication leaked out of his mouth or were observed remaining in his oral cavity. We continued to brush his teeth for approximately 1 minute, during which time he showed no distinct swallowing movements and displayed no disquiet during the injection. We then stopped brushing, turned off the lights, darkened the room, and observed him at rest so as not to stimulate him.

Thirty minutes after administration, he was lying on his side on the stretcher, asleep and unresponsive to voice commands. We attempted to move him into the treatment room; however, stimulation from the move awakened him. He became more alert, refused to lie on the stretcher at that point, and remained in a sitting position.

Fifteen minutes later, we brushed his teeth again with the suction toothbrush and administered an additional dose of sublingual midazolam 5 mg/1 mL in the same manner described above. He fell asleep again approximately 10 minutes later and was easily transported into the anesthesia room without being awakened. At that time, the depth of sedation was 2 on the Modified Observer's Assessment of Alertness/Sedation scale, and his respiratory status was stable.

After entering the room, he tried to get up in a dazed state. The anesthesiologist gently held his head while performing mask induction using nitrous oxide 4 L/min, oxygen 2 L/min, and sevoflurane 5% to safely facilitate IV cannulation. The patient was successfully anesthetized without significant agitation or the need for physical restraint, and the inhalational agents were discontinued once the IV cannula was successfully placed. Blood pressure, oxygen saturation as measured

by pulse oximetry (SpO_2), electrocardiographic, and bispectral index (BIS) monitoring were then initiated. Deep IVS was maintained with a continuous infusion of propofol 50 mcg/kg/min to 83 mcg/kg/min along with supplemental oxygen 3 L/min via nasal cannula. No local anesthetic was used for the dental treatment. His intraoperative vital signs were as follows: blood pressure 70 mm Hg to 105 mm Hg/45 mm Hg to 64 mm Hg, heart rate 88 beats/min to 105 beats/min, SpO_2 98% to 100%, and BIS 44 to 70. Significant body movements, airway obstruction, and cough associated with aspiration were not observed during anesthesia, and the periodontal treatment was successfully completed. Operative time was 1 hour and 1 minute, and anesthesia time was 2 hours and 17 minutes.

After the dental treatment ended, the patient was transferred to the recovery room while still in a sleeping state. After we confirmed that SpO_2 was maintained above 98% under room air conditions, the IV catheter was removed, and he opened his eyes approximately 5 minutes later. The patient was briefly agitated but was calmed down within a few minutes with the help of his parents. He remained calm, did not become somnolent, and had a stable respiratory status throughout the recovery period. The patient was discharged home after confirming that he was clearly awake and back to his baseline level of consciousness. We called his mother 6 and 9 hours later for follow-up and confirmed that he was stable with no signs of re-sedation, was able to eat, had resumed his daily activities without any problems, and had no postanesthetic complications. Of note, he did not refuse to come to our clinic afterwards and continues to receive regular dental treatment.

DISCUSSION

Patients with intellectual disabilities tend to have complex dental needs and poor oral health because they have difficulty accessing preventive dental care and understanding its importance. In addition, when they need dental care, they are often unable to accept treatment because of strong fears and anxiety. It is common practice to treat such patients using sedation or general anesthesia.¹ However, common anesthetic procedures, like use of a face mask or establishing IV access, can be extremely stressful. In the absence of adequate cooperation, physical restraint is often unavoidable, which can easily lead to psychological trauma for the patient. There is also a risk of adverse events like physical injury to patients and/or medical staff when physically restraining an uncooperative patient. Anesthetic premedication is commonly used to help avoid such events.²

Midazolam, a short-acting benzodiazepine, is a commonly used agent among the various sedatives used for premedication. Because of its anterograde amnesic effects, it is well suited for patients with fear and anxiety regarding anesthetic procedures, as noted in this case.³ Midazolam as premedication can be administered intravenously, orally, intramuscularly, sublingually, intranasally, or rectally.^{4,5}

Sublingual administration, as used in this case, has the advantages of faster onset, less variation in gastrointestinal absorption, and lower dosage for optimal effects compared to oral administration because the drug enters the systemic circulation directly and avoids first-pass hepatic metabolism.^{6,7} In a pharmacokinetic study of midazolam administered sublingually to children, a dose of 0.2 mg/kg was reported to produce blood levels above 70 ng/mL.⁸ Another study reported that a sublingual dose of 0.2 mg/kg produced adequate sedation depth that allowed mask fitting without discomfort.⁹ Therefore, we set the initial dose at 10 mg (~0.26 mg/kg) to account for potential drug leakage out of his mouth in this case. However, an additional 5-mg dose was administered because adequate sedation was not achieved initially. One possible drawback of this method may be that some of the drug may have been swallowed and migrated into the gastrointestinal tract, making it unclear exactly how much was absorbed sublingually.

Midazolam has a strong bitter taste, so it might be assumed that a patient would spit it out when administered orally or sublingually. However, when administered in a small volume (eg, 2 mL) and in the appropriate area sublingually as in this case, the patient tolerated the midazolam well and did not spit it out. We also recommend that midazolam be administered without dilution so as not to increase the drug solution volume.

In a pharmacokinetic study of midazolam tablets administered sublingually in healthy adults, it was reported that the maximum blood concentration was reached within approximately 15 minutes after sublingual administration of 15 mg, with an elimination half-life of approximately 5.5 hours.¹⁰ In the present case, the patient fell asleep approximately 30 minutes after the first sublingual administration of midazolam. Time until optimal sedative effect may vary depending on a patient's state of mental tension and the surrounding stimuli during administration.

We attempted to reduce his anxiety by continuing desensitization for the procedures involved with this sublingual administration method prior to anesthesia and by keeping the room dark and quiet after drug administration to avoid overstimulation. The patient refused to wear a pulse oximeter or other monitoring

devices, so monitoring was not possible until he lost consciousness. After administering sublingual midazolam, we visually monitored his respiratory status and were prepared to respond immediately in case of an emergency. In a study examining the effect of premedication with sublingual midazolam 0.3 mg/kg in children, serious adverse events, such as hypoxemia, were not reported after administration.¹¹ However, oxygenation monitoring should ideally be performed in anticipation of rapid oversedation, and preparations should be made for emergency airway management.

Because the patient poorly tolerated spending long periods in an unfamiliar space, which would make inpatient management difficult, we opted for ambulatory anesthesia in this case. We telephoned his mother after discharge home to inquire about his condition several times and confirmed that he was progressing without any issues. However, because the sedative effects of midazolam may persist, it may be advisable to consider inpatient management for appropriate patients.

Because the method of premedication used in this case requires patient acceptance and cooperation, it may be difficult to perform on patients who refuse administration because of fear or anxiety. In the present case, we used the time when we brushed his teeth, as that was the only chance we had to easily access his mouth, and used a suction toothbrush to administer the midazolam sublingually through its suction hole. Toothbrushing is a less invasive and rudimentary step in dental care and is often easily accepted by uncooperative patients with intellectual and developmental disabilities. Another possible advantage is that the patient is often preoccupied during toothbrushing, making them less conscious of the stimulation from oral or sublingual drug administration. Although this method requires additional time and practice for both providers and patients, it may be a means of successfully premedicating patients who have difficulty accepting drug administration without significant distress.

CONCLUSION

The use of a suction toothbrush to administer sublingual midazolam during toothbrushing may be an effective method of premedication delivery. This method can be considered for patients who are uncooperative and refuse to easily accept premedication using other methods but do permit toothbrushing. However, this technique may take additional time and practice for success.

Conflict of Interest

The authors declare no conflict of interest.

Consent Approval

The parents of the patient gave permission to use clinical information and photographic material.

Ethical Approval

All procedures involving human participants were conducted in accordance with the 1964 Declaration of Helsinki and its later amendments.

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