

Evaluation of Sedation Levels Using SedLine During Intravenous Sedation for Dental Procedures: A Case-Series Study

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The Patient State Index (PSI) is the numerical value of anesthesia depth as measured using a SedLine Sedation Monitor (Masimo Corporation). In this pilot study, we evaluated PSI values captured during intravenous (IV) moderate sedation for dental treatment. During the dental treatment, a dental anesthesiologist maintained the Modified Observer's Assessment of Alertness/Sedation (MOAA/S) score at 3 to 4 by adjusting the administration of midazolam and propofol while PSI values were recorded. The mean (SD) and median (25th percentile, 75th percentile) PSI values during dental treatment under IV moderate sedation were 72.7 (13.6) and 75 (65, 85), respectively.

Key Words: Intravenous sedation; Moderate sedation; SedLine; Patient State Index (PSI).

The Patient State Index (PSI) is measured using the SedLine Sedation Monitor (SedLine; Masimo Corporation) proprietary equipment and represents a numerical value of anesthesia depth. However, no study has examined PSI values for moderate sedation. We conducted a case-series study to investigate PSI values during moderate intravenous (IV) sedation for dental treatment.

This pilot study was approved by the ethics committee of Okayama University Graduate School of Medicine, Dentistry, and Pharmaceutical Sciences and Okayama University Hospital (approval No. 2006-047) and was registered in the University Hospital Medical Information Network (UMIN) Clinical Trials Registry (UMIN000042451).

METHODS

Potential subjects included patients scheduled for IV moderate sedation at the Department of Dental

Anesthesiology, Okayama University Hospital. Selection criteria included (1) age ≥ 20 years and (2) American Society of Anesthesiologists physical status classification scores of 1 or 2. Furthermore, we excluded (1) patients requiring deep sedation, (2) patients taking medications acting on the central nervous system (eg, antidepressants, antiepileptic drugs, and/or antipsychotic drugs), (3) patients with contraindications for propofol and/or midazolam, and (4) patients otherwise considered to be ineligible for study participation as determined by the study director or investigators.

IV midazolam (1-3 mg) was administered, followed by a continuous target-controlled infusion of propofol. The propofol rate was adjusted during dental treatment by the dental anesthesiologist to ensure the Modified Observer's Assessment of Alertness/Sedation (MOAA/S) score¹ remained at 3 or 4 while the study investigators recorded the PSI values. The dental anesthesiologists remained blinded from the PSI values during treatment. After completion of the dental treatment, the PSI values recorded at 2-second intervals during treatment (from start until completion) were extracted from the SedLine monitor.

To evaluate intraoperative amnesic effects and patient satisfaction with the IV moderate sedation, attending dental anesthesiologists requested patients respond to a postoperative questionnaire survey. The

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questionnaire used a 4- and 5-point scale to evaluate intraoperative amnesia and assess patient satisfaction, respectively.

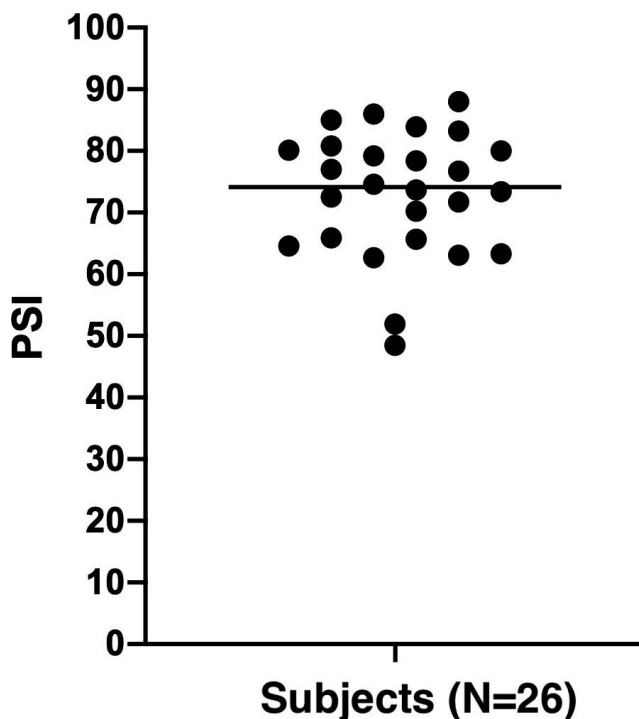
RESULTS

A total of 26 subjects participated in this study and were administered on average 1.5 mg of midazolam and propofol infusions at 3.7 mg/kg/h (61.7 µg/kg/min; Table). The mean (SD) PSI was 72.7 (13.6), and the median (25 percentile, 75 percentile) PSI was 75 (65, 85) for the entire study cohort (Figure). Per the postoperative survey, ~85% reported not remembering much or anything, and 92% reported being “satisfied” with the IV moderate sedation (Table).

DISCUSSION

On both SedLine and bispectral index (BIS) monitors, the depth of anesthesia is calculated as PSI and BIS values, respectively, through electroencephalogram analysis. Previous studies compared the sensitivity and specificity of these 2 monitoring systems for detecting changes in the level of consciousness and indicated that the sensitivity and specificity of SedLine were more favorable than those of a BIS monitor.² Furthermore, it was reported that SedLine markedly reduced artifacts

Figure. Scatter plot of mean PSI values during dental treatment.



Each point represents the mean PSI value for an individual subject. The horizontal line represents the mean PSI (72.7) for all subjects. PSI, Patient State Index.

Table. Subject Demographics, Anesthetic Dosing, Treatment Times, and Postoperative Survey Data.

| <i>Subject demographics (N = 26)</i> | | |
|---|-------------------------------------|--------------|
| Age, mean (SD), y | | 43.3 (13.3) |
| Sex, male/female | | 17/9 |
| Height, mean (SD), cm | | 159.9 (8.5) |
| Weight, mean (SD), kg | | 54.3 (10.3) |
| Body mass index, mean (SD), kg/m ² | | 21.2 (3.6) |
| <i>Anesthetic agents and treatment times</i> | | |
| Midazolam dose, mean (SD), mg | | 1.5 (0.5) |
| Propofol dose, mean (SD), mg | | 154.7 (57.3) |
| Propofol infusion rate, mean (SD), mg/kg/h | | 3.7 (0.9) |
| Propofol infusion rate, mean (SD), mcg/kg/min | | 61.7 (15) |
| Treatment time, mean (SD), min | | 44.0 (16.4) |
| <i>Postoperative survey</i> | | |
| Amnesia, No. (%) | 1. I don't remember it at all | 14 (53.8) |
| | 2. I don't remember much | 8 (30.8) |
| | 3. I remember most of the procedure | 3 (11.5) |
| | 4. I remember it well | 1 (3.8) |
| Satisfaction, No. (%) | 1. I was satisfied | 24 (92.3) |
| | 2. | 0 (0) |
| | 3. I can't say either way | 2 (7.7) |
| | 4. | 0 (0) |
| | 5. I was unsatisfied | 0 (0) |

during the use of an electric knife in comparison with a BIS monitor.²

Soehle et al³ reported that PSI values during general anesthesia were 10 to 15 points lower than corresponding BIS values. However, no study has compared the 2 values during IV moderate sedation. Sandler and Sparks⁴ indicated the relationship between OAA/S scores and BIS values for patients undergoing IV sedation for third molar extraction. According to that study, OAA/S scores of 3 and 4 corresponded to mean BIS values of 81.3 and 87.1, respectively. On the other hand, Drover and Ortega⁵ reported the data used for PSI calibration; OAA/S scores of 3 and 4 corresponded to PSI values of ~67 and ~73, respectively. These findings are consistent with the data from our study. In comparison with the existing literature, the PSI values observed during IV moderate sedation might be lower than the BIS values.

In conclusion, the mean (SD) and median (25th percentile, 75th percentile) PSI values during IV moderate sedation with MOAA/S score at 3 to 4 were 72.7 (13.6) and 75 (65, 85), respectively.

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