

Additional Clinical Observations Utilizing Bispectral Analysis

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Additional observations were made in the use of the bispectral (BIS) index with the use of ketamine and in performing general anesthesia without the use of local anesthesia in nonintubated patients. Twenty-five subjects undergoing extraction procedures in an outpatient setting were analyzed using bispectral analysis with ketamine and midazolam. Despite repeated injections of midazolam during the procedure, only transient decreases of the BIS occurred to the 80s, with a low value of 77 in all but 1 patient where ketamine was used. In comparison, values in the 50–70 range are typically seen immediately after the administration of sedative doses of midazolam, propofol, or methohexital. In the second study, once propofol anesthesia was initiated, BIS readings in the 30s were commonly seen in patients during their procedure. The lowest BIS level observed was 18. Bispectral analysis was useful to trend the present anesthetic state and adjust the dose of propofol accordingly. In no case was laryngospasm or total airway obstruction observed. In 1 case, partial airway obstruction secondary to repositioning of the tongue occurred with a subsequent decrease in oxygen saturation to 89%. This was rectified by repositioning the patient to alleviate the obstruction. Consistent with previous studies utilizing ketamine, BIS values are consistently higher when compared with other hypnotic agents. With the subsequent injection of midazolam, the BIS level did not decrease to anticipated levels. In the final study reviewed, when local anesthesia was not used during general anesthesia, bispectral analysis was a useful adjunct in helping maintain a steady state of general anesthesia in nonintubated patients undergoing third molar extractions. Bispectral analysis offers additional information on the depth of the hypnotic state and is useful in helping control the depth of anesthesia. A limitation of the index includes the inability to titrate the level of sedation induced by hypnotic agents such as midazolam when ketamine is concomitantly administered.

Key Words: Bispectral analysis; Ketamine; General anesthesia; Propofol.

Observations were made in the use of the bispectral index with the use of ketamine and in performing general anesthesia without the use of local anesthesia in nonintubated patients.

DEEP SEDATION WITH KETAMINE RESULTS IN MINIMAL CHANGES IN THE BISPECTRAL INDEX

The unique state of dissociative anesthesia produced by ketamine is different from that seen with other agents.

Received August 2, 2000; accepted for publication December 6, 2000.
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Anesth Prog 47:84–86 2000
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In previous studies using bispectral (BIS) monitoring, a paradoxical increase in BIS with the use of ketamine was observed.¹ The purpose of this project was to study the effects of intravenous ketamine on the BIS index.

Patients and Methods

Twenty-five subjects who gave written informed consent approved by the University of Minnesota Review Board undergoing extraction procedures in an outpatient setting were analyzed. The bispectral index was again recorded continually during surgery. Patients were sedated using midazolam in 1-mg intravenous boluses until Ver-rill's sign was achieved (approximately 0.05 mg/kg lean body weight [LBW]). Fentanyl was given in 50- μ g bo-

ISSN 0003-3006/00/\$9.50
SSDI 0003-3006(00)

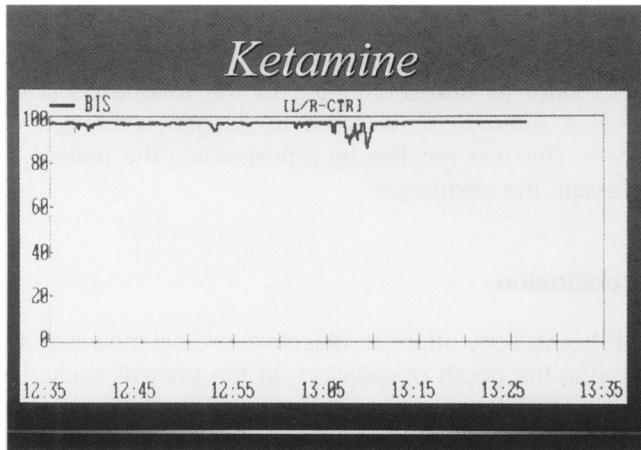


Figure 1. BIS tracing of patient with ketamine induction with minimal response to subsequent midazolam boluses (X-axis = time; Y-axis = BIS reading).

luses for a total of approximately 1.5 $\mu\text{g}/\text{kg}$ LBW. Ketamine was then given in a 10- to 20-mg intravenous bolus until clinically desirable deep sedation level was achieved (patient staring with evidence of nystagmus and unresponsive to conversation). Additional sedation was provided by administering boluses of 1 mg of midazolam as determined by the anesthetist (NS). Postprocedure, the BIS trend screen was printed and saved for analysis.

Results

Despite repeated injections of midazolam during the procedure, only transient decreases of the BIS occurred to the 80s, with a low value of 77 in all but 1 patient, where ketamine was used. In this 1 patient, the BIS did fall to a level of 60 after the initial induction with midazolam, then remained in the 77-92 range. It is interesting to note that this patient did experience a period of apnea of approximately 30 seconds after the induction of deep sedation, when the BIS was 60. No other periods of apnea were noted in the patients medicated with ketamine. In comparison, values in the 50-70 range are typically seen immediately after the administration of sedative doses of midazolam, propofol, or methohexital (Figures 1 and 2).

Discussion

Consistent with previous studies utilizing ketamine, BIS values are consistently higher when compared with other hypnotic agents. This may be due to high-frequency EEG activity seen during anesthesia with ketamine that is interpreted as a sign of light anesthesia by the monitor. In this study, even with the subsequent injection of

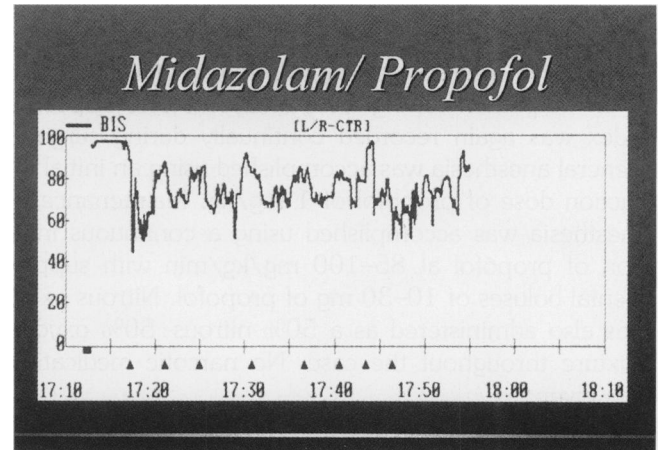


Figure 2. BIS tracing of typical patient undergoing midazolam/propofol sedation (X-axis = time; Y-axis = BIS reading).

midazolam, the BIS level did not subsequently decrease to anticipated levels.

GENERAL ANESTHESIA WITHOUT THE USE OF LOCAL ANESTHESIA USING BISPECTRAL ANALYSIS

It was the purpose of this project to analyze BIS technology in nonintubated patients undergoing third molar extractions without the use of local anesthesia. This method of anesthesia was desired for studying the relationship of pain and substance P levels in fresh extraction sites using microdialysis probes. Written informed consent for the study, including the use of general anesthesia, was obtained in conformity with the previously approved University of Minnesota Institutional Review Board protocol.

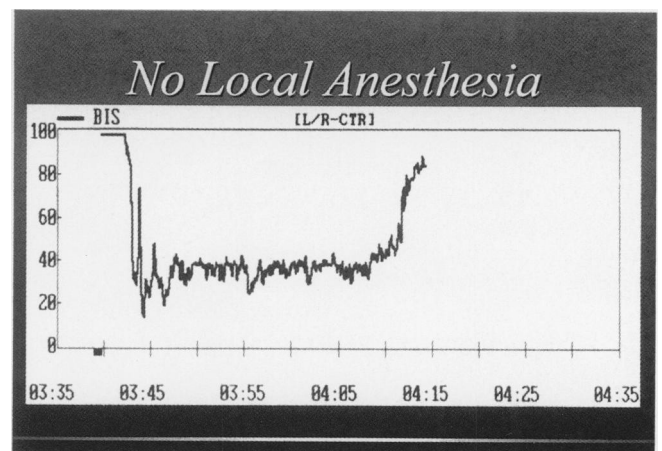


Figure 3. BIS tracing of patient undergoing propofol general anesthesia without the use of local anesthesia (X-axis = time; Y-axis = BIS reading).

Methods

Twenty-five subjects undergoing third molar extraction in an outpatient setting were analyzed. The bispectral index was again recorded continually during surgery. General anesthesia was accomplished using an initial induction dose of propofol of 1 mg/kg. Maintenance of anesthesia was accomplished using a continuous infusion of propofol at 85–100 mg/kg/min with supplemental boluses of 10–30 mg of propofol. Nitrous oxide was also administered as a 50% nitrous : 50% oxygen mixture throughout the case. No narcotic medication was given.

Results

Prior to initiating the propofol infusion, no changes in the bispectral index were noted with 50% nitrous oxide anesthesia, consistent with previous studies.² Once propofol anesthesia was initiated, BIS readings in the 30s were commonly seen in patients during their procedure (Figure 3). This compares with values in the 50–80 range in sedation performed with the concomitant use of local anesthesia. The lowest BIS level observed was 18. Bispectral analysis was useful to trend the present anesthetic state and adjust the dose of propofol accord-

ingly. In no case was laryngospasm or total airway obstruction observed. In 1 case, partial airway obstruction secondary to retropositioning of the tongue occurred with a subsequent decrease in oxygen saturation to 89%. This was rectified by repositioning the patient to alleviate the obstruction.

Conclusion

BIS technology offers an objective, ordinal means of assessing the depth of sedation. In the present study, bispectral analysis was a useful adjunct in helping to maintain a steady state of general anesthesia in nonintubated patients undergoing third molar extractions.

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