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Original contribution

A prospective study of bispectral index scoring in mentally retarded patients receiving general anesthesia☆

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Abstract
Study Objective: To determine whether degree of mental retardation (MR) affects bispectral index scale (BIS) scores during general anesthesia.
Design: Prospective clinical study.
Setting: University Hospital.
Patients: 80 ASA physical status I, II and III patients with varying degrees of MR, undergoing dental rehabilitation.
Interventions: Patients were grouped into mild, moderate, severe or profound degrees of MR, by an independent registered research nurse according to criteria by the American Psychiatric Association.
Measurements: All patients were given a standard sevoflurane in oxygen anesthetic with ASA standard monitoring. A research assistant who was blinded to study group assignment recorded the BIS scores continuously on a computer and compared the scores at the following time points: awake, induction of anesthesia, intravenous catheter placement, tracheal intubation, start of surgery, end of surgery, awakening to commands, and tracheal extubation.
Main Results: No significant differences in BIS scores existed among the study groups at any time point. No significant difference in slope of induction of anesthesia was noted among the study groups. However, the slope of emergence from anesthesia leading to tracheal extubation showed a significantly longer emergence time in the higher MR groups.
Conclusion: MR does not affect BIS values during general anesthesia.

☆ Conflict of interest: The authors have no conflict of interest to declare.

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1. Introduction

The Bispectral Index Scale (BIS) monitor is commonly used in current anesthetic practice not only to prevent intraoperative awareness and recall during general anesthesia but also to titrate anesthetic delivery to promote early recovery from general anesthesia [1-4]. BIS provides a quantifiable measure of the effect of anesthetics on the brain that correlates with depth of anesthesia [5,6]. Randomized multicenter clinical trials have shown that using a BIS monitor to guide anesthetic drug delivery leads to more efficient drug utilization, faster emergence from anesthesia, and improved patient recovery [7-9]. However, as a unique processed electroencephalogram (EEG), the usefulness of BIS is often questioned for mentally retarded (MR) patients [10]. This idea is due partly to a lack of controlled studies establishing the usefulness of BIS monitoring in MR patients [11-13].

This prospective, controlled study was carried out to investigate the effect of MR on BIS scores by comparing BIS scores at different time points among patients with varying degrees of MR, undergoing dental rehabilitation with a standardized general anesthetic regimen.

2. Materials and methods

This prospective study was approved by the Institutional Review Board (IRB) of the University of Medicine and Dentistry of New Jersey and the Division of Developmental Disabilities of the State of New Jersey. Written, informed consent was obtained from the legal guardian of each patient enrolled in the study. A total of 80 MR, ASA physical status I, II, and III patients, aged 12 to 65 years, were recruited for this investigation. All patients underwent dental rehabilitation during general anesthesia.

The research team was composed of three groups of investigators: 1) a registered research nurse, who was trained to use the conventional formula approved by the American Psychiatric Association, categorized the MR patients as mild, moderate, severe, or profound; 2) an anesthesiologist, who was blinded to MR categorization of patients, and who administered standardized anesthetic care; and 3) a research assistant, who was also unaware of the MR categorization and who did not take part in the anesthetic care of the patients. Thus, the research assistant was blinded to both MR category and anesthetic regimen.

The registered research nurse calculated the intellectual intelligence quotient (IQ) score based on the patient's mental and chronological ages. Mental age, as recommended by the American Psychiatric Association [14], was scored on the following life skills: daily living skill, motor skill, communication skill, social skill, and maladaptive behavior skill.

After verifying the mental and chronological ages, the intellectual IQ score was determined from the formula: intellectual IQ score = mental age/chronological age × 100.

The intellectual IQ score was used to categorize patients into the mild, moderate, severe, and profound MR groups (Table 1).

General anesthetic management consisted of face mask inhalation induction with sevoflurane 8% in oxygen followed by an intravenous (IV) catheter placement. Intravenous succinylcholine 1.5 mg/kg was given to facilitate tracheal intubation. General anesthesia was maintained with one minimum alveolar concentration (MAC) of sevoflurane in oxygen. The MAC of sevoflurane (2%) was age-adjusted by an increase or a decrease of 7% for every decade of life below or above age 40 years, respectively. The anesthesiologist was allowed a rescue adjustment in the inspired anesthetic concentration only when vital signs [eg, heart rate (HR) and blood pressure (BP)] varied by more than ± 20% from the baseline. The lungs were ventilated with oxygen in air to maintain an inspired oxygen fraction (FIO_2) of 0.5. Ondansetron 4 mg and ketorolac 30 mg were given IV to attenuate postoperative vomiting and pain, respectively. In addition to ASA standard monitors, a BIS monitor (Aspect Medical Systems, Norwood, MA, USA) was placed, and the BIS score was continuously recorded from awake status to tracheal extubation by the research assistant. The anesthesiologist used clinical criteria to monitor depth of anesthesia, emergence level, and readiness for tracheal extubation. Following tracheal extubation, patients were cared for in the recovery room and discharged home according to the customary guidelines practiced in the institution.

The research assistant specifically compared BIS scores among the 4 MR groups at the following time points: 1) awake, 2) induction of anesthesia, 3) IV catheter placement, 4) tracheal intubation, 5) start of surgery, 6) end of surgery, 7) awakening to commands, and 8) tracheal extubation.

2.1. Statistical analysis

A power analysis, which was done before the start of the study, showed that a total of 80 patients would provide 80% power to detect a clinically meaningful difference of 10 or more BIS values among the groups, at 5% level of significance. BIS scores are expressed as means ± SD. The slope of induction of anesthesia and the slope of emergence from anesthesia leading to tracheal extubation were

Table 1 Categorization of study patients

Intellectual IQ range	MR category
55–69	Mild
40–54	Moderate
25–39	Severe
Below 25	Profound

IQ = intelligence quotient, MR = mental retardation.