monitor now makes bedside monitoring of the depth of anesthesia feasible.[9] The use of the BIS index to assess the adequacy of anesthesia has been validated with most of the presently used anesthetic drugs.[1-3,10-13] Based on the clinical data reported, the manufacturer of the BIS monitor (Aspect Medical System) recommended a set of BIS range guidelines with the index at 100-70 being awake, 70-60 having light hypnotic effects with low probability of recall, 60-40 having moderate hypnotic effects with unconsciousness, 40 and below having deep hypnotic effects, and 0 indicating total EEG suppression.[14]

In our study, the administration of midazolam 0.05 mg/kg I.V. produced a sedative effect on our patients with a corresponding decrease in the BIS index which is in accordance with those reported in the literature.[4] In contrast, with administration of a full anesthetic dose of ketamine at 1.5 mg/kg, the BIS index showed persistant values above 90 as patients entered the clinical anesthetic state. This paradoxical change in BIS values probably stem med from the increased EEG activities associated with ketamine. Corssen et al. showed that ketamine at 1 mg/kg I.V. caused heightened theta activity on EEG, and coinciding with the appearance of theta activity, the patients lost consciousness.[15] Suzuki et al. using 3 different low dosages of ketamine (0.1, 0.25, and 0.5 mg/kg) I.V. observed dose-dependent sedation but no correlation between BIS and the level of ketamine-induced sedation. After ketamine 0.5 administration at mg/kg, the patient became very sedated responding only to prodding or shaking, and the BIS index remained at 97 ± 2.2 when the EEG showed a significant increase in theta activity and a decrease in delta activity.[16] Morioka et al. also reported a paradoxical increase of BIS after a ketamine 0.5 mg/kg I.V. bolus following propofol anesthesia.[17] However they did not give patients the full anesthetic dose of ketamine, nor was BIS monitored at dose higher than 0.5 mg/kg. Our study, on the other hand, specifically monitored the BIS index with the full anesthetic dose of ketamine of 1.5 mg/kg. All patients in our study received a sedative dose of midazolam which is a recognized clinical practice to minimize the psychomimetic effect of ketamine. Midazolam pretreatment might explain why none of our patients reported any adverse psychological reactions to ketamine; however its effect on the BIS index seems to be superceded by that of ketamine. All patients in our study were female due to the study design; however there are no reports in the literature indicating any gender difference in EEG changes associated with ketamine.

A question has been raised as to whether this increased BIS reading is due to the motor movements sometimes observed with ketamine anesthesia. In our study we observed no any facial movements, nystagmus, or myoclonic activity in any of the patients, and the EMG reading stayed essentially unchanged after ketamine administration. Hence, the change of BIS values resulting from an artifact of EMG activity is not very likely. The elevated BIS index induced by ketamine was not changed by the use of the muscle relaxant, rocuronium, nor by the stimulating effect of intubation; however it was effectively suppressed by the subsequent administration of a potent inhalation agent, and the use of sevoflurane after ketamine would explain why none of the patients in our study had recall, delirium, hallucinations or awareness throughout the entire anesthetic course.

BIS monitoring is gaining rapid acceptance in the clinical practice of anesthesia, and its usefulness is being validated with increasing experience reported in the literature. Ketamine in inducing dissociated anesthesia consistently produces BIS values different from those of other conventional anesthetic agents. The established range of the BIS index appears not to be applicable to patients under ketamine anesthesia. Monitoring of the depth of ketamine anesthesia remains a difficult issue.

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