Letter to the Editor

Korean J Anesthesiol 2011 July 61(1): 93-94
DOI: 10.4097/kjae.2011.61.1.93

# Audiovisual stimulation with synchronized pulsed tones and flickering lights set at a delta frequency can induce a sedative effect

Jong-Man Kang[1], Byungdo Lee[2], Hyup Huh[2], Wha Ja Kang[2], and Moo Il Kwon[2]

Department of Anesthesiology and Pain Medicine, [1]Kyung Hee University Hospital at Gangdong, [2]Kyung Hee University Hospital, Seoul, Korea

The perioperative period is a source of significant fear and anxiety for patients. Therefore, anxiolytic and sedative drugs are administered routinely, before and during surgery [1]. However, a larger dose of sedatives can delay the recovery in the ambulatory setting and be associated with an increased risk for complications.

Nonpharmacologic methods can be alternatives for the relief of patient discomfort and anxiety under regional anesthesia. There exist some studies on the sedative effect of binaural auditory beats and music [1,2]. MC square® (GEOMC CO, LTD, Seoul, Korea) is a portable audiovisual device for inducing synchronized pulsed tones and flickering lights set at a delta frequency [3].

Eleven healthy participants (6 males and 5 females, ages from 24 to 44 years) without otological or neurological disease in their histories were recruited for this experiment.

Participants had enough sleep the previous night and the test was performed in the daytime. Each participant lay supine on an operating table with a pillow under the head. We applied the "sleep mode" (synchronized pulsed tones and flickering lights set at a delta frequency) of MC square with a headset and an eye goggle device to participants and other stimuli were absent during the test. The test was performed for 40 minutes; we monitored basic vital signs (electrocardiogram, non-invasive blood pressure and pulse oximeter) and the degree of sedation by the bispectral index (BIS) every 5 minutes.

The BIS score showed a steady decline as time passed (Fig. 1). Vital signs were maintained within normal limits. None of the volunteers had any discomfort or complaints.

Brain electrical activity is largely composed of oscillations at characteristic frequencies. These rhythms are thought to perform important pathological and physiological functions. There are two kinds of sleep characterized as non-rapid eye movement and rapid eye movement sleep and they have different brain wave patterns. Non-rapid eye movement sleep brain waves typically have taller and slower delta waves (1−4 Hz).

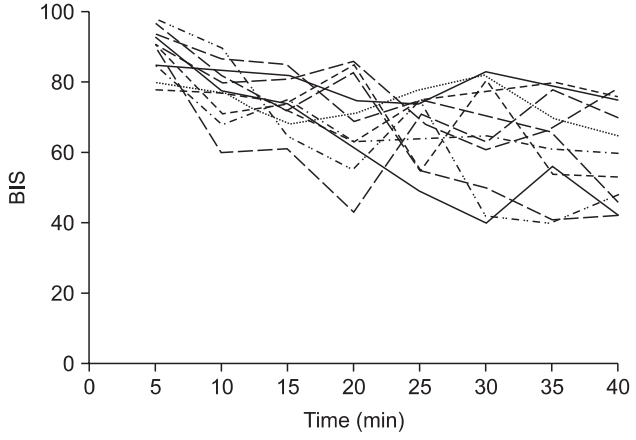


**Fig. 1.** Changes of BIS in 11 volunteers during audiovisual stimulation with synchronized pulsed tones and flickering lights set at a theta frequency. BIS: bispectral index.

Corresponding author: Jong-Man Kang, M.D., Ph.D., Department of Anesthesiology, Kyung Hee University Hospital at Gangdong, 149, Sangil-dong, Gangdong-gu, Seoul 134-090, Korea. Tel: 82-2-440-6193, Fax: 82-2-440-7808, E-mail: jongmankang@gmail.com

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MC square is an audiovisual aid for improving cognitive function but it also has a sleep mode that induces delta brain waves. This utilizes sound and light to entrain or synchronize brain waves to alpha, beta, theta and delta neural rhythms. The device uses a series of flashing red lights in conjunction with pulsed tones and background relaxing sounds (river gurgling, birds chirping) to achieve its effect. The lights are presented through an eye goggle device [3].

The BIS ranges from 0 to 100 (0: no cortical activity or coma, 40−60: unconscious, 70−90: varying levels of conscious sedation, 100: fully awake). Surgical patients undergoing general anesthesia require a BIS from 40 to 60. BIS values of 65−85 have been recommended for sedation, whereas values between 40−65 have been recommended for general anesthesia.

In our study, the results showed a steady decline of the BIS score to the recommended sedation level within 15 min by the sleep mode of MC square. Nonetheless, this study had several limitations. First, we used only BIS for monitoring the level of sedation. However, recent research showed that BIS is a better monitor of depth of sedation and hypnosis, whereas the Observer's Assessment of Alertness/Sedation scale may be more useful for monitoring sleep versus wakefulness [4]. Second, this study was not performed in patients undergoing surgery. We thought that the investigation in healthy volunteers should precede actual patients. Further studies are needed in the clinical setting. Third, individual variance of the sedation level induced by the MC square was not negligible. Combination with sedative drugs may be helpful in alleviating individual variance or MC square may lower the overuse of sedatives.

In conclusion, audiovisual stimulation by MC square appeared to have sedative effect on healthy persons by inducing delta waves and may be used to reduce the anxiety of perioperative patients as an alternative or adjunct to conventional sedative methods.

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