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Original contribution

Comparison of the two different auditory evoked potentials index monitors in propofol-fentanyl-nitrous oxide anesthesia☆

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Abstract

Study Objective: To determine the difference in performance of two different auditory evoked potentials (AEP) monitors, the A-Line AEP (AAI) and the aepEX, and their indices, during general anesthesia.

Design: Prospective study.

Setting: Operating room at a private hospital.

Patients: 40 ASA physical status I and II women, aged 30 to 70 years, scheduled for partial mastectomy.

Interventions: Anesthesia was induced with propofol and fentanyl, and a Laryngeal Mask Airway (LMA) was inserted. Anesthesia was maintained with propofol, fentanyl, and nitrous oxide.

Measurements and Main Results: The AAI or the aepEX was continuously monitored and their performance was compared at the start of monitoring, at LMA insertion, after disturbance by electric cautery, and during anesthesia. Eighteen of 20 patients had low enough impedance to extract good electroencephalogram signals at the first electrode application with the A-Line AEP, and 14 of 20 patients, with the aepEX. The time to return to good signals after signal disturbance by electric cautery was 14 ± 3 seconds (SD) with the AAI and 19 ± 4 seconds (SD) with the aepEX ($P = 0.035$). Both AAI and aepEX decreased after anesthesia induction, with significantly lower values seen in AAI than the aepEX.

Conclusions: The A-Line AEP (AAI) is better detects the response to painful stimuli and during recovering from noise of electric cautery than the aepEX. The aepEX shows higher values than the AAI during propofol-fentanyl-nitrous oxide anesthesia.

1. Introduction

Hypnotic level (anesthetic depth) is monitored using various kinds of electroencephalographic (EEG) monitors. When applying these monitors in clinical practice, one must know the difference in performance of each monitor or

☆ This study was performed at Ofuna Chuo Hospital, Kamakura, Japan.

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index. In previous studies [1-3], the auditory evoked potentials (AEP) derived index (AAI) using the A-Line AEP was more sensitive than the bispectral index (BIS) to stimuli such as Laryngeal Mask Airway (LMA) insertion and skin incision during general anesthesia.

Two different AEP monitors are the A-Line AEP, which calculates the AAI extracted by advanced signal processing, and the aepEX, which calculates the AEP index (aepEX) extracted by a moving time average. No comparative study of the performance of these two monitors exists. The purpose of the present study was to determine the difference in performance of these two monitors and indices.

2. Materials and methods

After receiving approval of the Ofuna Chuo Hospital ethical committee and written, informed consent, 40 ASA physical status I and II women, aged 30-70 years, and scheduled for partial mastectomy, were randomized to two groups by sealed envelope assignment. Those patients who had neurological disorders, hearing disturbance, liver or renal disease, mental impairment; or those who were using any drugs affecting cerebral function, such as hypnotics or antidepressants, were excluded from the study.

The monitors used in this study were the A-Line AEP (version 1.4; Alaris Medical Systems, Hampshire, UK) and the aepEX (the first version; Audiomex, Glasgow, Scotland).

Midazolam 2-5 mg and atropine 0.2-0.5 mg were intramuscularly administered as a routine premedication 15 minutes before patient arrival at the operating room. After the forehead and mastoid were swabbed with alcohol, electrodes specially supplied by the manufacturer of each AEP monitor were attached. When impedance was higher than the acceptable range shown by each monitor (<5 kΩ), the electrodes were re-attached after the skin was cleaned once more. When control values were obtained for the AAI or aepEX, anesthesia was induced with propofol two $mg \cdot kg^{-1}$ and fentanyl three $\mu g \cdot kg^{-1}$. A #3 LMA was inserted. Anesthesia was maintained with propofol 4 $mg \cdot kg^{-1} \cdot h^{-1}$, fentanyl one $\mu g \cdot kg^{-1}$ administered at the start of surgery (total dose: 4 $\mu g \cdot kg^{-1}$), and nitrous oxide 4 $L \cdot min^{-1}$ in oxygen two $L \cdot min^{-1}$. Propofol infusion was stopped at the start of skin suture and nitrous oxide was stopped at the end of surgery. The AAI or aepEX was continuously monitored from anesthesia induction to removal of the LMA. The number of patients with low enough impedance (<5 kΩ) to extract EEG signals at the first electrode application (success rate), the time to return to good EEG signals after signal disturbance by electric cautery (recovery time), and the index before surgery, during anesthesia, and at recovery from anesthesia were compared. Recovery time was defined as the time from the end of electric cautery to recovery of good signals and was calculated by averaging 5 randomly selected episodes per patient. The mean value over 30 seconds of each index at measuring points was used for comparison. Blood pressure (BP) and heart rate (HR) were also monitored.

Statistical analysis was performed using StatView 5.0 J software (SAS, Cary, NC, USA) with the chi-square test and Student's t test after F test for demographic data, success rate, and recovery time. AAI, aepEX, BP, and HR were compared with two-way repeated measures analysis of variance followed by Student Newman Keuls test as a post-hoc analysis. A *P*-value less than 0.05 was considered to be statistically significant.

Table 1 Demographic data

	AAI	aepEX
Age (yrs)	57 ± 10	55 ± 9
Body weight (kg)	55 ± 9	57 ± 8
Height (cm)	155 ± 10	158 ± 8
Duration of surgery (min)	84 ± 18	75 ± 16
Emergence time (min)	4 ± 2	5 ± 2

Means ± standard deviation. No differences were seen between the two groups. Emergence time was judged as the time from the end of surgery (stop of nitrous oxide inhalation) to the appearance of verbal response.

3. Results

Demographic data were not different between the two groups (Table 1).

The success rate was 18 of 20 patients with the A-Line AEP and 14 of 20 patients with the aepEX (no statistical difference). Recovery time was 14 ± 3 seconds with the A-Line AEP and 19 ± 4 seconds with the aepEX ($P = 0.035$).

Both AAI and aepEX decreased after anesthesia induction, with significantly lower values seen with the AAI than the aepEX (Fig. 1). Only the AAI significantly increased at

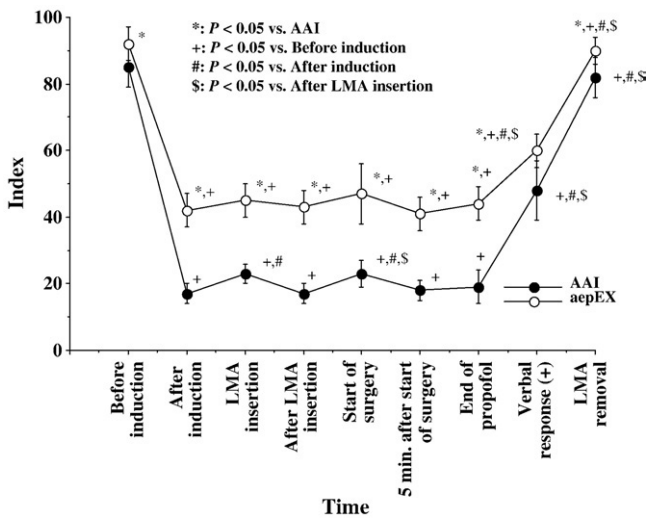

Fig. 1 The AAI and aepEX. Data are means ± standard deviation; LMA = Laryngeal Mask Airway.