Evaluation of Feasibility and Reliability of Intraoperative Visual Evoked Potential Monitoring During Craniotomy

Yuka Akasaki, Hironobu Hayashi, Masahiko Kawaguchi
Department of Anesthesiology, Nara Medical University, Nara, Japan

Nara Medical University Anesthesiology

BACKGROUND

Postoperative visual dysfunction (POVD) after craniotomy is a devastating complication. Intraoperative visual evoked potential (VEP) has been considered to monitor the functional integrity of visual pathway during neurosurgical procedures, in which the optic pathway is at a risk of injury. Recent advances in techniques including a new light-stimulating device consisting of high-luminosity light-emitting diodes (LEDs) and induction of electroretinography (ERG) to ascertain the arrival of the stimulus at the retina have provided better conditions for stable VEP recording under total intravenous anesthesia (TIVA) with propofol.

PURPOSE

In this study, we investigated feasibility and reliability of intraoperative VEP monitoring during craniotomy.

MATERIALS and METHODS

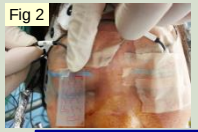
- Ninety patients undergoing elective craniotomy under general anesthesia from May 2009 to December 2013 were enrolled. (male 39, female 51: age: 59±18)
- Visual field and visual acuity were examined preoperatively and postoperatively for all patients.
- TIVA was maintained by propofol with 2.0-3.0 μg/ml using target controlled infusion, remifentanil with 0.05-0.3 μg/kg/min, fentanyl and rocuronium.
- In all patients, VEP and ERG monitoring were performed at bilateral eyes throughout the operation.
- ERG was recorded simultaneously with VEP to guarantee the delivery of adequate flash stimuli to the retina.
- LED flash stimulation for recording VEP was performed with LSF-101 Ⅱ (Unique Medical Co, Japan). (Fig 1)

The setting for intraoperative VEP monitoring

Luminosity: 10000-20000 Lx (supramaximal stimuli)
Duration: 10-20 msec
Frequency: 1.0-2.0 Hz
Summation: 50-100 responses
Filters: 10 Hz (low) and 500 Hz (high)
Analysis time: 200 msec
Recording: O1, O2 and Oz (International 10/20 method)
Reference: A1 and A2 (International 10/20 method)

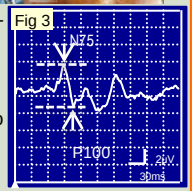
Fig 1

Fig 2



- VEP amplitudes were defined as the range of peak-to peak amplitude between N75 and P100. (Fig 3)
- More than 50% decrease in VEP amplitudes compared to the control level was defined as significant VEP change.

Fig 3



- ***Assessment of intraoperative VEP monitoring***

1. Success rate of recording baseline VEP amplitude
2. Accuracy of VEP monitoring during craniotomy when the association between intraoperative significant change of VEP amplitude and postoperative new visual dysfunction was evaluated.

(Accuracy was defined as the sum of the true positive and true negative cases out of all cases.)

RESULTS

Table 1. Diagnosis of all patients (n=90)

Diagnosis	Case
Pituitary tumors	43
Saddle nodule section meningioma	8
Rathke cyst	9
Others	30

Table 2. Types of surgeries procedured (n=90)

Types of surgeries procedured	Case
Hardy	53
Craniotumorectomy	31
STA- MCA anastomosis	2
Others	4

Table 3. The results of preoperative visual examinations and the number of eye with postoperative worsen visual function. (n=180 eyes)

Visual examination	Preope (eye)	Worsen (eye)
Visual field		
Quadrantanopia	9	0
Hemianopia	50	0
Blind	9	0
Others	40	0
Normal	72	1
Visual acuity *		
< 0.4	15	0
0.4≦	165	0

* Visual acuity was examined using Landolt C

- ***Success rate of recording control VEP***

94.4 % (85 of 90 cases)

Table 4. The association between significant change of VEP amplitude and postoperative visual dysfunction

	POVD (+)	POVD (-)
VEP change (+)	0	8
VEP change (−)	1	76

POVD: postoperative visual dysfunction

False positive : 9.4% False negative: 1.2%

Case presentation of the false negative result (male, 44 years old):
The value of preoperative corrected visual acuity was 1.0 examined using Landolt C, and there was no visual defect. There was no significant VEP change during Hardy operation. Postoperatively, he had quadrantanopia of his left eye, while there was no change of visual acuity.

- Accuracy of intraoperative VEP monitoring during craniotomy

89.4% (76 of 85 cases)

DISCUSSION

- In this study, 5 cases were failed to record control VEP. The causes of failed recording were the displacement of the stimulation pad for the one case, the interruption of the alternating current into the waveform for the another 2 cases and preoperative almost blind for the remaining 2 cases.
- The previous reports indicated that there was difficulty to perform reliable VEP monitoring for the patients with visual acuity less than 0.4. (references 1 and 2)
- VEP monitoring under general anesthesia might have difficulty to detect intraoperative small changes of visual faction.
- For recording stable VEP waveform during craniotomy, it was necessary to apply flash stimulation pads containing high-luminance LED and combination of ERG for ascertaining delivery of adequate flash stimuli to the retina under TIVA with propofol.

CONCLUSIONS

Clinical use of intraoperative VEP monitoring might have feasibility and satisfying reliability to prevent postoperative visual dysfunction during craniotomy under general anesthesia.

REFERENCES

1. Kodama et al. Acta Neurochir 152: 643-648, 2010
2. Sasaki et al. J Neurosurg 112: 273-284, 2010