INTRODUCTION

Combined Electrophysiological Intraoperative Monitoring of Hearing During Acoustic Tumor Removal

Krzysztof Morawski, MD1; Kazimierz Niemczyk, MD1; Rafal Brzezinski, MD1; Ola Hryciuk, MD1; Fred Telischi MD2
1Dept. of Otolaryngology, Medical University of Warsaw, Poland, 2Dept. Of Otolaryngology, University of Miami Medical School, Miami, FL

ABSTRACT

Maintaining auditory function during and after operations of CPAT removal remains a substantial surgical problem. IM measurements need to be made as close to real-time as possible to provide surgeons with timely information on which they can make appropriate management decisions. IM tool presented by the authors of this paper supports surgeons in such an appropriate manner by providing intraoperatively (i) information about hearing status in real time domain, (ii) performing on-line analysis of ECochG features by developed strategy of CAP-Amplitude and -Latency automatic detection and (iii) displaying of recorded and analyzed data.

In the last Table Spearman correlation test confirmed significant negative correlation between IM CAP Amplitude reduction and post-op PTA Worsening and positive correlation between IM CAP Latency increase and post-op PTA Worsening in CPAT patients. The same tendency was not revealed for ABR parameters. No correlation was presented in patients with SVN section.

In Table 2 statistical analysis details were presented. For all IM parameters statistically significant differences were revealed in MW-test but ABR Wave V Latency and CAP-Latency were not.

In Table 1 all parameters of TT-ECochG and ABR were compared.

RESULTS

TT-ECochG parameters as CAP Amplitude decrease and CAP Latency increase measured intraoperatively in near real-time showed good correlation to postoperative hearing status.

TT-ECochG recorded directly from the promontory is relatively high and easy to record every 128 sweeps while corresponding ABR recorded simultaneously is not repeatable.

In the last Table Spearman correlation test confirmed significant negative correlation between IM CAP Amplitude reduction and post-op PTA Worsening and positive correlation between IM CAP Latency increase and post-op PTA Worsening in CPAT patients. The same tendency was not revealed for ABR parameters. No correlation was presented in patients with SVN section.

CONCLUSIONS

TT-ECochG parameters as CAP Amplitude decrease and CAP Latency increase measured intraoperatively in near real-time showed good correlation to postoperative hearing status.

TT-ECochG recorded directly from the promontory is relatively high and easy to record every 128 sweeps while corresponding ABR recorded simultaneously is not repeatable.

TT-ECochG and ABR recorded in IM. Easy recordable CAP is associated with uninterpretable ABR recordings.

Both above figures show that to repeatable and easy interpretable TT-ECochG correspond ABR recordings that are characterized by poor amplitude and contamination by artifacts, that make them impossible for intraoperative interpretation in real time domain.

REFERENCES


METHODS AND MATERIALS

Intraoperative monitoring (IM) of the cochlear nerve and auditory pathway in patients with cerebello-pontine tumors (CPAT) has been used for over the last 20 years (Fischer and Bertrand 1993; Winzenburg et al 1993; Moller 1996; Fischer et al 1997; Colletti and Fiorino 1998; Guertet 1998; Yokoyama et al 1998; Mullatti et al 1999; Yamakami et al 2003). Such IM may be performed in three electrophysiological options: the monitoring of auditory brain stem responses (ABR), direct recording of cochlear nerve action potential (CNAP) and ECochG. ABR as a far-field technique has a very low signal to noise ratio (SNR) and requires high number of sweeps (usually more than 512 sweeps) to get interpretable and repeatable responses every 15-20 seconds (Bertrand et al 1990; Fischer and Bertrand 1993). CNAPs are also elicited by click stimuli and are recorded using Teflon-insulated silver electrode wires placed directly in the proximal region of the cochlear nerve. CNAP signals have higher SNRs and amplitudes than ABR (around 15-20 µV), and require fewer sweeps (100) at high rates (3/1s). Only 2-3 second intervals are needed to obtain a new signal (Colletti and Fiorino 1998). However performing CNAP strategy of intraoperative monitoring also demonstrates some limitations. Firstly, it is nearly impossible to continuously monitor the cochlear nerve when it is hidden behind tumor mass making impossible touching nerve structure by stimulator. Basically, having an access to the cochlear nerve operator can monitor hearing status in any moment of surgery, thus the surgeon could decide about tumor removal for that time exceeding time course of surgery. Considering all these limitations it is clear that this strategy most of all confirms the status of hearing at the moment of testing but there is no continuous monitoring for the entire time of surgery.

AIM: Retrospective review of 35 patients with CPAT monitored intraoperatively using TT-ECochG and ABR.

METHODS: Thirty five patients with CPAT were operated using middle fossa approach. Pure tone average (PTA) from 0.5-, 1.0-, and 2.0-kHz were calculated pre- and post-operatively (pre-op, post-op). TT-ECochG needed 64-256 sweeps for effective IM while ABR 512-1024 sweeps. A specially developed by the authors software analyzed and collected all data on-line. The following parameters were recorded intraoperatively: ABR-Wave-V latency, compound action potential amplitude (CAP-Amplitude) and latency (CAP-Lat).

RESULTS: CAP-Am, CAP-Lat and ABR wave V are on-line visualized. Readable CAPs were always recorded while ABR wave-V relatively often disappeared or morphology changes did not allow easy automatic analysis. To average and visualize CAP-Amplitude and CAP-Lat 2-3 seconds were needed, while ABR consumed usually 20-30 sec. Intraoperative changes of CAP-Amplitude and CAP-Lat corresponded faster and more sensitive to various intraoperative situations than ABR. The Spearman Correlation Test revealed that preoperative PTA, prolongation of post-op CAP-Lat, ABR-Wave-V, and ABR V-I Latency value as well as CAP-Amplitude reduction correlated with post-op PTA.

CONCLUSIONS: Some parameters of ABR and TT-ECochG were measured during IM of hearing in near real-time showed good correlation to postoperative hearing measures.