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Original research

An optimized abnormal muscle response recording method for intraoperative monitoring of hemifacial spasm and its long-term prognostic value

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HIGHLIGHTS

- Providing an optimized AMR recording method during MVD for HFS.
- Optimized method improves the positive detection rate of AMR.
- Optimized method increases accuracy of decompression effect prediction.
- Increasing the immediate remission rate and reducing the delayed recovery rate.

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ABSTRACT

Background: Intraoperative electrophysiological monitoring is used to determine whether decompression is sufficient during microvascular decompression (MVD) for hemifacial spasm (HFS). However, the real offending vessel is sometimes neglected by the neurosurgeons. Here, we reported our experience in using optimized abnormal muscle response (AMR) monitoring and continuous intraoperative monitoring for MVD.

Methods: This study included 2161 HFS patients who underwent MVD using traditional (1023 patients) and optimized (1138 patients) methods. Modified AMR monitoring was adopted in our study, with the zygomatic branch of the facial nerve stimulated and the temporal branch, buccal branch, marginal mandibular branch and cervical branch of the facial nerve detected for AMR. These cases were analyzed retrospectively with emphasis on the postoperative outcomes and intraoperative findings. The therapeutic effect was evaluated at day 1, month 3 and year 1 after operation.

Results: The relief rate at day 1, month 3 and year 1 after operation for patients who employed optimized AMR recording method was 95.1%, 97.4% and 99.3%, comparing with 92.2%, 95.0% and 97.8% in traditional method. There was significant difference in achieved immediate remission and recovery rate during 12-month follow-up between the two groups ($P < 0.05$). The modified intraoperative monitoring showed the sensitivity of AMR disappearance to judge the relief at day 1, month 3 and year 1 after HFS operation was 95.7%, 96.3% and 97.3%, respectively; the specificity was 44.6%, 43.3% and 50.0%, respectively; the accuracy was 93.1%, 94.9% and 97.4%, respectively.

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Conclusions: Our findings demonstrated that the optimized method could improve the positive detection rate of AMR and accuracy of decompression effect prediction. The evaluation for the decompression effect by optimized intraoperative monitoring can increase the immediate remission rate and reduce the delayed recovery rate.

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1. Introduction

Hemifacial spasm (HFS) is a syndrome of the unilateral facial nerve hyperexcitability, resulting in an involuntary contraction or twitching of the facial muscles, which is thought to be caused by neurovascular compression of the facial nerve at its root exit zone (REZ) [1,2]. Due to the anatomical configuration of the posterior fossa, orientals are more susceptible to the attack [3]. Microvascular decompression (MVD), initially developed by Jannetta [4,5] and Gardner [6], is widely accepted as a safe and effective treatment modality for HFS owing to its high curative and low recurrence ratio [1]. However, the postoperative curative rate varies between 84% and 97%, and there is a 2.6%–18.3% chance of delayed relief and a 1%–5.3% chance of recurrence [3,7,8]. Delayed improvement or recurrence may be directly related to incomplete decompression. Furthermore, small arterioles compressing the branches of the facial nerve have often been ignored. Abnormal muscle response (AMR), as an objective indicator in the MVD, is an abnormal facial muscle EMG activity, which is elicited by stimulating a branch of the facial nerve and recorded from facial muscles innervated by the other branches. Besides, AMR is an abnormal electromyogram response observed exclusively in individuals who suffer from HFS [9] with the latency of approximately 9–10 ms and the amplitude of 0.1–0.2 mV. In most HFS patients, intraoperative facial nerve EMG is instantaneously eliminated when the involving vessels are isolated from the facial nerve [10]. Accordingly, AMR is used for identifying offending vessels and confirming if the decompression of the facial nerve is satisfactory [11]. Occasionally, multiple compressing vessels are observed during the surgery and the traditional method for facial nerve EMG monitoring cannot determine which one is the major culprit and multiple neurovascular compression is observed in about 38% cases of HFS [12]. In addition, controversy remains regarding the value of intraoperative AMR monitoring as a reliable and significant indicator of post-operative situation [13,14]. Failure to identify the offending vessels is the primary cause for MVD failure. Intraoperative electrophysiology is a favorable adjuvant to navigate the surgery and a new monitoring method is therefore needed when AMR derived from only one branch of the facial nerve is occasionally not available or unreliable. This study was an observational clinical trial and retrospective study exploring a new method which recorded the AMR when the intraoperative facial nerve EMG was absent before sufficient decompression, hoping to investigate if the improved AMR findings for MVD surgery adequately reflected the long-term outcomes of HFS patients and increased the efficiency of surgery.

2. Materials and methods

2.1. Patients

This study involved 1138 classical HFS patients (455 men and 683 women) who underwent optimized AMR monitoring during MVD, from 1st January 2013 to 31 January 2015 in Yuquan Hospital, Tsinghua University. Also, the current study included 1023 HFS undergoing traditional intraoperative monitoring from 1st January 2010 to 31st December 2012 in the same center. All the patients were surgically treated by Huancong Zuo medical group. Clinical characteristics of all the HFS patients are shown in Table 1. The mean age of the patients at surgery was 53.6 years (range, 28–70 years), and the median duration of the symptom was 68.1 months (range, 5–192 months). The spasm affected the left side in 531 patients and the right side in 607 patients. The diagnosis of HFS was made based on the clinical history of typical symptoms and physical examination. Besides, preoperative magnetic resonance imaging was performed in all these HFS patients to exclude tumors or any other causes of HFS. To confirm the neurovascular compression before surgery and rule out other diseases, three-dimensional time of flight magnetic resonance angiography (3D-TOF MRA) was performed. All the patients had been medicated preoperatively but eventually in vain. All these patients gave their consent for inclusion in this submission. Their clinical features and surgical outcomes were analyzed.

2.2. Anesthesia

General anesthesia was induced and maintained by intravenous infusion of propofol (1 mg/kg for induction and 7–8 mg/kg/h for maintenance) and fentanyl. Higher dose of muscle relaxant would cause neuromuscular junction dysfunction and affect electromyography responses of the facial nerve, accordingly affecting the sensitivity and accuracy of intraoperative abnormal facial muscle EMG activity monitoring. After anesthesia was stabilized, abnormal EMG activity was elicited with supramaximal stimulation.

2.3. Optimized intraoperative AMR monitoring method

Monitoring equipment and electrodes: Eclipse Neurological Workstation was used for intraoperative monitoring (AXON, USA). The stimulating and recording electrodes were needle electrodes. All patients received operation under electrophysiological monitoring. General anesthesia was induced by using the muscle relaxant that had a shorter half-life. No more muscle relaxant was administered after anesthesia induction.

Table 1
Clinical characteristics of 1138 patients with HFS who employed the optimized methods.

Variable	
Age (years)	53.6 ± 12.1
Sex	
Male, No. (%)	455 (40.0)
Female, No. (%)	683 (60.0)
HFS side	
Right, No. (%)	607 (53.3)
Left, No. (%)	531 (46.7)
Duration of HFS (months)	68.1 ± 13.6
Follow-up periods (months)	20.7 ± 9.3
Type of vessel compression	
Single, No. (%)	849 (74.6)
Multiple, No. (%)	289 (25.4)

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