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Technical note

Intra-operative monitoring of two facial muscles in hemifacial spasm surgery

Monitorage peropératoire de deux muscles faciaux dans la chirurgie du spasme hémifacial

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ABSTRACT

Background. – Hemifacial spasm (HFS) is a chronic facial nerve disorder characterized by spontaneous muscle contractions. Microvascular decompression (MVD) is the neurosurgical treatment of choice. Intraoperative neurophysiologic monitoring (IOM) during MVD can help determine when adequate decompression is performed.
Methods. – MVD with IOM was performed on 16 patients with HFS that included recording the abnormal lateral spread response (LSR) in lower facial muscles, considered as neurophysiologic marker of HFS. Two lower facial muscles were monitored as opposed to a standard monitoring of a single muscle.
Results. – All patients underwent preoperative thin cut MRI confirming the presence of neurovascular conflict. Patients underwent small retrosigmoid craniotomy and MVD. In 13 cases, the LSR guided the surgeon to continue MVD until the response was unobtainable from all recorded lower facial muscles. In four of those (30%), the LSR persisted on one of the recorded muscle and prompted further exploration and decompression until complete disappearance of LSR in all recorded muscles. In two cases, the LSR disappeared after dural opening and never recurred during the procedure, therefore the completion of MVD was based on non reappearance of LSR. In one case, the LSR persisted despite apparent complete decompression of the nerve. Fourteen patients had complete relief of their symptoms after surgery, one had partial improvement and the one with persistent LSR was unchanged.
Conclusion. – Evaluation of the LSR by monitoring of two lower facial muscles provides valuable neurosurgical guidance during MVD for HFS. This simple modification of intra-operative monitoring may improve prediction of satisfactory MVD and HFS resolution.

Mots clés :
Spasme hémifacial
Décompression microvasculaire
Réponse de propagation latérale

RÉSUMÉ

Introduction. – Le spasme hémifacial (SHF) est un trouble chronique du nerf facial, caractérisé par des contractions musculaires spontanées. La décompression microvasculaire (DMV) est le traitement neurochirurgical de choix. Au cours de la DMV, le monitorage neurophysiologique peropératoire peut aider à déterminer l'instant où la décompression adéquate est atteinte.
Méthode. – La DMV sous monitorage neurophysiologique a été effectuée sur seize patients avec SHF : l'enregistrement d'une réponse anormale de propagation latérale (RPL) dans les muscles du territoire inférieur du visage était considéré comme le marqueur neurophysiologique du SHF. Deux muscles du territoire inférieur du visage ont été pris en compte (contre un seul lors d'une surveillance standard).

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Résultats. – Une IRM en coupe fine préopératoire, confirmant le conflit neurovasculaire, a été réalisée chez tous les patients avant la petite craniotomie rétrosigmoïde et la DMV. Dans 13 cas, la RPL a guidé le chirurgien pour poursuivre la DMV jusqu'à l'absence de réponses de tous les muscles enregistrés. Dans 4 cas (30 %), la RPL a persisté sur l'un des muscles enregistrés et a incité à la poursuite de l'exploration et de la décompression jusqu'à disparition complète de la RPL dans tous les muscles. Dans deux cas, la RPL a disparu après ouverture durale et n'a pas récidivé au cours de l'opération, montrant ainsi que la non-réapparition de la RPL pouvait être considérée comme le signe de la réussite de la DMV. Dans un cas, la RPL a persisté malgré l'apparente décompression complète du nerf. Quatorze patients ont eu un soulagement complet de leurs symptômes après chirurgie ; un patient a eu une amélioration partielle ; et l'état de celui qui avait une RPL persistante est resté inchangé.
Conclusion. – L'évaluation de la RPL sur deux muscles du territoire inférieur du visage est un guide neurochirurgical précieux lors de la DMV pour SHF. Cette simple modification de critère du monitorage peropératoire peut améliorer les résultats de la DMV et la résolution du SHF.

1. Introduction

Hemifacial spasm (HFS) is a chronic facial nerve disorder characterized by unilateral spontaneous repetitive contractions of facial muscles. Usually, these contractions start in the orbicularis oculi muscle, and over time progress to the lower facial muscles. HFS is thought to be caused by a combination of mechanisms: a hyperexcitable facial motor nucleus (central hypothesis), axono-axonal conduction due to demyelination or ephaptic transmission (which is the theory in favor of peripheral hypothesis responsible for hemifacial spasm), and vascular compression of the facial nerve at the site of demyelination [1–5]. Moller and Jannetta hypothesized that the activity at the facial nerve lesion, or site of demyelination at the root exit zone (REZ), may travel antidromically and cause abnormal functioning of the facial motor nucleus in a process similar to kindling [4]. Non-surgical intervention of HFS, such as medications or botulinum toxin injections, can be successful in patients, but usually only for short-term relief of symptoms. Microvascular decompression (MVD) most often perform near the REZ of the facial nerve at the brainstem has shown to have an 85–95% success rate [1,4,6]. The vessels most often involved in compression include the posterior inferior cerebellar artery (PICA) and the anterior inferior cerebellar artery (AICA). The vertebral artery, other veins, and/or small arteries are sometimes found as the compressing vessels, although less often [2,7,8].

During an MVD, electromyographic recordings eliciting a lateral spread response (LSR) can be performed to demonstrate that cranial nerve 7 (CN7) has been successfully decompressed. Lateral spread can simply be explained as the electrical version of HFS. It can be measured by stimulating over a peripheral branch of the facial nerve and recording from the muscle of another branch. This abnormal response is hypothesized from ectopic excitation of CN7 by an impinging vessel creating an "ephaptic transmission" [3,5]. In contrast, Moller explains that ephaptic transmission does not cause the abnormal muscle response, but that the facial motor nucleus is the site of cross transmission as evidenced in the recordings of neural conduction times of the facial nerve in HFS patients undergoing MVD [6]. Typically the zygomatic or temporal branch of CN7 is stimulated during LSR testing and recordings are obtained from the mentalis muscle [7]. In an ideal case, after the surgeon has decompressed the facial nerve, this abnormal response will become unobtainable, which correlates with post-operative cessation of HFS. Thirumala et al. demonstrated that in approximately 80% of MVD cases, the LSR disappeared after decompression while the response persisted post-operatively in 20%. In their study, 93–95% of patients that showed absent LSR after decompression had spasm relief, although in cases where the LSR persisted post-operatively, 67% still had a successful outcome [9].

The objective of this technical note is to further emphasize the importance of intra-operative monitoring in hemifacial spasm surgery. Moreover to introduce a minor modification of intra-operative monitoring by including two lower facial muscles as opposed to standard monitoring of a single muscle and evaluate the effectiveness of this modification.

2. Methods

Between 2010 and 2014, sixteen patients who underwent monitoring of lateral spread during MVD surgery for HFS were evaluated. In each case, lateral spread was elicited before incision and monitored throughout the case until after decompression, and dural closure.

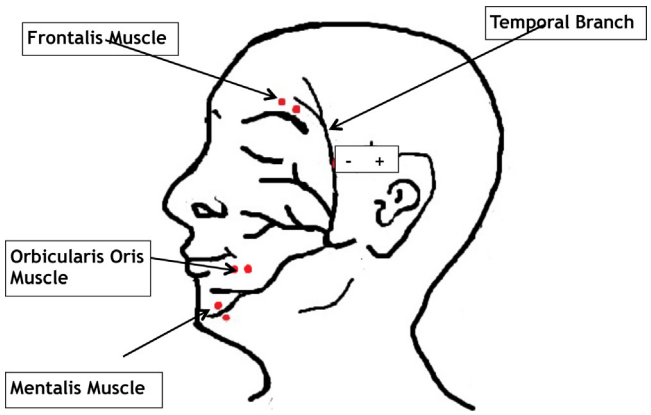

Fig. 1. Schematic diagram showing electrode placement for obtaining the lateral spread response (LSR). Two subcutaneous needle electrodes are placed in the frontalis muscle, the upper or lower orbicularis oris muscle, and the mentalis muscle approximately 0.5–1 cm apart for recording triggered electromyographic (tEMG) responses after stimulus is applied over the temporal branch of the facial nerve. Subcutaneous needle electrodes are also used for the tEMG stimulus. We begin by placing the anode (return) electrode approximately 1–2 cm medial to the crus of helix and anterior notch of the pinna (inserting parallel to sagittal plane). We then lay the cathodal electrode over the outer skin in various locations, starting approximately 1–2 cm lateral to the outer canthus of the eye while running the tEMG, to observe the LSR. We generally move the cathodal electrode superiorly (sometimes slightly medially, laterally and/or inferiorly) until we elicit a maximal response. We finally insert the cathodal needle in this location.
Schéma montrant le placement des électrodes pour obtenir la réponse de propagation latérale (RPL). Deux électrodes placées dans des aiguilles fines sont introduites en sous-cutané dans le muscle frontal, le muscle orbiculaire (supérieur ou inférieur) de la bouche, le muscle mentonnier, à environ 0,5 à 1 cm de distance pour enregistrer les réponses électromyographiques déclenchées (tEMG) par stimulus de la branche temporale du nerf facial. Des électrodes sous-cutanées servent aussi à la stimulation tEMG. Nous commençons par placer l'anode (retour) à environ 1–2 cm de la racine de l'helix et de l'encoche antérieure du pavillon auriculaire (insertion parallèle au plan sagittal). Puis nous posons la cathode sur la peau, en divers endroits, à environ 1–2 cm de l'angle externe de l'œil, durant le tEMG, pour observer la RPL. Nous déplaçons la cathode vers le haut, parfois légèrement à l'intérieur, ou latéralement, ou vers le bas, jusqu'à obtenir une réponse maximale : c'est alors à cet endroit que nous insérons l'aiguille cathodique.