Short Communication

Intraoperative identification of the facial nerve during parotidectomy by electrical stimulation

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One of the major challenges in parotid surgery is the prevention of facial nerve injury. In the past, several methods of its identification were used. Lately, intraoperative electrical stimulation was accepted as the most reliable method for the detection and preservation of facial nerve branches. The aim of the study is to estimate the safety and efficacy of electrical stimulation as a method for identification and preservation of the facial nerve and its branches during parotidectomy. The authors analyzed the localization and identification of 55 nerves in 55 patients undergoing parotid gland surgery in the Department of Ear Nose and Throat Disease, University Hospital Kaspela, Medical University-Plovdiv from January 15, 2017 to December 15, 2018. Nerve integrity monitor Neurosign 100 and specially designed electromyographic (EMG) electrodes were used. In all patients, electrical stimulation of the facial nerve was successfully used to locate, identify and evaluate the integrity of the facial nerve during and at the end of the operation. No postoperative facial nerve injury was detected clinically. In conclusion, the results indicate that the identification of the facial nerve by electrical stimulation is a safe, effective and simple method for monitoring during parotid gland surgery.

Key words: Parotidectomy, facial nerve, electrical stimulation.

INTRODUCTION

The facial (seventh cranial) nerve emerges from the pontomedullary junction through the motor root conveying fibers to muscles that is derived from the mesoderm of the second pharyngeal arch and the intermediate nerve that carries visceral sensory fibers from the tongue and palate, and parasympathetic preganglionic fibers to the pterygopalatine and submandibular ganglia (Monkhouse, 1990). Many scientific studies have investigated the anatomy of the facial nerve (Kalina, 2003; OV, 2004).

One of the major challenges in parotid surgery is the prevention of facial nerve injury; that is, despite the potential for modern surgical equipment and modern diagnostic techniques, there is still a risk of suffering a facial nerve injury during surgery (Asma et al., 2009). Intraoperative damage results in paresis (paralysis) of the facial muscles, which leads to a degradation in the quality of life of patients. In the past, several methods of its identification were used. Electromyography (EMG)-responses could only be found when damage to the facial nerve was already done. The first attempt to use a stimulating cutter was done by H. Silverstein in 1990. He used a pneumatic burr with an adapter for continuous stimulation, located in the corner of the patient’s mouth (Silverstein, 1990). Bernardeschi et al. (2011) suggested using 1 mA to safely drill near the facial nerve through a translabyrinthine approach. Lately, intraoperative electrical stimulation was accepted as the most reliable method for the detection and preservation of facial nerve branches (Dulguerov et al., 1999; Eisele et al., 2010; Witt, 1998). Therefore, the stimulation of the facial nerve determines the new requirements on the technique of carrying out the intraoperative facial nerve identification.

Surgical anatomy

The surgeon should pay more attention to the course of the facial nerve within the parotid gland due to the risk of...
injury during operations for parotid gland tumors, especially when the tumor is located deep in the nerve. After emerging from the stylomastoid foramen, the facial nerve is located slightly posterolateral to the base of the styloid process, inferior and medial to the conchal cartilage, and medial to the tympanomastoid fissure. In the parotid gland, the facial nerve is divided into temporofacial (upper) and cervicofacial (lower) divisions, which in turn divide to form the goose’s foot (pes anserinus).

Commonly, the facial nerve is divided into five branches: temporal, zygomatic, buccal, marginal mandibular, and cervical, which leave the parotid gland along the anterior border.

The aim of the study is to estimate the safety and efficacy of electrical stimulation as a method for the identification and preservation of the facial nerve and its branches during parotidectomy.

MATERIALS AND METHODS

The localization and identification of 55 facial nerves was analyzed in 55 patients undergoing parotid gland surgery in the Department of Ear Nose and Throat Diseases (ENT), University Hospital Kaspela, Medical University-Plovdiv from January 15, 2017 to December 15, 2018. Nerve integrity monitor Neurosign 100 and specially designed EMG electrodes (Magstim Company Ltd., Wales, UK) were used.

Choice of recording electrodes

Specially designed reusable needle electrodes 20/0.4 mm P/N 1178-00 were used.

Placement of the recording electrodes

The recording electrodes were placed deep in the related muscle, separated by at least 2 cm from each other to avoid possible signal cancellation and increase the number of sampled muscle fibers. The muscles included were orbicularis oculi, orbicularis oris, and frontalis, which are supplied by the largest and most vulnerable branches of the facial nerve: the zygomatic, buccal, and temporal branches.

Stimulating electrodes

The devices used to apply electrical stimulation to a nerve are supplied with two electrodes. The anode and cathode of the bipolar stimulators are approximately equal in size and less than 5 cm apart. Stimulation of the nerve in our patients was performed using a bipolar stimulating probe P/N 1050-00.

Method of monitoring

The place of nerve crossing was stimulated by the electric current, characterized by 0.5-1.5 mA. With the stimulation of the nerve or the branches, the specific sound and light indicators were activated.

Ethical considerations

This potential observational study was approved by the institutional review board, and the participants gave their informed consent after explaining the purpose and procedure of the study.

RESULTS

Proper electrode positioning was achieved in all patients. The light and sound indicators of channels 1 and 2 helped to identify the course of the facial nerve. The evoked EMG potentials could be triggered from a distance of 3-5 mm up to the nerve through the interposed tissue using a mean electric current level of 0.8±0.2 mA. Further in the dissection, the location of the facial nerve was clearly detected with a lower stimulation 0.3±0.2 mA.

DISCUSSION

The posterior, superior, inferior or anterior approach can achieve the identification of the facial nerve during parotidectomy (Dulguerov et al., 1999; Anon et al., 1991; Bensadoun et al., 2008; Terrell et al., 1997). In the posterior approach, the conchal cartilage and tympanomastoid suture are used to locate the main trunk of the facial nerve. The superior approach relies on the superficial temporal artery and vein, which penetrates deeply into the temporal branches of the facial nerve. The posterior facial vein, which is deep to the mandibular branch of the facial nerve, is the landmark in the inferior approach to the facial nerve. The main trunk can also be accessed through an anterior approach, using as a landmark the buccal branch of the facial nerve, which runs just above and parallel to the parotid duct (Bensadoun et al., 2008; Deneuve et al., 2010; Brennan et al., 2001; Grosheva et al., 2009). In any case, facial nerve monitoring can be used to identify the individual branches of the main trunk. Many authors believe that there are two main considerations in this regard. First, the surgeon should remember that the facial nerve was there before the tumor occurrence.

Second, based on physical examination (and the
imaging findings if available), one should be able to predict the direction of the facial nerve displacement caused by the tumor growth. The benign pleomorphic adenoma never surrounds the facial nerve. Therefore, the last is pushed in one or the other direction. Deep lobe tumors push the nerve laterally (Dulguerov et al., 1999; Witt, 1998; Brennan et al., 2001; Grosheva et al., 2009).

Rarely, even the most meticulous anatomical dissection may fail to identify the main trunk of the facial nerve. The use of the low voltage stimulator is beneficial and appropriate in these cases. The anatomical integrity of the facial nerve should be visually approved and verified by stimulation before wound closure at the end of the surgical procedure. In postoperative paresis, complete recovery is very possible. Complete paralysis is quite unusual and, in the anatomically intact nerve, almost always reflects neurapraxia (Anon et al., 1991). Hence, complete recovery should be expected. Our results confirm that the use of stimulator to locate and identify the facial nerve is an appropriate low-risk procedure.

Conclusion

In this study, 55 facial nerves have been located, identified and analyzed in 55 patients who underwent parotid gland surgery in the ENT Department of the University Hospital Kaspela, Medical University, Plovdiv, using the nerve integrity monitor Neurosign 100, and specially designed EMG and reusable needle electrodes. From the findings, no postoperative facial nerve injury was detected clinically. The results indicate that the identification of the facial nerve by electrical stimulation is a safe, effective and simple method for monitoring during parotid gland surgery.

REFERENCES