The Role of Intraoperative Neurophysiological Monitoring (IONM) in Parotid Gland Tumor Surgeries

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INTRODUCTION

The human oral cavity contains hundreds of small and large salivary glands in and around the mouth that produce saliva. Out of three major salivary glands, the parotid gland is the body's largest salivary gland, producing 25 percent of the saliva. The other two salivary glands are the sublingual gland (under the tongue) and the submandibular gland (below the jaw). Located in the retromandibular fossa, the parotid gland is bordered superiorly by the zygomatic arch, posteriorly by the sternocleidomastoid muscle, and anteriorly by the masseter. The primary function of salivary glands is to secrete saliva, which serves several digestive and non-digestive functions in the body, including facilitating chewing, swallowing, and speaking. Several diseases can affect salivary glands, including sialolithiasis (stone formation in the gland), sialadenitis (bacterial infection of the gland), viral infections of the gland (mumps), and tumor formation. Most salivary tumors are benign (noncancerous) and grow in the parotid gland.

A parotid gland tumor rises from an overgrowth of cells. According to the American Cancer Society, parotid masses account for about 70% of salivary gland tumors. The most common type is **pleomorphic adenoma**, a slow-growing tumor. In very unusual circumstances, this type of tumor can become cancerous. Research suggests that the longer a pleomorphic adenoma in the parotid gland remains in place, the higher the chance of it becoming cancerous. About 1.5% of the tumors become malignant in the first five years, rising to 9.5% after 15 years. The two major risk factors for developing parotid tumors include excessive exposure to radiation and smoking. The initial clinical picture of the parotid tumor includes the patient's notice of swelling in front of the ear and asymmetry in the mouth. Some patients may experience numbness, burning, or pins-and-needles sensations in the affected area or decreased facial movement. Most of the time, pleomorphic adenoma does not cause pain. Still, malignant parotid tumors can invade adjacent structures, including the facial nerve, resulting in severe pain and facial weakness or paralysis.

In either case, whether the tumor is benign or malignant, treatment begins with surgical removal of the tumor, called a parotidectomy. One of the greatest fears of parotidectomy is an injury to the facial nerve or one of its branches. The nerve courses through the middle of the parotid gland and is divided into five terminal branches, which supply facial expression muscles responsible for the eyes' closure, nose wrinkles, and lips' movement. Injury to the facial nerve or its branches may result in an inability to close the affected side eye, speech difficulty, saliva dribbling from the mouth’s angle, and gross facial asymmetry. During parotidectomy, the surgeons identify the facial nerve and trace its branches. The parotid gland can usually be removed without permanent injury to the facial nerve with the help of Intraoperative neurophysiological monitoring, which helps the surgeon identify the nerve during dissection and continuously monitor the functional integrity of the nerve throughout the surgical procedure.

Intraoperative neurophysiological monitoring (IONM) constitutes a group of modalities used to monitor neural pathways during high-risk surgical procedures. IONM assists surgeons in preventing damage and preserving the functionality of the nervous system. There is a vast list of IONM modalities that can be used to preserve the function of the nervous system (brain, spinal cord, nerves) and to map the structures of the nervous system. It includes somatosensory evoked potentials (SSEP), motor evoked potentials (MEP), brainstem auditory evoked potentials (BAEP), visual evoked potentials (VEP), electrocochleography (ECochG), electromyography (EMG) and nerve conduction studies, electroencephalography (EEG), and electrocorticography (ECoG) Cortical and subcortical motor mapping.

In parotidectomy, IONM is crucial in identifying the facial nerve and its branches and protecting them from iatrogenic injury. The modality used in such cases is EMG (both s-EMG & t-EMG). In this technique, recording electrodes are inserted in all the muscles of the face on the affected side corresponding to the branches of the facial nerve. These electrodes record spontaneous muscle activity generated by mechanical irritation or stretching of the nerves during the surgical procedure and alert the surgeon about his/her action. At the same time, t-EMG is used to identify nerves by stimulating them with the help of a hand-held probe by the surgeon. Literature evidence suggests a significant reduction in the incidence of facial nerve injury when parotidectomies were performed under IONM. During facial nerve monitoring, a more sophisticated form of nerve monitoring and mapping has been described, in which the main trunk and all facial nerve branches are percutaneously identified with the help of t-EMG by a neurophysiologist before the incision is given to the patient. This will assist the surgeon in making incisions safely without accidental injury to the facial nerve or its branches. Once inside the operation area, IONM assists the surgeon in identifying the nerve by directly placing the hand-held probe on the nerve. In this way, motor nerve identification and functional status are determined by the neurophysiologist in direct communication with the operating surgeon, allowing the surgeon to entirely focus on efficient lesion removal while relying on the neurophysiologist’s interpretation of nerve activity. Facial nerve mapping and monitoring in parotidectomy surgery enables direct identification of individual nerve branches and allows safe tumor removal with minimal chances of postoperative facial nerve weakness. [1] [2] [3]

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