EVALUATION OF THE MICROSURGERY RESULTS FOR ACOUSTIC NEUROMA USING AN INTRAOPERATIVE NERVE MONITORING SYSTEM

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Summary

Objectives: To evaluate the results of microsurgery for acoustic neuroma using an intraoperative nerve monitoring system. ***Subjects and methods:*** Cross-sectional, retrospective, and prospective description of 74 patients with acoustic neuroma who were microsurgically treated in Viet Duc University Hospital from October 2016 to March 2018. ***Results:*** Women (58.11%) were more predominant than men (41.89%). The age mean was 50.41% ± 9.43 years. There was no significant difference between the tumor location on the right and left side (54.41 compared to 45.59%). There were 40 patients with large tumors (54.05%), giant tumors in 20 patients (27.02%), and 14 patients (18.92%) with small tumors < 2.5cm. Postoperative magnetic resonance examinations were indicated for 100% of patients, in which 78.37% full of tumors were taken out and 21.63% were taken almost tumors. The rate of intact facial nerve was 93.3%. The damage rate of the facial nerve was about 20.28%. The most complications were cerebral edema, bleeding, hydrocephalus, death and meningitis (5.4%; 4.05%; 4.05%; 2.7%, and 1.35%, respectively). The recovery of the function of the VII nerve, grade I, II according to House-Brackmann was 79.72%. ***Conclusion:*** Neurosurgical intervention remains the main step in the effective management of vestibular schwannomas. Using a continuous monitoring system for the facial nerve in surgery for vestibular schwannoma has reduced the rate of post-operative facial nerve paralysis.

* *Keywords: Neuroma; Intraoperative nerve monitoring.*

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INTRODUCTION

The tumor of the vestibulocochlear nerve (VIII cranial nerve) is a benign tumor of the nerve vestibular branch of the VIII nerve. The tumors usually arise from the inner ear canal at the junction between the center and periphery of the myelin sheath and are located in the location of the cerebellopontine angle directly related to the brain stem, fourth ventricle, and cerebellum. If surgery is not done timely or is delayed, the mortality and disability rate is very high. The clinical symptoms of the VIII nerve tumor are cord diverse. However, the detection time is still slow due to silent clinical symptoms, but the patients think more about the problem of otolaryngology and the mistake is the common diseases. Surgery for neuroma of the VIII nerve is a common operation in the neurosurgery subspecialty. The aim of surgery is to remove tumor, preserve the function of the VII nerve and, if possible, preserve the funtion of the VIII nerve. The preservation of the VII nerve function depends on many factors such as tumor size, incision, technique and experience of the surgeon, and especially the method of the integrity of the VII nerve during surgery [1, 2]. One of the means used for monitoring is the NIM-nerve integrality monitoring system, an electromechanical system that continuously monitors the integrity of the cranial nerves that was introduced by Krauze in 1898, and that Delgado used the system according to intraoperative monitoring in 1979 [3]. This is a system that is installed right before surgery on the muscles of the face-region of the VII nerve, and during the operation, the surgeon can stimulate to find the position of the VII nerve to avoid damage to the VII nerve. In order to contribute to understanding the effectiveness of the VII nerve monitoring system in the surgical treatment of the VIII neuroma, we conducted this study: *To evaluate the microsurgery results for acoustic neuroma using an intraoperative nerve monitoring system.*

SUBJECTS AND METHODS

1. Subjects

74 patients with VIII nerve tumors underwent microsurgery to remove the tumor at the Neurosurgery Center of Viet Duc University Hospital from October 2016 to March 2018.

* *Inclusion criteria:* Patients with VIII nerve tumors were performed microsurgery to remove the tumor in surgery using a continuous monitoring system of the VII nerve, the pathology of tumor is a neuroma.

2. Methods

* *Research period:* October 2016 to March 2018

* *Research location:* Center for Neurosurgery, Viet Duc University Hospital

* *Research methods:*

- Research design: Cross-sectional, retrospective, and prospective description

- Sample size: Convenience sampling, N = 74.

- Research criteria: Age, gender, clinical examination, level of facial nerve paralysis before surgery, tumor size, location, tumor density on magnetic resonance image. In surgery: install NIM 3.0 system, continuously monitor, and find the position of the VII nerve. Outcomes were evaluated based on rates of survival, mortality, the extent of tumor removal, and intraoperative and postoperative complications. The function of the VII nerve was assessed at times of 24 hours after surgery, at discharge, 3 months, 6 months, 12 months after surgery, according to the House-Brackmann scale.

* *Data processing:* Using SPSS 20.0 software according to the medical statistics algorithm.

RESULTS

During the period from October 2016 to March 2018, 74 patients were included in the study when they met the criteria. Of which there were 43 women (58.11%) and 31 men (41.89%). The oldest was 76 years and the youngest was 11 years. All patients had unilateral VIII cord tumors. Right tumor was detected in 41 (54.41%), left side in 33 (45.59%).

Table 1: Tumor size

Tumor diameter	Number of patients (n = 74)	Percentage (%)	p
< 2.5 cm	14	18.92	> 0.05
From 2.5 - 4 cm	40	54.05	
> 4 cm	20	27.03	

There were 40 patients with large tumors (54.05%), 20 patients with giant tumors (27.02%), 14 patients (18.92%) with small tumors < 2.5cm; in which the smallest tumor had a diameter of 1.7 cm, and the largest tumor had a diameter of 6.7 cm.

Table 2: Function of the VII nerve according to the House - Brackmann scale.

House - Brackmann scale	Timepoints of re-examination				
	Before surgery (n = 74)	**After 24h (n = 74)**	**After 3 months (n = 72)**	**After 6 months (n = 72)**	**After 12 months (n = 52)**
Grade I	65 (87.83%)	59 (79.72%)	57 (79.16%)	57 (79.16%)	39 (75%)
Grade II	0	0	6 (8.34%)	11 (15.28%)	10 (19.23%)
Grade III	09 (12.17%)	14 (18.93%)	9 (12.50%)	4 (5.56%)	3 (5.77%)
Grade IV	0	1 (1.35%)	0	0	0
Grade V - VI	0	0	0	0	0
P-value	P < 0.05				

After surgery over 6 months, most of the patients recovered the funtion of the VII nerve with the rate of 94.44% according to the House – Brackmann scale.

Table 3: Postoperative complications.

Complications	Number of patients (n = 74)	Percentage (%)
Cerebral edema	4	5.40
Bleeding	3	4.05
Hydrocephalus	3	4.05
Dead	2	2.7
Meningitis	1	1.35

The most complications were cerebral edema, bleeding, hydrocephalus, death, and meningitis (5.4%; 4.05%; 4.05%; 2.7% and 1.35%, respectively)

DISCUSSION

Over a period of 18 months, we operated on 74 patients with VIII nerve tumors using NIM 3.0 system. Among them, 60 patients had tumors > 2.5cm (81.08%). When installing the NIM system, all 74 patients had fast, accurate installation and an average installation time of 5 - 10 minutes.

As soon as we approached the tumor, we did not use any instruments that affected the tumor but used the probe of the NIM system to locate the VII nerve. When it was certain that there was no facial nerve, we only used bipolar and cut the tumor at that location. The site of the VII nerve is usually located in the superior, anterior, or inferior poles of the tumor, rarely posteriorly [4]. We found the facial nerve position by looking at the superior pole of the tumor, then looking at the lower pole and the back of the tumor. In this way, we identified the facial nerve located at the superior pole of the tumor just before resection in 4 patients. Determining the path of the facial nerve is relatively difficult in the early stages of surgery because the tumor is large and there are not many areas to find the facial nerve. In a study that surveyed 34 vestibular schwannoma surgery centers in the UK, Goodden found that 100% of centers and surgeons used nerve monitoring systems in surgery [5]. The size of the tumor and the use of an intraoperative monitoring system are the two most important factors affecting the incidence of facial nerve palsy. When the tumor is large, the facial nerve is compressed and flattened. Facial nerves cannot be distinguished when they are pressed too thin without the use of the neuromuscular system. When the facial nerve is stretched thin and adheres tightly to the tumor, especially in the position of the inner ear, it will be difficult to separate from the tumor without causing damage.

Despite identifying the facial nerve, we still damaged the facial nerve in 5 patients (6.7%) during the surgery, but the facial nerve was not completely broken. This patient removed the tumor completely. The integrity of the facial nerve was 93.3%. When surveying 1151 vestibular schwannoma operated in Italy over a 20-year period, Falcioni found that the proportion of the facial nerve without injury was 95.8% [6].

After the facial nerve injuries, we decided not to remove all the tumors in later cases if the facial nerve was too firm to attach to the tumor. Because

the risk of paralysis of the facial nerve was very high if trying to remove all tumor. We met some patients with facial nerve paralysis after surgery for vestibular schwannoma tumors (when NIM has not been applied), and patients complained that if they were diagnosed with facial nerve paralysis, they would not accept surgery. Some of them have had to change their jobs because of distorted mouths. Sadly, there was a patient who was a teacher with paralysis of the facial nerve after removal of the vestibular schwannoma and retired from work. This is why we left a small piece of adhesive along the facial nerve if it is too difficult to remove. Although patients may require additional radiation surgery, complications of paralysis of the facial nerve may be avoided. In our study, after the surgery there were 02 patients with cerebral edema and death (2.7%), no patients with hemiplegia and no infection. Magnetic resonance examination after surgery was taken in all 74 patients. The function of the facial nerve immediately after surgery 24 hours was quite good. There were only 4 patients with grade III paralysis (6.7%) and 1 patient with grade IV paralysis (1.3%). Grade I and II (House-Brackmann) accounted for 79.72% 24 hours after surgery and 91.89% were re-examined at 6 months. There were no patients with grade V and VI paralysis (*Table 2*). This is an acceptable rate. In case the patient suffered from the facial nerve damage to was an incomplete lesion, and the patient was paralyzed at grade IV immediately after surgery at grade III at a 6-month follow-up. In fact, many authors believe that pulling while dissecting the tumor can also damage the facial nerve. Traction lesions are often too small, even with microsurgery, and sometimes cannot be detected [7, 8, 9]. We only removed totally tumors in 58 patients (78,37%) and subtotally in 16 patients (evaluated in surgery). This is a trend with mixed opinions because some surgeons do not accept to leave part of the tumor [5, 7].

In our study, there were 4 (5.4%) patients with brain edema, 3 (4%) patients had bleeding postoperatively, and 2 patients died (2.7%), 01(1.35%) patient had meningitis. Although the rate of tumor removal in our study was not high, all patients had a clear identification of the facial nerve position, and the rate of facial nerve paralysis was significantly reduced. Other complications of surgery are acceptable. Using a continuous monitoring system for the facial nerve in surgery for vestibular schwannoma

has reduced the rate of post-operative facial nerve paralysis [5 10, 11]. We found this was an effective and very necessary means to reduce the rate of paralysis of the facial nerve during surgery of the vestibular schwannoma. Moreover, surgery for glomerulus, foramen, and mid-cranial basal tumors can use this system to avoid complications of facial nerve injury [11, 12]. The mean hospital stay of the study group was 6.5 days (5-9 days).

CONCLUSION

Neurosurgical intervention remains the main step in the effective management of vestibular schwannomas. Using a continuous monitoring system for the facial nerve in surgery for vestibular schwannoma has reduced the rate of post-operative facial nerve paralysis.

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