

Postoperative Nerve Injury and Recurrence in Surgical Treatment of Head and Neck Schwannomas

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ABSTRACT

Introduction. We studied the postoperative status of a series of head and neck schwannomas that were treated during a eight-year period. Nerve injury symptom is a severe problem that occurs in schwannomas postoperative patients. Surgical treatment of the head and neck schwannomas is targeted at complete removal with preserved neurological function. **Materials and Methods.** This research describes a series of sixty-nine consecutive head and neck schwannomas patients who underwent primary surgical resection in Taichung Veterans General Hospital from January 2003 to December 2010. Twenty-five to forty-five percent of extracranial schwannomas were present in the head and neck region, and there was a female predominance (52%) of head and neck patients. **Results.** The average age was 48.13 years old when the diagnosis was made. Resolution rate is 43.5% after resection of the schwannomas. Thirteen patients had residual clotted morsels and four patients experienced a recurrence. The extent of resection was classified as follows: total resection, subtotal resection accompanied with Gamma knife radiosurgery, and subtotal resection. No statistical significance was observed in tumor size and survival rate. Subtotal resection accompanied with Gamma knife radiosurgery is the ideal surgical treatment for large or giant vestibular schwannomas. Total resection for small size vestibular schwannomas is the preferred option. Both have better facial nerve function preservation than other treatments for different tumor size, with a significant decrease in the risk of recurrence. **Discussion.** The treatment with Gamma knife radiosurgery is an excellent option for patients with recurrent or residual intracranial tumors.

Key words: head and neck schwannomas, Resolution rate, Gamma knife.

1. INTRODUCTION

Recently, treatment has become more effective and safe and the resection options offered to patients with head and neck schwannoma have changed at a number of centres. However, there are concerns that surgical procedures preserving facial nerve function increase a patient's risks of tumor recurrence. Around three decades ago, treatment was limited to surgery. Today, stereotactic high-dose radiotherapy, also known as Gamma knife surgery, provides a choice which depends on the properties of the tumor. In a review of studies of tumor patients at various times during the course of their disease, the prevalence of depression ranged from 4.5% up to 50% (Arriaga, 1993). Thus we consider that surgical

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treatment of head and neck schwannoma is aimed at complete removal with preserved neurological function (Bloch, Oghalai, Jackler, Osofsky, & Pitts, 2004; Deguine et al., 1998; El-Kashlan, Zeitoun, Arts, Hoff, & Telian, 2000). To reach the major goal of complete tumor removal with lower morbidity and mortality carries a significant risk of facial nerve injury. The incidence of postoperative facial nerve palsy remains high for large tumors (El-Kashlan et al., 2000; Fenton, Chin, Shirazi, & Fagan, 1999; House, 1983; Hwang et al., 2002). Partial tumor removal is most likely to preserve facial nerve function (Hwang et al., 2002; Kameyama et al., 1996). However, past research indicates that incomplete resection is not associated with a significant increase in the recurrence rate (Kemink, Langman, Niparko, & Graham, 1991; King & Morrison, 1980; Lownie & Drake, 1991). This research aims to discuss the relationship among tumor size and surgical treatment effects on recurrence and nerve injury from a retrospective study of the past eight years.

2. MATERIALS AND METHODS

Clinical records of sixty-nine head and neck schwannoma patients treated in Taichung Veterans General Hospital from January 2003 to December 2010 were retrospectively examined. We surveyed the tumor location, tumor size, postoperative nerve injury symptoms, surgical treatment, and recurrence after resection of head and neck schwannomas.

Statistical analysis was performed using SPSS 12.0. The evaluation of statistical significance was determined using Pearson's chi-square test with a significance level of value $p < 0.05$. Survival analysis was used to compare time to recurrence rate for different surgical treatment groups: total resection, subtotal resection accompanied with Gamma knife radiosurgery and subtotal resection over the follow-up periods. The log-rank test was used to determine if surgical treatment influenced a patient's risk of recurrence and nerve function.

3. RESULTS

In this study, none of the schwannomas were malignant and fifteen patients (16.3%) were without any postoperative nerve injury, symptom or sign. Table 1 displays the sixty-nine head and neck schwannoma cases with tumor location, these patients underwent primary surgical resection in Taichung Veterans General Hospital. From an inspection of the clinical records of these schwannomas patients from January 2003 to December 2010, there was female predominance (52%) of head and neck patients. Twenty-five to forty-five percent of extracranial schwannomas are present in the head and neck region.

From Table 1, the study group included thirty-one males and thirty-eight females with an average age of 48.17 years. Many surgeons believe that total removal of large or giant tumors from the intracranial region is difficult because of the perceived limitations of the operating space within the cerebellopontine angle.



The main purpose of surgical treatment in large head and neck schwannoma is to achieve the highest possible fraction of total tumor removal while maintaining a low mortality rate and keeping the occurrence of injury as low as possible. After undergoing first resection, four patients had recurrences and thirty patients had residual tumors. The mean tumor size was 1.949 cm in this study group and tumor size was not statistically related to recurrence, as shown in Table 2.

Table 1. Parameters of head and neck schwannoma patients with tumor location

Tumor Location	Male	Female
Head:		
Oral cavity	2	3
Brain cerebellopontine (C-P) angle	14	18
Brain (others)	6	5
Eye	0	2
Scalp	0	3
Total	22	31
Neck:		
Pharynx	1	1
Submandibular gland	1	1
Spinal cord	3	4
Neck soft tissue	4	1
Total	9	7

Table 2. Tumor size and recurrence rate

Tumor size (cm)	Number of patients	Recurrence rate
Less than 1 cm	19	42.1%
1.1 to 1.9 cm	22	13.6%
2 to 2.9 cm	12	25%
3 to 3.9 cm*	10	0%
Greater than 4 cm*	6	16.7%

Note. * Large and giant tumors.

Our research with regards to surgical strategy was to remove the tumors as completely as possible while preserving nerve function. Among the complications encountered, the most common sites observed were the brain (20 males and 23 females), nerves of origin such as the VIII acoustic nerve (34 patients), followed by the cervical plexus (10 patients), the trigeminal nerve (8 patients), and the vagus nerve (5 patients). In our study, the nerve of origin at C-P angle schwannomas attacked the acoustic nerve most frequently. Figure 1 demonstrates the Kaplan-Meier plot showing age versus survival curve according to surgical treatment.

Table 3 shows a recurrence rate of 8.6%, including six recurrent cases and only one scalp tumor recurrent case. From the five cases of intracranial schwannomas, four cases were C-P angle schwannomas and a single case was a schwannoma that originated from the oculomotor nerve. Obviously, intracranial schwannomas had a higher recurrence rate of 8.6% than the extracranial



schwannomas recurrence rate of 1.4 %. There are also indications in Table 3 that the most common sequelae after resection of head and neck schwannomas post-operative were facial numbness, in seven cases (10.0%).

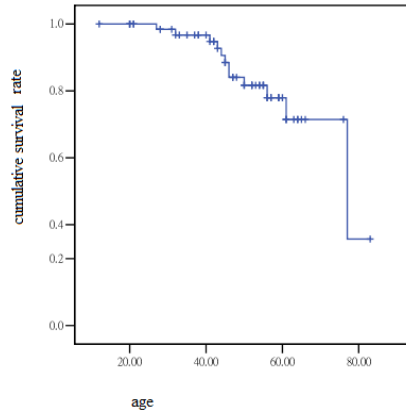


Figure 1. Kaplan-Meier survival curve.

Table 3. Postoperative sequelae and resolution after resection of schwannoma

Location	Preoperative signs and symptoms	Postoperative sequelae
Intracranial:		
C-P angle CN III CN VIII (CN VII involved) CN XII	Progressive blurred vision (1)	Facial numbness (1)
	Progressive hearing impairment (13)	Facial numbness (1) Deafness (1)
	Hearing impairment & facial numbness (4)	Facial numbness (1)
	Tinnitus (3)	
	Unstable gait (4)	Facial palsy (1)
	Headache (2)	Facial palsy (1) Facial numbness (1)
	Dizziness & intermittent vomiting (4)	
	Deviation of tongue (1)	
	Diplopia (1)	Facial numbness (1)
	Diplopia (1)	
Eye		
CN II		
CN II	Scalp mass (3)	
Scalp		
Cervical plexus	Neck mass (1)	Pain when stimulated
Extracranial		
Oral cavity :		
Tongue		
CN V	Tongue mass (2)	---
CN V	Unhealed tongue ulcer (1)	
Mandibular body		
CN V	Jaw bone mass (1)	Operation site numbness
Buccal mucosa		
CN V	Buccal mucosa mass (1)	



Table 3. *Postoperative sequelae and resolution after resection of schwannoma (continued)*

<i>Location</i>	<i>Preoperative signs and symptoms</i>	<i>Postoperative sequelae</i>
Intracranial:		
Pharynx	Neck mass (1)	Neck numbness (1)
CN X	Neck mass (2)	
Cervical plexus		
Submandibular gland		
CN V	Neck pain (2)	Scalp numbness (1)
Spinal cord		
	Weakness & numbness of left limb (1)	
Cervical plexus	Nausea & vomiting (1)	Palm numbness (1)
Brachial plexus	Neck pain (2)	
	Leg weakness (1)	
	Neck mass (3)	Palm numbness (1)
Neck soft tissue		
CN X, CSC	Neck mass (2)	
Cervical plexus		

Note. C-P angle: cerebellopontine angle, CSC: cervical sympathetic chain, (): number of cases.

The recurrence rates for the total resection, Gamma knife radiosurgery, subtotal resection accompanied with Gamma knife radiosurgery and subtotal resection were 78.26%, 1.45%, 18.84% and 1.45%, respectively. The relationships between surgical treatment, age, tumor size, nerve function preservation and recurrence rate are summarized in Table 4.

Table 4. *The relationships between the recurrence rate and surgical treatment for head and neck schwannomas patients*

<i>Surgical treatment</i>	<i>No. of patients</i>	<i>Mean age (years)</i>	<i>Mean tumor size</i>	<i>Mean time to resolution (months)</i>	<i>Recurrence rate (case no.)</i>
Total resection	54	49.6	2.046	6	0
Gamma knife radiosurgery only	1	18	1.73	18	100% (1)
Subtotal resection accompanied with Gamma knife radiosurgery	13	45.5	1.062	26	7.7% (1)
Subtotal resection	1	12	2.57	31	100%(1)

Overall, the surgical treatment was significantly related to the recurrence rate by the Spearman's Rank test ($p = 0.008$) and there was no statistically significant difference between age and recurrence rate ($p = 0.352$). Gamma knife radiosurgery was highly successful in nerve function preservation and reduced the recurrence rate ($p = 0.006$ and $p = 0.012$). After checking by a non-parametric method and obtaining the results, values show that the correlation between surgical treatment and recurrence rate is closely tied ($p = 0.873$).



4. DISCUSSION

Patients undergoing surgical excision for head and neck schwannomas had a significant reduction in social functioning and role limitations due to physical functioning. Most of the research studied, for instance Jacob and Craciun (G. Jacob, 2010), found that total resectioning obtains a low morbidity rate. When recurrence happens and severe scar tissue occurs, subtotal resection is recommended to improve the outcome for the treatment with reintervention. A tumor size of 1.75 cm was the cut-off point associated with the highest sensitivity and standards available concerning the prediction of facial impairment. They also compared with a haphazard cut-off point of 1.1 cm which led to 36% more accurate calculations (Hastan, Godefroy, Malessy, & van der Mey, 2007). We found Gamma knife stereotactic radiosurgery to be an optimal treatment for the large or giant head and neck schwannomas. Gamma knife radiosurgery works in the same way as other forms of radiation treatment. Although it does not remove the tumor completely, it damages the DNA of the tumor cells and these cells lose their ability to regenerate. These results confirm the results of previous research (Day, Wang, Chen, & Young, 2008; Kim & Nam, 2008) that has found that tumor sizes are significantly related to deficits. Kim and Nam (2008) suggest a novel strategy to preserve facial nerves and minimize complications with a reducing mass effect on the brain stem and cerebellum. Thereafter the subtotal tumor resection was performed via a retrosigmoid surgery without intervention of portion tumor. With total resection of the remaining tumor, the facial nerve was decompressed and demarcated during a second stage translabyrinthine approach at a later date. The successful evidence for those who underwent the staging operation for resection of huge vestibular schwannomas is shown in that paper.

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Appendix

Certifications: The authors have completed the IRB training courses and have been approved by Taichung Veterans General Hospital.

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訓練證明

證書編號: 20110826223

茲證明 **陳淑賢** D20113755 君
於民國 100 年 08 月 26 日參加本院人體試驗委員會舉辦之「人體試驗委員會 100 年度第 4 次委員講習/人體試驗計畫主持人講習 (進階班)」臨床試驗講習共 3 小時，特此證明。

課程及講師:

1. 人體研究的知情同意	講師: 陳淑昭醫師
2. 研究人員對人體試驗審查應有的認識	講師: 陳淑昭醫師
3. 綜合討論【互動式討論，採用 IRIS (Interactive Response System)】	講師: 陳淑昭醫師

主任委員





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訓練證明

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於民國 100 年 08 月 26 日參加本院人體試驗委員會舉辦之「人體試驗委員會 100 年度第 4 次委員講習/人體試驗計畫主持人講習 (進階班)」臨床試驗講習共 3 小時，特此證明。

課程及講師:

1. 人體研究的知情同意	講師: 陳淑昭醫師
2. 研究人員對人體試驗審查應有的認識	講師: 陳淑昭醫師
3. 綜合討論【互動式討論，採用 IRIS (Interactive Response System)】	講師: 陳淑昭醫師

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