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Correlation of vestibular schwannoma tumor with facial nerve weakness, hypoesthesia of face, and disequilibrium

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ABSTRACT

Introduction: Vestibular schwannoma is the most common lesion in the cerebellopontine angle. Some of the most common symptoms arise as the tumor grows bigger such as disequilibrium, hypoesthesia of the face, and facial nerve paresis. Based on the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) and the Consensus Meeting on Systems for Reporting Results in Acoustic Neuroma, there is still no clarity of a single method used to measure the tumor itself.

Methods: This was a retrospective study to analyze the correlation between the size (anteroposterior and mediolateral) of the vestibular schwannoma with disequilibrium, hypoesthesia of the face, and facial nerve paresis among the patients in the Neurosurgery Department of Hasan Sadikin Hospital Bandung from January 2014 to December 2019. The data was analyzed using Spearman and Binary Logistic Regression.

Results: A total of 58 patients were included in this study with median age was 43 years, ranging from 21 – 72 years. The most common symptoms were disequilibrium (48.27%), followed by facial nerve paresis (39.65%) and hypoesthesia of face (20.68%). The mean anteroposterior size was 3.8 ± 1.17 cm and the mean mediolateral size was 3.0 ± 1.01 cm. There were significant correlation between disequilibrium with anteroposterior size ($r = 0.385$; $p = 0.003$) and mediolateral size ($r = 0.409$; $p = 0.001$). There were also significant correlation between facial nerve paresis with anteroposterior size ($r = 0.458$; $p = 0.000$) and mediolateral size ($r = 0.321$, $p = 0.014$).

Conclusion: There were significant correlations between the anteroposterior and mediolateral size of the tumor with the occurrence of disequilibrium and facial nerve paresis in patients with vestibular schwannoma.

Keywords: diameter, disequilibrium, facial nerve paresis, hypoesthesia of the face, vestibular schwannoma.

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INTRODUCTION

Vestibular schwannoma is the most common lesion in the cerebellopontine angle (CPA) and reaches almost 75% of all lesions in this area. Vestibular schwannoma arises from the inferior division of the vestibular nerves. Three common earlier symptoms include loss of hearing (insidiously and progressive), tinnitus, and disequilibrium. A bigger tumor can cause numbness of the face, weakness of the face, and even symptoms related to the pressure of the brain stem or hydrocephalus.¹

Aside from the loss of hearing, most of the patients who came to our hospital at Hasan Sadikin Hospital showed symptoms like disequilibrium, numbness, and weakness of the face. Otalgia, weakness,

and numbness of the face occur as the tumor grows bigger and presses the trigeminal and facial nerves. A unique paradox is that weakness of the face is less frequent even it is always distorted since early; compared to numbness of the face that always occurs as it is squeezed. This phenomenon is thought of as motoric nerve more resist than sensory nerve.¹ Huang *et al.* stated that most experts defined this tumor only by one dimension in measuring the size, for example, the diameter > 3 cm, although the volume itself would vary, as the diameter 3 cm, the volume could be 4.3 until 17.3 cm³, ranging from 1.34 to 25.2 cm³.²

Total tumor excision with preservation of the neurologic function and quality of life is the goal of vestibular schwannoma surgery. Recognizing the course of the

facial nerve related to the tumor in the preoperative stage is valuable for the surgeon.³ Identification of facial nerve perhaps can be accomplished with 3 dimensions multiplanar Magnetic Resonance Imaging (MRI), but impossible with conventional MRI.⁴ It is almost impossible to visualize or predict the anatomy of the cranial nerve displaced preoperatively with the current diagnostic technique, especially in large vestibular schwannoma.¹

Some standard methods to report and measure tumors have been suggested by some national organizations, such as the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) in 1995 and the Consensus Meeting on Systems for Reporting Results in Acoustic Neuroma in 2003, but no single method is

clearly utilized.³

Vestibular schwannoma needs to be described as intracanalicular, extra-meatal or intra-meatal. The growth of

Figure 1. Measurement of extra-meatal vestibular schwannoma according to AAO-HNS.

tumors tends to be dominant at extra-meatal and some recommendations focus on measuring extra-meatal. AAO-HNS recommended using extra-meatal anteroposterior diameter (parallel with petrous ridge) multiply with the medial-lateral diameter (Fig. 1).³ Otherwise, the consensus meeting in 2003 prefer to measure the maximum extra-meatal diameter.

METHODS

This was a retrospective study evaluating vestibular schwannoma patients who preoperatively came to our hospital from 2014 until 2019. We defined the size of the tumor as the independent variable, while facial nerve paresis, numbness of the face, and disequilibrium as dependent variables.

Samples were grouped based on their symptoms, which were disequilibrium, hypesthesia of the face, and facial nerve paresis. The size of the tumor was measured with the AAO-HNS method. Data collected were analyzed to determine the correlation between the size of vestibular schwannoma and the symptoms of facial nerve paresis, hypesthesia of the face, and disequilibrium. The operational definition of the variable can be seen in Table 1.

RESULTS

Size of tumor and symptoms

As can be seen in Table 2, the mean age of the subjects was 43.53 ± 12.56 years old. There were 26 males (44.8%) and 32 females (55.2%). The most common symptom was disequilibrium (48.27%) and was followed by facial nerve paresis

Table 1. Operational definition of the variable included in this study.

Variable	Operational Definition	Measure scale
Size of tumor	Tumor in CPA area, cystic/solid. Scale on CT scan/MRI, measure in anteroposterior and mediolateral diameter.	Nominal
Hypesthesia of the face	Numbness of the face. No other cause than the tumor.	Categorical
Facial nerve paresis	Weakness of the face. No other cause than the tumor.	Categorical
Disequilibrium	Inability to maintain equilibrium, with Romberg test. No weakness of extremities	Categorical

CPA: Cerebellopontine angle; CT: Computed tomography; MRI: Magnetic resonance imaging

Table 2. Characteristic of samples.

Characteristic	Sample (N)	Value (percentage)
Demography		
Age (years)	58	
Mean $\pm$ SD		43.53 ± 12.56
Median		43
Min – max		21 – 72
Gender	58	
Male		26 (44.8)
Female		32 (55.2)
Symptoms	58	
Disequilibrium		28 (48.27)
Hypesthesia of face		12 (20.68)
Facial paresis		23 (39.65)
Size of tumor (cm)	58	
Anteroposterior		
Mean $\pm$ SD		3.8 ± 1.17
Median		4
Min – max		2.63 – 4.97
Mediolateral		
Mean $\pm$ SD		3.0 ± 1.01
Median		3
Min – max		1.99 – 4.01

Figure 2. Distribution of symptoms related to the size of the tumor.

Table 3. Correlation between size of the tumor and symptoms.

Size	Symptom	r	P-value
Anteroposterior	Disequilibrium	0.385	0.003
	Hypesthesia of face	0.137	0.305
	Facial nerve paresis	0.458	0.000
Mediolateral	Disequilibrium	0.409	0.001
	Hypesthesia of face	0.102	0.448
	Facial nerve paresis	0.321	0.014

Table 4. Causal correlation of size and symptoms.

Size	Symptom	P-value
Anteroposterior	Disequilibrium	0.004
	Hypesthesia of face	0.271
	Facial nerve paresis	0.002
Mediolateral	Disequilibrium	0.009
	Hypesthesia of face	0.302
	Facial nerve paresis	0.021

Table 5. Predicting symptoms based on the size of the tumor.

Symptom	Accuracy (%)	P-value
Disequilibrium	67.2	0.002
Hypesthesia of face	79.3	0.466
Facial nerve paresis	70.7	0.001

Table 6. Minimum size of the tumor for symptoms to occur.

Disequilibrium		Facial nerve paresis	
x (cm)	y (cm)	x (cm)	y (cm)
6	1	5	1
5	2	5	2
5	3	5	3
4	4	5	4
3	5	5	5
2	6	4	6

x: anteroposterior diameter; y: mediolateral diameter

and hypesthesia of the face, which were 39.65% and 20.68%, respectively. The mean anteroposterior diameter was 3.8 ± 1.17 cm while the mediolateral diameter was 3.0 ± 1.01 cm.

As can be seen in Fig. 2, disequilibrium and facial nerve paresis started to occur as early as the diameter of the tumor reached 3 cm and 2 cm in anteroposterior and mediolateral diameter, respectively. On the other hand, hypesthesia of the face occurred afterward.

Correlation between size of tumor and symptoms

The correlation between the size of the tumor and symptoms that occurred was analyzed using the Spearman test. Based on Table 3 below, there was a significant positive correlation between the size of the tumor, either anteroposterior or mediolateral diameter, with disequilibrium and facial nerve paresis. In order to know whether the size of the tumor has a causal correlation with the symptoms, we analyzed the data with Binary Logistic Regression as shown in Table 4, which showed a significant correlation between the size of the tumor with disequilibrium and facial nerve paresis, either in anteroposterior or mediolateral diameter.

Based on the correlation in Table 3 and Table 4, we tried to analyze the chance to predict the onset of the symptoms (disequilibrium, hypesthesia of the face, and facial nerve paresis) due to the size of the tumor. We utilized the Omnibus test to analyze the data as shown in Table 5 below.

As can be seen in Table 5 the anteroposterior and mediolateral diameter can predict disequilibrium and facial nerve paresis significantly, about 67.2% and 70.7%, respectively. In Table 6, we can see the prediction of the minimum size of the tumor to cause disequilibrium and facial nerve paresis.

DISCUSSION

This study included 58 subjects who fulfill the inclusion criteria. Based on demography characteristics, the median age was 43 years old, with a range of 21 – 72 years old, which was not different from previous studies.^{2,5-8} Twenty-six subjects (44.8%) were male and 32 subjects (55.2%) were female. Previous literature also

reported no significant difference in sex predilection in vestibular schwannoma.^{7,9}

Among the three symptoms, the most common symptom was disequilibrium (48.27%) and was followed by facial nerve paresis (39.65%) and hypesthesia of the face (20.68%). This study has a similar result as previous studies which reported disequilibrium as the most common symptom, followed by hypesthesia of the face and facial nerve paresis.^{1,5,6} However, other studies also reported when the tumor reaches 1.5 cm in size, it would cause compression to the facial nerve, but usually asymptomatic, until hypesthesia of the face occurs first.^{1,4}

In this study, the mean anteroposterior diameter of the tumor was 3.8 ± 1.17 cm, ranging from 2.63 – 4.97 cm, mediolateral diameter of the tumor was 3.0 ± 1.01 cm, ranging from 1.99 – 4.01 cm. This result was similar to previous studies about the symptomatic tumor, like the one studied by Ocak *et al.*⁵, with results of 3.0 ± 1.12 cm, and Savardekar *et al.*⁷, with results 3.26 ± 1.6 cm. However, previous studies utilized only the maximum diameter of the tumor. Some authors, like Huang *et al.* and Schnurman *et al.*, measure vestibular schwannoma in volumetric.^{2,10}

In this study, the size of the anteroposterior and mediolateral diameter of the tumors had a significantly strong correlation with disequilibrium and facial nerve paresis. It means that bigger in size increases the chance of disequilibrium and facial nerve paresis occurrence. We also found that the symptoms started to occur when the anteroposterior and mediolateral diameter reach 3 and 2 cm, respectively.

The main limitation of this study was the retrospective nature of the data analysis, which leads to potential ascertainment bias. Besides, the limited number of patients may have precluded a firm conclusion regarding the prediction of the size of the tumor and symptoms

caused by its size. In addition, this study was not a randomized controlled trial, which is another limitation. Further studies with more cases and a control group are necessary to confirm our findings. Our results also reflected the findings in a single-center, which may not be representative of the neurosurgical cases in other large academic centers and may limit the generalizability of the data.

CONCLUSION

The sequence of the occurrence of the symptoms when the anteroposterior diameter reaches three centimeters was facial nerve paresis, disequilibrium, and hypesthesia of the face. On the other hand, once the mediolateral diameter reaches 2 cm, the sequence was disequilibrium, facial nerve paresis, and hypesthesia of the face.

Once the earliest symptom is facial nerve paresis, the chance of the growth of the tumor is more likely in an anteroposterior direction. If the earliest symptom is disequilibrium, then the tumor is more likely to grow in the mediolateral direction, in which the tumor tends to compress the cerebellum and pons.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

AUTHOR CONTRIBUTIONS

All authors contributed equally in preparing this manuscript.

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