Natural History of Acoustic Neuromas

Abstract—The growth rate of acoustic neuromas was studied in a series of 50 patients who underwent follow-up imaging studies, since surgery was not performed after the initial diagnostic study or only performed after the follow-up studies. In 50% of the cases the tumor did not grow during the length of the follow-up. In the other patients the growth was less than 50% of the original tumor size in all but four. No correlation was observed between tumor growth, length of the follow-up, and age of the patient. Our results suggest a change in the management of this benign tumor.

Few studies are available in the literature about the growth rate of acoustic neuromas.¹⁻⁹ The available data include in vivo measurements obtained on computed tomography (CT) or magnetic resonance imaging (MRI) and a recent immunohistochemical investigation using the monoclonal antibody Ki-67.¹⁰ The latter study performed on surgically removed acoustic neuromas was able to differentiate two different growth groups, one with a rate five times faster than the other.

It is the purpose of this article to review the evolution of 50 acoustic neuromas that were not treated surgically or surgery was only performed after the follow-up imaging studies. In the attempt to understand the natural history of acoustic neuroma growth, we correlated the patient's age and follow-up length to the rate of tumor growth.

MATERIAL

During the past 26 years, we diagnosed 1652 space-occupying lesions in the cerebellopontine cisterns and internal auditory canals. Owing to the belief that these tumors become progressively larger, thus making their surgical removal increasingly difficult, surgery was performed shortly after the diagnostic tests in almost all of the cases. In this series acoustic neuromas accounted for 90% of the lesions found. The remaining 10% were other extra-axial lesions, such as meningiomas, primary cholestea-

tomas, cysts of various types, facial nerve neuromas, glomus tumors, metastatic tumors, hemangiomas, aneurysms, and varices.

In 50 cases we performed one or more follow-up imaging studies since surgery was not done or was postponed after the follow-up studies. Patients ranged in age from 16 to 81 years; 30 were women and 20 were men. Since it has been suggested that age may have a bearing on the progression of the tumor, patients were divided into age groups (Table 1). Thirty-three of the patients were over 50 years of age, 12 were 30 to 50, and five were younger than 30. In five cases, stigmata of neurofibromatosis were present, such as involvement of both acoustic and other nerves, multiple meningiomas, and café-au-lait skin spots. However, in none of the five cases were skin or deep masses palpable.

The type of imaging study performed for the initial and follow-up examinations varied with the evolution of the techniques for the diagnosis of acoustic neuromas. In 15 cases, both initial and follow-up studies were Pantopaque cisternograms. In four cases the initial study was a Pantopaque cisternogram, and the follow-up study was done by CT. In seven cases, both initial and follow-up studies were CT with contrast infusion or CT pneumocisternogram, and in 19 cases both studies were MRI. In five patients, the first study was a CT pneumocisternogram, and the follow-up was done by MRI. Although multidirection tomography was often used before CT scan for the

Table 1. Age Range of 50 Cases

<i>Age (yr)</i>	<i>Number</i>
Under 30	5
30 to 50	12
50 to 70	26
Above 70	7

study of the internal auditory canals, it was not used to judge changes in tumor size.

Considering that MRI has been available for the past 5 years only, it is apparent from these data that the number of follow-up cases is disproportionately high since the advent of MRI. This is certainly due to the significant increase in the diagnosis of small tumors by MRI obtained after injection of gadolinium. In addition, referring physicians are more likely to refer patients with subtle findings for MRI and patients are more accepting of this noninvasive procedure, which does not use ionizing radiation.

Patient follow-up ranged from 8 months to 12 years. In 21 cases the follow-up was between 1 and 2 years. Sixteen patients were followed longer than 2 years and for 13 patients the follow-up was shorter than 1 year (Table 2). Cases with follow-up shorter than 8 months were not included in this study. In 18 cases two or more follow-up studies were performed.

At the time of initial study, the tumor was completely intracanalicular in 13 cases, with a cisternal component smaller than 1 cm in 17 patients, 1 to 2 cm in 15 and over 2 cm in five cases.

RESULTS

The tumor became larger in 25 of the 50 patients and did not grow during the length of the follow-up in the remaining 25 patients. In one patient, a 76-year-old woman, the tumor mass actually became smaller by involution in the follow-up study performed 6 years later.

The growth rate was classified as zero when the tumor did not grow, minimal when it was under 20% of the original tumor size, moderate when it was under 50%, and marked if it was more than 50%. In our series the rate of growth was zero in 25 patients, minimal in 12, moderate in nine, and marked in four.

Since the probability of tumor growth could increase with greater follow-up lengths, the two were correlated (Table 3). No correlation was found between tumor growth

Table 3. Growth Versus Length of Follow-up

<i>Time</i>	<i>Larger</i>	<i>No Change</i>
8–12 mo	8	5
1–2 yr	10	11
Over 2 yr	7	9

and length of follow-up. In 13 patients with the shortest follow-up time of 8 to 12 months, the lesion became larger in eight and did not change in five. However, in 16 patients with the far longer follow-up of 2 or more years, tumor growth was observed in seven and no change in size was seen in nine (Table 3). In the four cases with marked growth rate, the follow-up time was 1 year in two and more than 3 years in the other two.

In 16 of the 25 patients with no change in tumor size at the first follow-up study, additional follow-ups were performed. The time interval between the first and last follow-up studies was 9 to 12 months in three cases, 1 to 2 years in six, and 2 to 12 years in seven patients. All but three of these cases again showed no change in the tumor size.

Only two of the patients with tumor growth on the first follow-up study underwent additional follow-up examinations. One was an 81-year-old woman with a 0.6 cm tumor in the original study. A follow-up study at 18 months showed that the tumor had grown to 1 cm in diameter. At a second follow-up at 3 years, the tumor was 1.3 cm and at a third follow-up at 5 years, it was 1.6 cm. No surgery was performed because of the patient's advanced age and she died of unrelated causes. The other was a patient with neurofibromatosis and bilateral acoustic neuromas.

To verify the common belief that acoustic neuromas grow faster in young people, growth and growth rate of the tumor were correlated to the patient's age (Table 4). No correlation was found between growth of the tumor and patient's age.

In the 33 patients older than 50 years, the tumor became larger in 17 and did not change in 16. In the five patients younger than 30 the tumor became larger in two and did not change in three. The 12 patients ranging in age between 30 and 50 were equally split between further growth and no change. The rate of growth versus age of patient in the 25 cases with tumor enlargement is summarized in Table 5. The figures show an even distribution for all age groups.

Eventually, 22 of the 25 patients showing tumor

Table 2. Length of Follow-up

<i>Number</i>	<i>Follow-up</i>
13	8–12 mo
21	1–2 yr
6	2–4 yr
10	Over 4 yr

Table 4. Growth Versus Age of Patient

<i>Age (yr)</i>	<i>Larger</i>	<i>No Change</i>
Under 30	2	3
30 to 50	6	6
51 to 70	14	12
Above 70	3	4

Table 5. Rate of Growth Versus Age of Patients

Age (yr)	Minimal	Moderate	Marked
Under 30	—	1	1
30 to 50	4	2	—
51 to 70	8	5	1
Above 70	—	1	2

growth and three of the 25 cases with no change in tumor size underwent surgery, and in all cases an acoustic neuroma was found.

Of the five patients with neurofibromatosis, three showed no change in tumor size, one had marked tumor enlargement, and one had moderate enlargement during the time of follow-up, which ranged from 1 to 4 years.

DISCUSSION

Acoustic neuroma is a benign tumor of the eighth cranial nerve that is found in the cerebellopontine cistern and internal auditory canal. Although little is known about the natural history and growth rate of the tumor, most surgeons remove these lesions as soon as possible after the diagnosis is made. This aggressive approach is justified by the belief that any delay will make the surgery more difficult and complications more frequent due to progressive enlargement of the mass.

Our findings on the natural history of acoustic neuroma growth may influence treatment choices. In 50% of our cases, we observed no appreciable change in tumor size during follow-up. Of the other 50%, tumor growth was only minimal to moderate in 42%. Therefore in over 90% of our patients, the tumor growth rate ranged from none to less than 50% of the original tumor size. In our series the probability of no tumor growth far exceeded the probability of rapid tumor growth.

Our data also show no correlation between tumor growth, patient's age, and follow-up length. Our study suggests that whenever tumor growth occurs, it becomes manifest within the first follow-up year. This conclusion is also supported by the lack of further growth of the tumor in 80% of the cases with no change in tumor size on the first follow-up study. The importance of a follow-up study before 12 months cannot be overstressed.

Clearly, improvements in audiometric tests (auditory brainstem response) and diagnostic imaging studies (MRI with gadolinium) have greatly reduced the size of the tumors at the time of the initial diagnosis. During the past 5 years almost 50% of the tumors in our series were completely intracanalicular.

The previously mentioned considerations should lead to a rethinking in our approach to acoustic neuromas. When the tumor is small at the time of diagnosis (1.5 cm or less) or the patient is 60 years or older, surgery may be deferred and the patient followed by MRI. The first follow-up study should be performed at 8 months. If no change is observed, another MRI should be done at 18 months. Additional studies should be performed every 2 years. Whenever significant tumor growth is observed, surgery should be considered.

This approach seems justified by the very limited risk of rapid tumor growth in 8 months. This approach is also cost effective. According to a recent article¹¹ the hospitalization cost for the removal of an acoustic neuroma is approximately \$10,000 when there are no complications. When the surgical fees are added, the total cost reaches \$20,000. If complications develop, the charges may easily double or triple. On the other hand, the average cost of MRI with gadolinium is \$1,000. Of course, other psychology and personal factors may affect the decision of immediate surgery versus follow-up.

Although our data may provide practical management guidelines, larger series of cases with longer follow-up is necessary to reach a final conclusion about the conservative management of acoustic neuromas.

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