ORIGINAL ARTICLE

Results in the Surgical Treatment of Giant Acoustic Neuromas

Ana Inés Giordano, a, * Ivan Domènech, a, d Alberto Torres, b Javier Skufca, a, d
Angela Callejo, d Laura Palomino, a Alberto Aparicio, b Josefina Junyent, c Manuel Maños a

a Servicio Otorrinolaringología, Hospital Universitario de Bellvitge, L’Hospitalet de Llobregat, Barcelona, Spain
b Servicio Neurocirugía, Hospital Universitario de Bellvitge, L’Hospitalet de Llobregat, Barcelona, Spain
c Servicio Medicina Física y Rehabilitación, Hospital Universitario de Bellvitge, L’Hospitalet de Llobregat, Barcelona, Spain
d Servicio Otorrinolaringología, Institut Universitari USP Dexeus, Barcelona, Spain

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Abstract

Introduction and objectives: To compare the results obtained in the resection of 21 giant vestibular schwannomas via retrosigmoid (RS) and combined retrosigmoid/translabyrinthine (RS/TL) approaches with respect to intra- and postoperative complications, facial nerve preservation and post-surgical sequelae.

Methods: This was a retrospective study of 21 patients who underwent a resection of a giant vestibular neuroma according to the Tos & Thomsen Scale (greater than or equal to 4 cm) in a tertiary care centre in the period between 2000 and 2008. We present the most significant characteristics of the series studied and the analysis of the advantages and inconveniences of each approach. We also analyse the results regarding facial nerve function preservation.

Results: We highlight the absence of mortality in the 21-patient group. There were no important intraoperative complications. Total resection of the lesion was achieved in the 87% of the cases, with facial nerve preservation of 73% using the combined RS/TL approach, in comparison to 40% using the RS. Facial nerve function after two years was acceptable or good in 67% (including those with heteronerve anastomosis). A global percentage of 14.3% of cerebrospinal liquid fistula was observed, as well as 9.5% of meningitis.

Conclusions: The results of the study demonstrate that the combined retrosigmoid translabyrinthine approach for giant schwannoma treatment offers increased facial nerve preservation and lower morbidity, constituting an important option in the treatment of this kind of tumours thanks to a multidisciplinary approach.

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KEYWORDS
Acoustic neuroma;
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* Corresponding author.
E-mail address: ninesgk@hotmail.com (A.I. Giordano).

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Resultados en el tratamiento quirúrgico de los neurinomas del acústico gigantes

Resumen

Introducción y objetivos: Comparar los resultados obtenidos en la resección de 21 schwannomas vestibulares gigantes, mediante vía retrosigmoidal y combinada retrosigmoidal/translaboríntico en cuanto a complicaciones intra y postoperatorias, preservación del nervio facial y secuelas posquirúrgicas.

Métodos: Se realizó un estudio retrospectivo de 21 pacientes a los que se practicó resección de neurinoma vestibular gigante según la escala de Tos & Thomsen (igual o mayor a 4 cm), en un hospital de tercer nivel en el período entre 2000 y 2008. Se presentan las características más significativas de la serie estudiada, y se analizan las ventajas e inconvenientes de los distintos abordajes, comparando los resultados obtenidos. Asimismo, se analizan los resultados en cuanto a la preservación de la función del nervio facial.

Resultados: Destaca la ausencia de mortalidad en el grupo de 21 pacientes estudiado. No hubo complicaciones intraoperatorias importantes. Se consiguió la resección total de la lesión en el 87% de los casos, con una preservación anatómica del nervio facial del 73% en el abordaje combinado retrosigmoidal/translaboríntico, respecto a un 40% en el retrosigmoidoide. La función del nervio facial a los dos años fue aceptable o buena en un 67% (incluyendo los resultados de las anastomosis heteronerviosas). Se observó un porcentaje global del 14,3% de fístula de líquido cefalorraquideo y un 9,5% de meningitis.

Conclusiones: nuestros resultados demuestran que el abordaje combinado retrosigmoidal translaboríntico para el tratamiento de schwannomas gigantes ofrece mayor preservación del nervio facial y disminución de la morbilidad, siendo una importante opción en el tratamiento de estos tumores, gracias a un enfoque multidisciplinar.

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Introduction

Acoustic neuroma is one of the most common intracranial tumours (8%–10% according to some series) and represents up to 90% of cerebellopontine angle tumours. It can cause a wide variety of symptoms related to mass effect due to its growth, with the classic triad being tinnitus, ipsilateral hearing loss and vertigo and instability. The diagnostic study is based on an MRI scan.

The treatment of choice is surgery with curative intent, since this is a benign tumour. Although there are other alternatives, such as radiosurgery, they are only indicated in specific cases.

Surgical treatment, according to a series of conditions determined by each individual patient and tumour, may be approached by different routes (translabyrinthine, middle fossa, retrosigmoid, etc.). Surgery is not without potential risks and complications, even vital, with the main one being facial nerve injury. Facial nerve injury, as well as injury of other cranial nerves (CN) and vascular structures, is determined by tumour size. Thus, we can observe that the morbidity and mortality associated with surgery increases significantly in large and giant tumours.

There is a certain degree of controversy in the literature in relation with this type of tumour, and the surgical treatment of choice has not been fully defined.

Classically, the neurosurgical view regarding the treatment of vestibular schwannoma (VS) advocates a retrosigmoid (RS) approach. The advantages of this technique are mainly the possibility of preserving hearing, greater exposure of the cerebellopontine angle and better visualisation of the lower cranial nerves. Its disadvantages include the cerebellar retraction required and a limited exposure of the internal auditory canal.

Compared with the retrosigmoid approach, the translabyrinthine (TL) approach enables full exposure of the internal auditory canal, which facilitates early identification of the facial nerve and provides access to the cerebellopontine angle without cerebellar compression. Its disadvantages include cophosis resulting from the approach itself and reduced exposure of lower cranial nerves.

Finally, different authors in the literature advocate a combined surgical approach (TL/RS) as the best treatment option for large and giant tumours of the cerebellopontine angle, since it provides a combination of the advantages offered independently by each approach. These include a wider working area at the level of the cerebellopontine angle, which enables the surgeon to obtain a better visualisation of the tumour and adjacent neurovascular structures, facilitating the work of dissection and reducing the risk of intra- and postoperative complications.

Methods

We performed a retrospective study of patients diagnosed and treated for VS at Bellvitge University Hospital between the years 2000 and 2008. In total, we obtained a group of 124 patients, of which 21 presented a diagnosis of giant vestibular schwannoma at the time of diagnosis according to the Tos & Thomsen scale. These are defined by having a size greater than or equal to 4 cm.
All patients were diagnosed through an MRI scan and in all cases the study was complemented by a computed tomography scan of the temporal bone. Surgical treatment was indicated in all cases. The minimum follow-up period was 2 years.

We collected clinical and epidemiological data of relevance, as well as radiological and neurophysiological data of interest. We studied the surgical findings, based on the resulting complications, analysing any intraoperative and postoperative complications. We also analysed the results obtained according to the surgical approach employed (retrosigmoid transmeatal or combined transtentorial), in order to determine the advantages and disadvantages of the combined approach.

We used the program SPSS 15 to analyse the data obtained. We compared the differences between each approach using the following tests: Mann–Whitney U test in relation to tumour size, Kendall’s tau b for the resulting function of the facial nerve and Fisher’s exact test for other complications.

Out of the total 21 patients studied, the retrosigmoid transmeatal approach was used in 10, while in the remaining 11 we used a combined transtentorial approach, that is, a translabyrinthine approach associated with a retrosigmoid approach. In most cases (8 patients) we also performed section of the tentorium.

Results

Clinical and Epidemiological Characteristics

We obtained a group of 21 patients, 9 males and 12 females, aged between 24 and 69 years, with a mean age of 43.6 years. Three patients were diagnosed with type II neurofibromatosis, which represents a frequency of 14.3% within the studied series.

The mean tumour size in the RS approach was 4.52 cm (range 4.5–5.2 cm) and in the combined approach it was 4.62 cm (range 4.5–5.3 cm). The difference in tumour size between both groups was not statistically significant.

Among the most relevant clinical data, we noted hearing loss as the most frequent clinical presentation. A high percentage of cases suffered hydrocephalus. The presence of facial palsy was close to 10% at the time of diagnosis. The classic triad of presentation of VS (hearing loss, tinnitus and instability) was observed in 47.6% of patients.

The signs and symptoms, according to the percentage of appearance in the group of patients studied, are detailed in Table 1.

Surgical Complications

In relation to the analysis of surgical results, our first observations were an absence of mortality and a percentage of complete tumour resection above 85%. This was not possible in 3 cases due to tumour size, with additional radiation therapy being required in 1 case, while in the remaining 2 we opted for clinical follow-up.

Regarding intraoperative complications, there were no cases of arterial injury in any major vessels.

Postoperative Complications

Focusing on short-term complications, there were no vascular complications, bleeding or postoperative haematomas. In relation to the percentage of postoperative facial involvement, we obtained an acceptable function (House-Brackmann scale [HB] 3–4) in 28.5% of cases and poor or absent facial involvement (HB 5–6) in 71.5% of cases.

With respect to lesion of other CN, we observed 33.3% involvement of the 5th CN, 28.5% involvement of the 6th CN and 23.8% involvement of the lower CN.

A total of 13 patients suffered postoperative cerebellar syndrome (62%). The method of closure employed was hermetic suture of the dura mater associating Duraseal in the RS approach and closure with fat and sealing with fascia and temporal muscle in the combined approach. Nevertheless, 3 patients presented cerebrospinal fluid fistula, which represents a percentage of 14.3%. Of these, only 1 case required surgical repair (4.6%). Another 2 patients suffered meningitis (9.5%), which was resolved with medical treatment.

The variables studied were grouped by type of surgical approach employed. A comparison is shown in Table 2.

Preservation of the Facial Nerve and its Functionality. Sequelae

Regarding postoperative controls, all patients were monitored for at least 2 years. We assessed the presence of resulting problems, as well as the results obtained by facial nerve function reconstruction treatment.

Out of the patients who underwent intraoperative anastomosis, in 1 patient we obtained a good facial function (HB 1–2), whereas in the other 2 the resulting function was acceptable (HB 3–4). During the monitoring period we conducted a hypoglossal-facial anastomosis with major

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Table 1  Signs and Symptoms, According to the Percentage of Occurrence in the Group of Patients Studied.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoacusis</td>
<td>91%</td>
</tr>
<tr>
<td>Instability</td>
<td>81%</td>
</tr>
<tr>
<td>Tinnitus</td>
<td>61%</td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>57%</td>
</tr>
<tr>
<td>Paresthesias 5th CN</td>
<td>28%</td>
</tr>
<tr>
<td>Papilloedema</td>
<td>12%</td>
</tr>
<tr>
<td>Paresis 7th CN</td>
<td>9.5%</td>
</tr>
<tr>
<td>Paresis 9–12th CN</td>
<td>9.5%</td>
</tr>
<tr>
<td>Ataxia</td>
<td>5%</td>
</tr>
</tbody>
</table>

CN: cranial nerve(s).
auricular interposition in 7 patients, obtaining an acceptable function (HB 3–4) in 4 patients, whereas the functional outcome was poor (HB 5–6) in the remaining 3.

Overall, facial nerve function results at 2 years of monitoring were the following:

- In 19% of patients, facial nerve function was good (HB 1–2).
- In 47.5% we obtained acceptable facial function (HB 3–4).
- In 33.5% of the remaining patients we observed facial nerve involvement (HB 5–6).

Thus, overall we obtained an acceptable or good facial nerve function in 66.5% of patients.

**Other Sequelae**

Diplopia due to 6th CN lesion persisted in 1 patient, while in 6 patients we observed persistence of affected lower nerves in different forms but without representing a condition which required aggressive therapeutic measures such as tracheostomy or gastrostomy.

**Discussion**

In relation to the results obtained, our first observation was the absence of mortality in the series studied, despite being a group of patients diagnosed with giant schwannoma. Although advances in microsurgery have decreased mortality considerably, overall mortality today is around 1%, 6,7,11,13,14,16,18,21,22. Neither did we observe major neurological complications as described in the literature1,16 or postoperative complications such as haemorrhage or haematomas which required reoperation.

When analysing the percentage of tumour resection, the results in our series were highly positive, with a percentage of complete tumour resection close to 87%.

Regarding the overall facial nerve function results obtained, we observed that although at first facial nerve function was low after surgery, we subsequently obtained acceptable results (HB 3–4) in 28% of cases and poor results (HB 5–6) in 71% of cases. When we assessed the final facial nerve function resulting from surgical treatment, i.e. after 2 years follow-up, the data obtained were close to those reported in the literature. While it is clear that facial nerve function in our series was somewhat lower, we must also remember that most of these series collected large and giant tumours, i.e. 3 cm or more, whereas our study focused exclusively on giant tumours, i.e. 4 cm or more. Perhaps it would be interesting to analyse the high percentage of complete tumoural resection obtained in our series, around 87%. It could be that this is associated with a lower percentage of anatomical preservation of the facial nerve, which in our series was around 52%, certainly less than reported by most authors, who present results around 80%–85%.13,14,21,22

It is important to note the positive results obtained with facial reconstruction techniques, either intraoperative or delayed. Even with a percentage of facial nerve section close to 50%, acceptable facial nerve function results were obtained in over 60% of patients. It is worth commenting the possibility that some of the results obtained in relation to facial nerve function were based on reconstructive surgeries, advocating intraoperative termino-terminal anastomosis in the cerebellopontine angle. In our case, this provided significantly better results than deferred hypoglossal-facial anastomosis.

Overall analysis of the comparative results of the 2 approaches employed shows how, in general, the combined approach (mostly transtorial) obtained results with less morbidity. It presented an overall superior functionality of the facial nerve, as well as lower incidence of lesions to other cranial nerves, significantly highlighting the lower percentage of cerebellar syndrome. In contrast, we did observe a slightly higher percentage of cerebrospinal fluid fistula.

Going further in the comparative study, we can see that we achieved better facial nerve anatomical preservation results with the combined approach (73% compared to 40%). In turn, this resulted in a postoperative period with better functional results for the group of patients who underwent the combined approach, as shown in Table 2. This was statistically significant in terms of severe involvement (HB 5–6). This increased capacity for facial nerve dissection was determined by the better exposure of the cerebellopontine angle and its neurovascular structures provided by the technique.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Postoperative Complications According to Approach Employed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RS-TM approach</td>
</tr>
<tr>
<td>Number of cases</td>
<td>10</td>
</tr>
<tr>
<td>Paresis 7th CN (HB 1–2)</td>
<td>0</td>
</tr>
<tr>
<td>Paresis 7th CN (HB 3–4)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Paresis 7th CN (HB 5–6)</td>
<td>8 (80%)</td>
</tr>
<tr>
<td>Hypoesthesia 5th CN</td>
<td>6 (86%)</td>
</tr>
<tr>
<td>Paresis 6th CN</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>Paresis 9–12th CN</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Cerebellar syndrome</td>
<td>9 (90%)</td>
</tr>
<tr>
<td>CSF fistula</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Meningitis</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Incomplete resection</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>0</td>
</tr>
</tbody>
</table>

HB: House-Brackmann; CSF: cerebrospinal fluid; CN: cranial nerve(s); RS-TM: retrosigmoid-transmeatal.
It is important to note the difference in percentage in relation to the presence of postoperative cerebellar syndrome, which was observed in 90% of patients treated with the retrosigmoid approach. The percentage was significantly reduced in patients operated through the combined approach, not reaching 40%. This was mainly due to the sometimes excessive cerebellar retraction required in the retrosigmoid approach for a correct visualisation of the tumour and the structures of the cerebellopontine angle, and which was especially notable in the case of giant schwannomas. The larger the tumour size, the greater the retraction needs to be, hence the high percentage reflected in our series, since for small or medium tumours the cerebellar retraction required is much less. There are studies in the literature which analyse the long-term effects of cerebellar retraction in neurona surgery (retrosigmoid vs translabyrinthine) showing no significant differences for small and medium tumours.25

It is also worthy of comment that the difference in percentage of 5th CN injury was again much higher in patients who had undergone the retrosigmoid approach. However, not all such differences could be attributed to the different approaches, since some patients already suffered preoperative involvement. Nevertheless, once again the lower morbidity of the combined approach was correlated with the better anatomical exposure provided, thanks in part to the transtentorial section which was associated in most combined procedures and which improved location of the 5th CN.

In addition, the results obtained regarding the 6th CN and lower cranial nerves were worse in retrosigmoid approaches. These differences are explained by the fact that dissection through that pathway involved greater difficulty. This was because the surgical field was more limited and the visualisation of the nerves, which were notably displaced from their normal position due to the large tumoural volume, was worse than with a combined preretrosigmoid approach. The lack of complete visualisation of the surgical field (in the RS-TM approach) could be compensated with excessive cerebellar retraction using a spatula, thus justifying a higher rate of postoperative cerebellar syndrome.

Lastly, in regard to the percentage of cerebrospinal fluid fistula, overall results in our series were comparable to those in the literature.25 We observed a higher percentage for combined approaches, with this group including the only patient who required surgical treatment. In this respect the retrosigmoid approach presented better results.

Despite the clear differences in the percentages obtained in the various complications according to the approach employed, by studying the statistical analysis (P result) we could observe that they were not statistically significant (P>.05). This is probably because our series of cases was limited.

Conclusions

We performed comparative analysis in order to study the combined approach and the retrosigmoid approach for the treatment of giant schwannomas of 4cm or more. We obtained better overall results for the combined procedure (translabyrinthine-retrosigmoid, mainly transtentorial).

The percentage of facial nerve preservation and function was clearly superior. Associated surgical morbidity also decreased, presenting fewer lesions of other cranial nerves and a lower percentage of cerebellar syndrome. However, this approach requires a longer operating time and involves an increased risk of cerebrospinal fluid fistula.

In relation to the results obtained in our series, we consider the combined approach as an excellent alternative for the treatment of large VS. We value positively the multidisciplinary approach provided at our centre for the treatment of these tumours.

In addition, we stress the importance of facial nerve function reconstructive surgery, based on the results obtained in the immediate postoperative period and long-term follow-up.

Conflict of Interests

The authors have no conflicts of interest to declare.

References

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