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Surgical management of vestibular schwannoma in elderly patients

Amjad Nuseir · Giuliano Sequino · Giuseppe De Donato · Abdelkader Taibah · Mario Sanna

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Abstract This study aimed to evaluate surgical results of vestibular schwannoma in elderly patients using a retrospective study in a Quaternary Neurotology and Skull Base Referral Center setting. The data of 232 elderly patients (above 65 years) operated on for vestibular schwannoma in the period between April 1987 and July 2009 were reviewed. Most patients were operated on via translabyrinthine approach (TLA) using transapical extension for large tumors. Other approaches used were retrosigmoid, middle cranial fossa, and transcochlear. Total tumor removal was achieved in the majority of cases, while planned subtotal removal was used in specific occasions. Postoperative complications included facial nerve palsy, other cranial nerves injury, persistent instability, intracranial hemorrhage, CSF leak, meningitis, and death. Patients were followed after surgery for tumor regrowth or occurrence of complications. The results showed low rate of morbidity and mortality. Despite that complete removal is the main target of the surgery; adoption of subtotal removal in selected cases can improve postoperative facial nerve results and reduce the duration of surgery.

Keywords Vestibular schwannoma · Elderly patients · Surgical management · Acoustic neuroma

G. Sequino · G. De Donato · A. Taibah · M. Sanna (✉)
Gruppo Otologico, C/o Casa di Cura "Piacenza",
Via Emmanueli, 42, 29122 Piacenza (PC), Italy

A. Nuseir (✉)
Jordan University of Science and Technology, Irbid, Jordan
e-mail: amjadeee@yahoo.com

Introduction

The controversy of the optimal management of elderly patients with acoustic neuroma still exists despite that most articles in literature focus on conservative treatment (wait and scan protocols) in this group of patients with short life expectancy. This does not undermine the importance of surgical intervention when it is needed, particularly in cases of large tumors compressing neurovascular structures, or small tumors with severe persistent vertigo.

Elderly patients are usually defined as being 65 years or older. These patients are at higher risk for intra and post operative complications as they have less residual functional capacity due to aging or comorbidities.

In the past few decades there has been a tremendous advancement in anesthetic techniques supported by intra operative monitoring facilities, thus rendering long surgeries under general anesthesia for elderly patients more tolerable than before. Patient's fitness for surgery can be assessed using the American Society of Anesthesiologists (ASA) physical status classification system. Preoperative evaluation should include detailed medical history, physical examination, radiologic and laboratory tests for the assessment of surgical risks, and identification of any systemic deficit which should be corrected prior to surgery to reduce complication rate.

Acoustic neuroma does not show a fixed growth pattern. Despite that in most patients tumors grow with a mean of 2 mm/year, this is not always true; in many cases it may stay the same size without further growth for years. On the other hand, it may grow with double or triple the average growth rate. This makes management decision individualized, balancing between complications of operating on an elderly patient, and risks of leaving the patient with a growing tumor.

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In this article we present our experience in surgical treatment of acoustic neuroma in 232 elderly patients. To our knowledge, this is the largest series of elderly patients concentrating on surgical management of acoustic neuroma in English literature.

Methodology

In our center (Gruppo Otologico, a quaternary neurotology and skull base referral center) we have operated 2,313 cases of acoustic neuroma up to June 2010. In this study we considered 2133 patients who had been operated in the period between April 1987 and July 2009. The elderly patients (>65 years) with acoustic neuroma were 380. 144 patients were primarily followed conservatively; out of them 24 patients needed intervention later (due to rapid growth in 19 patients, and 5 patients for having neurological symptoms including persistent vertigo associated with tumor growth) making the surgical group of patients 260. Twenty-eight patients were omitted due to incomplete follow-up period which should be at least 1 year, ending with 232 patients. Patients who were continued to be treated conservatively were not included in this study.

The follow-up of patients was conducted with physical exam, magnetic resonance (MR) imaging, Pure Tone Audiometry, and Speech Discrimination Score (SDS).

Management of acoustic neuroma should take in to account the following factors: age of patient, general medical status, tumor type, involved structures, size and rate of tumor growth, hearing level and speech discrimination scale, and facial nerve functional status [1].

Our strategy in treating elderly patients with acoustic neuroma is illustrated in Fig. 1.

The primary management of acoustic neuroma in elderly patients starts with conservative wait and scan protocol [2–6]. This is done if the patient meets the following criteria:

For a small tumor size (smaller than 1.5 cm in extrameatal portion) without further growth or with a slow growth rate and without impending neurological complications, patient will have another MR imaging 8 months after the initial diagnosis, then will be scanned annually. Rapid growth or developing neurological symptoms during the follow-up period will transfer the patient into the surgical group.

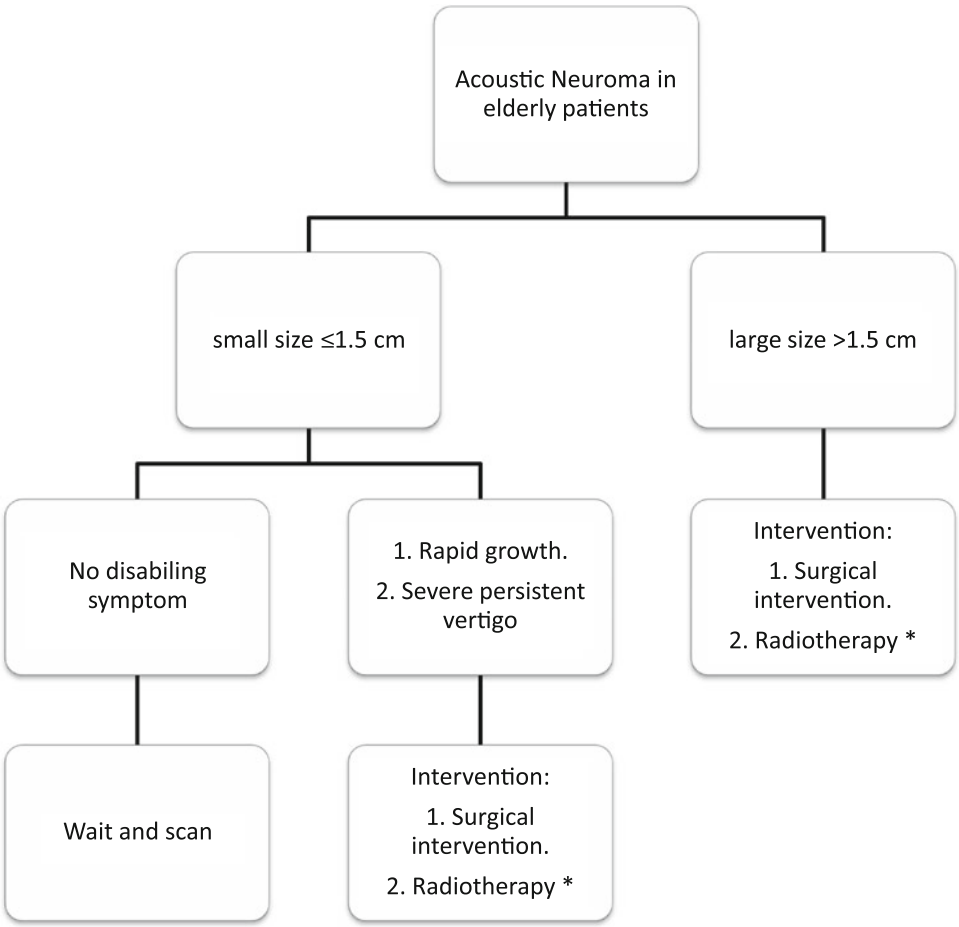

Fig. 1 Schematic drawing of Gruppo Otologico management policy for acoustic neuroma in the elderly. Gamma knife Radiotherapy is reserved for cases in which surgical management is absolutely contraindicated

It is worth mentioning that previously we used to operate on patients (regardless of tumor size) as soon as the diagnosis of acoustic neuroma was made; this attitude was changed after December 2002.

Results

Patients

This study includes 232 elderly patients who underwent surgical management for acoustic neuroma. 94 patients were males (40.5%), and 138 were females (59.5%). The age range was between 65 and 91 years with a mean of 69.5 years. The tumor was affecting the right side in 120 patients (52%) and the left side in 112 patients (48%). Most of the patients had a moderate to severe sensorineural hearing loss preoperatively.

General health status is a major concern in elderly patients preoperatively. According to ASA grading, class one includes normal healthy patients excluding very young or old patients; for this reason none of our patients was in this group. The majority of our cases were in class II (patient with mild medical illness). Some patients were in class III (patient with severe systemic disease that is not incapacitating). Only two patients were in class IV (patient with incapacitating systemic illness that is a constant threat to life). We had one patient with class V (moribund patient not expected to survive for 24 h with or without operation) who did well after the surgery.

Tumor size ranged from intrameatal up to 5 cm maximal diameter in cerebellopontine angle. According to Tokyo Consensus [7] the patients were categorized depending on tumor size as shown in Table 1.

Ten patients had hydrocephalus preoperatively; eight of them had neurological symptoms needing ventriculo-peritoneal shunting and most of them were done in other hospitals before presenting to us.

Three patients had previous interventions in other centers done via retrosigmoid approach; one of them underwent radiotherapy as well. The sizes of their residual tumors after surgery were 42, 50, and 20 mm, respectively.

Facial nerve status preoperatively was grade I except in 11 patients (Grade II in 3 patients, Grade III in 1, Grade IV in 3, and Grade VI in 4).

Hospital stay for operated patients ranged between 3 and 30 days, with an average of 6 days. Many patients were referred to rehabilitation centers after hospital discharge.

Surgical strategy

Most of the patients were operated on through translabyrinthine approach (TLA) with transapical (TA) extension (which has been developed in our center to overcome TLA limitation in large sized tumor) [8]. Other approaches were also used like retrosigmoid (2 cases), middle cranial fossa (2 cases) or transcochlear approach (2 cases, previously operated via retrosigmoid in other centers, both already presented with facial nerve grade VI, first patient had vagus nerve paralysis and the second had hemiplegia prior to our interventions).

Gross total removal was achieved in 163 cases (70.2%), pre-planned subtotal tumor removal in 61 patients (26.3%), and unplanned subtotal removal in 8 cases (3.5%).

Eight of our cases were of the cystic type which is usually characterized by their rapid growth and frequent involvement of facial nerve which makes complete tumor excision a difficult, risky task. Achieving complete tumor excision is easier in cases of central thick-walled cystic tumors. However, when peripheral thin-walled adherent cystic tumors are confronted and cysts are medially or anteriorly located, we recommend subtotal resection, leaving cyst wall over neurovascular structures. This surgical strategy allows us to improve facial nerve outcomes [9].

Planned partial tumor removal

Surgical strategy in elderly patients should be planned carefully as they are at a higher risk of intra and postoperative complications. Full assessment of the patient's health condition and possibly consulting anesthetist and cardiologist regarding patients' capability to withstand long-duration surgery under general anesthesia is recommended. Some patients are advised to have subtotal tumor removal leaving a small piece especially over the facial nerve. This policy helps in decreasing the duration of surgery and reducing life-threatening complications, at the same time preserving facial nerve function to the maximal possible grade. Elderly patients usually already have low muscle tone with atrophied muscle bulk, making facial nerve injury a dramatic noncompensable consequence. As we stated, near 30% of the patients had subtotal removal and in the majority it was pre-planned. Incomplete removal was unplanned in eight cases as decision was changed during the surgery due to risk on patient's life, or to

Table 1 Acoustic neuroma size and their frequency in our group of elderly patients

Size	Intrameatal	(0.1–1.0) cm	(1.1–2.0) cm	(2.1–3.0) cm	(3.1–4.0) cm	>4.0 cm
Number	11	48	83	65	21	4

preserve facial nerve function. Patients with subtotal removal were followed in out-patient clinic for any new growth in the residual tumor by sequential MR imaging. Only one patient needed another surgical intervention, and two patients were referred to gamma knife radiotherapy. So far, the remaining tumors did not show further growth.

Facial nerve outcomes

Facial nerve status was followed for all patients immediately after recovery, at time of discharge, and during the follow up period which extended for at least one year (the follow up period ranged from 1 to 17 years). We recorded the definitive status of the facial nerve from the last out-patient visit.

Twelve patients were eliminated from facial nerve postoperative outcome; 11 were already having facial nerve paralysis, and the 12th patient died few hours after the surgery due to pulmonary embolism.

We stratified the post operative facial nerve status of the patients according to tumor size, as illustrated in Table 2.

Table 3 shows facial nerve results for 61 patients who were scheduled for subtotal tumor removal. Four patients were eliminated from the table due to previous facial nerve palsy prior to surgery. 51 out of 57 patients (89.5%) of this group had facial nerve grade III or less post operatively.

Patients with previous facial nerve palsy were 11 and 4 of them who were grade VI remained the same after surgery. Three patients had grade IV preoperatively, two of them remained the same and 1eventually progressed to grade III. The patient with grade III had complete paralysis after surgery. Of the three patients with Grade II, 2 progressed into grade III facial paralysis while the third patient stayed with grade II.

Complications

Patients were followed for a period of at least 1 year. The follow-up protocol was through physical examination with MR imaging at the following intervals: 2 months, 1, 3, and 5 years after the surgery. The most common postoperative complication was facial nerve palsy as listed in Table 2. Hearing loss was inevitable consequence of using TLA in almost all cases; in the majority of cases, hearing level was not useful preoperatively or tumor was reaching the fundus of internal auditory canal making hearing preservation unachievable.

The other major complications are illustrated in Table 4. The majority of these complications were managed conservatively. Surgical treatment was needed in one case to stop cerebellopontine angle hemorrhage.

We had one reported case of mortality few hours after the surgery caused by pulmonary embolism.

Table 2 Facial nerve definitive outcomes in all operated elderly patients for acoustic neuroma showing the relation between tumor size and HB: House-Brackmann facial nerve grading (I–VI)

HB grade	Intrameatal	0.1–1.0 cm	1.1–2.0 cm	2.1–3.0 cm	3.1–4.0 cm	>4 cm
I	10 (91%)	29 (61.8%)	32 (41%)	27 (44.2%)	8 (38.1%)	1 (50%)
II	1 (9%)	5 (10.6%)	13 (16.7%)	8 (13.1%)	0 (0%)	0 (0%)
III	0 (0%)	11 (23.4%)	24 (30.8%)	17 (27.9%)	6 (28.6%)	0 (0%)
IV	0 (0%)	1 (2.1%)	1 (1.3%)	4 (6.6%)	2 (9.5%)	0 (0%)
V	0 (0%)	0 (0%)	3 (3.8%)	1 (1.6%)	0 (0%)	1 (50%)
VI	0 (0%)	1 (2.1%)	5 (6.4%)	4 (6.6%)	5 (23.8%)	0 (0%)
Total	11	47	78	61	21	2

Table 3 Facial nerve definitive status according to House-Brackmann grading system in pre-planned subtotal tumor removal

HB grade	Intrameatal	0.1–1.0 cm	1.1–2.0 cm	2.1–3.0 cm	3.1–4.0 cm	>4 cm	Percentage
I	0	1	6	20	7	1	35 (61.5%)
II	0	0	2	4	0	0	6 (10.5%)
III	0	1	3	4	2	0	10 (17.5%)
IV	0	0	0	1	1	0	2 (3.5%)
V	0	0	1	0	0	1	2 (3.5%)
VI	0	0	0	0	2	0	2 (3.5%)
Total	0	2	12	29	12	2	57

Table 4 Comparison between frequency of complication after surgical intervention for acoustic neuroma in our series of elderly patients and patients younger than 65 years with other articles of elderly patients' results [2, 10–20]

Complication	House [10] (1985)[a] $n = 116$	Pamela [12] (2007)[a] $n = 108$	Silverstein [21] (1993)[a] $n = 25$	Piazza [20] (1989)[a] $n = 36$	Present study $n = 232$
CSF leak	2 (1.7%)	14 (13%)	2 = 8%	3 = 8.3%	1 < 0.5%
Meningitis	7 (6%)	7 (6%)	2 = 8%	2= 5.6%	1 < 0.5%
Intracranial Hemorrhage	–	–	–	1 = 2.8%	3 = 1.3%
Hydrocephalus	3 (2.6%)	2 (1.9%)	1 = 4%	1 = 2.8%	–
Cerebrovascular Accident (CVA)	–	4 (3.7%)		–	1 < 0.5%
Ataxia	1 (0.86%)	–	2 = 8%	–	6 = 2.6%
LCN injury	–	–	–	–	3 = 1.3%
Need for further intervention (surgery or radiotherapy)	–	2 (1.9%)	5 = 14%	–	3 = 1.3%
Death	1 (0.86%)	–	1 = 4%	1 = 2.8%	1 < 0.5%

n Number of population of the study

[a] The year of publication

Discussion

In the past few decades, the importance of acoustic neuroma management in elderly patients has gained more attention after the increment in the numbers of these patients; this was a result of the advancement of diagnostic radiologic techniques and the improvement of health care system which led to an increase in the median age of population with better health status correlated to age in comparison with persons with the same age in previous periods.

Early surgical treatment for asymptomatic patients while their tumors are small in size may result in lower rate of complications and a higher chance to preserve hearing in some cases [10]. On the other hand, the risks of operating on elderly patients with short life expectancy should be taken in account, and also the effect of complications on the life quality of these patients with low functional capacity should be borne in mind. Balancing the above two opinions may lead to a higher tendency for watchful observation as these tumors have slow growth rate (<0.2 cm/year) in more than 80% of cases [2, 11], making this choice safe and cost effective for asymptomatic patients. One of the drawbacks of this conservative management is the psychological impact on observed patients, as leaving a growing tumor inside skull without intervention will put some patients in continuous stress, affecting their quality of life; on the other extreme, other patients may have a false impression that no intervention means unimportant disease, thus leading to loss of follow-up as documented in some studies [12, 13].

We used to operate on patients with acoustic tumors as soon as the diagnosis was confirmed; for this reason we had operated many cases with intrameatal tumors. This attitude was modified with time to follow the regulations illustrated in Fig. 1.

When active management is indicated according to the criteria stated above (Fig. 1) gamma knife radiotherapy will be an option, especially for patients who are poor surgical candidates. This modality of treatment usually results in a better quality of life when compared with surgical intervention or conservative treatment, especially when talking about postoperative facial nerve function and hearing results [14, 15]. Despite that, gamma knife has a strong opposition, especially in centers with good surgical experience in achieving complete removal. One of the objections is the risk of malignant transformation which is documented in literature [16, 17]. Other objections are related to complications like intracranial edema, effect on hearing, and most importantly the resulting adhesions between tumor and intracranial structures with loss of surgical landmarks and dissection plane leading to high risk of morbidity and mortality when further surgical intervention is needed.

The third modality of treatment which is our subject in this study is microsurgical intervention. The main goal of surgery is total tumor excision when it is possible. In our center we use translabyrinthine approach when the tumor size is larger than 1.5 cm in extra meatal diameter, tumor reaching internal auditory canal fundus, or having poor hearing level worse than modified Sanna class B2 [7]. Our modality of transapical extension enables tumor removal via enlarged translabyrinthine approach (TLA) for large size tumors [18].

Complete tumor removal was achieved in more than 70% of cases. Subtotal removal was planned to decrease the duration of the surgical procedure with preservation of the maximum possible facial nerve function and reduce the

rate of other complications. Partial removal did not show significant increase in the rate of tumor growth postoperatively, as stated by Rosenberg et al. [11] and shown by our published results [9].

Facial nerve preservation in most elderly patients is a challenging task due to their tendency of having atherosclerotic process in feeding vessels leading to low blood perfusion to the affected area, and decreasing tissue regeneration ability. The risk of facial nerve injury is higher with the increase in tumor size. Facial nerve injury was reduced by doing a planned subtotal removal leaving a small fragment that cannot be separated from the facial nerve. In this group, facial nerve function was satisfactory with HB grades (I–III) in 89.3%.

In our series we had a very low incidence of CSF leak and meningitis (<0.5%). Three of our patients had postoperative intracranial hemorrhage; one of them needed surgical intervention. Six patients had prolonged ataxia which resolved spontaneously. We did not have cases of hydrocephalus. Out of 232 patients, only three patients needed further intervention during the follow-up period (1 needed revision surgery, 2 referred for gamma knife radiotherapy due to tumor regrowth after subtotal excision). A 70-year-old patient with a 2 cm acoustic tumor died few hours after the surgery due to pulmonary embolism.

Table 4 shows a revision of major complication rates from different articles about surgical management of acoustic neuroma in elderly. The difference in complication rates between one study and another may be due to differences of patients' physical fitness preoperatively, differences in the sizes and sites of the tumors or differences in the surgical experience.

Conclusion

The number of elderly patients diagnosed with acoustic neuroma needing surgical intervention is increasing. Management of acoustic neuroma is started with wait and scan protocol in asymptomatic small tumors; patients are switched to surgical treatment when tumor starts to grow rapidly causing neurological complications as clarified in Fig. 1.

As Samii et al. had stated [19], "the general medical status and not the chronological age that affects the surgical outcome". Surgical management of acoustic neuroma in elderly patients done by experienced surgeons can carry good results with low incidence of complications. Wise decision of pre-planned subtotal tumor removal in selected cases can decrease the risk of injury for neurovascular structures.

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Conflicts of interest None.

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