ORIGINAL ARTICLE

Radiosurgery for Vestibular Schwannomas

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Background: Radiosurgery has been established as an important alternative to microsurgery. We report our experience with radiosurgery for tumor control and the complications of unilateral vestibular schwannomas.

Methods: We reviewed our early experience regarding clinical presentation, management and outcomes in 45 patients with acoustic schwannomas who underwent gamma knife stereotactic radiosurgery. The median follow-up period was 25 months (range, 6–48 months). Thirteen patients had undergone 1 or more previous resections before radiosurgery; 32 underwent radiosurgery as the first procedure. Median tumor volume was 4.5 mL (range, 0.5–30.0), and median radiotherapy dose was 11.5 Gy (range, 10.5–14.0 Gy).

Results: Tumor control was achieved in 43 patients (95.6%). Loss of central contrast enhancement was a characteristic change and was noted in 29 patients (64.4%). Reduction in tumor size was shown in 15 patients (33.3%). Thirteen patients (28.9%) had good or serviceable hearing preoperatively, and in all of these, the preoperative status was retained immediately after radiosurgery. At follow-up, however, 10 patients (76.9%) had preserved hearing and 3 (23.1%) had reduced hearing on the treated side. Hearing in 1 patient that was not serviceable preoperatively later improved to a serviceable level. No patients had delayed facial palsy or lower cranial nerve dysfunction, but one had delayed trigeminal sensory loss.

Conclusion: Radiosurgery achieved a high tumor control rate and a relatively low post-radiosurgical complication rate for acoustic neuromas. [*J Chin Med Assoc* 2005;68(7):315–320]

Key Words: brain tumor, radiosurgery, schwannoma

Introduction

Surgical excision is generally considered the preferred treatment for unilateral acoustic neuromas in healthy, non-elderly patients who have useful hearing in the contralateral ear.[1] The location and relationship of such neuromas to neurovascular structures, and adherence to the brain stem or cranial base, pose challenges for preserving cranial nerve function, and render complete surgical resection difficult in some cases. Resection is frequently associated with the development of new neurologic deficits.[1–3]

The clinical application of stereotactic radiosurgery began in Sweden in 1967,[4] and the first patient with acoustic neuroma was treated in 1969.[5] Since then, major improvements in the accuracy and efficiency of stereotactic radiosurgery have resulted from combination of the procedure with advanced high-resolution imaging techniques such as magnetic resonance imaging (MRI).[6,7] In this report, we analyze the preliminary results from 45 patients who underwent radiosurgery as management for newly diagnosed or recurrent acoustic schwannoma.

Methods

Patient population

During a 4-year period, 45 patients with unilateral acoustic schwannomas underwent stereotactic radiosurgery with a 201-source, cobalt-60 gamma knife. Thirteen patients had undergone 1–3 (mean,

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l.4) previous surgical resections. Thirty-two patients underwent radiosurgery on the basis of clinical findings and imaging criteria. Tumors in these patients were found along the course of the acoustic nerve, and had the characteristics of vestibular schwannowa or acoustic neuroma (cerebello-pontine angle location, and tail extending into the internal acoustic meatus). In these patients, radiosurgery was performed for 1 of the following reasons: 1) the patient had little neurologic deficit; 2) the patient was elderly or declined to undergo microsurgical resection; or 3) the patient had residual or recurrent tumors after surgical excision. Patient age ranged from 24 to 82 years (mean, 55 years).

Preoperative assessment

All patients had a detailed history taken, underwent a physical examination, and preoperative high-resolution MRI. All patients were evaluated with pure-tone audiograms. Preoperative and postoperative hearing was classified according to the system of Gardner and Robertson,[8] a modification of the Silverstein and Norrell classification system, as shown in Table 1.

Radiosurgical technique

In all 45 patients, a Leksell Model G stereotactic coordinate frame (Elekta Instruments, Atlanta, GA, USA) was applied to the head, under local anesthesia supplemented with mild oral or intravenous sedation. A high-resolution, contrast-enhanced MRI scan was performed to localize the target tumor. Multiple isocenter computer dose planning was completed using the GammaPlan® dose-planning system (Elekta Instruments). Median tumor volume was 4.5 mL (range, 0.5–30.0 mL), and mean maximum tumor dose was 23 Gy (range, 22–28 Gy). Median tumor-margin dose was 11.5 Gy (range, 10.5–14.0 Gy) (Figure 1).

The margin dose was the dose selected to cover the contrast-enhanced tumor margin, using the conformal dose-planning technique. This dose served to cover 100% of the target volume. Using MRI, we found that irregularities in tumor shape could be readily identified, and greater numbers of isocenters were used to obtain conformal irradiation. In 41 patients, the 50% isodose line was targeted to the tumor margin, and in 4 patients, the 55% isodose line was targeted to the tumor margin. The mean number of isocenters per patient was 14 (range, 3–29). The dose selected was based on tumor volume, although as low a dose as possible was selected. Tumor location and the projected radiobiologic risk to the adjacent brain stem and cranial nerves were considered during dose planning. Immediately after radiosurgery, all patients were given a single intravenous dose of methylprednisolone 40 mg. All patients were discharged within 24 hours.

Postoperative evaluation

Follow-up ranged from 6 to 48 months (median, 25 months). Our protocol for post-radiosurgical assessment included serial clinical examinations and MRI scans at 3, 6 and 12 months during the first year, and every 6 months thereafter. In patients with grade IV or better hearing preoperatively, a pure-tone audiogram was requested at the same intervals.

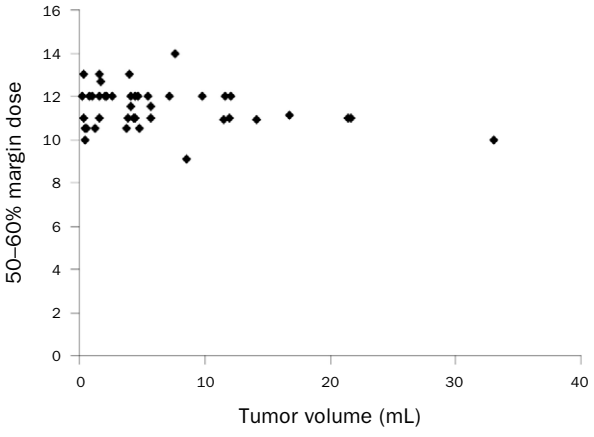

Figure 1. Scatter plot of tumor volume versus tumor-margin dose for radiosurgery in 45 patients with acoustic neuromas.

Table 1. Hearing classification in 45 patients with acoustic neuromas

Class description	Pure tone average (dB)	Speech discrimination score (%)	Number of tumors	
			Preoperative	Postoperative
I	0–30	70–100	4	3
II	31–50	50–69	9	8
III	51–90	5–49	10	12
IV	91–maximum	1–4	8	8
V	None detectable	0	14	14