Case Report

Can Gamma Knife Radiosurgery be an Alternative Treatment Modality to Surgery for Vestibular Schwannomas?: A Case Report with Critical Review of the Literature

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Abstract

Development of more sophisticated magnetic resonance imaging scans, the chances of finding asymptomatic patients with vestibular schwannomas as with other intracranial pathologies are increasing.

Gamma Knife radiosurgery for vestibular schwannomas has been documented as an efficient and safe procedure based on the treatments in worldwide literature. Preservation of hearing, but not tinnitus, is currently achieved by this minimal-invasive, alternative treatment method.

A 55 year-old female patient had applied with complaints of intractable tinnitus and hearing loss on her left ear for six months. Audiologic examination of the patient had revealed a severe degree sensorineural hearing loss on left ear (Average air threshold level: 78 dB, average bone threshold level: 68 dB). Then, magnetic resonance imaging with contrast agent was performed to the patient to detect any suspected lesion. On magnetic resonance imaging, the dimensions of the mass were detected as 15x17x16 mm at the left pontocerebellar angle that was compatible with vestibular schwannoma. Gamma knife radiosurgery was applied to the vestibular schwannoma in a referred center. A single-shot with a MRI-targeted dose (Leksell Gamma Knife, Model B, Gamma Plan 8.32) was applied as 12.5 Gy for 50% (range 42-50%) isodose field (maximal dose: 25 Gy) to cover at least 92% of the lesion.

In this paper, we discuss the effectiveness and outcomes of gamma knife radiosurgery, introduced recent few decades as a therapeutic method, with review of the literature for vestibular schwannoma’s management with this case.

INTRODUCTION

Annually incidence of clinically diagnosed vestibular schwannoma is nearly 1/100000 for the U.S. population [1]. Vestibular schwannomas are primarily benign, slowly growing lesions. In early stage of the disease, usually a complaint of tinnitus followed by a gradual sensorineural hearing loss can be seen with tumor enlargement. Other clinical symptoms are dizziness, facial nerve hypo function and other cranial nerve findings.

The management of the disease is usually surgical. There are some surgical management methods (translabyrinth, retrosigmoid, transcochlear, etc.) with considerably high surgical morbidities, which are designed to patient’s disease-related medical state such as hearing threshold, tumor size, facial nerve function, and general-health status of the patient.

Gamma Knife Radio surgery (GKS) is an alternative treatment method to surgical treatment of vestibular schwannoma, which was firstly used in 1969 [2]. From that time, GSK were used with dramatically increasing rate as an alternative treatment method.
with lower morbidity results compared to surgical treatment. It can be considered mainly for patients who decline surgical treatment, having unfavorable general-health status for general anesthesia and vestibular schwannoma on the only-hearing-ear.

Herein, we present a patient with left vestibular schwannoma, who underwent GKS as a curative management in a referred center because of the patient’s declining the surgery. It is discussed the effectiveness and outcomes of GKS as an alternative therapeutic method to surgery for vestibular schwannoma with review of the literature.

CASE PRESENTATION

A 55 year-old female patient had applied with complaints of intractable tinnitus and hearing loss on her left ear for six months. Pure tone audiologic examination of the patient revealed a severe degree sensorineural hearing loss on the left ear (pure tone threshold averages of 0.5 kHz, 1 kHz and 2 kHz were as following: air threshold level: 78 dB and bone threshold level: 68 dB). Then, magnetic resonance imaging (MRI) with intravenous contrast agent was performed to the patient to disclose a suspected intracranial lesion. On MRI, a mass with dimensions of 15x17x16 mm, which was contrast enhanced lesion at the left pontocerebellar angle compatible with vestibular schwannoma, was detected (Figure 1). In a referred center, gamma knife radio surgery was applied as 12.5 Gy for 50 % isodose field (maximal dose: 25 Gy) to the left pontocerebellar angle. A follow-up period of three months interval was planned for the patient in our clinic.

Nine months after the GKS protocol, pure tone threshold averages of 0.5 kHz, 1 kHz and 2 kHz were 85 dB for air conduction and 68 dB for bone conduction. It was slightly worse before GKS, but she was not aware of that. On MRI, the tumor size more or less was similar in dimensions, 17.6 mm in larger dimension, when it was compared with preoperative MRI findings (Figure 2). With a follow-up period of nearly two years; the tumor control had been achieved by this treatment, and hearing thresholds remained nearly stable.

DISCUSSION AND CONCLUSION

Although vestibular schwannoma is a slowly growing lesion contrast agent was performed to the patient to disclose a suspected intracranial lesion. On MRI, a mass with dimensions of 15x17x16 mm, which was contrast enhanced lesion at the left pontocerebellar angle compatible with vestibular schwannoma, was detected (Figure 1). In a referred center, gamma knife radio surgery was applied as 12.5 Gy for 50 % isodose field (maximal dose: 25 Gy) to the left pontocerebellar angle. A follow-up period of three months interval was planned for the patient in our clinic.

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**DISCUSSION AND CONCLUSION**

Although vestibular schwannoma is a slowly growing lesion
with benign character, enhancement of the tumor size can lead to hearing loss, facial and other cranial nerve disturbances and intracranial complications, which are potentially life threatening clinical situations.

Microsurgical treatment of vestibular schwannoma with a large number of patients was retrospectively analyzed in a study regarding with surgical complications [3]. The main postoperative neurologic complication was facial nerve dysfunction with a rate of 45% (124/333) in the follow-up period. Other mentioned neurologic complications were disordered vestibular compensation (13%), permanent trigeminal nerve dysfunction (1%), and transient other cranial nerve deficits (6%). Besides, the main non-neurologic complication was cerebrospinal fluid (CSF) leakage (63%), which was also the most frequent detected complication. Additionally, headache (9%) and intracerebral hemorrhage (5%) were the other nonneurologic complications. The complication rates were compatible with the literature except CSF leakage. They concluded that there were still important surgical complications related with microsurgery for vestibular schwannoma, even though, the improvement of fine surgical instruments and high-technique equipments.

Early detection for surgical treatment of the disease is important to protect hearing and other cranial nerve disturbances. However, surgery also has the potential complications to these vital organs itself. GKS has been used in an increasing number of patients, becoming an alternative treatment method to the microsurgery for the last few decades, in the management of vestibular schwannomas.

According to a prospective study that compared microsurgical outcomes of VS to GKS performed by Myrseth E et al. concluded that GKS had better outcomes related with facial nerve function and hearing preservation than open surgery in small and medium-sized VS [4]. Additionally, Delbrouck et al. has presented a large VS case series managed with GKS that was focused on serviceable hearing preservation. They showed that 95 patients out of 144 (nearly 66%) had preserved hearing results after the GKS procedure in a minimum one-year follow-up period [5].

Hasegawa et al. has reported the results of 10-year follow up of 73 patients who had undergone GKS for vestibular schwannoma [6]. They showed effectiveness of GSK in the majority of these patients with a long follow-up period of more than 10 years after the GKS procedure. They detected no malignant transformation or recurrence during the follow up period in their study. Nevertheless, they also reported that no patient had improved hearing results after the management.

In a recently published study, Bir et al. presented 82 vestibular schwannoma patients who underwent GKS as a primary therapeutic method as well as an adjunct therapy with a long-term follow-up period [7]. They managed 20 patients with GKS as an adjunct therapy prior to resection, and rest of the patients (62) treated with only GKS as a primary therapeutic method. They found that in 8 patients (10%) progression of tumor size and overall the disease improvement-free survival rates at 3rd, 5th and 10th years of the procedure were 98%, 95% and 95%, respectively. As a striking point, they stated that hearing, facial nerve function and performance scale of patients improved in patients with primary GKS procedure, 79 vs 90, when it was compared with previously managed GKS patients’ group. They concluded that GKS procedure was a favorable treatment method for vestibular schwannoma.

Yang et al. presented GKS treatment results of large vestibular schwannomas that were between 3 and 4 cm in maximum diameter with a long-term follow-up period [8]. In 6 months, 5 patients out of 65 (8%) showed slight tumor enlargement on MRI while most of them (82%, 53/65) remained stable in tumor size. In long-term follow-up, mean 36 months period, only 7 patients underwent tumor resection due to tumor improvement, and progressive symptoms. They also stated that 18 (82%) patient out of 22 who had serviceable hearing before GKS still had serviceable hearing results more than 2 years after the treatment. They concluded that patients with tumor size of less than 4 cm can be managed satisfactorily with GKS procedure.

Mindermann T and Schlegel I presented a large case series in a number of 235 patients with a various Koos grades [9]. In a medium follow-up time of 3.5 years, they found that tumor progression rates for Koos grade 1, 2, 3, and 4 were 3.1%, 9.8%, 8.6% and 11.3%, respectively. There was no statistically significant difference between the groups. GKS seems also an effective management method even in Koos grade 4 tumors. Additionally, they mentioned that tumors larger than 6 cc are not eligible for GKS. Our case is compatible with Koos grade 2. In another study, Mindermann T and Schlegel I showed that only 7% of 235 patients progressed, and underwent microsurgery or repeated radiosurgery in a medium follow-up time period of 3.4 years [10].

Paek et al. has presented 25 patients who were treated with GKS for unilateral sporadic vestibular schwannoma with a hearing threshold of < 50-dB pure tone average (PTA) and speech discrimination score (SDS) of > 50% [2]. The tumor average size of all patients was < 3 cm in maximum diameter. They reported that only one- half of the patients had favorable hearing preservation after low dose GKS protocol. They also had asserted that hearing deterioration after the first six months of GKS treatment were vulnerable to failure of hearing protection. Hearing loss got worsen a slightly in our case 9 months after GKS, which can be attributed to patient’s high level sensorineural hearing loss before the procedure.

In a study of 86 patients with unilateral vestibular schwannoma underwent GKS as a treatment method was evaluated with a serial Magnetic Resonance Imaging (MRI) to provide information for the clinical management of these tumors [11]. They divided the patients to four subgroups according to MR imagination results that are related with tumor size during the follow up: 1- initial enlargement followed by sustained regression, 2- no change, or sustained regression, 3- repeated alternate enlargement and regression and 4- continuous enlargement. They found that most of the cases were belong to the subgroup 1 and 2. They had concluded that most of the tumors showed temporary enlargement and reach to maximum size within one year and regressed within 2 years. In our case, the tumor size was similar in a period of nearly 21 months, and it was compatible with group 2. Nevertheless, it is early to make a certain decision.
Although, there are a lot of studies that show satisfying results of GKS management of vestibular schwannomas, there are also a few cases with undesirable results regarding with GKS management in the literature [12, 13]. A patient managed with GKS for a right-sided acoustic tumor, and he developed vomiting, facial weakness, tinnitus and hearing loss at right ear after two days [12]. Right facial nerve functions improved but hearing loss remained unchanged after eight months. In other case, a patient who had underwent GKS for vestibular schwannoma had a tumor with sustained involution for 7.5 years after the procedure. Then patient showed acute neurologic deterioration and enlargement of a mass on MR imagination. The histopathologic examination of mass after surgical resection was undifferentiated high-grade pleomorphic sarcoma, which was a result of malignant degeneration of a neoplasm following GKS [13]. Long-term risk for radiation-induced tumor, requires a time period of 5-30 years, is estimated less than 1 per 1000, which is lower than the perioperative mortality risk of surgical resection of a benign tumor (1 per 100) [14].

In conclusion; GKS as a minimally invasive procedure can be used with success in selected patients. Even though GKS has been used in the treatment of vestibular schwannomas only for a few decades, the case numbers are rapidly increasing in numbers recently. It seems having favorable results in the majority of patients, approximately 90%, according to current literature (Table 1). There are only a few cases with undesirable complications that have been presented in the literature. On the other hand, it needs results of much more patients with a longer follow-up period for the possible unknown complications that may need long time for emerging after the treatment. Overall, we agree about usage and its usefulness of GKS in selected patients.

REFERENCES


