

GAMMA-KNIFE: RADIOSURGERY IN GREECE EFFICIENCY OF THE METHOD FOR PATIENTS WITH VESTIBULAR SCHWANNOMAS (CLINICAL ASSESSMENT)

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Vestibular schwannomas are histologically benign tumours which arise from the Schwann cells in the acoustic division of the 8th cranial nerve. It is important to distribute the lowest possible dose during the "visual" route of the facial nerve around the ventricular part of the tumour, as the latter is located at the pontomedullary junction on the anterior margin of the internal auditory duct. We can note that using doses of gamma irradiation we can satisfactorily control the volume of the lesion, as is confirmed by the patients' bi-annually follow-up appointments while there is a low percentage of adverse events that involve the cranial nerves.

Keywords: Gamma-Knife, radiosurgery, vestibular schwannomas

INTRODUCTION

Based on the findings of gamma-knife radiosurgery performed at HYGEIA Hospital to treat patients with vestibular schwannomas, we can present the clinical and neuro-otological behaviour of these space-occupying lesions in 79 patients within a two-year follow-up period after treatment.

PRESENTATION

Vestibular schwannomas are histologically benign tumours which arise from the Schwann cells in the acoustic division of the 8th cranial nerve. Thanks to the latest technological advancements in neuro-imaging methods and neurophysiological techniques, there is an increase in incidence rate of vestibular schwannoma patients in the general population.

Nevertheless, despite these new techniques (monitoring of the 8th cranial nerve, evoked acoustic potentials during microsurgical procedure), the operation cannot eliminate morbidity and mortality. Based on the features of the tumour, we can apply several types of treatments beyond the conventional surgical approach. One of these non-invasive

techniques to treat vestibular schwannomas is radiosurgery using gamma radiation (photons) or "gamma-knife", as it is more widely known.

This study describes the findings of radiosurgery in patients with vestibular schwannomas who have been treated over the last four years at the gamma-knife unit of HYGEIA Hospital.

MATERIAL AND METHOD

Over the last four years, 79 cases of vestibular schwannomas have been treated at the gamma-knife unit of HYGEIA Hospital. Of these patients, 23 had already undergone a surgical operation and afterwards they chose to use this method as a supplementary treatment of the residual lesion. There are available audiograms performed upon 18 patients within two years after treatment while audiograms for other patients are still pending. Of the 79 patients who underwent the treatment, one passed away within four years after treatment (due to pre-existing heart problems), four patients lost to follow-up and have not reported on the response of the lesion to the gamma-

knife radiation, while twelve patients have not provided a pre-operation audiogram as requested before the treatment.

Two of the patients said that "their life quality deteriorated after the treatment", and one of them has also reported deterioration in hearing.

To analyze the effect of radiation, patients were recommended to comply with a follow-up schedule that included appointments on months 6, 12, 18, 24 after gamma-knife treatment and provide medical reports of recent brain MRI and audiogram. The objective of the follow-up was to be monitoring the vestibular schwannoma volume and any change in hearing acuity obtained through gamma-knife treatment. The used Gy dose and the isodose curve of radiation were also measured in terms of their effect on the progress of vestibular schwannomas.

The mean age distribution was 55 years (range 27 - 74 years). Of the 79 patients, 9 had intracanalicular tumours only, 19 had both intracanalicular and cisternal tumours, and 51 had simple tumours in the pontocerebellar cistern. The mean volume (Mv) was 4,79 cm³ (range 0.20-19.3 cm³).

FEATURES OF THE GAMMA-KNIFE TREATMENT

Gamma-knife radiosurgery utilises the following four principles:

(I) Locate the "target" using neuro-imaging techniques with a stereotactic head frame and a computer to record and edit data,

(II) Determine the volume (V) of the lesion.

(III) Determine distribution of radiation dose and finally

(IV) Treat using photons.

During the treatment, the mean isodose curve used was 48,2 % ranged between 40% - 54 %.

It is very important to locate the target and thus exclude significant brain structures from gamma-radiation, such as the cranial nerves surrounding the tumour, the cerebellum and of course the brain stem. At this point we should note that when defining important brain structures the facial nerve constitutes a major problem, mainly because it can be dislocated by the lesion (facial paresis is a common complication of

the surgical treatment). Consequently, when using neuro-imaging techniques, we should mainly be concerned about protecting the facial nerve and preventing complications that may be caused by radiation. For this, it is important to distribute the lowest possible dose during the "visual" route of the facial nerve around the ventricular part of the tumour, as the latter is located at the pontomedullary junction on the anterior margin of the internal auditory duct.

During the treatment, the mean dose was 12,09 Gy (range 11 - 14 Gy) and the mean maximum dose was 19,83 Gy (range 20,5Gy – 29,9 Gy). The mean volume of the radiated schwannomas was 4,72 cm³ (range 0.2 cm³ -19.3 cm³).

To follow the international literature and to protect non-defined segments of the facial and trigeminal nerves that may be included in the lesion area, we administered to these areas doses that did not exceed 13 and 15 Gy, respectively, while the dose administered to 2 patients having a tumour with a space-occupying effect on the brain stem did not exceed 10 Gy. All patients responded well to the treatment and all of them discharged from the hospital the next morning after the end of the treatment. No one reported problems, such as epileptic attacks during their hospitalization, while severe headache was reported by 12 patients as the only adverse event, probably due to the stereotactic frame. To treat headaches, analgesic medication was administered for a short time period (2-3 days) and after discharge.

FOLLOW-UP AND CLINICAL ASSESSMENT

With the exception of one case, all patients had an MRI test within six months after treatment. Six of them did not attend follow-up appointments of Month 12 and eleven of them did not undergo an audiogram within the two-year period (reporting as an excuse that they had fully regained their hearing). The rest of them have not yet completed two years since the gamma-knife treatment.

The clinical assessment included:

A) Hearing evaluation

B) Effect of radiation on the surrounding cranial nerves.

Based on these facts, we evaluated the progress of the patients' life quality depending on how they appreciated it after the gamma-knife treatment. We also asked them whether the treatment was worth it.

RESULTS

The mean follow-up period was 24 months (1-51 months). 84.2% of the patients provided at least the first MRI (at the 6-month follow-up appointment).

FUNCTIONALITY OF THE SURROUNDING CRANIAL NERVES

No one of our patients who underwent gamma-knife surgery as their first choice for treating their vestibular schwannoma developed any functional disturbances of the facial nerve or sensory disturbances of the trigeminal nerve immediately after treatment or later during the follow-up period. Patients who had developed a House-Brackmann grade III-IV facial paresis before radiosurgery did not show any significant change.

CHANGES IN HEARING

Most of the patients who underwent radiosurgery using a gamma-knife system have not reported any significant change in the hearing acuity they had before treatment although we should take into account that most of them did not comply with the follow-up and audiogram schedule, despite repeated recommendation. Nevertheless, those who provided pre- and post-treatment audiograms (only patients who belonged to Gardner-Robertson scale class I and II were evaluated) showed improvement in hearing ("gain" in dB) until their second follow-up appointment both at 2 KHz and 4 KHz, from 5 to 45 dB and from 4 to 20 dB, respectively. Only one woman patient showed a 10 dB decrease in hearing acuity at 2 KHz at the 12-month follow-up.

CHANGES IN CLINICAL STATE

Most of the patients, who underwent gamma-knife treatment and developed neurological symptoms before radiosurgery, say that they experienced

improvement or even complete regression of symptoms (nausea, dizziness, tinnitus, drowsiness etc.) Only one woman patient reported deterioration of symptoms and 3 other patients did not report any significant change of symptoms.

CONCLUSION

As a conclusion of this study on vestibular schwannoma cases treated at HYGEIA Hospital, we can note that using doses of gamma irradiation as low as those firstly applied at Karolinska and Pittsburgh institutes (lower than those used when the treatment was initially applied at hospitals on abroad), we can satisfactorily control the volume of the lesion, as is confirmed by the patients' bi-annually follow-up appointments while there is a low percentage of adverse events that involve the cranial nerves. Using stereotactic MRI imaging and a schedule of multiple doses seems to mainly contribute to this outcome. According to the international bibliography, the method may fail if the doctor chooses not to partially exclude lesions located within the upper size limit of the treated area. The "acoustic gain" in dB is also a notable point of interest, although most patients cannot perceive it as a significant change in their hearing.

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