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Editorial

Role of Stereotactic Radiosurgery in the Management of Cerebellopontine Angle Tumors

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Editorial

Tumors of the Cerebellopontine Angle (CPA) comprise 10-15% of all intracranial neoplasms [1]. Of all CPA tumors, 80-94% is vestibular schwannomas, 3-10% is meningiomas, and 2-4% is epidermoid cysts [2,3]. Depending on patient demographics and medical comorbidities, tumor characteristics, and neurological function, the management of CPA tumors may include observation, Stereotactic Radiosurgery (SRS), microsurgical resection, or a combination of SRS and microsurgery. The goals of the following discussion are to [1] examine the tumor control and complication rates of SRS for CPA tumors and [2] to define the indications for SRS in the management of CPA tumors.

Vestibular schwannomas are typically benign, slow-growing tumors. The goal of any intervention is to maximize tumor control while limiting damage to the nearby cranial nerves, brainstem, vascular structures, and cochlea. Gamma Knife Radiosurgery (GKRS) has been shown to provide excellent tumor control for vestibular schwannomas, with rates upwards of 97% at 10 years post-treatment [4]. There have been several single-center studies using various radiosurgical modalities and hearing assessment protocols for vestibular schwannomas, and these have reported a wide range of hearing preservation rates. In a systematic review of 4,234 patients harboring vestibular schwannomas that were treated with GKRS, Yang et al. reported an overall hearing preservation rate of 51% [5]. In another systematic review, Yang et al. reported overall facial nerve preservation rates of 96% in 2,204 patients treated with GKRS [6]. Both of these reviews demonstrated improved cranial nerve preservation with radiation doses less than 13 Gy. Younger patient age and smaller tumor size were good prognostic indicators for facial nerve preservation but not for hearing preservation.

Kano et al. reported a study of 77 patients with vestibular schwannomas and serviceable hearing who underwent GKRS [7]. The authors demonstrated that 89% of patients with Gardner-Robertson (GR) Class I hearing had hearing preservation, compared to the 71% overall hearing preservation found in GR Class I and II patients. Intracanalicular tumor location and smaller radiation doses to the cochlea were good prognostic indicators for hearing preservation. Sughrue et al. performed a prospective study demonstrating more rapid hearing loss in patients with vestibular schwannomas growing more than 2.5 mm/year [8]. With regard tonon-audiofacial morbidity, Sughrue et al. performed a systematic analysis of 5,631 patients treated with GKRS and found an incidence of 2.4% [9]. These symptoms included vestibular dysfunction, trigeminal neuropathy, and hydrocephalus, allof which were more frequent with higher radiosurgical doses. Clinical studies by Williams et al. and Yang et al., which utilized GKRS for the treatment of large vestibular schwannomas (diameter greater than 3 cm), revealed worse tumor control rates and higher patient morbidity as compared to small tumors (diameter 3 cm or less) [10,11]. Based on the aforementioned studies, neurosurgeons and radiation oncologists must take tumor size, growth rate, and location, as well as the patient's neurological function and age, into account when determining the ideal course of action for a vestibular schwannoma. Large tumors causing significant brainstem and cranial nerve compression, or those that have already failed radiosurgery require surgical intervention [12].

Surgical resection of CPA meningiomas can be challenging [13]. SRS has proven to be an effective and minimally invasive alternative to surgical resection for controlling the growth of skull base meningiomas while preserving neurological function [14]. Pollock et al. demonstrated equal Progression-Free Survival (PFS) rates for small- to medium-sized intracranial meningiomas treated by either SRS or Simpson Grade 1 resection [15]. Park et al. recently published a study of 74 patients treated with SRS for CPA meningiomas (median tumor volume and prescription dose were 3.0 cm^3 and 13 Gy, respectively) [16]. PFS was found to be 98% at one and three years and 95% at five years following treatment, while symptomatic Adverse Radiation Effects (ARE) were observed in 9% of patients. The authors noted that trigeminal neuralgia was the most likely symptom to worsen after treatment.

In another recently published study, Ding et al. performed a multicenter, retrospective analysis of 177 patients who underwent GKRS for CPA meningiomas (median tumor volume and prescription dose were 3.6 cm^3 and 13 Gy, respectively) [17]. The actuarial rates of PFS were 93% at five years and 77% at 10 years, while symptomatic ARE were reported in only 1.1% of patients. The authors also found that patients who exhibited signs of cerebellar compression, trigeminal neuropathy, or vestibulocochlear dysfunction prior to treatment were at increased risk for unfavorable outcomes (tumor growth or neurological deterioration) following GKRS. Taken together, these studies suggest that SRS is the appropriate treatment for small- to moderately-sized CPA meningiomas with minimal brainstem or cranial nerve involvement. SRS may also be preferred over surgical resection in cases of residual or recurrent tumor after previous surgical resection, patients with surgical comorbidities, or patients opposed to surgery. Similar to vestibular schwannomas, surgical resection is indicated for larger meningiomas that compress the brainstem and nearby cranial nerves.

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There is a paucity of studies in the literature regarding the radiosurgical treatment of CPA epidermoid cysts. Kida et al. report a series of seven patients with epidermoid cysts who underwent GKRS to relieve neurologic deficits caused by tumor compression of adjacent cranial nerves [18]. Total or partial tumor irradiation was achieved with mean maximal and margin doses of 25.6 Gy and 14.6 Gy, respectively. There was no evidence of tumor progression at a mean follow-up of 52.7 months, and most of the patients had improvements in trigeminal neuralgia or facial spasms. In a comprehensive review of all 58 cases of malignant transformation of intracranial epidermoid tumors reported in the literature, Nagasawa et al. showed that patients treated with SRS had a mean survival of 29.2 months (compared to 5.3 months for palliative management and 25.7 months for chemotherapy) [19].

In conclusion, SRS is a safe and effective alternative to microsurgery for the management of CPA tumors. Factors such as tumor growth rate, tumor size, brainstem compression, hearing status, baseline neurological function, and patient age and medical comorbidities should be taken into account when defining the best course of action. Further studies are necessary to determine the utility of fractionated radiotherapy for the treatment of large vestibular schwannomas and CPA meningiomas, as well as the role of SRS for the treatment of CPA epidermoid cysts.

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