Gamma Knife radiosurgery for meningioma

Gamma knife radiosurgery for intracranial meningioma treatment has proven to be a safe and effective treatment tool with successful long-term outcomes [1].

Stereotactic radiosurgery provides also an effective and safe treatment option for large meningiomas. In a retrospective study El-Shehaby et al. included 273 patients with large benign meningiomas (≥ 10 cc) who were treated by single-session SRS and followed up for more than 2 years. Tumors were in a basal location in 228 patients (84%). There were 161 tumors (59%) in the perioptic location. The median tumor volume was 15.5 (10-57.3 cc (IQR 12.3 cc)). The median prescription dose was 12 Gy (9-15 Gy (IQR 1 Gy)) [2]

Gamma knife radiosurgery can be especially effective in cases of remnant meningioma after surgical resection or where peritumoral edema (PTE) is not present [3]. Because of the excellent long term tumour control rate and low morbidity associated with GKRS, this treatment option should be used more frequently in the therapeutic management of benign skull base meningiomas [4]. However, meningiomas of the convexity, parasagittal region, or falx cerebri have a higher incidence of peritumorous imaging changes after GKS than those of the skull base. Therefore, the use of GKS needs to be considered very cautiously in cerebral hemispheric meningiomas, taking into consideration patient age and general condition, tumour size and location, pattern of cortical embedding, relation between the tumour and venous sinuses, presenting symptoms, and patient preference [5].

In patients with neurofibromatosis Type 2 represents a feasible modality with minimal toxicity for NF2-associated meningiomas. Increasing patient age was associated with a decreased rate of distant failure, whereas an increasing number of prior GKRS treatments predicted distant failure. Further studies are necessary to determine the long-term patterns of treatment failure in these patients [6].

The following Indexes: Homogeneity, Gradient, Conformity, Paddick Conformity and New Conformity of the dose distribution were compared. The parameters to assess a high dose to the organs at risk: V10/TV, V90%/TV and the Integral Dose were discussed. The higher the prescription isodose, the more uniform the dose distribution in the target, which is highly beneficial in the case of larger tumor sizes due to the lower risk of complications. For smaller tumors, higher dose heterogeneity is desirable. This can be obtained with a 40% prescription isodose [7].

Case series

Ge et al. retrospectively analyzed the follow-up data in 130 patients with intracranial benign meningiomas after Gamma Knife radiosurgery (GKRS), evaluated the tumor progression-free survival (PFS) rate and neurological function preservation rate, and determined the predictors by univariate and multivariate survival analysis.METHODSThis cohort of 130 patients with intracranial benign meningiomas underwent GKRS between May 2012 and May 2015 at the Second Hospital of Tianjin Medical University. The median age was 54.5 years (range 25-81 years), and women outnumbered

men at a ratio of 4.65:1. All clinical and radiological data were obtained for analysis. No patient had undergone prior traditional radiotherapy or chemotherapy. The median tumor volume was 3.68 cm3 (range 0.23-45.78 cm3). A median margin dose of 12.0 Gy (range 10.0-16.0 Gy) was delivered to the tumor with a median isodose line of 50% (range 50%-60%).RESULTSDuring a median follow-up of 36.5 months (range 12-80 months), tumor volume regressed in 37 patients (28.5%), was unchanged in 86 patients (66.2%), and increased in 7 patients (5.4%). The actuarial tumor progression-free survival (PFS) rate was 98%, 94%, and 87% at 1, 3, and 5 years, respectively, after GKRS. Tumor recurred in 7 patients at a median follow-up of 32 months (range 12-56 months). Tumor volume ≥ 10 cm3 (p = 0.012, hazard ratio [HR] 8.25, 95% CI 1.60-42.65) and pre-GKRS Karnofsky Performance Scale score < 90 (p = 0.006, HR 9.31, 95% CI 1.88-46.22) were independent unfavorable predictors of PFS rate after GKRS. Of the 130 patients, 101 (77.7%) presented with one or more neurological symptoms or signs before GKRS. Neurological symptoms or signs improved in 40 (30.8%) patients, remained stable in 83 (63.8%), and deteriorated in 7 (5.4%) after GKRS. Two (1.5%) patients developed new cranial nerve (CN) deficit. Tumor volume ≥ 10 cm3 (p = 0.042, HR = 4.73, 95% CI 1.06-21.17) and pre-GKRS CN deficit (p = 0.045, HR = 4.35, 95% CI 0.84-22.48) were independent unfavorable predictors for improvement in neurological symptoms or signs. Six (4.6%) patients developed new or worsening peritumoral edema with a median follow-up of 4.5 months (range 2-7 months).CONCLUSIONSGKRS provided good local tumor control and high neurological function preservation in patients with intracranial benign meningiomas. Patients with tumor volume < 10 cm3, pre-GKRS Karnofsky Performance Scale score ≥ 90, and no pre-GKRS CN deficit (I-VIII) can benefit from stereotactic radiosurgery. It can be considered as the primary or adjuvant management of intracranial benign meningiomas [8].

Stereotactic radiosurgery (SRS) has become a common treatment modality for intracranial meningiomas. Skull base meningiomas greater than 8 cm(3) in volume have been found to have worse outcomes following SRS. When symptomatic, patients with these tumors are often initially treated with resection. For tumors located in close proximity to eloquent structures or in patients unwilling or unable to undergo a resection, SRS may be an acceptable therapeutic approach.

Starke et al. review the SRS outcomes of skull base meningiomas greater than 8 cm(3) in volume, which corresponds to a lesion with an approximate diameter of 2.5 cm. The authors reviewed the data in a prospectively compiled database documenting the outcomes of 469 patients with skull base meningiomas treated with single-session Gamma Knife radiosurgery (GKRS). Seventy-five patients had tumors greater than 8 cm(3) in volume, which was defined as a large tumor. All patients had a minimum follow-up of 6 months, but patients were included if they had a complication at any time point. Thirty patients were treated with upfront GKRS, and 45 were treated following microsurgery. Patient and tumor characteristics were assessed to determine predictors of new or worsening neurological function and tumor progression following GKRS.

After a mean follow-up of 6.5 years (range 0.5-21 years), the tumor volume was unchanged in 37 patients (49%), decreased in 26 patients (35%), and increased in 12 patients (16%). Actuarial rates of progression-free survival at 3, 5, and 10 years were 90.3%, 88.6%, and 77.2%, respectively. Four patients had new or worsened edema following GKRS, but preexisting edema decreased in 3 patients. In Cox multivariable analysis, covariates associated with tumor progression were 1) presentation with any cranial nerve (CN) deficit from III to VI (hazard ratio [HR] 3.78, 95% CI 1.91-7.45; p < 0.001), history of radiotherapy (HR 12.06, 95% CI 2.04-71.27; p = 0.006), and tumor volume greater than 14

cm(3) (HR 6.86, 95% CI 0.88-53.36; p = 0.066). In those patients with detailed clinical follow-up (n = 64), neurological function was unchanged in 37 patients (58%), improved in 16 patients (25%), and deteriorated in 11 patients (17%). In multivariate analysis, the factors predictive of new or worsening neurological function were history of surgery (OR 3.00, 95% CI 1.13-7.95; p = 0.027), presentation with any CN deficit from III to VI (OR 3.94, 95% CI 1.49-10.24; p = 0.007), and decreasing maximal dose (OR 0.76, 95% CI 0.63-0.93; p = 0.007). Tumor progression was present in 64% of patients with new or worsening neurological decline.

Stereotactic radiosurgery affords a reasonable rate of tumor control for large skull base meningiomas and does so with a low incidence of neurological deficits. Those with a tumor less than 14 cm(3) in volume and without presenting CN deficit from III to VI were more likely to have effective tumor control [9)].

From January 2006 to May 2017, 354 patients newly diagnosed with asymptomatic meningioma were reviewed and categorized into GKS (n = 153) and observation (n = 201) groups. Clinical and radiological progression rates were examined, and changes in volume were analyzed. RESULTS Clinical progression (i.e., clinician-judged progression), combining symptomatic progression (n = 43) and clinician-judged increase in size using images routinely acquired (n = 34), occurred in 4 patients (2.6%) and 73 patients (36.3%) in the GKS and observation groups, respectively (p < 0.001). The clinical progression-free survival (PFS) rates in the GKS and observation groups were 98.7% and 64.6%, respectively, at 5 years (p < 0.001), and 92.9% and 42.7%, respectively, at 10 years (p < 0.001). The radiological tumor control rate was 94.1% in the GKS group, and radiological progression was noted in 141 patients (70.1%) in the observation group. The radiological PFS rates in the GKS and observation groups were 94.4% and 38.5%, respectively, at 5 years (p < 0.001), and 88.5% and 7.9%, respectively, at 10 years (p < 0.001). Young age, absence of calcification, peritumoral edema, and high T2 signal intensity were correlated with clinical progression in the observation group. Volumetric analysis showed that untreated tumors gradually increased in size. However, GKS-treated tumors shrank gradually, although transient volume expansion was observed in the first 6 months. Adverse events developed in 26 of the 195 GKS-treated patients (13.3%), including 1 (0.5%) major event requiring microsurgery due to severe edema after GKS. Peritumoral edema was related to the development of adverse events (p = 0.004). CONCLUSIONS Asymptomatic meningioma is a benign disease; however, nearly two-thirds of patients experience tumor growth and one-third of untreated patients eventually require neurosurgical interventions during watchful waiting. GKS can control tumors clinically and radiologically with high probability. Although the risk of transient adverse events exists, proactive GKS may be a reasonable treatment option when there are no comorbidities limiting life expectancy [10)].

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67 patients aged ≥65 yr who underwent SRS for benign intracranial meningioma (World Health Organization grade I) between 1990 and 2014 at our institution were retrospectively analyzed. The median age was 71 yr (range, 65-83 yr), and the mean and median follow-up were 62 and 52 mo (range, 7-195 mo), respectively. Tumor margins were irradiated with a median dose of 16 Gy, and the median tumor volume was 4.9 cm3 (range, 0.7-22.9 cm3).

Actuarial local tumor control rates at 3, 5, and 10 yr after SRS were 92%, 86%, and 72%, respectively. Previous surgery and parasagittal/falcine location were statistically significant predictive factors for failed tumor control. Mild or moderate adverse events were noted in 9 patients. No severe adverse event was observed. A higher margin dose was significantly associated with adverse events by

univariate analysis.

SRS is one of the standard therapies for meningiomas in elderly patients, providing both favorable tumor control and a low risk of adverse events under minimum invasiveness [11].

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