

Residual Tumor Volume Predicts Treatment Failure in Patients Undergoing Adjuvant Radiotherapy for Subtotally Resected Atypical Meningioma

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Introduction

The role of radiotherapy in WHO grade II atypical meningioma is controversial as an adjuvant for both gross-total and subtotal resections. Current analyses suggest observation after gross-total resection but adjuvant radiotherapy following subtotal resection, although not all publications have shown a benefit to adjuvant radiotherapy after subtotal resection. Few studies have examined factors associated with treatment failure and disease progression after adjuvant radiotherapy following subtotal resection. Here, we reviewed our large institutional experience with atypical meningioma to attempt to identify any patient subgroups who may benefit more from an aggressive adjuvant therapy paradigm. We also sought to identify if any risk factors could predict treatment failure / tumor progression despite up-front adjuvant therapies.

Methods

We retrospectively reviewed the adult patients treated at our institution between 1992 and 2011 for cranial atypical meningioma (based on current WHO guidelines) via subtotal resection and either adjuvant stereotactic radiosurgery (SRS) or external-beam radiation (XRT), with complete medical records including pre- and post-operative volumetric imaging. Patients with gross-total resection and those without volumetric MR imaging available for analysis were excluded. We then compared this cohort to those patients treated concurrently at our institution after subtotal resection with a "watchful waiting" management strategy, without up-front adjuvant radiation therapy.

Results

Forty-six patients with adjuvant therapy and 32 with no adjuvant therapy ("watchful waiting") met inclusion criteria out of all 228 atypical meningioma patients treated between 1992 and 2011 (Table 1). Patient age, gender, pre-operative tumor volume, MIB-1 indexing, and extent of resection were not associated with treatment failure in the adjuvant treatment group. Post-operative residual tumor volume was strongly associated with disease progression (average volume 8.1 cm³ vs. 1.6 cm³, $p < 0.002$) in the group treated with adjuvant radiation therapy. A threshold volume of 5 cm³ of residual tumor as a harbinger of tumor progression was noted. Ninety-two percent of patients with residual tumor volume > 5 cm³ suffered progression despite adjuvant radiation therapy and this rate did not differ significantly compared to those treated with a watchful waiting strategy in survival analysis. Patients with residual tumor volume < 5 cm³ demonstrated a significant progression-free survival advantage via Kaplan-Meier analysis when treated with adjuvant radiation therapy compared to watchful waiting (Figure 1).

	Adjuvant Radiation	"Watchful Waiting"
Patients, N	46	32
Age, average	57.7 years	64.5 years
Preop tumor volume, average	33.58 cm ³	43.2 cm ³
Postop tumor volume, average	4.1 cm ³	3.6 cm ³
Clinical follow-up, average	61.9 mo	60.8 mo
Recurrences (%)	18 (39%)	18 (56%)
Average time to progression	33.5 mo	27.7 mo

Table 1. Demographics of adjuvant therapy and "watchful waiting" atypical meningioma patients undergoing STR at our institution. No differences listed are statistically significant.

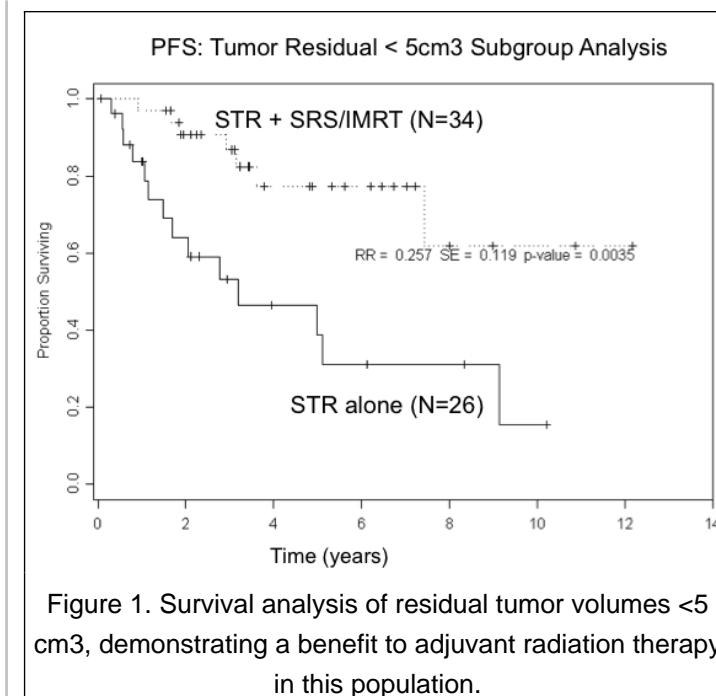


Figure 1. Survival analysis of residual tumor volumes < 5 cm³, demonstrating a benefit to adjuvant radiation therapy in this population.

Conclusions

A strong association exists between residual tumor volume and disease progression. This may explain the literature heterogeneity regarding the efficacy of adjuvant radiotherapy in subtotally-resected atypical meningioma. Residual tumor volume should be a reported variable in future studies of adjuvant radiotherapy, as this could bias many retrospective series. Patients with small residual tumor volumes appear to benefit from adjuvant radiation therapy. However, this benefit does not appear to hold for large tumor residual volumes, which have high rates of disease progression regardless of management strategy. We advocate return to OR for additional resection and cytoreduction of these lesions when feasible. The optimal radiation strategy (IMRT or SRS) for these tumors is still not elucidated and further study should compare these modalities fully.