Spontaneous Vs. Radiation-induced Pediatric Meningiomas – Histopathological Characteristics and Predictors of Recurrence; Large Single Institutional Experience

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Introduction

Pediatric meningiomas, including both primary and radiation-induced, are rare and account for 3% of all pediatric intracranial tumors. As a result, recurrence risk is extrapolated mostly from adult literature which suggests proliferation rate (MIB-1 SI) and atypia as the highest predictors. Here, we retrospectively review a large, single-center series to identify predictors of recurrence in pediatric meningioma.
Methods

Patients with pathology confirmed meningioma treated at Boston Children’s Hospital over a 20-year period were retrospectively reviewed. Categorical (gender, race, histology, tumor status (primary vs. radiation induced), atypia, extent of resection) and continuous (age at diagnosis, MIB-1) data were analyzed, using Pearson Chi square and Mann-Whitney U-tests, respectively. Two-tailed $p$ value < 0.05 was considered statistically significant.
Results

- Thirty-five patients were identified (14M:26F); n=11 radiation-induced and n=24 primary. Twenty-four patients were diagnosed with SMs. The mean age at time of diagnosis was 10.7 ± 5.7 years and the mean follow up period was 8.7 ± 5.05 years. Eleven patients were diagnosed with RIMs. The mean age at time of diagnosis was 17.3 ± 3.5 years and the mean follow up period was 7.8 ± 4.7 years. Three patients were previously diagnosed with NF-2.
Results

• All patients with RIMs underwent GTR. Of all patients with SMs, GTR was achieved in 15 patients, 5 patients had STR without any adjuvant therapy, 2 patients had STR followed by subsequent radiotherapy, 1 patient had STR followed by subsequent chemotherapy and 1 patient had STR followed by chemotherapy and radiotherapy.

• With the exception of one patient, all patients had WHO grade I or II meningiomas. WHO grade I (n = 15 spontaneous, n=2 RIM); WHO grade I with atypical features (n = 2 spontaneous, n=5 RIM); atypical meningioma, WHO grade II (n = 3 spontaneous, n=4 RIM); clear cell meningioma, WHO grade II (n = 3 spontaneous, n=0 RIM) and anaplastic meningioma, WHO grade III (n = 1 spontaneous).
Results

• A total of 8 patients recurred, of which all were primary meningiomas. The median latency period to recurrence/progression was 32 months (range 3 to 47 months). There were no recurrences in the radiation-induced cohort ($p=0.037$).

• Predictors of recurrence included primary etiology ($p=0.037$) histologic subset- clear cell ($p = 0.02$) and age $\leq 10.5$ years (AUC = 0.81; 95% CI, 0.63 – 0.97; $P = 0.01$).

• There was no significant difference for MIB-1 between primary vs. radiation-induced (3% vs. 7.3%; $p= 0.258$) or recurrent vs. non-recurrent tumors (6.5% vs. 4% $p=0.082$). Though elevated MIB-1 SI correlates with atypia; ($p <0.001$), neither was associated with recurrence (atypia and recurrence $p=0.2$; MIB-1 and recurrence $p=0.082$).
Figure 1. Representative post-contrast imaging for patients with spontaneous meningiomas.

Figure 2. Representative post-contrast imaging for patients with radiation induced meningiomas.
Conclusions

- Radiation-induced meningiomas may harbor more aggressive biological features such as pathologic atypia and higher MIB-1 SI, however, in this study, there were no patients with radiation-induced meningiomas who recurred after gross total resection and 9 years of follow-up.
- Young age and histopathologic diagnosis in pediatric patients with spontaneous meningiomas are independent significant predictors of recurrence.