

Tumor recurrence and survival following gamma knife surgery for brain metastases

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Object. The authors evaluated prognostic factors for tumor recurrence and patient survival following gamma knife surgery (GKS) for brain metastasis.

Methods. A retrospective review of 101 patient charts was undertaken for those patients treated with GKS for brain metastases from 1994 to 2001.

Recurrence rates of brain metastasis following GKS depended on the duration of patient survival. Long-term survival was associated with a higher risk of tumor recurrence and shorter-term survival was associated with a lower risk. The duration of survival following GKS for brain metastases seems to be characteristic of the primary disease rather than the cerebral disease.

Conclusions. Recurrence rates of brain metastasis following GKS are related to duration of survival, which is in turn mostly dependent on the nature and course of the primary tumor.

KEY WORDS • gamma knife surgery • brain metastasis • survival • recurrence

AN increasing number of patients with brain metastases are undergoing GKS. Excellent local tumor control rates are achieved even in so-called radioresistant tumors such as metastases of RCC or malignant melanoma.^{2,3} To evaluate prognostic factors for tumor recurrence and patient survival following GKS for brain metastases, we reviewed our 7-year experience.

Clinical Material and Methods

Due to reimbursement policy in Switzerland, the vast majority of patients undergoing GKS for brain metastasis had a Karnofsky Performance Scale score greater than or equal to 70, a maximum tumor diameter less than or equal to 3 cm, only up to three brain metastases at the time of diagnosis, and inactive systemic disease. The patient charts of 101 patients who underwent GKS for brain metastases from 1994 to 2001 were retrospectively reviewed. Tumor recurrence was defined as local and remote recurrence of brain metastases. Survival was defined as that occurring after the date of GKS of brain metastases. Differences in the proportion of tumor recurrence and differences in survival were compared for the various malignancies by using the analysis of variance and Fisher PLSD post hoc test. A p value of less than or equal to 0.05 was considered statistically significant.

Results

Initial Patient Population

The 101 patients harbored 253 cerebral metastases. There

Abbreviations used in this paper: GI = gastrointestinal; GKS = gamma knife surgery; RCC = renal cell carcinoma.

was a solitary metastasis in 30%, and 70% had multiple metastases at the time of GKS. Primary tumors were non-small cell lung carcinoma (40%), GI tract cancer (14%), breast cancer (11%), RCC (10%), malignant melanoma (6%), unknown primary tumor (6%), more than one primary tumor (5%), and other cancers (8%). The 253 tumors were treated with a mean prescription dose of 21.5 Gy.

Tumor Recurrences

We found the following recurrence rates: 67% for malignant melanoma, 30% RCC, 20% more than one primary tumor, 19% lung cancer, 18% breast cancer, 17% unknown primary tumor, 14% GI tract cancer, 12% other cancers. The differences in the high recurrence rates of malignant melanoma and RCC compared with the low recurrence rate of GI tract cancer were statistically significant ($p \leq 0.05$). Mean survival was as follows: 37 months for malignant melanoma, 35 months for unknown primary tumor, 20 months for RCC, 17 months for breast cancer, 15 months for lung cancer, 7 months for GI tract cancer, 7 months for more than one primary tumor, and 15 months for other cancers. The differences in the extended mean survival periods of patients with malignant melanoma, RCC, unknown primary tumor, and breast cancer compared with the short mean survival of those with GI tract cancer were statistically significant ($p \leq 0.05$).

Discussion

The high tumor recurrence rates of brain metastases caused by RCC and malignant melanoma are associated with the long survival of these patients. Similarly, the low tumor recurrence rates of GI tract cancer brain metastases are associated with short survival. This seemingly contra-

dictory finding is most probably due to the fact that our patients did not die of their brain metastases but of the progression of the systemic disease. In other words, only patients who live long enough experience recurrent brain metastases and in patients who do not live long enough, recurrent disease does not develop. Compared with the literature, our recurrence rates for brain metastases of RCC and malignant melanoma following GKS were higher (30% compared with 6% in RCC and 67% compared with 3% in malignant melanoma) and our patient survival period was longer (20 months compared with 6 months in RCC and 37 months compared with 8 months in malignant melanoma). This is most probably due to the fact that the recurrence rates in the literature refer to local tumor recurrence, whereas ours refer to local and remote tumor recurrence within the brain. The longer survival in our patients may also be a result of enforced selection because the vast majority of our patients had Karnofsky Performance Scale scores greater than or equal to 70, a maximum tumor diameter less than or equal to 3 cm, and inactive systemic disease. All of these parameters have been associated with an extended patient survival.¹

Conclusions

The primary tumors' histology significantly affects recurrence rates and patient survival. Extended survival of patients with malignant melanoma and RCC who underwent GKS for brain metastases is associated with high recurrence rates of brain metastases. Short survival of patients with GI tract cancer who underwent GKS for brain metastases is associated with low recurrence rates of brain metastases.

Accordingly, tumor recurrence rates of brain metastases following GKS seem to be determined by the duration of survival, and survival seems to be determined by the histological diagnosis. In patients with brain metastases, the systemic disease seems to be more active in GI tract cancer than in malignant melanoma or RCC. The duration of patient survival following GKS for brain metastases seems to depend mostly on the activity of the systemic disease and not on the cerebral disease. Gamma knife surgery for brain metastases proved to be a safe and efficient treatment in all patient groups.

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