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Safety and efficacy of Gamma Knife surgery for brain metastases in eloquent locations.

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Abstract

OBJECT: Brain metastases are the most frequently occurring cerebral tumors. Tumors that are located in eloquent cerebral parenchyma can cause considerable morbidity and may pose a significant challenge during surgery. Gamma Knife surgery (GKS) is a recognized treatment modality for brain metastases. This study was undertaken to assess the safety and efficacy of GKS, specifically for brain metastases in eloquent locations.

METHODS: Charts of patients harboring brain metastases that were treated by GKS at the Centre Hospitalier Universitaire de Sherbrooke between August 2004 and April 2008 were reviewed. Planning images were assessed by an independent neurosurgeon to assess tumor location. Eloquent locations included the primary motor, somatosensory, speech, and visual cortices; the basal ganglia; the thalamus; and the brainstem. Data on survival, tumor response, and complications were analyzed and compared with data published on surgical treatment of these lesions.

RESULTS: During the study period, 650 metastases in 295 patients were treated with GKS; of these, 164 metastases in 95 patients were located in eloquent areas. In this subgroup, the median age of patients was 59 years and women constituted 57.9% of the population. The median Karnofsky Performance Scale score was 80% (range 50%-100%). Patients were categorized according to their recursive partitioning analysis class: Class 1, 22.1%; Class 2, 70.5%; and Class 3, 7.4% of patients. Non-small cell lung cancer was the most common primary tumor (63.2% of metastases), followed by small cell lung (8.4%), breast (7.4%), colorectal (5.3%), and renal cell (4.2%) cancers, as well as melanoma (4.2%). The median dose to the tumor margin was 18 Gy (range 14-24 Gy). The median duration of survival after GKS was 8.2 months. The recursive partitioning analysis class was the most significant variable affecting survival ($p < 0.0001$). Immediate control was achieved in 92.9% of tumors, and 68.6% of tumors were still controlled at the last follow-up. The median time to tumor progression was 16 months. Higher margin dose ($p = 0.002$), the absence of edema ($p = 0.009$), and the non-small cell lung cancer tissue type ($p = 0.035$) positively affected response rates. Steroid medications were no longer used in 46% of patients after GKS. New neurological deficits occurred in 5.7% of patients and seizures in 5.7%. All these deficits were transient and patients completely recovered in response to a temporary course of steroids. Imaging studies showed that new edema occurred in 8.6% of treated metastases and biopsy-proven radiation necrosis in 1.4%.

CONCLUSIONS: Gamma Knife surgery is safe and effective for brain metastases located in eloquent areas.

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