

GAMMA KNIFE RADIOSURGERY FOR METASTATIC TUMOURS

Metastatic disease to the brain is the most common intracranial malignancy. The incidence rate ranges from 8.3-14.3 per 100,000 people, and corresponds to 9.6% of cancer patients (1). Management options for intracranial metastases have been focused on radiation procedures or surgical resection. Guidelines from multiple organizations support radiosurgery for brain metastasis management (IRSA, AANS, CNS, ASTRO, ESMO, NCCN, etc.).

Key Points

- Gamma Knife Radiosurgery (GKSRS) is a minimally invasive procedure that results in long-term stabilization and regression of metastases regardless of histology.
- There is no delay created for starting systemic therapy.
- Low morbidity and a rapid return to current activity levels are obtained.

Gamma Knife Radiosurgery

Gamma knife radiosurgery (GKSRS) has been utilized to treat over 335,004 patients worldwide with one or more brain metastases during the last 30 years. Over 29,405 patients were treated in 2014 alone. Based on Pubmed searches GKSRS accounts for over 1,700 publications on metastases, compared to less than 200 for stereotactic Linac and CyberKnife combined. GKSRS also has a lower dose to the surrounding brain compared to modified LINACS, Cyberknife, or Tomotherapy (2).

Economics: The average cost of treating metastases over a 12 months period using micro-surgery is \$55,938 compared to \$23,069 for GKSRS (based on USA data)(3). GKSRS is also more cost effective than whole brain radiotherapy for quality adjusted life years and avoids the learning and memory deficits associated with whole brain therapy (4,5).

Clinical Data

	Retrospective and prospective trials provide consistent and reproducible results with tumor control rates ranging from 84% to 97% based on histology.
	The number of metastases does not influence prognosis in terms of neurological status, recurrence rates or complications (6). Total volume of the metastatic deposits is more important for prognosis (7).
Breast:	The rate of tumor control for breast cancer metastases is 90% with an overall survival of 11.2 months (8).
Lung:	Non-small cell lung cancer has an overall brain metastasis control rate of 92.8%. This translated to a survival of 12.6 months after diagnosis of brain metastases (9). Small Cell Lung cancer has an 86% tumor control rate (10).
Melanoma:	This is a notoriously radio-resistant tumor but still has a control rate of roughly 86% with a median survival of 7.8 months from the diagnosis of brain metastases (11).
Gastrointestinal:	Gastrointestinal local tumor growth control rate is 94.1% with an overall survival of 6.2 months (12).
Renal Cell:	Renal cell carcinoma metastases treated with GKSRS has sustained local tumor control in 92% of patients (13).

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Tumor Bed: Tumor control rates for the post-surgical resection bed range from 80-94% (14,15).

Risks

- Delayed treatment complications range from 4% to 7% depending on the dose, location and volume of tumor treated by GKSRS (9,10). Adverse radiation effects can be treated by medical or surgical management options.
- Failure of tumor control: when caught early by appropriate follow-up, allows for retreatment.

Referral Recommendations

- All patients with a new diagnosis of intracranial metastases except for:
 - Larger brain metastases with a clinically symptomatic mass effect (surgery)
 - Miliary disease or Carcinomatous meningitis (Radiotherapy).
- If you are unsure whether a patient would be a candidate for GKSRS, our team would be happy to provide a consultation.

What your Patient should know

Gamma knife radiosurgery is a proven effective procedure that allows continuation of systemic therapy and almost no recovery period. This is a single treatment painless procedure, designed to inactivate the tumors to prevent further growth, while having a high probability of tumor shrinkage. There are no incisions and the patient does NOT experience perceived radiation side effects such cognitive decline or hair loss. Patients do not require an anesthetic and can maintain their current medications.

Radiosurgery Technique Protocol for Metastasis

1. Patients are treated in a single outpatient procedure.
2. A Leksell stereotactic frame is applied under mild sedation / local anaesthetic.
3. High-resolution axial imaging (MRI or CT) is conducted.
4. Radiosurgery dose planning (16-22Gy margin dose) is created emphasizing conformality and selectivity. The planning is based on multifactorial tumor characteristics including etiology, location, volume and previous treatments.
5. The patient is positioned in the Gamma Knife unit and the radiosurgery treatment is administered.
6. Patients are usually discharged within 2 hours of a completed procedure.
7. Clinical and imaging follow-up is requested at 3-month intervals after radiosurgery. However, if the intracranial disease burden increased as a result of new metastases or tumor growth, then repeat SRS procedures can be performed.

The expanded technical elements of this procedure are detailed in previous publication (8,13).

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