Hypofractionated adaptive stereotactic radiosurgery as a novel treatment option in large brain metastasis

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Background:
For brain metastases up to 2 centimetres, single-session stereotactic radiosurgery is well-established. However, increasing radiation dosage for larger neoplasms is hindered by potential brain tissue damage, while reducing it heightens tumour recurrence risk. A possible solution lies in hypofractionated stereotactic radiosurgery (HSRS) which administers approximately 30 Gy over 3-5 sessions, and hypofractionated adaptive radiosurgery (HARS) which features dynamic treatment plan adjustments between sessions.

Case presentation:

After receiving oncological treatment for pulmonary adenocarcinoma, a 74-year-old woman underwent brain magnetic resonance imaging (MRI), which detected a right cerebellar mass with central necrosis, resulting in compression on the fourth ventricle. She was admitted to the neurosurgical ward and started on anti-edema therapy (dexamethasone 2x8 mg with gastroprotection pre-operatively and two days post-operatively, gradually reducing the dose to 2x4 mg and 1x4 mg, and discontinuing the medication before discharge). Surgical intervention and pathohistological examination confirmed the tumour as a metastasis. Three months later, evidence of recurrent growth was found (volume=16.808 cm^3). Because of its size of over 15 cm^3, HARS was recommended. The patient underwent doses of 10 Gy administered in 3 fractions. After each session, a new treatment plan was devised to adjust the radiation dosage to encompass a smaller volume. Tumour volume decreased to 9.721 cm^3 before the second session and further to 3.751 cm^3 before the third. All sessions, with 2 weeks in between them, were completed without any complications. On the follow-up MRI performed 6 weeks later, there was no evidence of the tumour, no significant oedema, and the patient did not experience any neurological issues.

Conclusion:

HARS is a promising treatment for large brain metastases with limited options. It surpasses traditional HSRS by allowing plan adjustments after each radiation session. New planning at each irradiation stage facilitates ongoing modification to address tumour size reduction. This additional layer of customisation enhances the therapy effect, leading to a higher effective radiation dosage for the tumour and consequently reducing the risk of disease recurrence.

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