Motor cortex brain metastases

Brain metastases in the motor cortex is a challenging condition to treat.

Treatment of motor cortex brain metastases is a complex and multidisciplinary process. The motor cortex, located in the frontal lobe, controls voluntary muscle movements. Brain metastases in this area can cause significant neurological symptoms, such as weakness, paralysis, or difficulty with fine motor skills, making timely and effective treatment critical. The choice of treatment depends on factors such as the size and number of metastases, the type of primary cancer, the patient's overall health, and whether symptoms are present.

Key Treatment Options for Motor Cortex Brain Metastases: 1. Surgical Resection Indications: A single, accessible lesion located in a non-eloquent part of the motor cortex. Significant mass effect or peritumoral edema causing neurological deficits. Patients with a good performance status and controlled systemic disease. Goal: Complete resection can relieve mass effect and reduce neurological symptoms. In motor cortex metastases, preserving motor function is a priority, so surgery is carefully planned using preoperative imaging (functional MRI) and intraoperative neuro-monitoring. Risks: Surgery near the motor cortex carries a higher risk of postoperative motor deficits. 2. Stereotactic Radiosurgery (SRS) Indications: Patients with 1–4 brain metastases, especially smaller lesions (<3 cm). Deep or eloquent area metastases (such as the motor cortex) that are difficult to resect surgically. Recurrence after surgical resection or post-surgery to target residual disease. Goal: SRS delivers high doses of focused radiation precisely to the tumor while minimizing damage to surrounding brain tissue, preserving motor function. SRS is often used for motor cortex lesions to avoid surgical risks. Benefits: Non-invasive, with a low risk of post-treatment neurological deficits, especially important in eloquent areas like the motor cortex. 3. Whole-Brain Radiotherapy (WBRT) Indications: Patients with multiple (>4) brain metastases or widespread disease throughout the brain. Often used as a salvage treatment after failure of SRS or surgery. Goal: Treats both visible metastases and microscopic disease in the brain. Risks: While effective in controlling metastatic spread, WBRT is associated with neurocognitive decline, which is particularly concerning for patients with metastases in critical functional areas like the motor cortex. Neuroprotective strategies (such as hippocampal sparing) may be considered. 4. Systemic Therapy (Chemotherapy, Targeted Therapy, Immunotherapy) Indications: Depends on the primary cancer and molecular characteristics. Targeted therapies (e.g., EGFR inhibitors for EGFR-mutant lung cancer, HER2-targeted drugs for HER2-positive breast cancer) can be effective if the metastases harbor specific molecular alterations. Immunotherapy (e.g., checkpoint inhibitors like pembrolizumab for cancers with high PD-L1 expression or melanoma) has shown efficacy in treating brain metastases, including in the motor cortex. Goal: Manage both intracranial and extracranial disease, especially in patients with progressive or widespread metastases. Limitations: The blood-brain barrier can reduce the effectiveness of systemic therapies, though newer agents show better brain penetration. 5. Adjuvant Treatments Corticosteroids: Used to reduce peritumoral edema and alleviate symptoms caused by swelling or increased intracranial pressure. Steroids are particularly useful in motor cortex metastases when there are signs of motor deficits due to swelling. Anticonvulsants: Prescribed if the patient develops seizures, which can occur with cortical metastases. 6. Emerging Therapies Laser Interstitial Thermal Therapy (LITT): A minimally invasive technique that uses laser energy to ablate brain metastases. It is useful for patients with recurrent or inoperable metastases, including those in the motor cortex. Tumor Treating Fields (TTF): This non-invasive treatment uses alternating electric fields to disrupt cancer cell division. While primarily used for glioblastoma, it is being investigated for brain

metastases. 7. Palliative Care For patients with advanced disease or poor performance status, where curative treatment is not possible, palliative care aims to improve quality of life and manage symptoms such as pain, seizures, or neurological deficits. Factors Influencing Treatment Decisions Neurological Function: The preservation of motor function is a key concern in treating motor cortex metastases. Functional imaging (such as functional MRI or tractography) may be used to map critical areas before surgery or SRS. Primary Tumor Type: Certain primary cancers (e.g., lung cancer, breast cancer, melanoma) are more likely to metastasize to the brain, and their molecular characteristics may guide the use of targeted therapies or immunotherapy. Number of Metastases: Solitary or oligometastatic disease is more likely to be treated with surgery or SRS, while multiple metastases may be better managed with WBRT or systemic therapies. Overall Health and Disease Control: Patients with well-controlled systemic disease and good functional status are more likely to benefit from aggressive local treatment (surgery or SRS), while those with widespread disease may receive systemic therapy or palliative care. Treatment Approach by Scenario Single, Symptomatic Metastasis in the Motor Cortex:

Preferred treatment: Surgical resection or SRS, depending on the lesion's location and the patient's neurological status. Postoperative SRS or WBRT may be used to prevent recurrence. Multiple Metastases (Including in the Motor Cortex):

Preferred treatment: SRS for limited (oligometastatic) disease, or WBRT for widespread involvement. Systemic therapy based on the primary cancer type and molecular markers may also be considered. Motor Cortex Metastasis with Systemic Progression:

Preferred treatment: Systemic therapy, possibly combined with local treatments like SRS or surgery to manage neurological symptoms. Conclusion The treatment of motor cortex metastases aims to control tumor growth while preserving motor function. Surgical resection or SRS is often used for localized lesions, while WBRT and systemic therapies are considered for more extensive disease. Individual treatment plans are based on the number and size of metastases, molecular characteristics of the primary tumor, and the patient's overall health and neurological status.

Surgical resection or stereotactic radiosurgery (SRS)/hypofractionated stereotactic radiotherapy (hypoSRT) are valuable options up to now. Due to its unique location and potential for neurologic deficits, neither treatment is entirely satisfactory. There is still a lack of data on the treatment result of motor cortex metastasis.

A study provides a comprehensive review and meta-analysis comparing surgery and SRS/hypoSRT for treating brain metastasis in the motor cortex. Core databases, including PubMed, Embase, and the Cochrane Library, were systematically searched for brain metastasis in the motor cortex, demonstrating the clinical outcomes of both surgery and SRS/hypoSRT. Motor power outcome and treatment-associated complication rates were thoroughly evaluated. Twenty-five articles were listed for full-text review. Among them, 13 articles were eligible for inclusion criteria: retrospective cohort studies comparing surgery and SRS/hypoSRT. There are 323 patients in the surgery group and 220 in the SRS/hypoSRT group. The motor outcome is better in the surgery group, but without statistical significance (0.49 vs 0.37, $p = 0.3937$), and treatment-related complication is lower in the surgery group with statistical significance (0.09 vs 0.26, $p = 0.0218$). Treatment modality should be tailored by the patient's performance status, history of radiation, presence of ongoing chemotherapy, or extracranial progression status [1)].

1)
Shin DW, Yee GT. Surgical resection versus stereotactic radiosurgery for the treatment of brain metastases in the motor cortex; a meta-analysis and systematic review. Clin Exp Metastasis. 2024 Sep 20. doi: 10.1007/s10585-024-10311-4. Epub ahead of print. PMID: 39302558.