Metachronous intracranial meningioma

Metachronous intracranial meningiomas refer to multiple meningiomas that develop in different locations within the cranial cavity at different times. Unlike synchronous meningiomas, which appear simultaneously, metachronous meningiomas are characterized by the sequential development of tumors, often months or years apart.

Meningioma Overview Meningiomas are the most common type of primary brain tumors, accounting for about 30% of all intracranial tumors. They originate from the meninges, the protective layers of tissue covering the brain and spinal cord. Most meningiomas are benign (non-cancerous), but some can be atypical or malignant, characterized by more aggressive growth and potential for recurrence.

Causes and Risk Factors of Metachronous Meningiomas The exact cause of metachronous meningiomas is not fully understood, but several factors are thought to contribute to their development:

Genetic Factors:

Neurofibromatosis Type 2 (NF2): This genetic disorder is strongly associated with the development of multiple meningiomas. Mutations in the NF2 gene, which encodes the protein merlin, lead to a higher risk of developing meningiomas, often at multiple sites and potentially at different times. Familial Predisposition: In rare cases, there is a familial tendency for the development of meningiomas, suggesting a genetic predisposition beyond NF2. Previous Radiation Exposure:

Therapeutic Radiation: Individuals who have received radiation therapy to the head, particularly during childhood, are at an increased risk of developing meningiomas, sometimes years or decades after the exposure. Radiation-induced meningiomas can present as multiple tumors and may occur metachronously. Hormonal Influences:

Hormonal Factors: There is some evidence to suggest that hormonal factors, particularly estrogen and progesterone, may play a role in meningioma development, given the higher prevalence in females and observed growth changes during pregnancy or hormone therapy. Other Factors:

Cranial Trauma: While there is no conclusive evidence linking cranial trauma to the development of meningiomas, some studies suggest a potential association. Lifestyle and Environmental Factors: Some research suggests possible associations with obesity, certain dietary factors, or environmental exposures, but these links are less well established. Clinical Presentation The clinical presentation of metachronous intracranial meningiomas can vary widely, depending on the size, number, location, and growth rate of the tumors. Common symptoms include:

Headaches: Often due to increased intracranial pressure or irritation of the meninges. Seizures: A common symptom in patients with meningiomas, especially if the tumor is located near the cortex. Focal Neurological Deficits: Depending on the tumor location, patients may experience weakness, sensory changes, vision disturbances, or cranial nerve deficits. Cognitive and Behavioral Changes: Tumors located in the frontal lobes or other brain regions involved in cognitive function can lead to changes in personality, memory, or executive function. Diagnosis The diagnosis of metachronous intracranial meningiomas involves a combination of clinical evaluation, imaging studies, and sometimes histopathological examination:

Neuroimaging:

Magnetic Resonance Imaging (MRI): MRI is the preferred imaging modality for diagnosing meningiomas. It provides detailed information on the tumor’s location, size, number, and characteristics, such as its relation to surrounding brain tissue and its enhancement pattern after contrast administration. Computed Tomography (CT): CT scans can also be used, especially in cases where MRI is contraindicated. CT can help visualize calcifications within the tumor and its effects on the skull or surrounding structures. Histopathological Examination: If surgery is performed, the removed tumor tissue can be examined to confirm the diagnosis and determine the meningioma's grade and subtype. This examination is crucial for determining prognosis and guiding follow-up care.

Management and Treatment The management of metachronous intracranial meningiomas depends on several factors, including the number, size, location, and symptoms caused by the tumors, as well as the patient's overall health and preferences. Treatment options may include:

Observation:

Small, asymptomatic meningiomas that are not growing or causing symptoms may be monitored with periodic imaging studies (usually MRI) to assess for any changes in size or behavior. Surgical Resection:

Surgery is often the preferred treatment for symptomatic meningiomas or those causing significant mass effect or neurological deficits. The goal is complete resection, but this may not always be possible due to the tumor's location or its involvement with critical structures. In cases of multiple meningiomas, surgical management may focus on the most symptomatic or accessible tumors, with other tumors managed conservatively or with radiation. Radiation Therapy:

Stereotactic Radiosurgery (SRS): This is a non-invasive treatment option that uses focused radiation to target the tumor while minimizing exposure to surrounding healthy tissue. It is often used for smaller meningiomas, recurrent tumors, or those in locations where surgery would be high-risk. Fractionated Radiotherapy: This involves delivering radiation in multiple small doses over several weeks and may be used for larger tumors or those in sensitive locations. Medical Therapy:

Medical therapy options are limited for meningiomas, but hormone receptor-positive meningiomas may be treated with hormone-modulating agents in some cases. Clinical trials exploring the use of targeted therapies and other novel agents are ongoing. Prognosis The prognosis for patients with metachronous intracranial meningiomas varies depending on the tumor's grade, size, location, number, and response to treatment. In general, benign meningiomas (WHO Grade I) have a good prognosis with appropriate treatment, although the development of multiple meningiomas can complicate management and may require long-term follow-up.

Patients with atypical (WHO Grade II) or anaplastic (WHO Grade III) meningiomas may have a higher risk of recurrence and a more challenging clinical course, necessitating more aggressive treatment and closer monitoring.

Follow-up Regular follow-up with neuroimaging (typically MRI) is essential for detecting new meningiomas or recurrence of previously treated tumors, especially in patients with a history of multiple or metachronous meningiomas. The frequency and duration of follow-up will depend on the initial presentation, treatment received, and risk of recurrence.

Case reports

A report aims to describe a rare paediatric case of metachronous meningiomas without dural attachment, detailing their presentation, treatment, and outcomes.

Case details: A 2-year-old female presented with headaches, irritability, and excessive crying for one year. A CT scan revealed a mass in the fourth ventricle, causing obstruction, which was surgically decompressed. The biopsy confirmed a clear cell meningioma, WHO grade II. A follow-up MRI identified a new lesion in the suprasellar area six months later, for which she underwent right pterional craniotomy and gross total resection, which turned out to be a clear cell meningioma, WHO grade II. The patient recovered well and remained asymptomatic, with no recurrence on MRI at one-year follow-up.

Conclusion: This case highlights the unusual presentation of metachronous clear cell meningiomas without dural attachment in a young child. Surgical excision resulted in a favourable outcome, though long-term follow-up is essential due to the high propensity for recurrence [1)]

1)
Roy A, Shashidhar A, Birua GJS, Rao S, Kulanthaivelu K, Arimappamagan A. Metachronous intracranial meningiomas without dural attachment in a child - Rare case report and review of literature. Childs Nerv Syst. 2024 Aug 24. doi: 10.1007/s00381-024-06582-7. Epub ahead of print. PMID: 39180697.