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Perspective

Surgical Management and Treatment Considerations of Meningioma

Evelyn K Harper *

Department of Neurosurgery, Norwick University, London, United Kingdom

DESCRIPTION

The management of meningioma is guided by a combination of clinical symptoms, tumour size, location and histological characteristics. While many meningiomas remain asymptomatic and can be observed with periodic imaging, surgical intervention becomes necessary when lesions produce neurological deficits, demonstrate rapid growth or pose a risk of compromising adjacent brain structures. Surgical planning requires careful assessment of anatomical relationships, potential complications and patient-specific factors, including age, comorbidities and overall functional status. Surgical removal remains the primary approach for symptomatic meningiomas. The goal of surgery is maximal resection while preserving neurological function. Tumours located along the convexity of the brain or in accessible non-critical areas generally allow for complete excision with minimal risk. Skull base meningiomas, however, present additional challenges due to proximity to cranial nerves, major blood vessels and brainstem structures. In such cases, the surgeon must balance tumour removal with the risk of injury to essential neural or vascular elements, sometimes leaving small residual portions to prevent severe complications. Preoperative imaging plays a pivotal role in planning surgical strategies. Magnetic resonance imaging identifies the extent of the lesion, its relation to surrounding structures and the presence of dural attachment or bone involvement. Magnetic Resonance Imaging (MRI)and diffusion tensor imaging can be employed to map critical motor, sensory or language pathways, providing additional guidance for safe tumour excision. Computed Tomography (CT) can clarify skull base anatomy and identify areas of hyperostosis or bone infiltration that may require removal or reconstruction during surgery. Preoperative evaluation of vascular anatomy is also essential, particularly for lesions near major venous sinuses, to minimize the risk of intraoperative bleeding or postoperative complications.

The surgical approach varies depending on tumour location and size. Convexity meningiomas are often accessed *via* standard craniotomy, while lesions at the skull base may require more complex approaches, including sub temporal, retro sigmoid or trans petrosal techniques. Intraoperative neuronavigation, microscope-assisted dissection and ultrasonic aspirators are frequently used to enhance precision and minimize damage to adjacent neural tissue. Careful hemostasis is critical, as meningiomas can be highly vascular and bleeding control is essential to maintain visibility and reduce postoperative morbidity. Complete excision of meningiomas is associated with a lower risk of recurrence. However, residual tumour may remain when lesions are adherent to critical structures. In such cases, adjunctive therapies, including focused radiation or stereotactic radiosurgery, can be employed to control growth. Radiation is particularly useful for atypical or higher-grade tumours, for lesions in surgically inaccessible locations or for patients who are not ideal candidates for surgery. Careful coordination between neurosurgery and radiation oncology ensures that treatment planning optimizes tumour control while minimizing side effects. Postoperative care includes close monitoring for neurological deficits, seizure activity and complications such as edema or haemorrhage. Early mobilization, physical therapy and rehabilitation support recovery of motor, sensory and cognitive function. Long-term follow-up involves periodic imaging to detect recurrence, which can occur even in benign tumours, particularly if complete resection was not achieved. The frequency of follow-up depends on tumour grade, initial surgical outcome and patient-specific risk factors.

Histopathological analysis of resected tissue provides important information regarding tumour subtype, cellular density, mitotic activity and potential for aggressive behavior. This information informs prognosis and guides the frequency of postoperative surveillance. Molecular analysis can further identify genetic alterations, including Neurofibromatosis type 2 (NF2) mutations, chromosomal abnormalities and growth factor pathway dysregulation, which may influence the likelihood of recurrence and help in planning future therapeutic strategies. Surgical intervention for meningioma is generally associated with favorable outcomes, particularly for benign lesions in accessible locations. Advances in imaging, operative techniques and perioperative care have improved safety, reduced morbidity and enhanced functional recovery. Nevertheless, careful

Correspondence to: Evelyn K Harper, Department of Neurosurgery, Norwick University, London, United Kingdom; Email: evelyn.harper@norwicku.ac.uk

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preoperative planning, meticulous surgical technique and multidisciplinary coordination are essential for achieving optimal results and maintaining quality of life. In situations where surgery is not feasible, alternative treatments can provide effective tumour control while minimizing neurological impact.

In summary, surgical management of meningioma involves a nuanced approach that balances maximal tumour removal with preservation of neurological function. Preoperative imaging, careful planning and use of advanced surgical techniques contribute to safe and effective resection. Postoperative care, including monitoring, rehabilitation and long-term follow-up, is essential for managing residual disease, detecting recurrence and ensuring optimal recovery. Integrating clinical, anatomical and molecular information allows clinicians to provide individualized care and achieve favorable outcomes for patients affected by this common intracranial tumour.