Complete Resection of A Giant Convexity Meningioma Involving The Middle Cerebral Artery: A Case Report and Surgical Considerations

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ABSTRACT

Meningioma is the most common primary intracranial tumor in adults, accounting for approximately 37.6% of all primary central nervous system neoplasms. Although convexity meningiomas are generally surgically accessible, large tumors with neurovascular involvement present significant operative challenges, especially when acute neurological deterioration necessitates emergent intervention. A 46-year-old female presented with decreased consciousness (GCS E2V3M4) and progressive hemiparesis. Preoperative CT revealed a large temporoparietal extra-axial mass with significant mass effect and middle cerebral artery (MCA) involvement. Emergent craniotomy and stepwise debulking were performed utilizing gravity-assisted retraction, central dural incision, pial plane preservation, early arterial feeder coagulation, and systematic hemostasis. The philosophy of prioritizing patient safety over gross total resection guided the strategy. Postoperatively, the patient regained full consciousness (GCS E4V5M6) with marked motor improvement. Emerging evidence supports subtotal resection with adjuvant stereotactic radiosurgery for residual tumors. Emergent surgical debulking of large convexity meningiomas with neurovascular involvement is feasible and effective when guided by stepwise resection, pial plane preservation, and patient safety. Adjuvant radiosurgery should be considered for any residual tumor on follow-up imaging.

Keyword : Convexity meningioma; middle cerebral artery; simpson grading; surgical resection

Introduction

Meningiomas are the most common primary intracranial tumors in adults, accounting for approximately 37.6% of all primary central nervous system neoplasms and roughly 50% of all benign brain tumors[1,2]. These tumors arise from arachnoid cap cells and are predominantly benign (WHO Grade I), characterized by slow growth rates and favorable prognoses following complete resection[3]. Patients with parasagittal and convexity meningiomas may present with contralateral limb paresis or paralysis, along with headaches, seizures, and behavioral changes [1].

Surgical resection remains the cornerstone of treatment for symptomatic convexity meningiomas. Intratumoral debulking is often necessary to reduce mass effect and improve visualization of critical structures prior to circumferential dissection. The tumor-pia-arachnoidal plane must be diligently identified, with every effort made to remain extra-pial during tumor resection to minimize injury to adjacent eloquent cortex [2]. The extent of resection has been widely assessed using the Simpson grading system, which correlates with the risk of postoperative tumor recurrence. Grade I resection (complete removal of the tumor, its dural attachment, and any involved bone) carries the lowest recurrence rate, while Grade IV resection (subtotal removal) is associated with significantly higher recurrence rates. However, when total resection poses an unacceptable risk to vital neurovascular structures, intentional subtotal resection followed by adjuvant stereotactic radiosurgery represents a reasonable and increasingly accepted strategy [3,4].

Large convexity meningiomas with neurovascular involvement present particular surgical challenges, especially when acute neurological deterioration necessitates emergent intervention. The presence of adherence to major cerebral vessels such as the middle cerebral artery (MCA) significantly increases the risk of intraoperative complications and postoperative morbidity [1-4]. We report a case of a large temporoparietal convexity meningioma presenting with decreased consciousness and contralateral motor deficits, requiring emergent surgical debulking. This report details the preoperative planning, intraoperative approach, and postoperative course, highlighting key surgical principles including stepwise central debulking, pial plane preservation, middle cerebral artery protection, and the philosophy of prioritizing patient safety over the pursuit of complete resection.

Material and Methods

Study Design and Case Selection

This study is a single case report conducted following the CARE (CAse REport) guidelines for the reporting of clinical cases[4]. The patient was managed at a tertiary referral hospital with a specialized neurosurgical unit. Written informed consent was obtained from the patient for the publication of this case report and any accompanying images.

Patient Assessment and Data Collection

A 46-year-old female patient presented to the emergency department with acute neurological deterioration. Clinical data were collected through:

- **Auto-anamnesis:** Direct patient interview (limited due to decreased consciousness, supplemented by family members).
- **Hetero-anamnesis:** Collateral history obtained from family members regarding the patient's 5-year history of progressive weakness and communication decline.
- **Neurological examination:** Comprehensive assessment including Glasgow Coma Scale (GCS), motor power evaluation (Medical Research Council scale), and cranial nerve examination.
- **Preoperative imaging:** Contrast CT head was performed emergently to evaluate the intracranial pathology.

Surgical Technique

The patient underwent emergent craniotomy and tumor debulking under general anesthesia. The surgical approach was guided by the following principles: 1) Patient Positioning: The patient was positioned supine with the head turned to the contralateral (left) side. The right shoulder was elevated to create a flatter surgical field, facilitating tumor excision and allowing gravity-assisted brain retraction. 2) Dural Incision and Central Debulking: A central dural incision of approximately 3 cm was made directly overlying the tumor. The dura was opened gradually, followed by stepwise central debulking until a safety margin of 0.5 cm between the tumor and surrounding healthy brain parenchyma was achieved. 3) Tumor Capsule Management: Internal decompression was performed using surgical scissors and a Cavitron Ultrasonic Surgical Aspirator (CUSA) to fragment and evacuate the tumor core, allowing progressive and safe mobilization of the tumor capsule. 4) Preservation of the Pial Plane and Vascular Structures: Meticulous identification and maintenance of the pial plane was performed throughout the dissection, with particular attention devoted to preserving the integrity of the MCA. 5) Control of Arterial Feeders: Early identification and coagulation of the tumor's arterial feeding vessels was prioritized at the outset of the procedure to reduce intraoperative blood loss. 6) Hemostatic Control: A systematic one source at a time approach was employed, addressing each bleeding point individually. Hemostasis was achieved using direct pressure, oxidized cellulose (Surgicel), absorbable gelatin sponge (Gelfoam), and cotton patties. 7) Philosophy of Safety over Totality: In regions where the tumor capsule was firmly adherent to critical structures (including the MCA), a deliberate decision was made to leave a small remnant of tumor rather than risk catastrophic neurovascular injury.

Postoperative Assessment

Radiological Assessment. Postoperative non-contrast CT head was performed to evaluate the extent of resection and identify any complications and Clinical Outcome Assessment is Neurological status was reassessed using the GCS and motor power examination. The patient was subsequently enrolled in a medical rehabilitation program.

Data Analysis

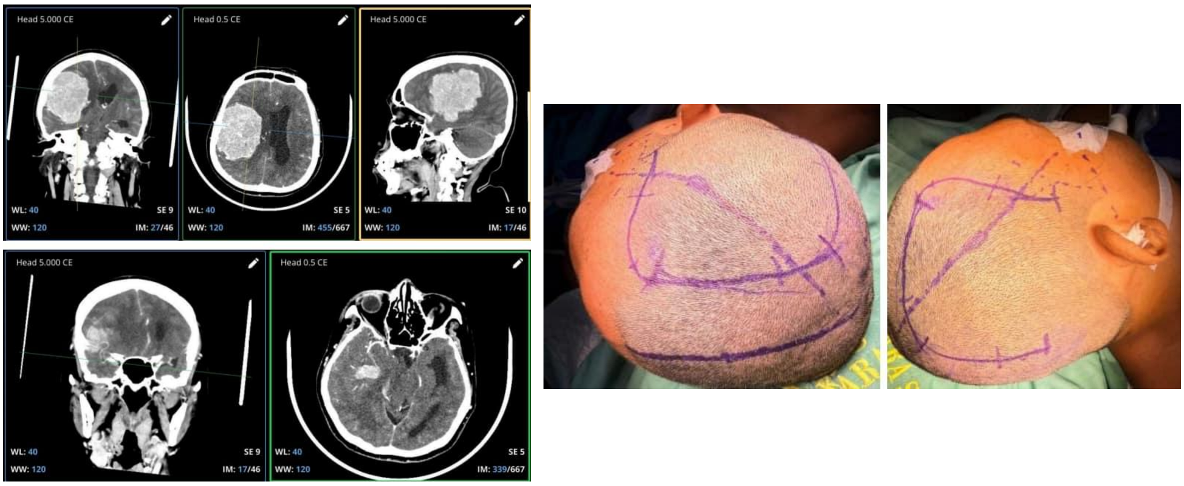
This case report presents descriptive data on clinical presentation, surgical technique, and postoperative outcomes. Long-term follow-up data are being collected prospectively.

Results

Baseline Patient Characteristics

A 46-year-old female presented to the emergency department with decreased consciousness for the past 6 hours. The patient also complained of progressively worsening dizziness over the preceding 3 days, which did not improve with medication. Over the past 5 years, the patient had experienced progressive right-sided weakness accompanied by a decline in communication ability. Preoperative clinical findings on admission, the patient's GCS score was E2V3M4, indicating significant impairment of consciousness. Neurological examination revealed right-sided hemiparesis (Grade 3/5) and dysarthria. Pupils were isocoric and reactive to light. No signs of meningeal irritation were observed.

Preoperative CT imaging of the head revealed a large extra-axial mass in the temporoparietal region with significant mass effect and midline shift. The tumor demonstrated characteristics consistent with meningioma, including broad dural attachment and hyperostosis of the adjacent calvarium. Importantly, the tumor was observed to be in close proximity to the MCA, raising concerns about vascular involvement during surgical resection in Figure 1a.



(a) (b)

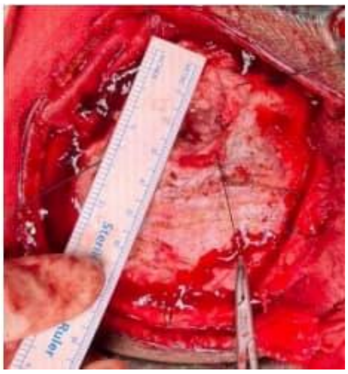
Figure 1. Tumor location and surgical approach. (a) Pre operative CT-Scan imagine for tumor observation (b) Patient positioning (Private documentation)

Patient Positioning and Gravity-Assisted Retraction

Determining the patient's position is a fundamental aspect of surgery. Proper positioning allows gravity to gently pull brain tissue away from the tumor, thereby minimizing the need for mechanical retraction. Gravity-assisted retraction not only provides better visualization but also reduces the risk of venous congestion and brain tissue damage. In this case, the patient was positioned supine with the head turned to the contralateral side (left). The right shoulder was elevated to create a flatter surgical field, facilitating tumor excision in Figure 1b.

Intraoperative Findings

The intraoperative phase commenced with a central dural incision of approximately 3 cm directly overlying the tumor in Figure 2a. The tumor was found to be a large, hypervascular, firm mass with broad dural attachment. The tumor-pia-arachnoidal plane was identified and preserved throughout the dissection. The MCA was identified in close proximity to the tumor capsule, with firm adherence in some regions. Internal decompression was successfully performed using surgical scissors and CUSA in Figure 2b. The tumor was removed in a stepwise, piece-by-piece fashion. Early devascularization of arterial feeders significantly reduced intraoperative blood loss. Systematic hemostasis was achieved using Surgicel, Gelfoam, and cotton patties in Figure 2c. In regions where the tumor capsule was firmly adherent to the MCA, meticulous dissection was performed to achieve gross total tumor removal while minimizing the risk of vascular injury in Figure 2d.



(a)

(b)

(c)

(d)

Figure 2. Intra-operative and debulking technique. (a) Centralized dural incision directly overlying the tumor mass (b) Tumor mass; (c) Normal brain parenchyma following tumor excision, demonstrating a well-relaxed brain without bulging; (d) Distance between tumor mass and normal brain (Private documentation)

Postoperative Clinical Outcome

At the time of postoperative assessment, the patient had regained full consciousness with a GCS score of E4V5M6 (GCS 15). Left-sided hemiparesis, which had been present preoperatively, demonstrated marked improvement following surgical decompression (Grade 4/5). The patient was subsequently referred for medical rehabilitation therapy to further optimize neurological recovery. Postoperative Imaging Postoperative CT of the head demonstrated a bony defect in the temporoparietal region, consistent with the craniotomy site. Residual hemorrhage was observed at the tumor base, with surrounding perihematomal edema. Notably, no residual extra-axial mass was identified, indicating successful gross removal of the tumor in Figure 3.

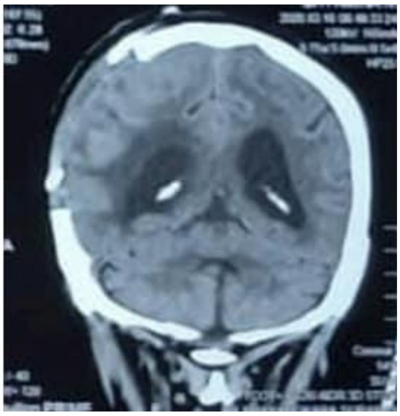


Figure 3. Radiological assessment post operative CT-Scan (Private documentation)

Discussion

Convexity meningiomas are generally considered the most surgically accessible of all intracranial meningiomas, with gross total resection achievable in the majority of cases.[2] However, the presence of neurovascular involvement particularly adherence to major cerebral vessels such as the MCA significantly complicates surgical management and increases the risk of morbidity[5]. This case illustrates the challenges inherent in managing a large convexity meningioma with MCA involvement, particularly when acute neurological deterioration necessitates emergent intervention.

The Simpson grading system remains the gold standard for assessing the extent of meningioma resection and predicting recurrence risk. Grade I resection (complete removal of the tumor, its dural attachment, and any involved bone) carries the lowest recurrence rate, while Grade IV resection (subtotal removal) is associated with significantly higher recurrence rates [3,5–7]. However, recent evidence suggests that the prognostic value of Simpson grading may vary according to tumor location. Voß et al. demonstrated that in convexity meningiomas, Simpson Grades I, II, and III may carry different recurrence risks compared to skull base meningiomas, with a less stringent threshold potentially acceptable in convexity lesions[8,9]. Similarly, Hasseleid et al. advocated that Simpson Grade I resection should remain the goal for convexity meningiomas, yet acknowledged that involvement of major vessels necessitates intraoperative judgment[8].

Otero-Rodriguez et al. re-evaluated the significance of Simpson Grade I, II, and III resections in WHO Grade I meningiomas, concluding that while Simpson I offers the lowest recurrence risk, Simpson II and III may still provide acceptable long-term control when complete resection is unsafe[8,10]. In this case, gross total resection was achieved with intentional preservation of a small adherent capsular remnant overlying the MCA, representing a Simpson Grade II or III resection depending on whether the dural attachment was completely excised.

Several key intraoperative principles guided the surgical strategy in this case: First, Gravity-Assisted Brain Retraction are **c**areful patient positioning allowed gravity to gently retract brain tissue away from the tumor, minimizing the need for mechanical retractors and reducing the risk of brain injury and venous congestion[11] This technique is particularly valuable in cases with significant mass effect, where mechanical retraction may exacerbate brain edema. The supine position with contralateral head rotation and shoulder elevation provided optimal exposure while minimizing pressure on the brain parenchyma. Second, Stepwise central debulking with a 0.5 cm safety margin allowed for gradual reduction in intracranial pressure and improved visualization of critical structures[10,11]. This approach is preferable to aggressive circumferential dissection, which may inadvertently injure adherent neurovascular structures. The central debulking technique creates space for safe peripheral dissection, reducing tension on the tumor-brain interface and minimizing the risk of cortical injury.

Third, the pial plane serves as a natural protective boundary between the tumor and the underlying brain parenchyma, and maintaining this plane minimizes the risk of cortical injury[2,12] In this case, particular attention was devoted to preserving the pial plane in areas where the tumor was adherent to the MCA, consistent with the anatomical challenges described in deep Sylvian fissure meningiomas[13]. The use of a CUSA facilitated internal decompression while preserving the integrity of the pial plane, allowing for safe mobilization of the tumor capsule. Fourth, early identification and coagulation of arterial feeders significantly reduced intraoperative blood loss and facilitated safer dissection.[2] Meningiomas are characteristically hypervascular, and early control of blood supply is a fundamental surgical principle that reduces operative time and morbidity. The hypervascular nature of meningiomas means that blood loss can be substantial, and early devascularization is essential for maintaining hemodynamic stability and providing a clear surgical field.

The “*Safety over Totality*” philosophy and adjuvant therapy. The decision to leave a small remnant of tumor firmly adherent to the MCA rather than risk catastrophic vascular injury reflects a growing acceptance of intentional subtotal resection followed by adjuvant treatment [13-15]. Stereotactic radiosurgery has been shown to be effective in controlling residual tumor growth following subtotal resection, with reported neurological improvement and increased tumor growth control[16].

Recent long-term cohort studies have further validated this approach. Teng et al. demonstrated that recurrence risk after meningioma resection shows temporal dynamics, with a significant proportion of recurrences occurring beyond 10 years, emphasizing the importance of long-term surveillance and adjuvant strategies[9]. Beighley et al. reported that image-guided stereotactic radiosurgery and fractionated radiotherapy provide excellent local control for intracranial meningiomas, including residuals in eloquent areas[10].

This philosophy aligns with contemporary neurosurgical thinking, which emphasizes patient safety and functional preservation over the pursuit of complete resection at all costs. As demonstrated in this case, the patient regained full consciousness and showed marked improvement in motor function, outcomes that might not have been achieved if aggressive dissection had been pursued.

Despite their size, giant convexity meningiomas can be safely resected with favorable outcomes. Studies on surgical resection of giant intracranial meningiomas have reported significant neurological improvement following maximum safe resection[16-17]. In a case of giant convexity en plaque anaplastic meningioma, surgical resection resulted in substantial neurological recovery despite the tumor's challenging characteristics.[17] These findings support the approach taken in our patient, where aggressive surgical treatment followed by neurorehabilitation produced meaningful clinical benefit.

The surgical principles employed in this case are consistent with established literature on convexity meningioma resection[2–4] Studies have demonstrated that gross total resection is achievable in 80–90% of convexity meningiomas, with recurrence rates of 3–10% at 5 years. However, the presence of neurovascular involvement increases the risk of incomplete resection and recurrence, highlighting the importance of careful patient selection and surgical planning. The use of the CUSA for internal tumor decompression is well-documented in the literature and has been shown to facilitate safer tumor resection by softening the tumor mass and reducing the need for aggressive traction. Similarly, early devascularization and meticulous hemostasis are recognized as fundamental surgical principles that reduce operative morbidity [2].

This case report has several limitations. First, it describes a single case, limiting the generalizability of the findings. Second, long-term follow-up data on tumor recurrence and functional outcomes are not yet available. Third, the absence of postoperative MRI (which is more sensitive than CT for detecting residual tumor) limits the ability to definitively assess the extent of resection. Fourth, the patient was not evaluated with a standardized functional outcome scale, which would have allowed for more objective assessment of neurological recovery. Finally, histopathological confirmation of meningioma subtype and WHO Grade (pending) would provide additional prognostic information and guide adjuvant therapy decisions.

Conclusion

This case illustrates the complexity of surgically managing a large convexity meningioma presenting with acute neurological deterioration. When elevated intracranial pressure mandates emergent intervention, the operative strategy must prioritize safe and effective decompression over the pursuit of gross total resection. Through gravity-assisted retraction, stepwise central debulking with a 0.5 cm safety margin, preservation of the pial plane and MCA, and systematic hemostatic control, adequate tumor removal was achieved without catastrophic neurovascular injury. Postoperative imaging confirmed successful tumor excision, and the patient demonstrated meaningful neurological recovery, regaining full consciousness with marked motor improvement. This case reinforces fundamental intraoperative principles: gravity-assisted retraction, early devascularization, meticulous dissection near critical structures, and accepting subtotal resection when complete removal risks irreversible harm. Adjuvant stereotactic radiosurgery remains a viable option for residual tumors. Continued advances in neurosurgery and intraoperative monitoring will further optimize outcomes in this challenging patient population.

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