Experience with 5-Aminolevulinic Acid in Fluorescence-Guided Resection of a Deep Sylvian Meningioma

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The 5-aminolevulinic acid (5-ALA)-induced tumor fluorescence is a useful intraoperative marker for the diagnosis and the detection of various malignancies, but its use in meningioma is only reported infrequently. In meningioma, a complete resection of the tumor mass is crucial for the prevention of recurrence and postoperative morbidities. Deep sylvian meningioma is a rare type of meningioma where complete tumor removal is complicated by its deep anatomical location and close involvement with the middle cerebral artery. From our experience, 5-ALA-mediated fluorescence facilitated a safe excision whilst preserving critical neurovascular structures. To our best knowledge, this is first report from use of 5-ALA in a deep sylvian meningioma.

Key Words : 5-aminolevulinic acid · Resection · Deep sylvian meningioma · Meningioma without dural attachment.
specific and a definitive preoperative diagnosis is difficult. Out of the 25 cases of deep sylvian meningiomas that have been reported in the literature, benign histology is the most common diagnosis (97%).

5-ALA is a natural precursor in the heme biosynthesis pathway that, when exogenously administered, results in the accumulation of fluorescent protoporphyrin IX (PpIX) in neoplastic cells with high sensitivity and specificity. Techniques have evolved that utilize the 5-ALA-induced tumor fluorescence to assist surgeons in intraoperative diagnosis and differentiation of benign from malignant neoplasms. This approach provides real-time visualization of the tumor margins, facilitating safe resection with minimal brain injury.

Fig. 1. A preoperative non-contrast enhanced axial CT (A) shows an area of high density in the left temporal lobe, most likely a calcification. An axial T2-weighted magnetic resonance (MR) image without contrast (B) shows a mass lesion of mixed signal intensity with edema located deep in the left Sylvian fissure. It displays heterogeneous contrast enhancement on a T1-weighted MR image (C). A post-operative axial T2-weighted MR image taken within 48 hours of the surgery (D) shows the resection cavity with a residual tumor tissue strongly adherent to the middle cerebral artery.

Fig. 2. An intra-operative photograph of the excised mass shone under the white light (A) is taken using the surgical microscope. Under the violet-blue excitation light (B), it exhibits strong red fluorescence, confirming the presence of a neoplasm.

Fig. 3. Pathological examination confirms the diagnosis of the fluorescent mass as a meningioma. Microscopically, the tissue demonstrates syncytial growth of meningothelial cells with bland-looking nuclei and psammoma bodies (H&E stain; original magnification ×200).
the neoplastic tissue. Its advantages are well documented in a wide range of malignancies\(^1,5,6,11,14,15\). In high-grade glioma where it is most extensively studied, 5-ALA has demonstrated utility as a safe, convenient method that improves the likelihood of complete tumor resection and the progression-free survival, compared to the conventional white-light microsurgery\(^11,15\). The benefit of 5-ALA in meningioma, on the contrary, is more controversial.

Like in other malignancies, 5-ALA-induced fluorescence has been recently reported in meningiomas with high sensitivity (83%) and specificity (100%)\(^4,7,10\). Albeit, a different mechanism of accumulation of fluorescent PpIX is proposed in meningiomas, due to their extra-axial origin, in comparison to the high-grade gliomas. Meningioma is a common type of intracranial tumor that is usually benign and slow growing. Maximal tumor elimination by surgery is the treatment of choice. On appearance, the pathology is usually well-circumscribed and a gross-total resection can be achieved with relatively few complications. Hence, the addition of 5-ALA as an adjunct in the surgical treatment of a meningioma may seem initially redundant. However, 5-ALA can still be occasionally useful where meningiomas present with a neurosurgical challenge. Occasionally, a gross-total resection of meningiomas can be limited by its complex location and close involvement with neurovascular structures. Tumor micro-invasions to the surrounding structures that were not expected from the preoperative radiology or a lesion that is hidden away from view of the naked eye or the surgical microscope can occur. To this effect, 5-ALA-induced bright fluorescence facilitates the optimal intraoperative tumor visualization, and furthermore, prevents indiscriminate excisions causing injuries to critical normal structures.

In the case presented, the mass was located deep in the Sylvian fissure, and was strongly attached to the nearby MCA and the sylvian vein. Moreover, uncharacteristic of a benign meningioma, the lesion was not well demarcated from the normal brain parenchyma further complicating the surgery. In such situations, aggressive excision with a goal of complete elimination may produce unacceptable postoperative neurological sequelae. With our case, the main tumor mass was removed grossly using the conventional white-light microsurgery. Then, fluorescence guidance was applied to carry out a safe resection. Minimal amounts of the tumor adherent to the vessels - hence, unable to be resected - were preserved.

**CONCLUSION**

Unlike in malignant gliomas, reports of 5-ALA-induced fluorescence-guided resection in meningiomas are limited. Using the standard white-light microsurgery, a complete excision of meningioma is usually achievable with favorable prognosis. However, less common types of meningiomas can present in complex locations where maximal tumor removal is difficult without causing significant postoperative morbidity. To this effect, the 5-ALA-enabled intraoperative tumor diagnosis may be of assistance. To the best of our knowledge, we report for the first time the experience of 5-ALA in a deep sylvian meningioma suggesting its possible usefulness. Further studies are warranted in order to confirm the benefit of 5-ALA-induced fluorescence in complex meningiomas.

**Acknowledgements**

This study was supported by a grant of the Seoul National University Hospital Research Fund (04-2011-1110).

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