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Introduction. Surgery of gliomas in eloquent areas: from brain hodotopy and plasticity to functional neurooncology

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In this issue of *Neurosurgical Focus*, the dilemma of the surgery for glial tumors in eloquent areas—with the goal to maximize the extent of resection while preserving or even improving the cerebral function—is covered from different aspects. Although the surgery has been a matter of debate for a long time, recent series have shown the significant impact of surgery on the natural history of low-grade[7] and high-grade gliomas.[8]

An in-depth knowledge of the anatomy of the CNS is crucial with regard to cortical (gyri and sulci) and subcortical (especially white matter pathways) structures. Nevertheless, because of the major interindividual anatomofunctional variability, relying solely on neuroanatomy is not sufficient to predict eloquence and thus to avoid the risks of postoperative permanent deficits. Recent advances in brain mapping methods have enabled a better understanding of brain processing in allowing us to identify the unique variations in patients. Functional neuroimaging and fiber tractography may help to identify eloquent areas before surgery, and they can be integrated into a multimodal neuronavigational system during resection. However, it is worth noting that these techniques are not yet reliable enough, especially methodologically regarding the selection of tasks, choice of biomathematical model, and in cases of glioma, neurovascular decoupling. Thus, intraoperative electrophysiological techniques (monitoring and electrostimulation mapping, particularly in awake patients) are still the gold standard for surgery of gliomas in eloquent structures. These techniques allow the detection of functional cortical areas as well as subcortical connectivity, on the condition that a rigorous methodology is applied. Therefore, it is possible to tailor the tumor resection according to individual functional boundaries to optimize the benefit/risk ratio of the surgery, namely to extend the surgical indications within regions usually considered inoperable (such as the Broca area, the central area, or the insula) and to increase the extent of resection by avoiding leaving a margin around the crucial areas while decreasing the rate of permanent deficit (< 2% in the recent literature) and even improving the quality of life of patients (particularly regarding seizure relief).[5]

In addition, a combination of these various techniques of pre-, intra-, and postoperative mapping is able to provide new insights into the anatomofunctional organization of the brain. It opens the door to the concept of brain "hodotopy" and plasticity, that is, a dynamic organization of the CNS constituted by parallel distributed networks that are interconnected and able to compensate themselves.[1,2] This plastic potential, which implies that the subcortical connectivity must be preserved, now makes it possible to consider a multistage surgical approach in tumors involving eloquent areas, especially in slow-growing lesions such as low-grade gliomas. The principle is to perform a second (or even a third) surgery after glioma regrowth in cases in which the first resection was incomplete for functional reasons. Indeed, it is possible the second time to improve the extent of tumor removal thanks to functional remapping over time. This reshaping can be induced by the first surgery itself, the tumor regrowth, and also partly by adapted programs of rehabilitation following the first operation.[6] Finally, from a fundamental point of view, such methodological and conceptual developments also participate in the better understanding of the neural foundations underlying cerebral processing. Nonetheless, ethical aspects of invasive human brain mapping must not be forgotten, given that the first goal of surgery is to be beneficial for the patient. To this end, longitudinal neuropsychological assessments, before and after each surgery, should be performed more systematically.[4]

In summary, neurosurgeons must now consider both the median survival and the quality of life to move toward a functional neurooncology.[3]

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