Brain Tumor Imaging: A Clinical (Surgical) Perspective

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Brain Tumor Surgery has significantly changed in the recent past, moving from procedures based on anatomical references to ones based on the functional recognition of cortical and subcortical essential structures, by means of intraoperative neurophysiology,and neuropsychology. This approach generally called as functional neuro-oncological surgery, allows the modern oncological neurosurgery to extend indications, increases the extent of resection and reduces permanent morbidity. Parallely, surgery has moved toward a multidisciplinary team approach, in which imaging is playing a peculiar role, along with the previous cited disciplines. Following the change of treatment paradigm from anatomy to function, brain tumor imaging has similarly gone through important modifications in the recent years. Clinicians, and neurosurgeon in particular, have been asking imaging to help in several questions. As a part of indications for surgery, imaging is asked to provide with anatomical information on tumor localization, tumor volume and tumor borders, along with differential diagnosis. The measurement of tumor speed of growth through serial volumetric analysis has been recognized as relevant as well for the indication of performing surgery. Moving from indications to surgical planning, at this time, imaging should provide with information on the relationship between the tumor mass and relevant vessels or nerves, according to the concept that maintenance of functional integrity depends also on the preservation of essential vascular supply. In this context, imaging is generically asked to provide the surgeon with functional information, giving an estimation of the degree of cortical and subcortical reorganization the brain has gone through as a result of the progressive tumor growth and peculiar patient history, the so called pre operative plasticity. In addition, imaging is also asked to generate metabolic information, and to define the degree of structural heterogeneity of the tumor, providing the clinicians also with molecular data. All this information are collected in the pre operative period, and merged with patient clinical history and neuropsychological and epileptic evaluation, serving in the decision process of choosing for surgery and how to perform it. Of course, the huge mass of relevant imaging information is also available during surgery, on line. In the theatre, imaging is faced with the direct information coming from intraoperative neurophysiology and neuropsychology. This combined approach allowed the validation of several imaging techniques and new imaging tools, defining their peculiar field of clinical application, and at the same time their integration allows to discover new brain functions. Various direct on line intraoperative systems are available today (intraop CT, MR, US) and the future will probably come from the integration of these systems, defining for each of them the cost benefit ratio of its clinical application, as well as in the improvement of the speed of imaging processing, In the post operative period and during the follow up, imaging is asked to provide with information on the effect of treatment, a demanding challenge considering the progresses of medical therapy and radiation oncology. The so called evaluation of the response is nowadays based not only on the analysis of serial morphological data, but also with functional and metabolic information. A further advance toward a more molecular approach will come as a consequence of the evolution of the field. In conclusion, imaging will be asked to play a significant role in the clinical field of neurooncology. Thanks to this strong multidisciplinary approach, neurooncology will reach more significant functional and oncological endpoints, keeping patient functional integrity and prolonging progression free survival and overall survival.