Pseudoprogression, recurrence and radiation necrosis

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Increased enhancement has been used as a surrogate for measuring tumor progression as part of the standard MacDonald criteria in response assessment of GBM (1). However recent studies have clearly indicated that increased gadolinium enhancement due to a disrupted blood-brain barrier may be influenced by a number of factors, including acute changes immediately after surgery or radiation therapy, corticosteroids, radiation necrosis or injury and effects to the vasculature (2,3). New treatment strategies for glioblastoma multiforme (GBM) have prolonged survival. For example the combination of temozolomide and radiation significantly prolongs survival compared with radiation alone and has become standard treatment for GBM (4). However treatment response assessment of GBM might be difficult as a result of the frequent occurrence of early imaging changes that are indistinguishable from tumor progression so called pseudoprogression (5-7) but also by delayed changes in form of radiation injury or necrosis (8). The incidence of pseudoprogression after concurrent chemotherapy and radiation is 15% to 30%.It have been suggested that the increased contrast enhancement seen in pseudoprogression may result from transient radiation effects on the vasculature, leading to vasodilatation, edema, and increased capillary permeability.

While pseudoprogression occurs early during ongoing treatment, radiation injury or necrosis might be seen much later during follow up scanning and remains a diagnostic dilemma (9, 10).

Different MR imaging methods are used such as for example MR spectroscopy, Dynamic susceptibility contrast enhanced MRI imaging and also new imaging analyzing methods like functional parametric response maps (11) are used in attempt to separate pseudoprogression from progressive tumor, or radiation necrosis from tumor recurrence. Also CT perfusion has shown some promising results (12,13) in this field.

The present presentation will focus on imaging findings of pseudoprogression and radiation injury and discuss if it is possible to distinguish these entities from progressive or recurrent brain tumor by the use of advanced imaging techniques and analyzing methods.

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