frontiers | Frontiers in Radiology

TYPE Editorial
PUBLISHED 12 June 2023
DOI 10.3389/fradi.2023.1204517

OPEN ACCESS

EDITED BY
Sotirios Bisdas,
University College London, United Kingdom

*CORRESPONDENCE
Nicoletta Anzalone
anzalone.nicoletta@hsr.it

RECEIVED 12 April 2023
ACCEPTED 18 May 2023
PUBLISHED 12 June 2023

CITATION
Anzalone N, Politi LS and Caulo M (2023) Editorial: Untangling post-treatment follow up of brain tumors: the role of neuroimaging. Front. Radiol. 3:1204517. doi: 10.3389/fradi.2023.1204517

Editorial: Untangling post-treatment follow up of brain tumors: the role of neuroimaging

Nicoletta Anzalone[1,2]*, Letterio S. Politi[3,4] and Massimo Caulo[5,6]

[1]Vita e Salute University, San Raffaele Hospital (IRCCS), Milan, Italy, [2]Neuroradiology Department, San Raffaele Hospital and Vita e Salute University, Milan, Italy, [3]Humanitas University, Pieve Emanuele, Milan, Italy, [4]IRCCS Humanitas Research Hospital, Rozzano, Milan, Italy, [5]University of Studies G. d'Annunzio Chieti and Pescara, Chieti, Italy, [6]Radiology Department, D'Annunzio University, Chieti, Italy

KEYWORDS

follow up of brain tumors, treatment effect, radionecrosis, perfusion, MR

Editorial on the Research Topic
Untangling post-treatment follow up of brain tumors: the role of neuroimaging

One of the most challenging issues that a neuroradiologist must face in brain tumor surveillance is to differentiate disease progression from treatment effects. This issue is well-known, and magnetic resonance imaging (MRI) with conventional acquisitions using gadolinium has reached its limits (1). A correlation between MRI timing with treatment phase has been shown to help with differential diagnosis (2), but the presence of late-onset cases render conventional imaging inconclusive. After introduction of the STUPP treatment protocol (3) as well as new immunotherapies for high-grade gliomas, treatment-related effects due to combined chemoradiotherapy have become increasingly present. The notorious "pseudoprogression," which involves an excessive inflammatory response that may mimic disease progression, is the hallmark of these treatment-related changes (4, 5). As for the effects of the monotherapy with irradiation, a correlation with the therapy timing may not provide diagnostic clues; pseudoprogression can also happen outside the more frequently described period (3–6 months) after treatment commencement. The limitations of conventional gadolinium-enhanced MRI have been very well described, and several recent studies have highlighted the merits of advanced MR techniques for the primary staging of brain tumors and their effective surveillance (6).

This special issue includes two reviews that describe in depth the role of MR advanced techniques such as perfusion, diffusion, and spectroscopy to differentiate disease progression from treatment effects in brain tumors with an emphasis on gliomas. Li and Iv considered the different potentials of each MR acquisition in their didactic review using representative cases. Malik et al. focused on the technical aspects of perfusion, especially those of dynamic susceptibility contrast-enhanced MRI, stressing the importance of relative cerebral blood volume thresholds to distinguish tumor progression from post-treatment radiation effects. In addition, the potential role of artificial intelligence along with machine learning and deep learning as diagnostic aids has been discussed, and the advantages of positron emission tomography (PET),

particularly the radiolabeled amino acid PET-tracers, have been reported (7). Li and Iv describe in detail their state-of-the-art use and role in differentiating disease progression from treatment effects. Moreover, the discussion dives beyond the STUPP protocol into the utility of advanced imaging techniques in patients receiving antineoangiogenic treatments such as bevacizumab, which is a popular second-line treatment for glioblastomas (8). Their effect on imaging findings through modification of the blood-brain barrier leads to shortcomings in the gadolinium-enhanced sequences and underpins the value of unenhanced acquisitions such as FLAIR and DWI (9). Gaudino et al. reported on MRI findings after regorafenib treatment, another antineoangiogenic molecule that has not previously been described in detail. Interestingly, two different patterns in MRI findings emerged during this treatment regimen, each related to a different prognosis. Furthermore, a case of a germinal thalamic tumor that showed spontaneous but transient regression after treatment with steroids is presented. This is a remarkably unusual case, indicating that response to treatment may also depend on a complex immune reaction cascade.

In conclusion, the contents of this special issue will provide the reader with useful and up-to-date information on how we can address the diagnostic challenges in the post-treatment imaging of brain tumors, a notoriously difficult task that can be made easier using advanced imaging techniques.

Author contributions

LP and MC contributed to the content of the manuscript and reviewed the paper. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors NA, LP and MC declared that they were an editorial board member of Frontiers at the time of submission. This had no impact on the peer review process and the final decision.

Publisher's note

References

1. Kumar AJ, Leeds NE, Fuller GN, Van Tassel P, Maor MH, Sawaya RE, et al. Malignant gliomas: MR imaging spectrum of radiation therapy and chemotherapy induced necrosis of the brain after treatment. *Radiology*. (2000) 217:377–84. doi: 10.1148/radiology.217.2.r00nv36377

2. Pruzincova L, Steno J, Srbecky M, Kalina P, Rychly B, Boljesikova E, et al. MR imaging of late radiation therapy and chemotherapy induced injury: a pictorial essay. *Eur Radiol*. (2009) 19:2716–27. doi: 10.1007/s00330-009-1449-8

3. Stupp R, Mason WP, van den Bent MJ, Weller M, Fisher B, Taphooorn MJB, et al. Radiotherapy plus concomitant and adjuvant temozolamide for glioblastoma. *New Engl J Med*. (2005) 352:987–96. doi: 10.1056/NEJMoa043330

4. Brandsma D, Stalpers L, Taal W, Sminia P, van den Bent MJ. Clinical features, mechanism, and management of pseudoprogression in malignant gliomas. *Lancet Oncol*. (2008) 9(5):453–61. doi: 10.1016/S1470-2045(08)70125-6

5. Thust SC, van den Bent MJ, Smits M. Pseudoprogression of brain tumors. *J Magn Reson Imaging*. (2018) 48(3):571–89. doi: 10.1002/jmri.26171

6. Strauss SB, Meng A, Ebani EJ, Chiang GC. Imaging glioblastoma posttreatment progression, pseudoprogression, pseudoresponse, radiation necrosis. *Radiol Clin N Am*. (2019) 57(6):1199–216. doi: 10.1016/j.rcl.2019.07.003

7. Prather K, O'Neal Christen M, Westrup Alison M, Tullos Hurtis J, Hughes Kendall L, Conner Andrew K. A systematic review of amino acid PET in assessing treatment response to temozolomide in brain glioma. *Neuro-oncol Adv*. (2022) 4(1):1–14.

8. Gilbert MR, Dignam JJ, Armstrong TS, Wefel JS, Blumenthal DT, Vogelbaum MA, et al. A randomized trial of bevacizumab for newly diagnosed glioblastoma. *New Engl J Med*. (2014) 370:699–708. doi: 10.1056/NEJMoa1308573

9. Hygino da Cruz LC, R.C. Domingues RC Jr, Gasparetto EL, Sorensen AG. Pseudoprogression and pseudoresponse: imaging challenges in the assessment of posttreatment glioma. *AJNR Am J Neuroradiol*. (2011) 32:1978–85. doi: 10.3174/ajnr.A2397