

T1 intensity: an indication of 1p 19q deletion in oligodendroglial neoplasms

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Introduction

Tumor genotype is becoming increasingly influential in guiding the treatment of brain tumors. Allelic losses on 1p and 19q have an incidence of 60-90% in oligodendroglioma cases^{1,2}. It has been found that tumors displaying the 1p 19q co-deletion are more responsive both to radiation and chemotherapy and have a longer overall survival^{3,4}. It would be highly beneficial for oncologists to have an indication of deletion status via imaging in cases where biopsy is not preferable. It has been found that 1p 19q deleted oligodendrogliomas tend to have a mixed intensity signal on T1 and that 1p 19q intact oligodendrogliomas and oligoastrocytomas have greater T1 signal homogeneity^{5,6}. In this study we aim to find an imaging characteristic that is more readily apparent and quantifiable in order to allow for easy identification of tumors with 1p 19q deletion status.

Methods

This current retrospective study included WHO grade II and III oligodendrogliomas, oligoastrocytomas, and mixed gliomas of oligodendroglial and astrocytic composition. Thirteen of these were 1p 19q deleted and eight tested negative for the deletion by fluorescence in situ hybridization (FISH) or loss of heterozygosity (LOH) studies. T1 values were extracted from the MRI scans most immediately preceding the biopsy or resection during which the sample used to determine deletion status was taken. Regions of interest (ROIs) corresponding to the region of enhancing tumor on a voxel-by-voxel basis on post-contrast T1 weighted images were drawn. In cases where there was more than one lesion, the ROI included only the one from which the biopsy was taken. We hypothesize that the reported pattern of patchy enhancement in 1p 19q deleted tumors will result in a lower mean T1 intensity as compared with the 1p 19q intact group. All MRI studies were performed on either a 1.5T GE CV or LX Scanner. Pre- and post-contrast T1 images were acquired (SE, TE/TR = 14-24ms/667 ms) before and after a 0.10 mmole/kg dose of Gadodiamide (Omniscan; Nycomed Amersham, Princeton, NJ).

Results

We did not find significant difference in the mean T1 intensity between 1p 19q intact and deleted tumors ($P > 0.05$). However, mean T1 intensity is significantly different between the intact and deleted groups of oligodendrogliomas and mixed gliomas whose primary component is oligodendroglial ($P < 0.005$, Figure 1). Statistical significance persists between intact and deleted anaplastic oligodendroglial neoplasms. Pictured on the far right are representative images showing increased signal intensity on T1 for the 1p 19q intact tumors in comparison to the deleted tumors (Figure 2A, 2C). The intratumoral regions that had lower signal intensity on T1 in deleted cases were also found to have higher signal intensity on T2, as shown in Figure 2C and Figure 2D.

Discussion

The finding that 1p 19q deleted oligodendroglial neoplasms tend to have a lower T1 intensity is useful for clinicians in determining preoperatively whether the tumor is likely to harbor the deletion and in subsequently gauging prognosis. The fact that there is statistical significance among the oligodendroglial neoplasms but not among the larger patient population suggests that the 1p 19q deletion has different characteristics in the astrocytic environment. Further research is necessary to discover the underlying cause of this decrease. Sources of lower signal intensity on T1-weighted images that would also generate the observed higher signal intensity on T2-weighted images include various kinds of cell death such as apoptosis, necrosis and ischemia. Since oligodendrogliomas with the deletion have been found to have higher counts of apoptotic bodies than those without the deletion, that there are increased proportions of cells undergoing apoptotic cell death in these regions of low intensity is an explanation worth exploring⁷. Further studies are needed to correlate regions of interest on T1-weighted images with apoptotic counts in order to link imaging with underlying biological differences in 1p 19q deleted oligodendroglial neoplasms. With a larger sample size, we hope to identify a threshold mean T1 intensity value below which all tumors could be believed to be 1p 19q deleted with reasonable confidence.

References

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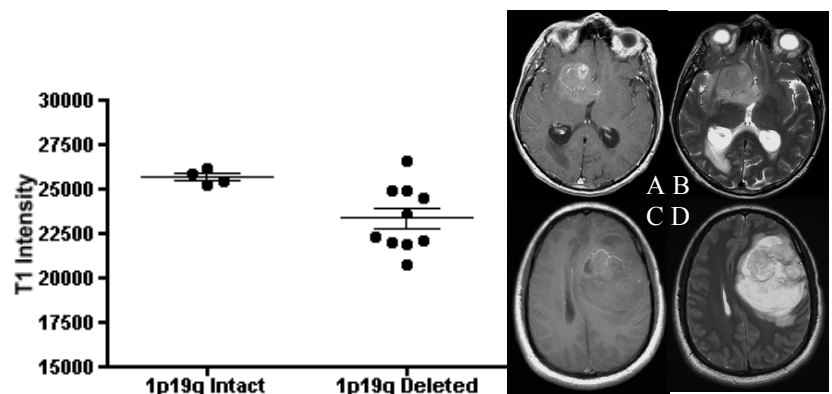


Figure 1. A) T1+C of anaplastic oligodendroglioma, 1p19q intact B) T2 corresponding to A C) T1+C of anaplastic oligodendroglioma, 1p19q deleted D) T2 corresponding to C