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Impact of corticosteroid administration on contrast-enhancing volume and diffusion MRI in treatment naïve glioblastoma

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Abstract

Background: Corticosteroids impact the radiographic interpretation of glioblastoma, including artificial reduction in contrast-enhancing tumor volume and intensity (i.e., a "pseudoresponse") and in the apparent coefficient diffusion (ADC). This study aimed to estimate the influence of corticosteroids on these measurements in treatment naïve glioblastoma before surgery.

Methods: 57 pairs of MRI scans from 54 patients with pre-surgical treatment-naïve glioblastoma were retrospectively grouped as increased (n=29, all corticosteroid-free at baseline), stable (n=25), or decreased (n=3) corticosteroid dose between scans (median interval: 15 days). Tumor size and ADC changes between timepoints were compared between lesions with increased and stable corticosteroids. Volumetric changes ascribable to increased corticosteroid dose was modeled, adjusting for the time between scans.

Results: Increased corticosteroid dose showed an observed volumetric shrinkage of the contrast-enhancing tumor (median: -23.7%) and reduction in estimated growth rates (median: -2.48% per day), significantly different ($p < 0.0001$) from the control group receiving a stable dose (median: +36.0% volume; +2.08% growth rate). When adjusting for the time interval between scans, the estimated corticosteroid-induced volumetric shrinkage was 44.0% ($p < 0.0001$, 95%C.I. 25.7-62.2%). Increased corticosteroid dose also decreased ADC in the contrast-enhancing tumor (median: 180, IQR=39-281 $\times 10^{-6}$ mm²/s, $p = 0.0005$).

Conclusion: Corticosteroid administration can induce a significant "pseudoresponse" in glioblastoma, with an observed reduction in contrast-enhancing tumor volume of 23.7% and a time interval adjusted reduction of 44.0% (25.7-62.2%), and an ADC drop of 180 $\times 10^{-6}$ mm²/s (14.2%). These data confirm that radiographic measurements are impacted by corticosteroids and provide benchmarks for development of adjusted response criteria accounting for corticosteroid use.

Keywords: Glioblastoma; corticosteroids; glucocorticoids; magnetic resonance imaging; pseudoresponse.