Differentiation between Nonenhancing Tumor in Glioblastoma and Vasogenic Edema

Here is a structured summary of the key findings and implications of **Alizada et al.**:

Key findings

1. **Study aim & design**

   - The study retrospectively examined 111 glioblastoma patients (from January 2022 to December 2023) with available pretreatment MRIs, to assess whether diffusion-weighted imaging (DWI) and dynamic susceptibility contrast (DSC) perfusion MRI metrics could distinguish **non-enhancing glioblastoma tissue** from **vasogenic edema**. PubMed+1

   - They included:
     • 13 patients (15 lesions) with *solid nonenhancing glioblastoma* (i.e. tumor tissue without contrast enhancement) PubMed
     • 98 patients with perilesional nonenhancing T2/FLAIR hyperintensity surrounding enhancing glioblastomas (as a proxy for edema / infiltrated areas) PubMed+1
     • Additionally, 30 brain metastasis cases (age- and sex-matched to the nonenhancing GBM group) were used for comparison PubMed

2. **Quantitative MRI results: ADC and rCBV differences**

   - **Apparent diffusion coefficient (ADC):**
     • The mean ADC in solid nonenhancing glioblastoma was significantly lower than in vasogenic edema (1.08×10^{-3} mm²/s [SD 0.22] vs. 1.74×10^{-3} mm²/s [SD 0.17]) ($P < .001$). PubMed+1
     • In contrast, perilesional nonenhancing T2/FLAIR hyperintense regions around enhancing GBM had ADC values statistically indistinguishable from vasogenic edema (1.67×10^{-3} vs. 1.74×10^{-3}; $P = .32$). PubMed+1

   - **Relative cerebral blood volume (rCBV):**
     • Solid nonenhancing glioblastoma showed markedly higher rCBV than vasogenic edema (mean 2.4 [SD 0.86] vs. 0.30 [SD 0.13]) ($P < .001$). PubMed+1
     • The perilesional nonenhancing FLAIR regions also demonstrated significantly elevated rCBV compared to pure edema (0.60 [SD 0.61] vs. 0.30 [SD 0.13]; $P = .03$). PubMed+1

3. **Diagnostic thresholds & performance**

- For **distinguishing solid nonenhancing tumor vs. vasogenic edema**, the optimal thresholds were:
  - ADC ≤ 1.36 × 10⁻³ mm²/s
  - rCBV ≥ 1.04

- Using those cutoffs, the sensitivity ranged from 0.93 to 1.00 and specificity was 1.00 (i.e. perfect specificity) in this cohort. PubMed+1

- For **perilesional nonenhancing FLAIR regions**, to separate tumor infiltration from pure edema, an rCBV cutoff of 0.42 provided 86% specificity. PubMed+1

4. **Interpretation & implications**

- Diffusion (ADC) and perfusion (rCBV) MRI metrics hold strong discriminative power between **nonenhancing glioblastoma tissue** and **vasogenic edema**, especially when both parameters are considered. AJNR+1

- The findings suggest that **nonenhancing tumor foci** often present with **restricted diffusion** (lower ADC) and elevated perfusion (higher rCBV), reflecting greater cellularity and vascularity compared to edema. AJNR+1

- In perilesional regions, tumor infiltration may raise perfusion (rCBV) even when diffusion metrics are not distinct, offering an adjunct marker to detect infiltrative tumor beyond what ADC alone shows. PubMed+1

- These imaging biomarkers and threshold values may assist in better **preoperative planning**, more precise **image-guided biopsy/targeting**, and improved delineation of tumor margins versus edema. AJNR+1

5. **Limitations & caveats** (as noted by authors)

- Retrospective design and limited sample size for nonenhancing tumor group (only 13 patients, 15 lesions). PubMed+1

- The thresholds need external validation in larger, prospective cohorts. (Authors acknowledge the need for further study.) AJNR+1

- Potential overlap in imaging metrics in heterogenous or mixed regions; some infiltrated edema may not fully segregate by ADC or rCBV alone.

- The study focuses on pretreatment imaging; it does not address longitudinal changes or treatment effects.

Summary statement

Alizada et al. show that combining diffusion-weighted and perfusion-weighted MRI, specifically ADC and rCBV, can reliably differentiate *nonenhancing glioblastoma tissue* from *vasogenic edema*. They propose specific threshold values (ADC ≤ 1.36 × 10⁻³ mm²/s; rCBV ≥ 1.04) with high sensitivity and perfect

specificity in their cohort. Additionally, even in nonenhancing perilesional FLAIR areas, elevated rCBV (above ~0.42) may indicate tumor infiltration. These findings, if validated, could refine image-based delineation of tumor margins and assist in surgical/radiation planning.

Citation (Vancouver style)

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