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Comparison of arterial spin labeling and dynamic susceptibility contrast perfusion MR imaging in pediatric brain tumors: A systematic review and meta-analysis

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Abstract

Background: Brain tumors are a leading cause of mortality in children. Accurate tumor grading is essential to plan treatment and for prognostication. Perfusion imaging has been shown to correlate well with tumor grade in adults, however there are fewer studies in pediatric patients. Moreover, there is no consensus regarding which MR perfusion technique demonstrates the highest accuracy in the latter population.

Purpose: To compare the diagnostic test accuracy of dynamic-susceptibility contrast and arterial spin-labelling, in their ability to differentiate between low-and high-grade pediatric brain tumors at first presentation.

Data sources: Articles were retrieved from online electronic databases: MEDLINE (Ovid), Web of Science Core Collection and SCOPUS.

Study selection: Studies in pediatric patients with a treatment naïve diagnosed brain tumor and imaging including either ASL or DSC or both, together with a histological diagnosis were included. Studies involving adult patient or mixed age populations, studies with incomplete data and those which used dynamic contrast enhanced perfusion were excluded.

Data analysis: The sensitivities and specificities obtained from each study were used to calculate the true-positive, true-negative, false-positive, and false-negative count. A case was defined as a histologically proven high-grade tumor. The random-effect model was used to merge statistics. Significance level was set at $p < 0.05$.

Data synthesis: Forest plots showing pairs of sensitivity and specificity, with their 95% confidence intervals, were constructed for each study. The bivariate model was applied in order to account for between-study variability. The SROC plots were constructed from the obtained data-sets. The AUC for the SROC of all studies was estimated to determine the overall diagnostic test accuracy of perfusion MRI, followed by a separate comparison of the SROC of ASL versus DSC studies.

Limitations: Small and heterogenous sample size.

Conclusions: The diagnostic accuracy of ASL was found to be comparable and not inferior to DSC, thus its use in the diagnostic assessment of pediatric patients should continue to be supported.

Abbreviations: ASL = arterial spin labelling, DSC = dynamic susceptibility contrast, DCE = dynamic contrast-enhanced, rCBF = relative cerebral blood flow, rCBV = relative cerebral blood volume, MTT = mean transfer time, TR = repetition time, TE = echo time, SROC = summary receiver operating characteristics, HG= high-grade, LG = low-grade, AUC = area under the curve, PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

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