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Umbrella review and network meta-analysis of diagnostic imaging test accuracy studies in Differentiating between brain tumor progression versus pseudoprogression and radionecrosis

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Abstract

Purpose: In this study we gathered and analyzed the available evidence regarding 17 different imaging modalities and performed network meta-analysis to find the most effective modality for the differentiation between brain tumor recurrence and post-treatment radiation effects.

Methods: We conducted a comprehensive systematic search on PubMed and Embase. The quality of eligible studies was assessed using the Assessment of Multiple Systematic Reviews-2 (AMSTAR-2) instrument. For each meta-analysis, we recalculated the effect size, sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio from the individual study data provided in the original meta-analysis using a random-effects model. Imaging technique comparisons were then assessed using NMA. Ranking was assessed using the multidimensional scaling approach and by visually assessing surface under the cumulative ranking curves.

Results: We identified 32 eligible studies. High confidence in the results was found in only one of them, with a substantial heterogeneity and small study effect in 21% and 9% of included meta-analysis respectively. Comparisons between MRS Cho/NAA, Cho/Cr, DWI, and DSC were most studied. Our analysis showed MRS (Cho/NAA) and 18F-DOPA PET displayed the highest sensitivity and negative likelihood ratios. 18-FET PET was ranked highest among the 17 studied techniques with statistical significance. APT MRI was the only non-nuclear imaging modality to rank higher than DSC, with statistical insignificance, however.

Conclusion: The evidence regarding which imaging modality is best for the differentiation between radiation necrosis and post-treatment radiation effects is still inconclusive. Using NMA, our analysis ranked FET PET to be the best for such a task based on the available evidence. APT MRI showed promising results as a non-nuclear alternative.

Keywords: Network meta-analysis; Pseudoprogression; Radiation necrosis; Radionecrosis; Tumor recurrence.

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