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Intraoperative MRI in pediatric epilepsy and neuro-oncology: a systematic review and meta-analysis

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Abstract

Objective: Intraoperative magnetic resonance imaging (iMRI) use is becoming increasingly widespread in neurosurgical practice, and most of the data reporting its use are in adult populations. There is less evidence on the use of iMRI in pediatric neurosurgery. The aim of this paper was to synthesize the available literature into a systematic review and meta-analysis to evaluate the evidence for iMRI in pediatric neurosurgery, with a particular focus on neuro-oncology and epilepsy surgery.

Methods: This review was registered on PROSPERO and conducted according to PRISMA guidelines. A comprehensive search strategy of Medline via Ovid and Embase was conducted with predetermined key terms. Studies in English reporting the outcomes of patients < 21 years of age who underwent neuro-oncological or epilepsy surgery with the use of iMRI were included in the study. The types of studies eligible for inclusion were observational case-control and cohort studies, randomized clinical trials, cross-sectional studies, editorials, case series, and commentaries. Articles were de-duplicated and abstracts independently screened for inclusion by two reviewers. Full texts were screened, and data on demographic characteristics, etiology, outcome (extent of resection for neuro-oncology and Engel class for epilepsy), and technical iMRI data were extracted.

Results: Thirty-five articles were included in the review, 25 of which were observational cohort studies. Four articles were suitable for meta-analysis. In total, 1217 patients underwent iMRI-guided neuro-oncology surgery in 26 studies, most commonly for gliomas (n = 443). A total of 148 patients underwent iMRI-guided epilepsy surgery in 9 studies, with focal cortical dysplasia being the most common diagnosis (n = 95). The mean \pm SD operating time was 357 \pm 94 minutes (12 studies), with a mean of 1.32 scans per patient. There was a mean re-entry rate into the operative field of 42% (across 20 studies). Complications were noted in 21% of epilepsy surgery patients and 11% of neuro-oncology surgery patients. Meta-analysis of 4 eligible studies revealed that iMRI was more likely to lead to better Engel outcomes in terms of seizure freedom (OR 3.84, 95% CI 1.38-10.68, p = 0.69) and complete tumor resection (OR 3.19, 95% CI 0.28-36.92, p = 0.06).

Conclusions: iMRI appears to be a useful adjunct in optimizing resective pediatric epilepsy and neuro-oncology surgery, with a low complication rate.

Keywords: brain neoplasms; epilepsy; magnetic resonance imaging; meta-analysis; pediatrics.

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