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Resting-State Functional MRI: Current State, Controversies, Limitations, and Future Directions- *AJR* Expert Panel Narrative Review

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Abstract

Resting-state functional MRI (rs-fMRI), a promising method for interrogating different brain functional networks from a single MRI acquisition, is increasingly utilized in clinical presurgical and other pretherapeutic brain mapping. However, challenges in standardization of acquisition, preprocessing, and analysis methods across centers, and variability in results interpretation, complicate its clinical use. Additionally, inherent problems regarding reliability of language lateralization, interpatient variability of cognitive network representation, dynamic aspects of intranetwork and internetwork connectivity, and effects of neurovascular uncoupling on network detection still must be overcome. Although deep-learning solutions and further methodologic standardization will help address these issues, rs-fMRI remains generally considered an adjunct to task-based fMRI (tb-fMRI) for clinical presurgical mapping. Nonetheless, in many clinical instances, rs-fMRI may offer valuable additional information that supplements tb-fMRI, especially if tb-fMRI is inadequate due to patient performance or other limitations. Future growth in clinical applications of rs-fMRI is anticipated as challenges are increasingly addressed. In this *AJR* Expert Panel Narrative Review, we summarize the current state and emerging clinical utility of rs-fMRI, focusing on its role in presurgical mapping. We present ongoing controversies and limitations in clinical applicability and discuss future directions including the developing role of rs-fMRI in neuromodulation treatment for various neurologic disorders.

Keywords: ICA; SCA; brain-tumor; epilepsy; global-signal-regression; neurovascular-uncoupling; resting state fMRI; rsfMRI.

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