

INPLASY PROTOCOL

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None declared.

Surgical effects of stereo EEG and MRI-guided laser interstitial fever in the treatment of refractory epilepsy: a systematic review and meta-analysis

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Review question / Objective: MRI-guided laser interstitial thermal therapy (MRg-LITT) is an alternative to open epilepsy surgery. This meta-analysis aimed to review the effectiveness of the combination of SEEG and MRg-LIT in the treatment of drug-resistant epilepsy (DRE).

Condition being studied: Epilepsy is a common condition, with an average prevalence of 0.55% in high-income countries; As such, it can be considered one of the most common neurological disorders in the world, with significant implications for patients and the health care system. Drug-resistant epilepsy requires referral to an epilepsy surgery centre to consider alternative therapies, including epilepsy surgery. The use of stereoscopic electroencephalogram (SEEG) methods is growing explosively worldwide. It is now the preferred method for intracranial monitoring of epilepsy. MRg-LIT is a minimally invasive procedure that causes epileptic foci by laser energy ablation. Targeted thermal energy leads to protein denaturation and coagulative necrosis. Stereoscopic electroencephalogram (SEEG) and mri-guided laser interstitial hyperthermia (MRgLITT) have emerged as safe and effective minimally invasive techniques for locating and treating drug-resistant epilepsy.

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 14 May 2023 and was last updated on 14 May 2023 (registration number INPLASY202350054).

INTRODUCTION

Review question / Objective: MRI-guided laser interstitial thermal therapy (MRg-LITT) is an alternative to open epilepsy surgery.

This meta-analysis aimed to review the effectiveness of the combination of SEEG and MRg-LIT in the treatment of drug-resistant epilepsy (DRE).

Rationale: This meta-analysis aimed to review the effectiveness of the combination of SEEG and MRg-LIT in the treatment of drug-resistant epilepsy (DRE).

Condition being studied: Epilepsy is a common condition, with an average prevalence of 0.55% in high-income countries; As such, it can be considered one of the most common neurological disorders in the world, with significant implications for patients and the health care system. Drug-resistant epilepsy requires referral to an epilepsy surgery centre to consider alternative therapies, including epilepsy surgery. The use of stereoscopic electroencephalogram (SEEG) methods is growing explosively worldwide. It is now the preferred method for intracranial monitoring of epilepsy. MRg-LIT is a minimally invasive procedure that causes epileptic foci by laser energy ablation. Targeted thermal energy leads to protein denaturation and coagulative necrosis. Stereoscopic electroencephalogram (SEEG) and mri-guided laser interstitial hyperthermia (MRgLITT) have emerged as safe and effective minimally invasive techniques for locating and treating drug-resistant epilepsy.

METHODS

Search strategy: Electronic literature searches were conducted using MEDLINE/PubMed, Scopus, Cochrane and EMBASE databases from 2013 to May 2023. Keywords used include in the title, abstract, or keywords (laser interstitial therapy [AND] refractory epilepsy) or (SEEG[AND] refractory epilepsy). The compiled bibliography is then reviewed for potential relevance. The included bibliographic studies are also used to search for missing articles. This study was planned and executed in accordance with published Preferred Reporting Items for Systematic Reviews and meta-analysis (PRISMA) guidelines.

Participant or population: The included studies met the following criteria: (1) if $n \geq 5$ patients were reported to receive a combination of SEEG and MRg-LITT for

DRE, and Follow-up duration of at least 6 months to ensure stability of Engel results¹⁰; (2) report the free rate of postoperative seizures; (3) Use English. We excluded the following studies: (1) not associated with exposure (treatment with SEEG and MRg-LITT) or outcome (absence of seizures, reoperation rate and postoperative complications); (2) Focus on technical aspects, no patient information; (3) $n < 5$ cases; (4) seizure results not reported using Engel et al.¹¹ or a directly translatable scale; (5) include older data published in newer articles at the same epilepsy center to avoid unquantified duplication bias; (6) case reports, reviews, abstracts – records only, short correspondence such as letters and comments to editors. (7) Not using English. Literature that did not meet the criteria was excluded because the quality of such studies could not be adequately assessed. Multiple articles from the same study population were analysed. Figure 1 summarizes the selection process for this article, and Table 1 lists the included studies. Two independent reviewers applied inclusion criteria to PubMed search results; There are no disagreements. Three independent reviewers applied exclusion criteria to the remaining articles. There are 3 examples of disagreement, and in each case, the opinion of 2 agreeing authors is used.

Intervention: If $n \geq 5$ patients were reported to receive a combination of SEEG and MRg-LITT for DRE, and Follow-up duration of at least 6 months to ensure stability of Engel results¹⁰.

Comparator: Report the rate of seizure freedom after surgery.

Study designs to be included: Risk of bias was assessed using the Newcastle-Ottawa Quality Assessment Scale (NOS) for observational studies, and all six included studies were mostly of high quality. All studies clearly stated their respective objectives, population characteristics, interventions, and outcomes. Most studies did not include consecutive patients, using only descriptive statistics to describe their

results. Nevertheless, the results were clear, study populations were comparable, and all articles were adequately followed postoperatively. The funnel chart check did not show significant asymmetry (Figure 5) and E.

Eligibility criteria: The included studies met the following criteria: (1) if $n \geq 5$ patients were reported to receive a combination of SEEG and MRg-LITT for DRE, and Follow-up duration of at least 6 months to ensure stability of Engel results¹⁰; (2) report the free rate of postoperative seizures; (3) Use English. We excluded the following studies: (1) not associated with exposure (treatment with SEEG and MRg-LITT) or outcome (absence of seizures, reoperation rate and postoperative complications); (2) Focus on technical aspects, no patient information; (3) $n < 5$ cases; (4) seizure results not reported using Engel et al.¹¹ or a directly translatable scale; (5) include older data published in newer articles at the same epilepsy center to avoid unquantified duplication bias; (6) case reports, reviews, abstracts – records only, short correspondence such as letters and comments to editors. (7) Not using English. Literature that did not meet the criteria was excluded because the quality of such studies could not be adequately assessed. Multiple articles from the same study population were analysed. Figure 1 summarizes the selection process for this article, and Table 1 lists the included studies. Two independent reviewers applied inclusion criteria to PubMed search results; There are no disagreements. Three independent reviewers applied exclusion criteria to the remaining articles. There are 3 examples of disagreement, and in each case, the opinion of 2 agreeing authors is used.

Information sources: The MEDLINE/ PubMed, Scopus, Cochrane and EMBASE databases were searched for publications between 2014 and May 2023. Data on the Engel Epilepsy Surgery Prognosis Scale (grade I-IV) and postoperative complications were analysed at 95% CI.

Main outcome(s): Six studies (172 patients) were analysed. The overall prevalence of Engel grade I outcomes was 55% (95% confidence interval 47% to 62%). Side effects appear to be rare, the most common being neurological deficits.

Quality assessment / Risk of bias analysis: Risk of bias was assessed using the Newcastle-Ottawa Quality Assessment Scale (NOS) for observational studies, and all six included studies were mostly of high quality. All studies clearly stated their respective objectives, population characteristics, interventions, and outcomes. Most studies did not include consecutive patients, using only descriptive statistics to describe their results. Nevertheless, the results were clear, study populations were comparable, and all articles were adequately followed postoperatively. The funnel chart check did not show significant asymmetry (Figure 5) and Egger's test ($P = 0.755$) was not rejected (Figure 6).

Strategy of data synthesis: We analysed data at the study level. We calculated the combination of SEEG and MRg-LIT for people with drug-resistant epilepsy Good prognosis rate after surgery. Random-effects meta-analysis using DerSimonian and Laird methods to calculate the combined good outcome rate; Estimates of 95% confidence intervals (CIs) were made using precise methods. The effect size is expressed as a percentage of ENGEL I in the patient's seizures. Use Stata version 17 (StataCorp, College Station, TX, USA) and the user-written package metaprop to do all Statistical analysis¹² for proportional random-effects meta-analysis and db metan subgroup analysis.

Subgroup analysis: Our analysis showed that the overall seizure-free prevalence decreased from 57% (95% CI 0.48% to 0.66%) with a shorter follow-up duration (12-24 months) to 49% (95% CI 0.35% to 0.63%) when the mean follow-up duration was longer than 24 months (Supplementary Table 4). The data showed that the result of increased follow-up duration was slightly

worse than that of extended follow-up after epilepsy resection.

Sensitivity analysis: No sensitivity analysis is required for single-group rates.

Country(ies) involved: China.

Keywords: Refractory epilepsy; Laser interstitial thermal therapy (LITT); Stereoelectroencephalography (SEEG); drug-resistant epilepsy (DRE); Epilepsy surgery; Seizure freedom; Meta-analysis.

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