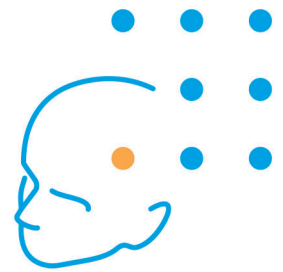


VALUE OF SISCOM (SUBTRACTION ICTAL SPECT CO-REGISTERED TO MRI) IN PRESURGICAL EVALUATION OF EPILEPSY: A PROSPECTIVE STUDY



Joachim von Oertzen¹, Karl Reichmann², Ulrike Lengler¹, Horst Urbach³, Hans J. Biersack² and Christian E. Elger¹
 Departments of ¹Epileptology, ²Nuklear Medicine, and ³Radiology - Neuroradiology, University of Bonn, 53105 Bonn, Germany

RATIONAL:

In presurgical evaluation of patients with epilepsy discordant results or non-lesional MRI might complicate diagnostic work up. Ictal SPECT especially when postprocessed as subtraction ictal SPECT co-registered to MRI (SISCOM) might be an additional useful diagnostic tool. Previous studies have shown that SISCOM has the same diagnostic value than intracranial EEG. We examined the prospective value of SISCOM in presurgical evaluation of difficult cases with either non-lesional MRI or discordant results in semiology, EEG-recordings, MRI and/or neuropsychological testing.

METHODS:

116 patients with medically intractable epilepsy undergoing presurgical evaluation were included. Patients showed no abnormalities in MRI or discordant results of MRI, EEG, seizure semiology and/or neuropsychological testing.

SPECT:

For ictal SPECT about 370-740 MBq HMPAO were injected intravenously as soon as possible after ictal onset. Injection was performed by an automatic injector (XT 7000, Ulrich Medizintechnik, Ulm, Germany), operated by the EEG assistants, placed next to the EEG-Video-monitoring screen. Interictal SPECT was performed 48 h later.

SPECT imaging was performed with a CERASPECT (Digital Scintigraphics, Inc., Waltham, MA) with a FWHM of 6-8 mm. The field of view diameter was 214 mm and the matrix size was 128 x 128 resulting in 64 images with cubic voxel dimensions of 1.67 mm. A 3D-T1 weighted MRI dataset was performed on a 1,5 T ACS-NT system (Philips, Best, The Netherlands). SISCOM was calculated with ANALYZE PC 3.0/4.0 software (Biomedical Imaging Resource, Mayo Foundation, Rochester, MN) as described previously.¹ Minimum threshold for activation map was two standard deviations above mean cerebral activity. (Fig. 1)

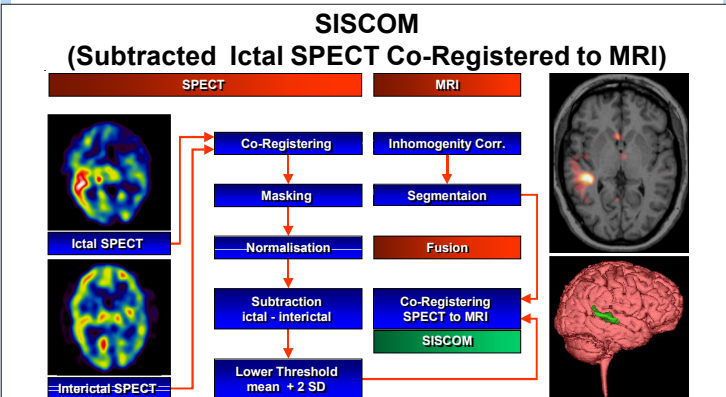


Fig. 1: Scheme of SISCOM method.

RESULTS:

In 29 cases, no seizure took place in the required time period. 87 SPECTs were successfully injected. Median injection time was 13 s (range 2-90s). For MRI diagnosis² of the successfully injected cases see figure 2. SISCOM results were monofocal in 51% of cases, multifocal in 34%, and without any significant hyperperfusion in 5%. 9% could not be calculated due to insufficient quality of ictal SPECT (i.e. movement artefacts). In 25%, SISCOM hyperperfusion was localized in functional eloquent brain areas.

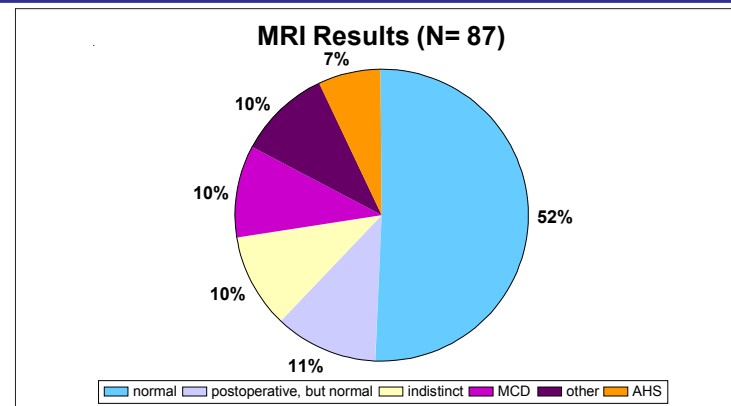


Fig. 2: Distribution of MRI results in 87 patients with epilepsy undergoing ictal SPECT during presurgical evaluation. (MCD = malformations of cortical development; AHS = Ammon's horn sclerosis)

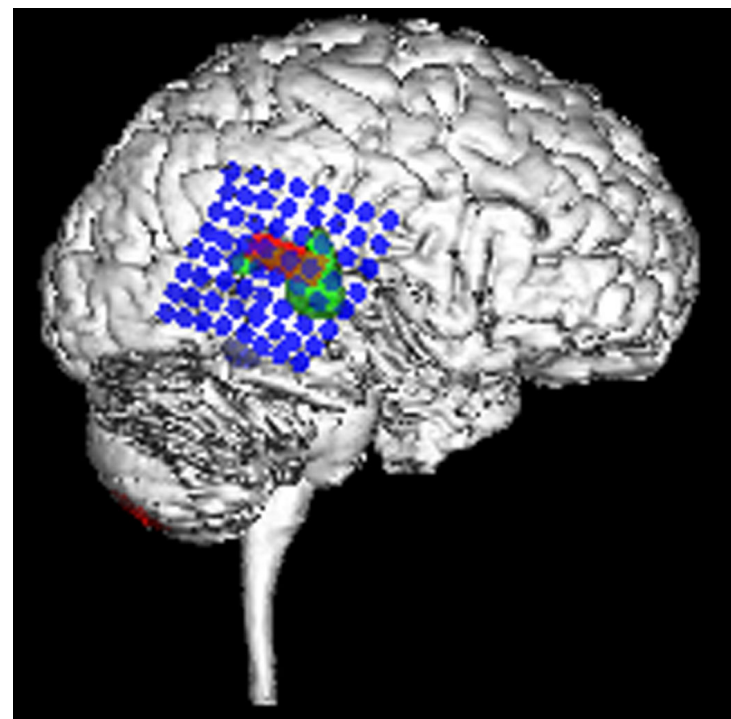


Fig. 3: 19 year old patient with drug-resistant epilepsy, who underwent anterior 2/3 temporal lobectomy 8 years before without long lasting improvement. Reevaluation with MRI showed postoperative defect but no other focal abnormalities, ictal and interictal EEG did not point to a circumscribed focus. Surface brain rendering with right sided view, SISCOM result (green), intracranial electrode contacts (blue) and ictal onset zone (red). Topectomy of superior temporal gyrus was performed, the patient is free of seizures since operation (12 month).

Fig. 4: 22 year old patient with drug resistant epilepsy. Seizure semiology included frontal and temporal elements, MRI showed no abnormalities, SISCOM showed hyperperfusion fronto-orbital and temporal, both on the left side. Intracranial electrode implantation (bitemporo-basal, bitemporo-lateral, and left fronto-lateral and -orbital strip electrodes and bihippocampal depth electrodes) revealed seizure onset simultaneously left temporal and fronto-orbital. Therefore, surgical intervention was denied.

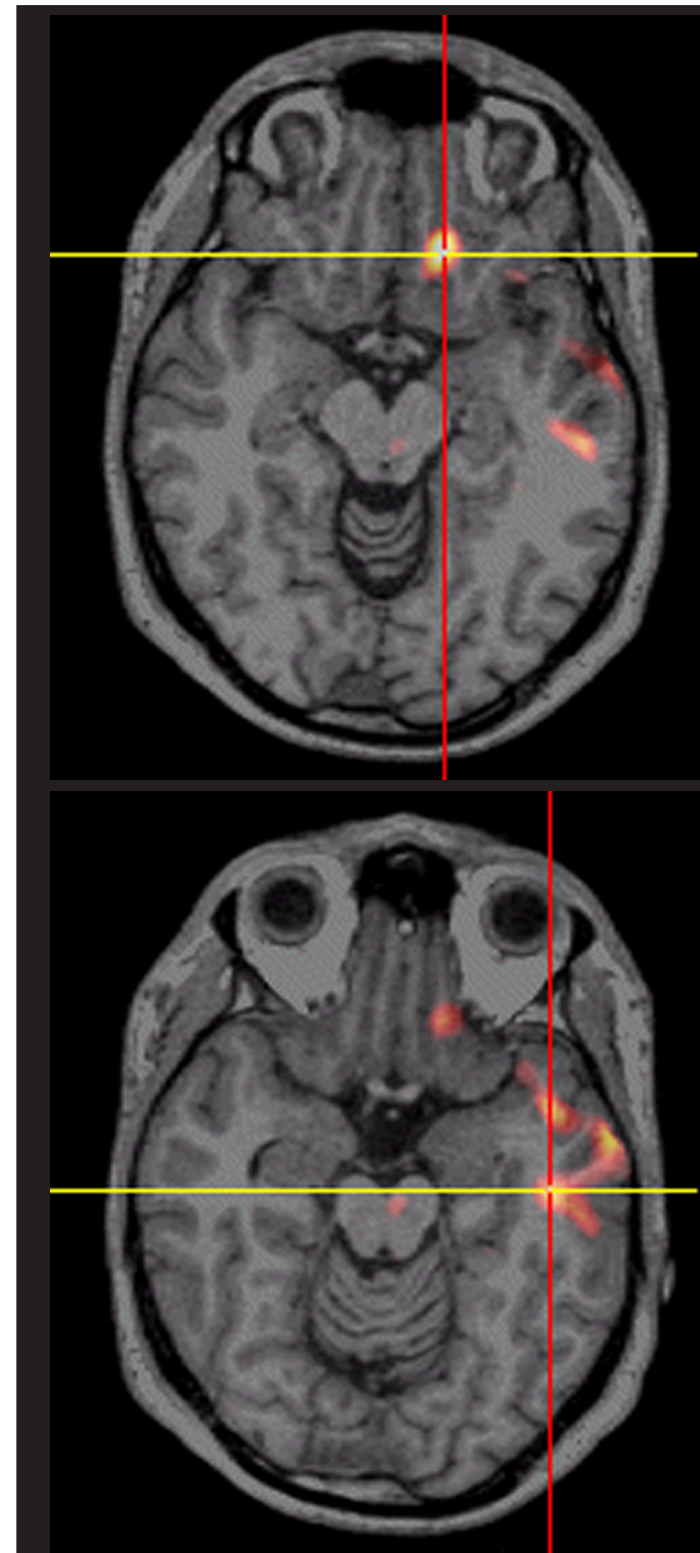


Fig. 4

CONCLUSION:

Especially patients with an MRI without focal abnormalities might benefit from SISCOM.

In presurgical epilepsy-evaluation of difficult cases SISCOM can provide helpful additional information to create a successful hypothesis for intracranial electrode placement. Furthermore, as SISCOM localized in about 1/4 of cases with focal hyperperfusion to eloquent areas, it might also identify patients who are inoperable.

As there are false positive results, the value is to grad lower than intracranial EEG, but repeated ictal SPECTs might increase specificity.

However, as SISCOM is a very time- and manpower-consuming diagnostic tool, it can be offered to a restricted number of patients only. Further investigations are necessary to evaluate the value of the variables as for example significance of multifocal results, injection latency, duration of seizure, type of seizure, or test-retest reliability.

REFERENCES:

- O'Brien TJ, O'Connor MK, Mullan BP, Brinkmann BH, Hanson D, Jack CR et al. Subtraction ictal SPET co-registered to MRI in partial epilepsy: description and technical validation of the method with phantom and patient studies. Nucl Med Commun 1998;19:31-45.
- Von Oertzen J, Urbach H, Jungbluth S, Reuber M, Fernández G, and Elger CE. Standard magnetic resonance imaging is inadequate for patients with refractory focal epilepsy. J Neurol Neurosurg Psychiatry 2002;73:643-647.