Welcome to Miami!

On behalf of the Program and Course Committees and the ACMEGS Board, I hope that you enjoy your visit to Miami, its climate, food and people.

This is our 7th Annual Conference of the ACMEGS and the fourth joint meeting with the American Clinical Neurophysiology Society (ACNS). The goal of this format is to save ACMEGS members who are also associated with ACNS one trip to a conference, as well as to spark some interest among the members of ACNS who are not so familiar with MEG technology and its clinical applications. After all, MEG is a neurophysiological method, and we have been enjoying a productive synergy with our sister society (ACNS).

As usual, we kept the Annual Business meeting and the MEG-Economics component to the morning session to encourage interested ACNS members to join us subsequently for the scientific presentations.

The past year was another successful year for our Society, during which we resolved all administrative issues with the Commonwealth of Massachusetts, reached out to other related professional organizations (i.e. ACNS, AES, ASET, ABRET, etc.), increased our Center membership and continued to work on enhancing the value of the Society to its members and the value of the MEG Centers to their institutions. To this extent, we also engaged in a conversation with the Research Triangle Institute that performs annual US News & World Report Hospital rankings.

We will have a very interesting scientific program this year with eight presentations delivered by experts in the field of clinical MEG, and we are very glad to welcome among them Dr. Ritva Paetau from Finland, and Dr. Sylvain Baillet from Canada.

Our conference aims to provide an informal and friendly atmosphere for discussing and exchanging recent clinically relevant studies that might lead to new clinical MEG indications. In addition we are dedicated to enabling you, our members, to promote the appropriate use of Magnetoencephalography. We wish to empower you to work closely with national and local health insurance carriers and governmental regulatory bodies to ensure accurate and successful reimbursement.

Welcome to Miami and I hope you will enjoy the conference and our traditional Society dinner at the end of a day filled with lectures and discussions.

Sincerely,
Anto Bagić, M.D., Ph.D.
President, American Clinical Magnetoencephalography Society

Organizing Committee:
Anto Bagić, University of Pittsburg, Pittsburgh PA
Susan Bowyer, Henry Ford Hospital, Detroit MI
Richard Burgess, Cleveland Clinics Foundation, Cleveland OH
Michael Funke, University of Texas, Houston, TX
Jeffrey Lewine, MIND Research Network, Albuquerque NM
John Ebersole, University of Chicago, Chicago, IL
Gretchen Von Allmen, University of Texas, Houston, TX
ACMEGS Annual Meeting Program
February 7, 2013 • Miami Marriott Biscayne Bay • Miami, Florida

8:00 AM Arrival/Breakfast Reception

8:45 AM Welcome and Introduction
ACMEGS Presidential Address - Anto Bagic, M.D.

9:00 AM Business Meeting (ACMEGS Members Only)
* Financial Report - Susan Bowyer, M.D.
* Public Relations Committee - Susan Bowyer, M.D.
* New Business/Elections
* Update on Reimbursement/Coverage - Mr. Michael Longacre

10:00 AM Workshop: Ictal MEG - Chairperson: Anto Bagic, M.D.
* Ictal MEG: High Hopes and Mixed Fulfillments - Anto Bagic, M.D.
* Methodological and Clinical Aspects of Ictal MEG - Ritva Paetau, M.D.
* Ictal Events Simultaneously Modeled By MEG and EEG - John Ebersole, M.D.
* Sensitivity and Specificity of Seizure-Onset Zone Estimation by Ictal Magnetoencephalography - Ritva Paetau, M.D.

12:00 PM Annual ACMEGS Photo Shoot/Lunch

1:30 PM Poster Session

2:00 PM Workshop: Clinical MEG - Chair: Michael Funke, M.D.
* Technical Expert's View: Source Models in Clinical MEG: A Review - Sylvain Baillet, Ph.D.
* Clinician's View: Role of MSI in Pediatric Epilepsy - Gretchen Von Allmen, M.D.
* Clinical Researcher's View: Genuine Benefits of MEG in Epilepsy - Robert Knowlton, M.D.

3:30 PM Coffee Break

4:00 PM Update on Educational Initiatives - Chair: Anto Bagic, M.D.
* Update on Clinical MEG Fellowship - Richard Burgess, M.D.
* Update on MEG/EEG-Technologist Survey - Judy Ahn-Ewing, R EEG/EP T, CNIM
  - Janice Walbert, R EEG T
* Discussion

4:30 PM ACMEGS Annual Lecture: Simultaneous MEG and Intracranial EEG Recordings: What Have We Learned? - Andreas Alexopoulos, M.D.

5:30 PM Meeting Adjourn

6:00 pm ACMEGS Dinner
(Casablanca on the Bay • 1717 North Bayshore Drive • Just minutes from the Miami Marriott Biscayne Bay • Please refer to the walking map at the end of the handout)
ACMEGS Presidential Address
Anto Bagic, M.D., Ph.D.
Department of Neurology, University of Pittsburgh Medical Center, Pittsburg, PA
Presidental Address 2013

Anto Bagić, MD, PhD
(Pittsburgh, PA)

February 7, 2013; Miami, FL

ACMEGS Year In Retrospect (1/5)

• Society in good standing with Commonwealth of MA.
• Center Members (16): (32 delegated members).
• Individual Members: 21.
• First full year with S&S.

Society In Good Standing With The Commonwealth Of MA

• Administrative Issues
  – All resolved
  – Collective efforts:
    • ACMEGS Board
    • S&S Management Inc.
    • Attorney in Boston
    • Accountant in Pittsburg
ACMEGS Year in Retrospect (2/5)

- Meeting with Elekta leadership (AES, December 2, 2012).
- AES Epilepsy Resource Center (December 3, 2012).
- Continued productive relationship with the ACNS.
- Planning for the 2nd Board Retreat (likely Pittsburgh, PA; May 12-14, 2013).

AES Meeting with ELEKTA Leadership

- Tom Brennan, Sales Manager, Neuro
- Jonas Karlstrom, Director Operations
- Aditi Ahmar, Director Customer Relations
- Anna Pustali, Business Manager MEG
- Gordon Haid, Sales MEG (Western US and Canada)
- Jim Pearl, Director of AES Sales (Eastern US and Mexico)

December 2, 2012: San Diego, CA

Continued Productive Relationship with the ACNS
ACMEGS Year In Retrospect (3/5)

- Continued efforts on increasing the value to our (center) members:
  - Web-based resources (policies, CPGs, cases, jobs, etc.).
  - Addressing individual center member concerns.
  - Assistance to the new sites.
  - Strategic decision not to get on the CMS radar.
  - Newsletter (Check it out and contribute!).
  - Website redesign (upcoming).

ACMEGS Web-based Resources
Sustained efforts on increasing the value of the MEG centers to their institutions members:
- Supplementing the items on the previous slide.
- Improving billing practices.
- Monitoring insurance situation.
- Engaging with the RTI (US News & World Report).
- Promoting clinical MEG and ACMEGS at ACNS, AES (ACMEGS boot and Dr. M. Funke had a public presentation), ASET, AAN, and other relevant conferences.
ACMEGS educational efforts and activities:
- Annual Course.
- Survey on the training opportunities (Dr. R. Burgess).
- Upcoming discussion later today (Moderator: Dr. R. Burgess).
- Fellowship concept.
- MEG technologists survey (ASET).
- Web-based resources.
- Individual help.
What Is Ahead?

- Sustain the current efforts on all fronts.
- Cultivate the relationship with the ACNS.
- Structure relationship with Elekta.
- Increase our presence at appropriate neurosurgical conferences.
- Escalate efforts on increasing (center) membership.
- Foster the relationship with the AES, AAN, ASET, ABRET, ISACM.
- Facilitate collaborative efforts on clinical research leading to new potential indications for MEG.

Tune Your Travel Plans

- ACNS 2013 Annual Meeting (February 8 - 10, 2014). You are here!
- ISACM 2013 (Sapporo, Japan, August 28 - 30, 2013).
- AES 2013 Annual Meeting (Washington, DC; December 6 - 10, 2013).
- ACMEGS 2014 Annual Meeting (Atlanta, GA; February 6, 2014).
- ACNS 2014 Annual Meeting (Atlanta, GA; February 7 - 9, 2014).
- Biomag 2014 (August 24 - 29, 2014; Halifax, Canada)

Acknowledgments

- ACMEGS Members (Centers and individuals)
- Elekta Neuromag Oy
  - Unrestricted educational grant
- ACNS
  - Synchronized meetings
  - CME approval
  - Sharing posters
- ASET/ABRET
  - Educational programs for technologists
- S&S Management Inc. (Jackie Coleman, Marie Westlake)
Caution

- Please do not share your institutional reimbursement and billing rates.

- Sharing such information could be considered collusion and may have legal ramifications for you and the society.

Have a Productive and Joyful Meeting

and

Continue to Promote Clinical MEG

and

ACMEGS!
I. Call to Order (Dr. Bagic)

II. Minutes of February 9, 2012, Business Meeting (Dr. Bagic)

III. President's Report (Dr. Bagic)

IV. Financial Report (Dr. Bowyer)

V. Public Relations Report (Dr. Bowyer)

VI. New Business/Elections (Dr. Bagic)

VII. Update on Reimbursement/Coverage (Mr. Longacre)

VIII. Adjourn
ACMEGS President's Report
Anto Bagic, M.D., Ph.D.
Department of Neurology, University of Pittsburgh Medical Center, Pittsburg, PA

Anto Bagic
New Business/Elections
Anto Bagic, M.D., Ph.D.
Department of Neurology, University of Pittsburgh Medical Center, Pittsburg, PA
2013 ACMEGS Initiative
Affordable Care Act - Medicaid Strategy
Michael Longacre
Executive Director, ACMEGS
Medicaid

• Medicaid is the United States health benefit program for people with low incomes and limited financial resources.

• Medicaid is essentially an entitlement program
  – where the costs are shared by the states and the federal government,
  – and the local Medicaid programs are managed by the states.

• It is financed through a state-federal partnership, with Washington paying an average of 57 cents of every dollar spent.
Medicaid

- Medicaid provides comprehensive and long-term medical care for more than 60 million low-income Americans.

- Medicaid spending for 2009 was $380.6 billion and in 2010 was estimated at $404.9 billion.

- In 2011, it was estimated that 1 in 5 Americans were enrolled in the Medicaid program.

ACA - Medicaid

- Under the Affordable Care Act (ACA), Medicaid is one of the platforms to expand health care coverage. Roughly half of the people newly “covered” through the ACA are projected to be enrolled in Medicaid.

- The ACA hopes to expand Medicaid beyond its current population and potentially cover all adults making up to 138 percent of the federal poverty level. In return, states that expand their programs would receive an increase in their federal reimbursement.

ACA - Medicaid

- The ACA compelled states to cover this expanding population or risk losing all of their federal Medicaid reimbursement. But the Supreme Court held this provision unconstitutional. Whether to expand coverage under Medicaid is now a state’s choice.

- A major source of savings for several of the states will be the ACA’s higher federal match (100% for 2014–16 and then gradually declining to 90 percent in 2019 and beyond)7 for populations under 139 percent of FPL that they already provide limited Medicaid coverage to or currently cover in state-only financed health programs.
Requirements for the Exchanges

• The states must establish an Insurance Exchange by 2014 or allow the federal government to establish one for the states

• The states must demonstrate significant progress in the establishment of the Exchange and signal “readiness” in 2013
  – Expected to be ready for open enrollment by October 1, 2013

State Federal Partnership Exchange

To date, six states are planning to pursue a state-federal partnership exchange: Arkansas, Delaware, Illinois, Michigan, North Carolina, and Ohio. However, Governors in Michigan and Arkansas have indicated their preference for a state-based exchange and continue to work with their legislatures to press for the passage of authorizing legislation. Similarly, Illinois has already signaled that it will move to a state-based exchange in 2015. While only a few states have committed to a partnership to date, this option may become an increasingly viable strategy for the 10 states that remain undecided. States not ready to run their own exchanges in 2014 may transition from a partnership exchange to a fully state-based exchange at a later date when they have the capability, though they must receive approval for their exchange at least 11 months prior to the start of coverage.

Federally Facilitated Exchanges

• As of the end of November 2012, 17 states had declared they would not create a state-based exchange and will likely to a federally-facilitated exchange. Many of these states had decided early on to default to a federal exchange; however, some had begun laying the foundation for a state-based or partnership exchange before reversing course.
State-Based Exchanges

<table>
<thead>
<tr>
<th>State</th>
<th>Name of Exchange</th>
<th>Governance</th>
<th>Relationship with State</th>
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<td>Actively pursuing</td>
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<td>Montana</td>
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<td>Wisconsin</td>
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<td>C-Exchanges</td>
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</tr>
</tbody>
</table>

ACA - Medicaid

*Political Consideration: Federally managed state insurance exchanges are expected to aggressively sign up eligible Medicaid beneficiaries*

*It is estimated that by 2020, 1 in 4 Americans could be eligible for Medicaid*
### Medicaid Strategy

1. Prepare a packet of materials to support the clinical necessity of MEG in children with epilepsy.

2. Each MEG center should contact your state Medicaid agency and make inquiries concerning coverage and reimbursement for MEG.

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A listing of all state Medicaid agencies can be found on the ACMEGS website or available from me via email – longacre777@msn.com
Medicaid Strategy

**Discussion**

Who has interacted with their state Medicaid agency?

What information was required?

What was the result?

What additional resources might be available to influence your state Medicaid agency?

Thank you!

ACA - Medicaid

1. By 2014, Medicaid coverage will be expanded to everyone under the age of 65 that are below 133% of the Federal Poverty Level (FPL), also known as the poverty guidelines. This will remove the current Medicaid eligibility criteria which leaves many individuals that are currently in poverty to go uninsured.

2. Increase Medicaid reimbursements to 100% of Medicare for primary care providers for 2013 and 2014.

3. Under the Medicaid drug rebate program equalize treatment of fee-for-service and managed care.

4. Create state-based health exchanges where individuals can purchase coverage, with premium and cost-sharing credits are available to individuals and families with incomes between 133% and 400% of the poverty guideline.

5. Provide an individual mandate to make sure that all Americans participate in the insurance risk pool which should result in lower insurance cost coverage for everyone. This also requires that insurers provide coverage to those with pre-existing conditions, removes Lifetime Limbs, prevention services must be covered at 100%, and prohibits removing someone from coverage.

6. The Medicare Advantage Special Needs program was reauthorized.

7. By 2020, the Medicare prescription drug “doughnut hole” will be closed.

8. Improve the coordination of Medicaid and Medicare dual eligibles.
3rd ACMEGS Poster Presentation
Complementary Nature of MEG/EEG & SISCOM in Epilepsy Surgery

Michael A. Stein, MD, Travis R. Stoub, PhD, Marvin A. Rossi, MD, PhD

MEG/EEG source localization and SISCOM are functional neuroimaging modalities that can provide localizing information in planning epilepsy surgery when the standard evaluation including MRI, continuous video-EEG monitoring, and neurocognitive evaluation is non-diagnostic. Although others have compared their relative sensitivities (Knowlton RC et al., 2008, Seo JH et al., 2011), this study presents a case series (n=35) analyzing coregistered MEG/EEG and SISCOM data with emphasis on their complementary nature. Since MEG/EEG and SISCOM provide similar but also unique information, we argue that using both in conjunction adds localizing power in planning for epilepsy surgery which should lead to improved outcomes. Both tests have high spatial resolution. Advantages of SISCOM are that it is an ictal measure, and it can localize deep sources. MEG/EEG has advantages of being a direct measure of neuronal function, and having high temporal resolution. When used together MEG/EEG-SISCOM provides information on both ictal and interictal localization with high spatial and temporal resolution. We also show how the shortcomings of one modality can be compensated for with information from the other. Finally a model incorporating MEG/EEG-SISCOM into planning for intracranial electrode placement that minimizes the extent of necessary electrode coverage and hence associated morbidity and mortality is presented.

Focal High Frequency Oscillations With Generalized Seizures

Jeffrey R Tenney, MD, PhD, Hisako Fujiwara, EEGT, Douglas F Rose, MD, Nat Hemasilpin, MS

Background: Absence seizures are characterized by briefly impaired consciousness with diffuse 3 Hz spike and wave discharges on EEG. High frequency oscillations (HFOs) are promising biomarkers of the seizure onset zone. This goal of this study was to use MEG to evaluate whether HFOs occur during childhood absence seizures and where the sources localize.

Methods: Children, aged 6 to 12 years old, with newly diagnosed and untreated absence seizures were recruited and MEG recordings were conducted on a 275 channel CTF magnetometer. Time-frequency analysis using short time fast Fourier transform (STFFT) was completed during absence seizures at 1-20Hz, 20-70Hz, 70-150Hz, and 150-300Hz. Source localization was then completed using a sLORETA algorithm for the first generalized spike and slow wave complex.

Results: Twelve children were recruited and forty-four absence seizures occurred during MEG recording. Time-frequency analysis with STFFT showed significant power density in the 1-20Hz, 20-70Hz, and 70-150Hz bandwidths. Source localized preferentially in the parietal region at 1-20Hz and to the lateral inferior frontal region at 20-70Hz and 70-150Hz.

Conclusions: Using MEG, we have been able to detect focal ictal HFOs in children with untreated absence seizures. These areas could be components of the network responsible for generating absence seizures.
Workshop: Ictal MEG

Ictal MEG: High Hopes and Mixed Fulfillments

Anto Bagic, M.D., Ph.D.

Department of Neurology, University of Pittsburgh Medical Center, Pittsburg, PA
Ictal MEG: High Hopes and Mixed Fulfillments

Bagić, Anto
MD, PhD
Chief, Epilepsy Division
Chief, Epilepsy Research
Chief Scientific Advisor, MEG Research Program
Director, UPMC MEG Epilepsy Program
Associate Professor, Neurology & Neurosurgery
Director, University of Pittsburgh Comprehensive Epilepsy Center (UPCEC)

January 7, 2013

Reality of Medically-refractory Epilepsy*

• About 30% of patients will remain uncontrolled in spite of our best efforts.
• Level I evidence (RTC) for efficacy of surgery exists.
• CPGs are defined, endorsed by major societies and widely publicized.
• Medications and surgery are 4 times more likely to control seizures than medications alone.
• A delay from diagnosis to surgery remains about 17 years.
• Surgery is ultimately offered to (at most) 1 in 30 of the potential benefactors.

How do we change this tragic reality?


Goals of Presurgical Evaluation

Descriptions of zones and lesions of the cortex (adapted from Lüders and Awad, 1992)*

• Epileptogenic zone (EZ)
  – Region of cortex that can generate epileptic seizures.
  – By definition, total removal or disconnection of the epileptogenic zone is necessary and sufficient for seizure freedom.
• Irritative zone (IZ)
  – Region of cortex that generates interictal epileptiform discharges in the EEG or MEG.
• Seizure (ictal) onset zone (SOZ)
  – Region where the clinical seizure originates.
• Epileptogenic lesion
  – Structural lesion that is causally related to the epilepsy.
• Ictal symptomatic lesion (ISL)
  – Region of cortex that generates the ictal seizure manifestations.
• Functional-deficit zone (FDZ)
  – Region of cortex that generates a functional deficit or deficit in tasks sensitive to the epileptogenic activity.
• Eloquent cortex
  – Region of cortex that is indispensable for defined cortical functions.

From Beliefs to Facts

- Believed to be an infrequent spontaneous occurrence.
- First published ECoG-confirmed case in 1992 (Stefan et al.).
- First larger studies with partial-head systems in 2002:
  - Tib et al. (N = 10)
  - Elashew et al. (N = 7).
- First larger studies with whole-head systems in 2012:
  - Egnace et al. (N = 8).
  - Medvedovsky et al. (N = 12).
- So, how frequently we capture clinical seizure during a MEG?

Frequency of Ictal MEG Recordings?

- Pittsburgh PA): about 1 in 25.
- Salt Lake City (UT): about 1 in 20.
- Cleveland (OH): 10.3% (Burgess et al, 2013; submitted).
- Other centers?
Optimal Strategy?

- Since it is a rare event, do we simply apply watchful waiting?
- Or, do we provoke (facilitate) it?
- If so, how? After all, we don’t even have any consistency in approaching activation of IEDs during MEG recordings…
- Should it be a goal for some or all recordings?
- If we neglect risks, is it worth of effort?

Extended Recordings*

- The acquisition time: up to 40 h.
- 42.6% experienced a seizure during the first hour.
- 70.7% experienced a seizure within the first 5 hours.

Duration of Recordings*

(N = 54, Age range: 3 - 40)

Table S1. MEG acquisition length until the first seizure.

*Medvedovsky et al. 2012.
What Are Our (Realistic) Options?

• 1. Standard activation procedures.
• 2. Sleep deprivation.
• 3. Pharmacologic manipulations.
• 4. Extended recordings.
• 5. ???

Methodological Challenges of Ictal MEG

• 1. The limited time of MEG recording.
• 2. The head movements.
• 3. Movement-related magnetic artifacts.
• 4. A low signal-to-noise ratio (SNR) of ictal MEG and EEG signals.
• 5. Topology of the sources.

Population-specific Challenges: Children*

• 1. Extratemporal epilepsy more common.
• 2. Interictal EEG findings are often multifocal or generalized (i.e. malformations of cortical development (MCD)).
• 3. Epileptic spasms may be associated with multifocal or generalized localization on scalp EEG.
• 4. The high prevalence of cases of “non-lesional” and “multilesional” (i.e. 15q).
Ictal MEG Studies in PubMed on 12/01/12
(N = 20)

<table>
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<tr>
<th>Year</th>
<th>Author</th>
<th>Country</th>
<th>Patients</th>
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</table>

ECD = equivalent current dipole, HFO = high frequency oscillations, WBN = Wavelet-based beamformer, STFT = short-time Fourier transform, T = temporal, F = frontal, O = occipital, P = parietal, L = lobe, SE = status epilepticus, MC = movement compensation.

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Ictal and Interictal Activity in Partial Epilepsy Recorded with Multichannel Magnetoencephalography: Correlation of Electroencephalography/Electrocoricography, Magnetic Resonance Imaging, Single Photon Emission Computed Tomography, and Positron Emission Tomography Findings


Department of Neurology, University of Heidelberg, Germany


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Epilepsy THREE-DIMENSIONAL LOCALIZATION OF SUBCLINICAL Ictal Activity BY MAGNETOENCEPHALOGRAPHY: CORRELATION WITH INVASIVE MONITORING

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KEY WORDS

Magnetoencephalography, magnetic resonance imaging, single photon emission computed tomography, positron emission tomography, temporal lobe epilepsy.
In MEG studies, analysis of ictal discharges has been complicated by body movements during the seizures. However, we detected ictal activity on the MEG in all our patients. The ECDs derived from the spikes at MEG ictal onset, which often preceded clinical seizure onset, and closely corresponded to the tightly clustered ECDs derived from the interictal discharges. Thus the ictal MEG supports findings obtained from the interictal MEG.

Reference:
Fusiform gyrus epilepsy: the use of ictal magnetoencephalography

Case report


Ictal onset localization of epileptic seizures by magnetoencephalography


Ictal Magnetoencephalography in Temporal and Extratemporal Lobe Epilepsy

Consistency of interictal and ictal onset localization using magnetoencephalography in patients with partial epilepsy.


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Objectives: The current study was to evaluate the spatial accuracy of interictal magnetoencephalography (MEG) in localizing the primary seizure onset zone (POSZ) in patients with complex partial seizures with or without secondary generalization. Methods: During the interictal study, 52 patients with epilepsy who had undergone successful surgical treatment were enrolled. MEG recordings were done in 11-channel head-coupled magnetic field sensors (MCI; Neuroscan, Inc., Ann Arbor, MI), and all seizure-onset zones were lateralized. Positivity of the interictal source was >50% for 30 sec of the time domain signal. Results: Ictal and interictal MEG source localizations were compared with surgical outcomes, and a significant correlation was found (R^2 = 0.60); 95% confidence intervals ranged from 0.17 to 0.72. Conclusion: Interictal MEG source localization is an accurate method for lateralizing the POSZ in patients with complex partial epilepsy, and the results of the present study suggest that MEG may be useful in presurgical evaluation.

Keywords: magnetoencephalography, magnetic source imaging, epilepsy, presurgical imaging, seizures, ictal spike, interictal spike.

SHORT REPORT

Ictal magnetoencephalographic discharges from elementary visual hallucinations of status epilepticus


Purpose: The aim of this paper is to describe the ictal magnetoencephalographic (MEG) discharges associated with elementary visual hallucinations of status epilepticus. Methods: We report a patient with a history of temporal lobe epilepsy who presented with a complex partial status epilepticus.EEG recordings were performed using a 32-channel brain array, and ictal MEG was performed. Results: ictal MEG discharges were identified in the right temporo-occipital area, and were followed by an ictal EEG discharge in the right temporal lobe. Conclusion: These findings suggest that ictal MEG may be a useful tool for the identification of ictal discharges associated with visual hallucinations in status epilepticus.

SHORT REPORT

Ictal magnetoencephalographic study in a patient with ring 20 syndrome

H. Tanaka, K. Kondo, T. Takeuchi

Objective: The aim of this paper is to describe the ictal magnetoencephalographic (MEG) discharges associated with visual hallucinations in a patient with ring 20 syndrome. Methods: We report a patient with a history of temporal lobe epilepsy who presented with a complex partial status epilepticus.EEG recordings were performed using a 32-channel brain array, and ictal MEG was performed. Results: ictal MEG discharges were identified in the right temporo-occipital area, and were followed by an ictal EEG discharge in the right temporal lobe. Conclusion: These findings suggest that ictal MEG may be a useful tool for the identification of ictal discharges associated with visual hallucinations in status epilepticus.
Magnetoecephalography for surgical treatment of refractory status epilepticus

Epileptic spasms in older pediatric patients: MEG and ictal high-frequency oscillations suggest focal-onset seizures in a subset of epileptic spasms

The applications of time-frequency analyses to ictal magnetoencephalography in neocortical epilepsy
SHORT COMMUNICATION

Clinical evidence for the utility of movement compensation algorithm in magnetoencephalography: Successful localization during focal seizure

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Received 30 November 2011; revised 1 March 2012; accepted 18 March 2012.

Available online 4 April 2012

Networks involved in seizure initiation


ABSTRACT

Objective: To define the critical cortical/structural network of reading-related seizures.

Methods: We analyzed scalp magnetoencephalography (MEG) and EEG correlated with 128-lead MEG and EEG data in a patient with reading-related seizures triggered by reading content.

Results: MEG localizations revealed activity extending symmetrically into both hemispheres, consistent with left frontal (left posterior, FPc, and left inferior frontal gyrus, IFG). Dynamic causal modeling provided evidence of a causal link between hemodynamic changes in the left IFG and high-frequency seizures.

Conclusions: Our findings support the important role of mesial temporal and subcortical structures, in particular the mesial Temporal, as key regions in eliciting and regulating seizures activity; in our patient, with RE, EEG appeared to be the area linking cognitive activation and seizure activity. Neurology 2012;79(3):249-53.
Maximizing Promises of Ictal MEG

1. Learning how to maximize localizing value:
   - Not all spikes are created equal...

2. Broaden zones of personal comfort with seizures:
   - More openness to active facilitation...

3. Discerning when it has a higher clinical value:
   - Suboptimal V-EEG, SPECT, PET...

4. Standardizing methodological approaches:
   - Sharing experience, multicenter studies...

5. Exploring new methods and their rational integration in presurgical evaluation.
Workshop: Ictal MEG
Methodological and Clinical Aspects of Ictal MEG
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Methodological and Clinical Aspects of ictal MEG

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Ictal & inter-ictal Video-MEG acquisition and analysis at HUCH

• Indication
  – to localize the seizure-onset zone in epilepsy surgery candidates

• Typical problems
  – conflicting or non-localizing results from video-EEG, FDG-PET, SPECT, MRI.
  – to aid the modelling of an EEG spike
  – to localize functional sensori-motor or language areas

BioMag laboratory
Ictal MEG 2007 - 2012 (5 yrs: 30-40/y)

All epilepsy surgery candidates with MEG  156
Successful Ictal recording  41 (26 %)
Mean time until 1st seizure  7.8 h
Median  6.3 h
Range  1 – 40 h
**History of Ictal MEG 1987‡ 2005**

- **First ictal MEG recordings (4)** Sutherling et al 1987.
- **Ictal and inter-ictal MEG give non-redundant information (N=20)** Eliashiv et al. 1999, Tilz et al. 2002.
- **The need of long immotility during MEG made ictal MEG unpractical,.... until 2006**

**Patient preparation:**

FLAT EEG electrodes essential to enable long painless recordings

The cap fixes the position of 4 HPI coils, which must be attached high enough to remain inside the helmet in case the patient’s head moves partly out.

The head deep enough to cover basal frontal areas.

The bed plate enables rapid and safe removal of the head from helmet in case of big motor seizure.

**Acquisition 3 or 6 hours**

- **Functional landmarks**
  - (SEF, AEF, VEF, motor cx, at least 2 modalities)
- **Monitoring:**
  - Continuous head position
  - Audio-Video recording
  - ECG, O2-saturation, vigilance
- **Activations**
  - Inter-ictal activity: wake, hyperventilation, and sleep
  - Ictal activity sleep deprivation, AED reduction
- **In the shielded room:**
  - Accompanying person
  - Emergency medication
Signal analysis

- All data maxfiltered (tSSS)
- Visual screening of the Video-MEG signal:
  - recognition of epileptiform signals and/or seizure-related pathological rhythms
  - recognition of ictal onset timing and activity
- Dipole analysis, NeuroMag SourceModelling
  - BESA occasionally
  - MNE occasionally
  - Beamforming: maybe in future

Some new tools for ictal MEG

1. Temporal Signal Space Separation (tSSS), continuous head position monitoring to enable moderate degree of movement during long recordings
   Taulu et al. 2005-2006

2. Suppression of uncorrelated sensor noise and artifacts, to enhance the signal-to-noise ratio in the beginning of a seizure
   Taulu and Helle, in preparation

3. Integrated Video-MEG, 2 infra-red cameras, for accurate timing of ictal and other events
   Zhdanov et al. 2008

Original data: onset of 30-Hz VNS stimulation, 5 s
after tSSS: onset of 30-Hz VNS stimulation, 5 s

Healthy until 6y, then 3-month period of nearly continuous left-arm-onset tonic seizures
Conclusion from ictal recording of patient 1:

- Multiple sources and complex networks at the onset of motor seizure already may represent propagated activity

- In FCD, the inter-ictal activity is often more local, than the ictal discharges.

- Later, the seizures of patient 1 had stopped and an inter-ictal MEG was acquired.
Tuberous Sclerosis
Epileptic spasms from 8m >>
Rare psychomotor seizures at 2 y

Daily Spasms
EEG: several spike foci
VEEG: Right temporal?

Which tuber is causing the spasms?

Sources of ictal spike discharge close to the right parietal tuber

Seizure onset

Spasm Spasm Spasm
The seizure continues with epileptic spasms

Complex field patterns and source configurations during spasm

Contribution from sources in both temporal lobes
Also the Right parietal tuber participates into the spasm
Ictal EEG Right Temporal lobe dominant
E both the right parietal and the right temporal tuber were removed
E complete cessation of spasms

Right temporal and parietal tubers resected. Intraoperative ECoG showed intensive spiking in the tissue between the 2 tubers.

No spasms since surgery, (4,5 y), psychomotor szs 1-2/y.
Spells of vertigo without EEG change since age of 16.
When to record ictal MEG?

- Even a long recording is worthwhile, if there is no good hypothesis about the seizure onset area
  - normal MRI and ictal EEG, or
  - multiple foci on MRI and ictal EEG (e.g. Tuberous sclerosis)
Workshop: Ictal MEG
Ictal Events Simultaneously Modeled by MEG and EEG
John Ebersole, M.D.
Adult Epilepsy Center, University of Chicago Medical Center, Chicago, IL
Concurrent Source Modeling of MEG and EEG Seizures

John S. Ebersole
Illinois MEG Center, Alexian Brothers Medical Center & The University of Chicago

Clinical Value of Seizure Recording

Interictal spike foci are not necessarily the origins of seizures
Patients may have multiple spike foci, but only one epileptogenic focus
Ictal recordings can confirm the lateralization and at times localization of seizure onset
Considered the gold-standard for pre-surgical evaluations

Ictal MEG and EEG Fields

Cerebral ictal onset is often very focal and low amplitude and produces no recordable MEG or scalp EEG fields
The first recognizable ictal rhythms commonly come after propagation and recruitment of adjacent cortex
Models of ictal waveforms may not localize the seizure origin as well as thought
Techniques of Seizure Modeling

Seizures are often accompanied by movement and muscle artifact.
Only the first few seconds of a seizure may be without artifact and head movement.
Regardless, selective bandpass filtering is essential prior to source modeling.

Techniques of Seizure Modeling

Tight bandpass filter settings are best.
MEG and EEG seizures have characteristic frequencies that define the lowpass filter.
High pass filters stabilize the baseline.
For temporal lobe seizures – 2-15 Hz.
For extra-temporal seizures – 2 -25 Hz.
Only intracranial seizures have higher frequencies.
Techniques of Seizure Modeling

Model earliest recognizable rhythm before substantial propagation
Average sequential ictal waveforms over short period of field stationarity
Employ same principles as spike dipole modeling on averaged ictal waveform of higher S/N
Technique of Seizure Modeling

Average and model both MEG and EEG waveforms
Just as with spikes MEG will identify the tangential ictal field component
EEG will preferentially identify the radial ictal field component
As with spikes, there may be both or only one

Ictal Interpretation Scenarios

MEG and EEG seizures are equally well visualized
Dipole models of both provide nearly the same localization
MEG characterizes the tangential field, EEG the radial and/or tangential field
Ictal Interpretation Scenarios

- MEG seizure is better visualized or lateralized than EEG seizure
- MEG shows a better or earlier tangential ictal component
- MEG source localization is more accurate
Ictal Interpretation Scenarios

- EEG seizure is better visualized or lateralized than MEG seizure
- EEG shows a better or earlier radial ictal component
- EEG source localization is more accurate
Ictal Interpretation Scenarios

MEG and EEG source localizations are displaced
MEG or EEG source localizations are falsely lateralized, secondary to propagation
Conclusions

MEG and EEG strengths are complementary!

MEG: superior source localization and sensitivity
EEG: more complete characterization of source orientation and propagation

Dipole modeling using both MEG and EEG improves the characterization of spike and seizure foci

Clinical epilepsy evaluations should whenever possible include source models of both data
Workshop: Ictal MEG
Sensitivity and Specificity of Seizure-Onset Zone Estimation
By Ictal Magnetoencephalography
Ritva Paetau, M.D.
Department of Clinical Neurophysiology, Helsinki University Central Hospital
Helsinki, Finland
Sensitivity and specificity of ictal MEG

ACMEGS
Annual meeting February 7, 2013
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BACKGROUND for Ictal MEG:

- Eliashiv et al. 1999:
  - Ictal MEG possible (7/20 patients)
  - Æ finds seizure onset zone (SOZ) better than interictal MEG (3/7 pats.)
- Shiraisi et al. 2001:
  - Four pats with ictal Frontal lobe sources
- Tiltz et al. 2002:
  - Ictal onset localized in 6/13
  - Æ correspond to ictal invasive EEG in 4/6.
- Knowlton et al. 2008:
  - 180 group studied epilepsy surgery candidates; 62 pats. MEG vs. IIEEG.
  - Æ MEG spikes predict IIEEG SOZ at 58-64 % sensitivity and at 79-88 % specificity.
- Fujiwara et al. 2011:
  - 20 ictal recordings, 8 operated, 7 ictal MEG signals readable.
  - Ictal and inter-ictal MEG sources equal to predict ictal intracranial EEG SOZ at lobar resolution.
  - Ictal MEG is better than interictal MEG at sublobar resolution.

Sensitivity and specificity of seizure onset zone estimation by ictal magnetoencephalography.
Medvedovsky et al. 2012, Epilepsia, Sep;53(9):1649-57

AIM:
- How well ictal MEG can predict the results on ictal intracranial EEG?
- How sensitive MEG is to deep brain sources?

METHODS:
- Elekta Vectorview 306-ch. + 32 or 64 EEG
- 300 or 600 Hz sampling
- Interference removal by signal-space separation (SSS, and/or tSSS)
- Continuous head position monitoring + tSSS enabled accurate data recording despite ictal movement.
Methods

- Elekta Vectorview 306-ch. + 32 or 64 EEG
- 300 or 600 Hz sampling
- Interference removal by signal-space separation (SSS, and/or tSSS)
- Continuous head position monitoring + tSSS enabled accurate data recording despite ictal movement
- Recording time until 1st seizure 1-40 h, mean 5.6 h
- ECD on visually selected inter-ictal and ictal-onset signals
- Sphere model of head

Etiology of epilepsy (N=47)

- Focal cortical dysplasia type 2 8
- Focal cortical dysplasia type 1 9
- Tuberosous sclerosis 2
- Cavernoma 1
- Traumatic bleeding 1
- Gangliogioma 1
- Local atrophy 2
- Ring chromosome 17 1
- Mesial temporal sclerosis 1
- Unknown 21
Seizure types (patients 23)

- Focal or bilateral tonic 8
- Epileptic spasms 3
- Focal somato-sensory 6
- Visual/vertigo 2
- Psychomotor 6
- Sensory/visual > Psychomotor 2
- Hypermotor 3
- Abdominal > Hypermotor 1
- Atypical absence 1

Definitions

- **SENSITIVITY** = 
  \[
  \frac{\text{TRUE POSITIVES}}{\text{TRUE POSITIVES} + \text{FALSE NEGATIVES}}
  \]

- **SPECIFICITY** = 
  \[
  \frac{\text{TRUE NEGATIVES}}{\text{TRUE NEGATIVES} + \text{FALSE POSITIVES}}
  \]

Definitions

- **TRUE POSITIVES** = 
  1. MEG dipoles present in the location
  2. IC-EEG electrodes covered the location
  3. IC-EEG showed ictal onset in the location

- **FALSE POSITIVE** = 
  1. + 2. as above
  3. IC-EEG did not show ictal onset in the location
Definitions

- **TRUE NEGATIVES** =
  1. No MEG dipoles in the location
  2. IC-EEG did not show ictal onset in the location

- **FALSE NEGATIVE** =
  1. No MEG dipoles in the location
  3. IC-EEG showed ictal onset in the location

Study design

**Inclusion criteria**

- Seizure onset signal was recorded in MEG (N = 22)
- Seizure onset activity was recorded by intracranial EEG (N = 14)

**Exclusion criteria**

- Seizure was recorded in MEG, but no ictal signal could be identified (N<3)

Resolution

**Hemisphere-lobe (HL)**

- Frontal
- Temporal
- Parietal
- Occipital
- Insula

2 x 5 = 10 lobes
Resolution: Hemisphere-Lobe-Surface (HLS); max. 2 x 15 = 30 surfaces
Frontal dorsolateral opercular, basal, medial
Temporal lateral, opercular, basal, medial
Parietal dorsolateral, opercular, medial
Occipital lateral, medial, basal
Insular

Results

13-year-old patient with tonic seizures

Results

Interictal cluster (MEG C) is less distributed and ictal MEG is more distributed than the gold std ictal iEEG.

Table 3. Source distribution of ictal and interictal MEG and of iEEG

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>p-value vs. ictal MEG</th>
<th>p-value vs. ictal iEEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLS iMG A</td>
<td>6.4</td>
<td>4.7</td>
<td>0.0107</td>
<td>0.0027</td>
</tr>
<tr>
<td>HLS iMG B</td>
<td>4.9</td>
<td>3.7</td>
<td>0.1005</td>
<td>0.0077</td>
</tr>
<tr>
<td>HLS iMG C</td>
<td>1.6</td>
<td>0.9</td>
<td>0.0308</td>
<td>0.0663</td>
</tr>
<tr>
<td>Ictal MEG</td>
<td>3.6</td>
<td>3.4</td>
<td>0.1260</td>
<td></td>
</tr>
<tr>
<td>Ictal iEEG</td>
<td>2.4</td>
<td>1.1</td>
<td>0.1260</td>
<td></td>
</tr>
<tr>
<td>HLS iMG A</td>
<td>3.4</td>
<td>2.3</td>
<td>0.0294</td>
<td>0.0126</td>
</tr>
<tr>
<td>HLS iMG B</td>
<td>2.9</td>
<td>1.8</td>
<td>0.1039</td>
<td>0.0223</td>
</tr>
<tr>
<td>HLS iMG C</td>
<td>2.0</td>
<td>1.4</td>
<td>0.3636</td>
<td>0.3986</td>
</tr>
<tr>
<td>Ictal MEG</td>
<td>2.4</td>
<td>1.6</td>
<td>0.0211</td>
<td></td>
</tr>
<tr>
<td>Ictal iEEG</td>
<td>1.6</td>
<td>0.9</td>
<td>0.0211</td>
<td></td>
</tr>
</tbody>
</table>

Note: interictal, A, B, and C — conditions A, B, and C, iEEG, intracranial EEG.
Predictive values of ictal MEG. HLS: positive 0.77; negative 0.66
HL: positive 0.96; negative 0.90

<table>
<thead>
<tr>
<th></th>
<th>True positive</th>
<th>True negative</th>
<th>False positive</th>
<th>False negative</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLS-dorsolateral</td>
<td>13</td>
<td>10</td>
<td>4</td>
<td>6^d</td>
<td>33</td>
</tr>
<tr>
<td>HLS-deep</td>
<td>11</td>
<td>9</td>
<td>3</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>HLS-all</td>
<td>24</td>
<td>19</td>
<td>7</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>HL</td>
<td>23</td>
<td>9</td>
<td>1^b</td>
<td>1^b</td>
<td>34</td>
</tr>
</tbody>
</table>

Deep locations: medial, basal, opercular, surfaces and insula.
HLS, hemisphere lobe surface; HL, hemisphere lobe.
^dDorsolateral ictal MEG sources were in the sensory-motor cortex near the prefrontal border in four out of six false negative HLS reports.
^bIctal MEG sources were in the sensorimotor cortex near the frontoparietal border in all false positive (one) and false negative (one) HL reports.

On Lobe-level, Inter-ictal cluster and ictal MEG sources were equally sensitive, but ictal sources were more specific.
On surface level, inter-ictal cluster and ictal sources were equally specific, but ictal sources were more sensitive.
DISCUSSION

Because icEEG placement was planned to cover the MEG sources, some false negatives may have been missed. The real sensitivity probably is lower than we calculated.

The specificity, sensitivity, and predictive values are similar as reported from other centers using different MEG devices.

The specificity of interictal cluster was high but its sensitivity was low. Ictal MEG with higher sensitivity would thus complement the interictal MEG.

Dorsolateral (superficial) and non-dorsolateral (deep) sources showed similar sensitivities and specificities down to 4 cm below scalp.

CONCLUSIONS

On lobe level, ictal MEG has both a high sensitivity and specificity.

On surface level, ictal MEG was equally specific but more sensitive than the interictal cluster in predicting the ictal onset zone found by icEEG. Ictal MEG would thus complement the interictal MEG.

Ictal MEG showed similar sensitivities and specificities for dorsolateral (superficial) and non-dorsolateral (deep) sources until a mean depth of 4 cm below scalp.
Technical Expert's View: Source Models in Clinical MEG - A Review

Sylvain Baillet, Ph.D.
Montreal Neurological Institute, Montreal, Quebec, Canada
Perspectives on the Clinical Value of MEG Source Modeling for Epilepsy

Sylvain Baillet
Director, MEG Research
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Google 'MEG MNI'

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   • Reza Khan, MD
   • Ray Borioni, PhD
   • Brenda Hernandez
   • Dana Visi

Outline

1) MEG source imaging generates large data volumes
   • Suggest simple, but practical data reduction techniques
2) Review of MEG source imaging outcome is time consuming in a clinical setting
   • Suggest exploratory approaches to reveal new clinical MEG markers of neurological syndromes
3) Imaging is only for diagnosis
   • Suggest MEG can also act as a therapeutic instrument
Event-related analysis e.g., interictal epileptic activity

Regional clustering of dipole models based on location and temporal profile

Color-encoding of dipole latency with respect to peak of spike
Histogram of single dipole model locations, with [goodness of fit] > threshold

Tadel et al., Comp. Intell. Neurosc., 2011
Google 'brainstorm MEG EEG’

Synoptic visualization of dipolar propagation

Exhaustive fits of single dipoles for all time points +/- 50 ms around a spike peak
Dipole selection: > 80% goodness-of-fit

Fast (<100 ms) cortico-cortical propagation of interictal epileptic activity

Baillet, Raghavan et al., (in preparation)
Summary statistics are required for synoptic review of event-related source models.

Local amplitude > threshold

Event count at each location where amplitude reaches threshold

Recurrence map of distributed source activity across a group of interictal events

up to 100% of all events
Exploratory approaches for new clinical MEG markers

Most likely scenario: no or few eloquent epileptic events / no well-identified MEG marker of syndrome

13

14

15
Spectrum of ongoing brain activity

[1.5 - 40] Hz

Amplitude scale

Spectrum of ongoing brain activity

[40 - 300] Hz

HFO event detection & event-related analysis

Event-related MEG detection and imaging of HFO generators

Doshi, Raghavan, Baillet et al., (in preparation)

High-frequency oscillations (HFO)

80-150 Hz
Clinical specificity of HFO's!

Need to establish new standards for epileptogenic brain dysrhythmias

Empirical data mining and databasing

Tracking of power dynamics in ongoing brain signals

Normative distribution of ongoing brain rhythms (average power, n=45 healthy controls, resting-state, eyes open)
Assessing the likelihood of individual data as normal variant

Empirical distribution of local metrics across normative database

Patient data

Synoptic histogram of outliers, voxels, from expected range of normative distribution

Local deviants from normative ongoing brain activity: interictal epilepsy

Epilepsy case study: contrast with normative distribution, p < 0.01

Baillet, Raghavan, et al. (in preparation)
Markers of epilepsy:

Is there more than magnitude effects of local/regional/global brain dysrhythmia?

First non-invasive evidence of localized disrupted cross-frequency coupling in partial epilepsy

The resting brain: frequency power spectrum

Cross-frequency phase-amplitude coupling: A generic mechanism for local and long-range brain dynamics?

Can MEG help? Is it pertinent for epilepsy evaluation, other neuropathologies?
First non-invasive evidence of local phase-amplitude coupling (PAC) between neural rhythms in the resting-state

- Low-frequency ‘nesting’: [2, 12] Hz
- Phase-locked high-frequency bursts: [35, 250] Hz
- 2 subjects
- 10-min MEG session

Florin & Baillet (submitted)

-> Esther Florin’s talk @ S-Th-A1 Resting-state symposium

Intracranial investigations of PAC dysrhythmia

Luneau, Chabot, Raghavan et al. (in preparation)
MEG investigations of PAC dysrhythmia

Luneau, Dubeau, Raghavan et al., (in preparation)

- Increased PAC
- Increased nesting frequency
- Resected area

EcoG

- Seizure onset

MEG

- Interictal recurrence map

MEG as a therapeutic instrument

Targeted modulation of ongoing brain activity

Real-time neuroimaging with feedback to subject

"neurofeedback"

Concept

(Sudre, Parkkonen, Bock, Baillet et al., Comp. Intell. Neurosc, 2011)

(Bock et al., Int. Conf. for Human Brain Mapping, 2011)
Real-time neuroimaging with feedback to subject

Targeted training of regional brain activity

- Efficient data mining with simple representations & efficient software
- Detection of interictal HFOs w/ MEG; colocalized w/ ECoG
- Detection of normal cross-frequency phase-amplitude coupling w/ MEG
- Towards MEG therapy?

Thank you.
Workshop: Clinical MEG
Clinician's View: Role of MSI in Pediatric Epilepsy
Gretchen Von Allmen, M.D.
University of Texas, Houston, TX
Genuine Benefits of MEG in Epilepsy

Robert Knowlton, MD, MSPH

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Epilepsy Surgery and Imaging

I. History of epilepsy imaging
II. Role of epilepsy imaging: Mesial temporal versus neocortical epilepsy surgery
III. Clinical validity and diagnostic value of epilepsy imaging tests
IV. Decision analysis

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Clinical value of Functional Imaging in Epilepsy Surgery

- Epilepsy surgery clinical context—stakes are uniquely high (effect size is very large)
- Impact of a test (MSI) must account for and distinguish between two important effects:
  1. Diagnostic value on patient selection
     a. Go — no go further in surgical evaluation
     b. Who should and should have surgery
  2. Effect on cure rate
- Trials, decision analysis and cost effectiveness
The Problem
Impact of Imaging: MRI detection of hippocampal sclerosis

Berkovic et al., 1991; Jackson et al., 1990

Impact of Imaging: Detection of epileptogenic lesions
Impact of Imaging: FDG-PET detection relative hypometabolism

Abou et al., 1987; Engel, 1984; Mazziotta, 1984; Shimizu et al., 1985; Sperling et al., 1986; Stefan et al., 1987; Theodore et al., 1986

Epilepsy Surgery Candidates

Video-EEG (VEEG), standard imaging (MRI)

Standard Invasive Tests: ICEEG and Wada

Functional Imaging:

MSI, FDG-PET, ictal SPECT

Functional Imaging and Epilepsy

1. Localization of epileptogenic tissue
2. Determining the functional significance (epilepsy relationship) of other imaging abnormalities that cannot stand alone
3. Mapping of brain function
Epilepsy relationship / significance

Focal Cortical Dysplasia with Taylor Type II Balloon Cells
EEG/MEG: Source Localization

Concordance: PET-MSI-iSPECT
Brain function mapping

MTLE Surgery Decision Analysis
MEG Populations of Interest?

1. Temporal lobe–MRI negative
2. Neocortical epilepsy
3. Lesional epilepsy (uncertain functional significance; ambiguous or multiple abnormalities on MRI)
Decision Tree: NE Surgery

Surgical outcome: UAB subdural grid based neocortical epilepsy resections

NE surgery outcomes

The findings are consistent with the average published seizure-free surgical outcome for neocortical epilepsy (~50%)†

<table>
<thead>
<tr>
<th>MRI (-)</th>
<th>MRI (+)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>204/463 (44%)</td>
<td>143/250 (57%)</td>
<td>347/713 (49%)</td>
</tr>
</tbody>
</table>

† Based on 13 published studies in which distinction between MRI class could be determined.
Inserting Test Effect into Analysis

<table>
<thead>
<tr>
<th>Test Effect</th>
<th>Clinical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>Patient selection</td>
</tr>
<tr>
<td>Treatment</td>
<td>Improve outcome</td>
</tr>
<tr>
<td>Additive</td>
<td>Increase proportion of “go” cases</td>
</tr>
<tr>
<td>Risk assessment</td>
<td>Reduce morbidity</td>
</tr>
<tr>
<td>Economic</td>
<td>Reduce net costs</td>
</tr>
</tbody>
</table>
Test Effects on NE Decision Analysis

Effecting Outcomes vs Discrimination

- Curable
- Not Curable
- Surgery
Effecting Outcomes: Increasing availability only

Curable Not Curable

Surgery

Impact of Epilepsy Surgery: Cost Effectiveness in Test Utility

The Cost-Effective Use of 18F-FDG PET in the Presurgical Evaluation of Medically Refractory Focal Epilepsy

O'Brien et al.

Cost Effectiveness in Test Utility

O'Brien et al.
MEG Value in NE Surgery

1) Patient selection (?)
2) Improving ICEEG localization yield and accuracy → increase cure rate
3) Aiding other tests such that an increased proportion of patients may proceed to surgery
4) Decrease costs

What is needed to show test clinical value?

1) Test must effect an improvement in net seizure-free outcome (around 10-15%).
2) If test cannot sufficiently effect the total cure rate, then it must be demonstrated to allow more patients to receive surgery (with or without effect on outcome).

Acknowledgements
Update on Educational Initiatives
Update on Clinical MEG Fellowship
Richard C. Burgess, M.D.
Cleveland Clinical Epilepsy Center, Cleveland, OH
Update on Educational Initiatives
Update on MEG/EEG Technologist Survey
Judy Ahn-Ewing R EEG EP/T, ASET President
Janice Walbert R EEG T, ABRET Executive Director
ABRET/ASET ACMEGS Presentation
Judy Ahn-Ewing, R. EEG/EP T, CNIM, CLTM, FASET
ASET President
Janice Walbert, R. EEG/EP T.
ABRET Executive Director

Collaboration History

• Dec 2011
  – ACMEGS, ABRET, ACNS, and ASET reps meet in Baltimore during the AES conference

Collaboration History

• Feb 2012
  – ASET creates MEG Interest Section
  – MEG forum added to the discussion forums on the ASET website
Collaboration History

• ASET 2012 Annual Conference in St. Paul, MN
  – Sundown Seminar: MEG Workshop by John Ebersole, M.D. and Susan Ebersole, R. EEG T.

Collaboration History

• ASET Webinars
  – April 2008 Magnetoencephalography by Susan Bowyer, Ph.D.
  – Sept 2009 Comparison of MEG Source Localization Techniques by Susan Bowyer, Ph.D.

Collaboration History

• Fall/Winter 2012
  – MEG Personnel Survey developed by ACMEGS, ABRET, and ASET
• January 10, 2013
  – MEG Personnel Survey sent to 35 MEG technologists
• January 30, 2013
  – last day to respond to the survey
What about credentialing or certification?

- Certification – Complete required curriculum and take a certification examination.
- Credentialing – Meet set eligibility requirements to be accepted for examination.

Pathway
- Education First
- Competency Assessment Second
To develop an exam...

- Establish eligibility
- Identify subject matter experts
- Perform Task Delineation or Job Analysis
- Set examination specifications
- Develop an item bank (writing and reviewing)
- Review the examination
- Administer

Subject Matter Experts are key

- Item writers
- Item reviewers
- Exam reviewers

ABRET has a 50 year history of credentialing technologists in neurodiagnostics

How can ABRET help?
- Planning
- Development
- Testing
- Psychometrics
- Credential Management
ACMEGS Annual Lecture
Simultaneous MEG and Intracranial EEG Recordings:
What Have We Learned?
Andreas Alexopoulos, M.D.
Cleveland Clinic, Cleveland, OH
Grateful acknowledgment is made to the following organizations for their generous support of this workshop in the form of unrestricted educational grants.
Evaluation Form

Please identify yourself:  
☐ Neurologist  
☐ Neurosurgeon  
☐ Radiologist  
☐ MEG/EEG Technologist  
☐ Other ____________________________

Please rate each speaker’s effectiveness in conveying the material of his/her presentation using 5 as most effective and 1 as least effective:

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Most Effective</th>
<th>Least Effective</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Bagic</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Dr. Paetau</td>
<td>5</td>
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<tr>
<td>Dr. Ebersole</td>
<td>5</td>
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<tr>
<td>Dr. Baillet</td>
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<tr>
<td>Dr. Von Allmen</td>
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<td>Dr. Burgess</td>
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<tr>
<td>Ms. Ahn-Ewing</td>
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<td>Ms. Walbert</td>
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<tr>
<td>Dr. Alexopoulos</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Please rate using 5 as most effective and 1 as least effective:

Rate your overall satisfaction with the opportunity to network with colleagues. 5 4 3 2 1  
Rate your overall satisfaction with the quality of this conference/workshop. 5 4 3 2 1  
Please rate your satisfaction with the organization of the conference/workshop. 5 4 3 2 1  
How would you rate the cost of registration versus what you personally got out of the conference? 5 4 3 2 1

What topics should be addressed at future meetings?
____________________________________________________________________________________________
____________________________________________________________________________________________

What features should be added to future meetings?
____________________________________________________________________________________________
____________________________________________________________________________________________

What features should be deleted from future meetings?
____________________________________________________________________________________________
____________________________________________________________________________________________

Did you perceive commercial bias in any of the presentations?  
☐ Yes  
☐ No

Explain: ______________________________________________________________________________________