Intra-Cranial Monitoring for Epilepsy

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Disclosures

I’m Biased!
Mesial Temporal Lobe Epilepsy: A Burdensome Problem

- Temporal lobe epilepsy arguably the most common form of human epilepsy
  - Clearly, the most intractable form of epilepsy
- Of the 2.5 million patients in the United States with epilepsy, 30% are medically refractory
  - Half of these have mesial temporal lobe epilepsy (MTLE)
- Pharmacoresistant MTLE may account for up to 5 billion dollars in cost per year in US.

Kwan and Brodie 2000
A RANDOMIZED, CONTROLLED TRIAL OF SURGERY FOR TEMPORAL-LOBE EPILEPSY

SAMUEL WIEBE, M.D., WARREN T. BLUME, M.D., JOHN P. GRVIN, M.D., PH.D., AND MICHAEL ELIASZIW, PH.D.,
FOR THE EFFECTIVENESS AND EFFICIENCY OF SURGERY FOR TEMPORAL LOBE EPILEPSY STUDY GROUP

ABSTRACT

Background Randomized trials of surgery for epilepsy have not been conducted, because of the difficulties involved in designing and implementing feasible studies. The lack of data supporting the therapeutic usefulness of surgery precludes making strong recommendations for patients with epilepsy. We conducted a randomized, controlled trial to assess the efficacy and safety of surgery for temporal-lobe epilepsy.

EPILEPSY, a serious health problem that affects people of all ages, races, and socioeconomic backgrounds, has a prevalence of 5 to 10 per 1000 population in North America. Epilepsy is the second most common cause of mental health disability, particularly among young adults, and accounts for a worldwide burden of illness similar to that of breast cancer in women and lung cancer in men.
Surgical Candidate

- Seizure onset is well localized
- Seizure focus is accessible
- No adverse effects from resection (removal) of seizure focus
Epileptogenic Zone

Irritative Zone

Epileptic lesion
LOCALIZATION

- MRI
- Clinical data
- EEG
- Wada
- PET SPECT
- Neuro-psychology

FOCUS
IDEALLY

+ PET/SPECT + NPE + Wada

p<.05
Real Estate

• Location
• Location
• Location
Aim of invasive recordings

• Define epileptogenic zone

• Determine the location and extend of eloquent cortex
Practical Considerations

• To complement or resolve contradictory findings obtained by non-invasive tests.

• Adds costs/risks to epilepsy surgery

**surgical outcomes are inferior if iEEG necessary**

Relative Indications

• Normal high-resolution brain MRI

• Extra-temporal location

• Proximity to eloquent cortex

• Multiple lesions
PHASE II EVALUATION (iEEG)

- Invasive but is devoid of muscle artifacts/signal attenuation

- Limited coverage (can be misleading)

- Requires a clear hypothesis
Visible surface (cortex): 25-30%

- Two Schools: 1950’s
  - North America
    - Jasper & Penfield: subdural electrodes (2D)
  - Europe
    - Taillarach & Bancaud: stereo EEG/depths (3D)
EEG vs. SEEG

EEG

Subdural Grids

EZ

Depth Electrodes
Advantages

• Cortical mapping for eloquent cortex (extra-operative)
Outcome and complications of chronically implanted subdural electrodes for the treatment of medically resistant epilepsy

F.L. Valea,⁎, G. Pollocka, J. Dionisiob, S.R. Benbadisc, W.O. Tatumd

A B S T R A C T

Background: Surgery for medically resistant epilepsy is safe and effective. However, when noninvasive techniques are insufficient, then consideration is given to invasive electrocorticography (ECoG).

Objective: The aim of the study was to analyze results and complications of subdural electrodes placement in the treatment of intractable epilepsy.

Methods: Ninety-one consecutive patients who underwent placement of subdural electrodes (1999-2010) were considered for this study. All patients underwent a standardized pre-operative evaluation. Invasive subdural electrode placement was considered when there were inadequate ictal recordings, there was discordance between EEG and neuroimaging or the epileptogenic zone was localized near eloquent cortex.

Results: Resective epilepsy surgery was performed in 70/91 patients (76.9%). Twenty-four out of seventy (34.3%) who underwent surgical resection were seizure-free (CL-I) at last follow-up. A statistical evaluation revealed a very strong trend for patients with positive lesional pre-operative MRI to have improved outcomes compared to normal brain MRI population (p = .028). There were 10 surgical related complications (11%), but no mortality or permanent morbidity. Statistical analysis demonstrated that placement of a subdural grid in any combination was statistically significant (p = .01) for surgical complications.

Conclusions: Invasive monitoring is a useful and necessary technique for the surgical treatment of intractable epilepsy. Careful surveillance is required during the monitoring period especially when the patient has undergone large subdural grid placement. A good working hypothesis can minimize complications and achieve better outcomes.
Table 2
Outcome for the 70 resective patients based on localization, lateralization and lesional radiographic findings.

<table>
<thead>
<tr>
<th>Engel classification</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=70</td>
<td>24/70 (34.3)</td>
<td>22/70 (31.4%)</td>
<td>17/70 (24.3%)</td>
<td>7/70 (10%)</td>
</tr>
<tr>
<td><strong>Localization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal</td>
<td>9/32 (28.1%)</td>
<td>13/32 (40.6%)</td>
<td>7/32 (21.9%)</td>
<td>3/32 (9.4%)</td>
</tr>
<tr>
<td>Extratemporal</td>
<td>4/9 (44.4%)</td>
<td>1/9 (11.1%)</td>
<td>3/9 (33.3%)</td>
<td>1/9 (11.1%)</td>
</tr>
<tr>
<td>Both</td>
<td>11/29 (37.9%)</td>
<td>8/29 (27.6%)</td>
<td>7/29 (24.1%)</td>
<td>3/29 (10.3%)</td>
</tr>
<tr>
<td><strong>Lateralization</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Unilateral</td>
<td>13/31 (41.9%)</td>
<td>7/31 (22.6%)</td>
<td>7/31 (22.6%)</td>
<td>4/31 (12.9%)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>11/39 (28.2%)</td>
<td>15/39 (38.5%)</td>
<td>10/39 (25.6%)</td>
<td>3/39 (7.7%)</td>
</tr>
<tr>
<td><strong>MRI results</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lesional</td>
<td>12/22 (54.5%)</td>
<td>6/22 (27.2%)</td>
<td>2/22 (9%)</td>
<td>2/22 (9%)</td>
</tr>
<tr>
<td>Nonlesional</td>
<td>12/48 (25%)</td>
<td>16/48 (33.3%)</td>
<td>15/48 (31.3%)</td>
<td>5/48 (10.4%)</td>
</tr>
</tbody>
</table>
Stereo-EEG
Stereoelectroencephalography in the presurgical evaluation of children with drug-resistant focal epilepsy

Massimo Cossu, M.D., Francesco Cardinale, M.D., Nadia Colombo, M.D., Roberto Mai, M.D., Lino Nobili, M.D., Ivana Sartori, M.D., and Giorgio Lo Russo, M.D.

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**TABLE 4**

Outcome on seizures in the 35 children

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total No.</th>
<th>SF†</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<tbody>
<tr>
<td>patients</td>
<td>35</td>
<td>16</td>
<td>21 (60)</td>
<td>1 (3)</td>
<td>4 (11)</td>
<td>9 (26)</td>
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<tr>
<td>preop neurological deficit</td>
<td>11</td>
<td>5 (46)</td>
<td>5 (46)</td>
<td>1 (9)</td>
<td>3 (27)</td>
<td>2 (18)</td>
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<tr>
<td>present</td>
<td>24</td>
<td>11 (46)</td>
<td>16 (67)</td>
<td>0 (0)</td>
<td>1 (4)</td>
<td>7 (29)</td>
</tr>
<tr>
<td>absent</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>preop MRI</td>
<td>19</td>
<td>10 (53)</td>
<td>14 (74)</td>
<td>0 (0)</td>
<td>2 (11)</td>
<td>3 (15)</td>
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<tr>
<td>focal lesion</td>
<td>10</td>
<td>4 (40)</td>
<td>5 (50)</td>
<td>1 (10)</td>
<td>2 (20)</td>
<td>2 (20)</td>
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<td>multifocal/hemispheric</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>negative</td>
<td>6</td>
<td>2 (33)</td>
<td>2 (33)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>4 (67)</td>
</tr>
</tbody>
</table>
The Stereo-Electroencephalography Methodology

Soha Alomar, MD, MPH, Jaes Jones, BS,
Andres Maldonado, MD, Jorge Gonzalez-Martinez, MD, PhD*

KEYWORDS
- Epilepsy surgery • Stereo-electroencephalography • Stereotaxy • Morbidity • Seizure outcome

KEY POINTS
- Stereo-electroencephalography (SEEG) defines the anatomic boundaries of the cortical and subcortical brain areas responsible for primary generations and early propagation of the epileptiform activity.
- Both frame-based and frameless techniques can be used for implantation of SEEG electrodes.
- Vascular imaging is fundamental for the safe implantation of SEEG electrodes. Attention to the vascular anatomy is essential to reduce the risk of hemorrhagic complications.

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Advantages

• Can sample deep cortex (e.g. insula)

• Faster recovery
Subdurals vs Depths

- Unilateral vs Bilateral
- Mapping vs Recording
- Re-operation
- Complications
Conclusion

• Working Hypothesis

• Both approaches are effective

• Management should be individualized to patient (“Hybrid”)

Comprehensive Epilepsy Program

We provide the most advanced care for patients with seizures that are difficult to control. The program meets and exceeds the guidelines of the National Association of Epilepsy Centers for a 4th (highest) level medical and surgical center.

The program is one of only 4 centers in Florida with this level of expertise, and as of 2002 we are the highest volume surgical center.

http://epilepsy.usf.edu

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CONCLUSIONS

- Epilepsy is not rare
- Many new medications available
- 70% of patients controlled by medications
- For the 30% that are not
  - Surgery: safe & effective, but under-utilized
Epilepsy surgery: the message

• Is a well-established treatment
• Is very effective
• Is safe
• Is the victim of many misconceptions
• Is underutilized
“Myth-Busters”: The victim of many misconceptions

- Safe & Effective (No need to try 14 medications!!!)
- Is underutilized
- Minimal complications
- Not disfiguring