Invasive EEG & SEEG
SEEG

• Bancaud J & Talairach J.
• Sainte-Anne Hospital, Paris, France
• Second half of the 20th century
Anatomo-electro-clinical correlations

- Spatio-temporal organization of the epileptic discharge within the brain
- Anatomo-electrical relationships
  - Temporal dynamic of ictal symptom with respect to the brain anatomy
- Electro-clinical relationships
  - Clinical picture must be evaluated as the discharges spread
  - Seizure pattern (identical clinical sign may result from the ictal disorganization of cortex regions)
- 3-dimensional arrangement

Textbook of epilepsy surgery. Chapter 73, 104.
Subdural electrode recordings
Depth recordings

• Ensure the side of seizure onset in TLE
• Differentiated frontal lobe seizures from temporal lobe seizures
Principle of SEEG methodology

• Hypothesis of the EZ localization
• Individualized “Custom-tailored”
• Adequate stereotactic Technique
Epileptogenic zone

“The site of the beginning and of the primary organization of the epileptic seizures”
Ictal onset

• Cortical area where the first clear ictal electrical change is recorded.
  • Prior to the clinical onset of seizure
  • Fast synchronizing discharge (low-voltage fast activity or recruiting fast discharge of spikes)
Primary organization of the discharge

• The cortical area participating in early seizure spread
  • Spatial extent of discharges at the moment where the clinical sign(s) occurs
  • The coherence between the localization of the discharge and the type of concomitant symptom(s).
  • Cortex areas that are able to generate fast synchronizing discharge.
Indications

• Drug resistant focal epilepsy
• Non-invasive investigations fail to correctly localize the epileptogenic zone
Specific criteria for SEEG

• The possibility of a deep-seated or difficult-to-cover location of the epileptogenic zone (mesial structures of the temporal lobe, opercular areas, cingulate gyrus, interhemispheric regions, posterior orbitofrontal areas, insula, and depth of sulci)

• Failure of a previous subdural invasive study to clearly outline the exact location of the seizure-onset zone

• The need of extensive bihemispheric explorations (multilobar or bihemispheric lesions)

• A presurgical evaluation suggestive of functional network involvement (e.g. limbic system) in the setting of normal MRI

Requirement

• Epileptologist who can understand the methodology and knows how to read SEEG recordings/EMU

• MRI

• Angio Image (CTA, Angiogram)

• Stereotactic device (Frame, Frameless, Robot)

• Floroscopy
PNI workflow for SEEG procedures

• MRI & contrast
• CTA, CTV
• Stereotactic frame placement
• Planning
Equipments

• Skin probe
• Dura Probe
• Ruler
• Screw drivers
• Stylet
• Drill and Bit

SEEG
Post op CT fused with pre-op MRI
How to define the extent of resection?

“Subdural method does not apply for SEEG resection”

• Anatomo-electro-clinical correlation
• Up to the non-involved electrode
• Up to eloquent cortex (will need functional mapping)
• Cytoarchitectonic area, Functional anatomy
• Surgeons judgement (risks vs benefits).
SEEG

- 122 patients (March 2009-April 2012)
- M 65, F 57 (21 pediatric patients)
- Time for planning 33 mins (20-47 mins)
- Time for implantation 107 mins (47-150 mins)
- Complication per electrode 0.18%
- Hypothetical epileptogenic zone was localize in 115 patients (94%)
- Seizure-free 62% (@12 months)

SEEG following SDE

- 14 patients who had previous SDE evaluation
  - 10 (71%) underwent a resection after SEEG
  - 4 (29%) not undergo resection, 2 eloquent cortex, 1 bitemporal epilepsy, 1 previous TL contralateral to the EZ
- 7 pts nonlocalizable ictal onset from SDE => 6 had hypothetical EZ localized after SEEG (deep or difficult-to-access cortical regions)
- 7 pts midleading ictal patterns => inadequate/incomplete resections
- 60% seizure free at 11 months

Morbidity

• SEEG
  • Low
  • Mainly intracerebral bleeding
  • Permanent neurological deficit <1%
    • (Gonzalez J, 2013) complication rate 3% (0.2%/implanted electrode)
    • (Cossu et al. 2005) morbidity 5.6%, permanent deficits 1%
Thank you