Updated 'Stereo EEG' Workflow Simplifies Planning Of Epilepsy Surgery

For patients with "drug-resistant" epilepsy requiring surgery, an updated stereoelectroencephalography (SEEG) technique provides a more efficient process for obtaining critical data for surgical planning, according to a study in the March issue of Neurosurgery, official journal of the Congress of Neurological Surgeons. The journal is published by Lippincott Williams & Wilkins, a part of Wolters Kluwer Health.

"SEEG is a safe and accurate procedure for invasive assessment of the epileptogenic zone," according to the new report by Dr. Francesco Cardinale of Niguarda Ca' Granda Hospital, Milan, and colleagues. Their "updated workflow" combines sophisticated imaging data reconstructions and robot-assisted surgery, "providing essential information in the most complex cases of drug-resistant epilepsy."

Stereo EEG Technique Updated and Simplified

The researchers describe the development of and initial experience with an updated SEEG technique for planning epilepsy surgery. The concept of SEEG is not new. Originally developed by French researchers named Talairach and Bancaud, SEEG uses electrodes implanted in the brain to localize the epileptogenic zone—the area in which seizures originate. The traditional SEEG technique includes two surgical steps: 3-D imaging of the brain blood vessels (stereotactic angiography) followed by electrode implantation.

Over the last few years, Dr. Cardinale and colleagues have been working to develop an updated SEEG workflow allowing a one-step surgical technique. Before surgery, the patient undergoes 3-D magnetic resonance imaging and 3-D digital subtraction angiography. The digital imaging data then undergo processing for reconstruction, resulting in the creation of a detailed computerized model of the brain and of the vascular tree. A key part of the development process was creating a "homemade" computer script to automate the necessary series of data processing steps.

Using the software program from an image-guided neurosurgical robot, the reconstructed data are used to plan the surgical approach, or "trajectory." Robot-assisted surgery was then performed to implant the electrodes. Whether performed by the traditional or updated workflow, the goal of SEEG is to provide the surgeon with highly precise information on the location of the epileptogenic zone, used for planning epilepsy surgery.

The researchers report on the outcomes of 500 SEEG procedures performed between 1996 and 2011 in patients with drug-resistant epilepsy. Both techniques were highly successful in guiding electrode placement to localize the epileptogenic

zone. Complications occurred in 12 cases, for a rate of 2.4 percent.

The first 419 procedures were done with the traditional two-step process; the next 81 procedures were done using the new workflow. The updated technique provided good data reconstructions with no loss of information and a "dramatic reduction in procedural error risks." Use of the 3-D data with the neurosurgical robot allowed neurosurgeons to target any area of the brain, from a wide range of angles. They were also able to create 3-D representations of the brain anatomy and electrode placement, which facilitated communication among the surgical team members and patients.

Detailed analysis in a subset of cases found improved accuracy with the new technique. Median error in localizing the implanted electrodes decreased by about 1 millimeter both at the entry point (the most risky zone) and at the deepest point. The authors believe their technique allows them to estimate a "safe entry region" for electrode placement with 99 percent accuracy.
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The new experience adds to the evidence that SEEG is a safe and effective procedure for electrode placement and surgical planning in patients with drug-resistant epilepsy. Dr. Cardinale and colleagues conclude, "The traditional Talairach methodology, recently updated by the use of the most advanced multimodal planning tools and robot-assisted surgery, allows one to directly record electric activity from every brain structure, providing valuable information in the most complex cases of refractory epilepsy." They are currently working on developing a "SEEG automatic planner."

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