Working Group Meeting for the DBS Consortium
Neural Interfaces Workshop 2006

During the Neural Interfaces Workshop held at the Bethesda North Marriott Hotel and Conference Center, a working group meeting of the Deep Brain Stimulation Consortium was convened by Drs. Joseph J. Pancrazio and Eugene Oliver, NINDS, following presentations on the first day of the meeting on August 21st. The purpose of this brief working group meeting was to discuss future or emergent scientific opportunities/challenges, some of which may have been presented during the first day of the Workshop, and how the NIH can transform these opportunities/challenges into programs. The attendance to this working group meeting was open, but largely intended for more senior DBS consortium members and stakeholders rather than students and fellows. Dr. Ali Rezai of the Cleveland Clinic agreed to facilitate the discussion.

During the first day of the Workshop, there were several sessions focused on the DBS. These sessions aimed to address the growing knowledge concerning the pathophysiology of Parkinson's Disease and the implications for DBS, patient/user perspectives on DBS, approaches for optimization of DBS through improved implantation and targeting methods, new clinical indications for DBS, and the current understanding and characterization of the tissue/device interface for DBS and neural prostheses. The major points from the presentations for these Workshop sessions is available in a companion document entitled "Neural Interfaces Workshop Summary 2006".

Several critical issues concerning DBS were identified by the attendees to the working group meeting:

- There remains a significant hurdle for the translation of research findings from the bench to the clinic. Principle investigators in institutions without an IRB or clinic voiced concern that they are unable to participate fully in the transfer of research to clinical products.
- While there are substantial data concerning the efficacy of DBS on relatively short time scales, there is a lack of information concerning the long-term effects and stability of DBS. One recommendation from the working group was to develop a mechanism or initiative to monitor DBS outcomes longitudinally over a long time scale consistent with the anticipated life cycle of the intervention.
- Significant concerns were expressed by the investigators concerning the review of proposals for new clinical indications for DBS. The expressed view was that DBS is such a novel treatment approach for various neurological conditions that there is little chance to engage a champion during the review in disease/disorder specific study sections. On the other hand, there was also concern that the bioengineering and neurotechnology-oriented programs may not elicit a better suited review to appreciate innovation inherent in pursuing a new clinical indication with an existing or moderately tailored technology. There was enthusiasm for a funding opportunity announcement, through a request for applications or the development of a new study section, that would call for research and development to explore and advance clinical indications for DBS.
- Several concerns were expressed relative to the technology pipeline for DBS, especially with regard to the exploration of new clinical indications for DBS.

    - Clinicians are locked into existing technology provided by device manufacturers, which may not be sufficiently flexible for optimization of stimulus parameters.
    - Clinical studies that critical for exploring new clinical indications are inherently expensive and typically beyond the scope of the modular grant budgets limited to 250k direct per year. Industry support of new clinical indications, especially for those disorders where the patient market does not generate the likelihood of significant financial returns, is difficult to garner.
    - Investigators pursuing new clinical indications for DBS perceive a concern from their institutions relative to liability.
- There was discussion among the group about creating an open-architecture DBS device for research and development purposes, which would parallel the approach used by NIDCD to create an open architecture cochlear implant. The open architecture DBS device would conceivably make use of percutaneous electrodes and allow testing of novel stimulation patterns for research purposes. It was noted that the value of an open architecture device would depend on the breadth of technological capabilities and flexibility embedded in the design.
- There was recognition that there needed to be a database for capturing imaging and efficacy data for clinical use of DBS and a tissue repository to permit post mortem analyses of implanted tissue.
- Members of the user perspectives panel made it clear that there are important opportunities and concerns for improving the current clinical delivery of DBS for movement disorders. The basis of speech dysfunction, one of the few negative correlates identified by DBS users, is not well understood. There is a lack of widespread expertise in DBS programming which led to the suggestion of algorithm/tool development to facilitate the identification of optimal stimulation parameters.

Dr. Rezai provided a brief, although comprehensive overview distilled from the research challenges and opportunities relative to DBS. He identified many points which were consistent with those identified by the attendees and offered thoughtful perspectives on these topics:

- There are significant research needs that are related to the mechanism of DBS including the understanding of neuronal networks/systems and their integrated functions, disease pathophysiology, identification of targets for movement disorders, the potential of multiple nodes of intervention by electrical stimulation, and the capacity for neuronal network plasticity induced by electrical stimulation.
- In the areas of surgical targeting and post-surgical monitoring, research leading to improved safety, precision of electrode placement at desired targets, and speed is necessary. Technological advances allowing frameless surgery and high resolution imaging could have a major impact on the delivery of DBS in the clinical setting.
- While the current electrode technology is effective, it is relatively simple. An open loop single shaft device with limited number of electrical contacts consisting of platinum-iridium is used. This “one size fits all” product is associated with side effects due to current spread (e.g. speech dysfunction and falling), which effectively limit clinical benefits. There are opportunities to improve electrode technology, such as the use of new metal alloys, directional electrodes to steer current, arrays of electrodes with independent stimulation control, electrode assemblies that are designed specifically for particular regions of the brain, and entirely new interfaces such as cortical epidural electrodes.

- Potential improvements to the implantable pulse generator technology include miniaturization, improved battery life and/or rechargeable capability, wireless telemetry, feedback capability to meet the demands of symptoms that vary in intensity, and greater versatility in the form and frequency of pulse waveform delivery. The parameter space for DBS programming presently spans the frequency, pulse width, and magnitude domains, therefore automated tools to facilitate the identification of optimal parameters for specific patients would also be beneficial.
- There are several ways in which the government could reduce the barriers to clinical success. NIH program development to support: 1) studies to evaluate DBS safety and efficacy; 2) establish tech transfer/innovation functions in hospitals; 3) medical school and residency training concerning intellectual property and technology transfer; 4) creation and growth of early stage device development companies through the SBIR program.