Predicting and Preventing Epileptic Seizures

Nicholas Paiva, *Biomedical Engineering, University of Rhode Island*
BME 281 Second Presentation, November 14, 2012 <npaiva@my.uri.edu>

***Abstract*—This paper outlines the methods being developed to help those suffering from epilepsy. It shows the current state of technology and also where research can take this field in the future.**

I. Introduction

EPILEPSY is the fourth most common neurological disorder, which affects about 1-2% of the world population. Out of the 65 million people affected by this disorder, nearly 30% are not helped at all by medication. The only other option for these patients is to undergo surgery, which can be very risky and also ineffective. Brain surgery options vary and they only apply to those whose epilepsy is crippling. Even the medicinal treatments are accompanied by serious side effects that can end up harming the patient in the long run. Therefore, recent research by Purdue University, regarding a "living electrode" design that is able to localize the affected tissue and release a neurotransmitter to stop the seizure is an enormous breakthrough in helping to stop epileptic seizures safely.

II. Methods

The first step to curing epilepsy is pinpointing what area of the brain is causing the seizures. Electrodes are surgically placed on different regions of the brain. They are connected to a miniature transmitter that is implanted just below the scalp. The electrodes send information regarding brain activity to the transmitter and next, the transmitter communicates with an external receiver. When irregular electrical activity is detected, the external receiver will determine which region of the brain is causing the seizures.

The next step is to implant a prosthetic device within the affected brain tissue that will be able to interrupt the signals causing the seizures. The most innovative model being tested right now is designed by Professor Rickus of Purdue University. It is basically an electrode covered in living tissue that will release the neurotransmitter GABA when stimulated by an electric current. The GABA will be released into the tissue and stop the seizure from spreading throughout the brain. These two ideas are combined so that when a seizure is about to occur, the transmitter is alerted and an electrical pulse is sent into the brain to release GABA and stop the problem.

III. Results

Overall, the results from clinical trials have been extremely promising. One design called the NeuroPace has brought stability to the lives of many. Reports show that many participants in the NeuroPace clinical trials have gone from ten seizures per day to a few every month. This has enabled many people to work more effectively in the workplace, at home, and in social environments. Nevertheless, biomedical engineers are still working to bring the number of seizures down to zero and to eliminate the "false alarms" that are often associated with neural devices such as these.

IV. Discussion

Scientists are optimistic about the potential for this type of brain, computer interfacing and how it can be used to help treat not only epilepsy but also other neurological diseases. The ability to retrieve information about the status of the brain and then in turn being able to immediately react and change the outcome of specific neural firings is something that holds a lot of power. In the future, scientists hope to expand the number of channels the transmitters are able to receive, therefore broadening the amount of data being analyzed by the computer. The more information gathered about regions of the brain, the easier it would be to understand and then treat the problem. Some limitations associated with this field of biomedical engineering include the potential damage to the brain from electrical stimulus and also the size of the electrodes being inserted into the brain. There are many safety precautions that must be considered before surgery and implantation.

References

[1] "About Epilepsy." *Epilepsy Foundation*. Epilepsy Foundation, n.d. Web. 9 Nov. 2012. <http://www.epilepsyfoundation.org/aboutepilepsy/>.
[2] "Asian Correspondent Asia News." *Biomedical Engineers Research to Control Epilepsy*. Melborne University, 3 Aug. 2012. Web. 10 Nov. 2012. <http://asiancorrespondent.com/87000/biomedical-engineers-research-to-control-epilepsy/>.
[3] "Common Epilepsy Seizure Medications: Types, Uses, Effects, and More." *Epilepsy Drugs to Treat Seizures*. WebMD, n.d. Web. 10 Nov. 2012. <http://www.webmd.com/epilepsy/medications-treat-seizures>.
[4] Iaesemidis, Leon E. "Epileptic Seizure Prediction and Control." *IEEE Transactions on Biomedical Engineering*. N.p., n.d. Web. 10 Nov. 2012.<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=>.
[5] Johnson, Carolyn. "Treating Epilepsy with Electrodes." *Abc Local*. N.p., 11 July 2008. Web. 9 Nov. 2012.
[6] "Nueroprosthesis for Epileptic Seizures." *Nueroprosthesis for Epileptic Seizures*. Purdue University, n.d. Web. 11 Nov. 2012. <http://www.fountia.com/nueroprosthesis-epileptic-seizures>.