Epilepsy Surgery & Neuroimaging Techniques
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Abstract—An examination of the processes and technology in pairing neuroimaging techniques with epilepsy surgery.

I. INTRODUCTION

The topic I chose for this presentation was epilepsy surgery assisted by neuroimaging techniques. This topic is close to me because I know someone who just underwent surgery for epilepsy and had a preoperative invasive electroencephalography (EEG). This topic is fascinating because the brain may be considered the most interesting organ of the body, and it is certainly an important one. It has been compared to an organic computer, which fits because the brain takes in and processes a lot of information just like a computer (it is much more versatile however). So it makes sense to treat brain disorders, such as epilepsy, like a computer malfunction. First, when fixing a computer, one must run tests to pinpoint the location and manner of the problem, and then diagnose it. This is similar to how neuroimaging aids in the preparation for epilepsy surgery.

II. METHODS

In order for a patient to qualify for epilepsy surgery, they must have uncontrollable and medically resistant epilepsy. Then the patient undergoes non-invasive diagnostics; an intense seizure history, a neurological examination, a MRI, a psychiatric evaluation, a non-invasive EEG, and possibly other imaging such as a CT scan or a PET scan. After this process, a patient can undergo an invasive EEG in which electrodes are implanted after a craniotomy. There are two types of electrodes commonly being used for brain surgery. The first are microwire electrodes, and they are easy to fabricate. It consists of wires of a conducting metal coated with a non-cytotoxic insulator material attached to an array. The number of wires can range from four to over one hundred. The other commonly used electrode is silicon-based. These electrodes allow for more complex designs and a greater control over electrode placement. The number of electrodes and their placement is based upon the preoperative evaluation. Then a patient undergoes one or more induced seizures and a 3-D model of their brain is made. With this model, the surgery team can see the landmarks and the problems areas of the patient’s brain and assess whether surgery would result in a positive outcome.

III. RESULTS

Neuroimaging has greatly improved the care of patients with neurological diseases. This is due to the fact that it results in a more accurate diagnosis. Since the diagnosis is more accurate, the resulting procedure(s) are also more accurate and results in a reduced mortality rate. However, there are certain risks always associated with brain surgery. There’s a risk of irreversible damage due to intracranial hemorrhage or stroke. Irreversible brain damage occurs in about 1% of craniotomies. Other risks include infection, memory loss, and partial paralysis. Nevertheless, the benefits in this specific case are always considered to outweigh the risks because epilepsy patients considered for surgery have exhausted all other options to control their seizures.

IV. DISCUSSION

The future of this process is currently resting in the development of silicon-based electrodes. They are the future of invasive EEGs because the developer can control the shape, size, texture and spacing. I believe there is a possibility in the future for patient specifically designed electrodes, but time and costs obviously restrict that from happening today. The cost of surgery itself has a very wide range ($50,000-$200,000) based upon the type of surgery preformed, and the preoperative procedures needed. In all, epilepsy costs the U.S. around $15.5 billion in both direct (medical) costs and indirect (lost/reduced earnings and productivity of patients) costs. There is a great need to form less expensive treatment for epilepsy, especially considering that about 2 million people in the U.S. have epilepsy.

REFERENCES