CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Petcharat Denprasert; Nathalie Rodriguez

Project Number

31856

Project Title

Injectable Fetal Pacemaker

Abstract

Objectives/Goals

Build a fetal pacemaker for the hydrops fetalis condition, which has a 100% fatality rate, with prior microtechnology expertise in order to be injected into the fetal heart and keep it there to support the heart for one month. The technology that comes with the complete pacemaker can be used as a precedent for other injectable devices in order to make them less invasive and more reliable.

Methods/Materials

In the mechanical engineering issue, we used fruits such as mangos, potatoes, celery, Jell-O, and cucumbers to emulate fetal heart tissue. Using an electrode coil of iridium, we measured the amount of force needed to turn the electrode in 90 degrees using a pressure gauge to create a ratio. After setting the coil against the material at 0 N, we began to turn the electrode in and marked the degrees of turn it took to penetrate the surface. Using the ratio, we convert the force to Newtons to measure the ease of use for the device.

In the electrical engineering issue, we designed a circuit with the intention of having the 3V battery durability last one month, which will give physicians time to deliver the fetus, or for the fetus to correct its own heart rate. Another circuit is being designed to recharge the pacemaker while it is not in use in order to eliminate leakage of energy from the battery and extend storage life.

Results

In the mechanical experiment, we discovered that the large electrode was easier for physicians to use because it required fewer degrees of turns to penetrate the surface of the material.

In the electrical experiments, we discovered that due to the battery cell's rechargeable quality, the battery life was about 1/4th of that of a nonrechargeable cell. The circuit with a rechargeable cell would last about 6 days, and with a nonrechargeable, the circuit would last about 24 days. The recharge circuit works optimally and minimizes leakage of the lithium cell.

Conclusions/Discussion

Both mechanical and electrical components of the device closely meet the demands of the objective. The electrical designs can be changed to support a different normal heart rate. The mechanical designs of this project will initially be used for fetuses, but can be expanded for other life-saving devices.

Summary Statement

The development of a fetal pacemaker will save the lives of about 500 unborn children per year who otherwise have no cure and are subject to 100% fatality rate.

Help Received

Used lab equipment at University of Southern California under the supervision of Dr. Gerald Loeb