CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

S0908

Project Title

The Tin Man and His Heart: Protecting Pacemakers from Predators

Abstract

Objectives/Goals

This experiment was conducted to determine the feasibility of developing a passive defense system to protect implanted medical devices from predatory radio frequency attacks. The first hypothesis stated that variances in skin and fat composition would cause differences in the amount of RF signal received by an implanted pacemaker. The second hypothesis stated that various skin and fat compositions, combined with a layer of various metal fabrics would cause differences in the amount of RF signal received by an implanted pacemaker

Methods/Materials

The experiment used a network analyzer, horn antennas and a human analog to replicate the predatory conditions that a patient with a pacemaker could encounter. Four types of metal fabrics were tested with three patient types. The first hypothesis was tested using three different human analogs, thin normal and obese. The test protocol used a network analyzer emitting a 2.4 GHz signal with the first horn style antenna and then measured signal attenuation in decibels(dB), that occurred with each sample using a second horn style antenna. The second hypothesis was tested using the same protocol with the addition of four metal fabrics; silver, copper, stainless steel and silver-nickel, as a single layer, individually with the three patient types.

Results

The results for the first hypothesis demonstrated that fat and skin composition do contribute to signal attenuation as shown by the 4.1dB signal reduction in the obese patient. The data from the second hypothesis demonstrated that significant signal attenuation of the 2.4GHz signal occurred using silver fabric and stainless steel mesh fabric. The best fabric was silver which reduced signal by 11.4dB in a normal patient, a 44% reduction in signal and the stainless steel mesh reduced signal by 10.4dB. The silver fabric had a p value of 0.014 demonstrating that the data is statistically significant for the fabric type.

Conclusions/Discussion

The percentage of signal strength attenuation at 11.4dB with the silver fabric when tested at 2.4 GHz does demonstrate the feasibility of passively blocking predatory RF signals from reaching a pacemaker. The data from this experiment confirms that it is physically possible to reduce radio frequency signals at the levels most likely to be used in a predatory attack, by using simple and affordable metal fabrics.

Summary Statement

This experiment was conducted to determine the feasibility of developing a passive defense system to protect implanted medical devices, namely pacemakers, from predatory radio frequency attacks.

Help Received

I received lab safety assistance from Dr. Kiourti at Ohio State University.