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Advantages of Air Cooling in Thermal Ablation

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Advantages of Air-Cooling in Thermal Ablation

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Introduction

Thermal ablation is the method of destroying tumors through extreme temperatures. Ablation provides many benefits compared to traditional surgery: it is less invasive, more time efficient, cost effective, and can treat some tumors that cannot be surgically removed. Typically, tissue heating is achieved by energy transferred through an antenna which is then inserted into a designated tumor area. To control this heat, a form of cooling is incorporated within the antenna. Without cooling, the device becomes overheated and destroys unwanted tissue, causes unnecessary pain, and yields a smaller ablation zone. Previous studies have used water cooling as the primary source of cooling. Air cooling may provide an alternative technique. This experiment will test the effects of an air cooled system and compare its results to ablation with a water cooled device and ablation with no cooling at all.

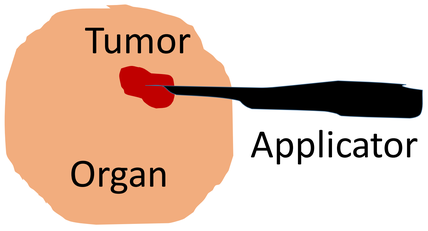

Figure 1: ablation diagram

Methods

An air cooling device will be constructed at a frequency of 2.45 GHz. The device will be tested ex vivo on pieces of cow liver. The goal is to create a device that maximizes the size of the ablation zone and avoids the heating of unwanted tissue. The results of the tests using air cooling will be compared to the ablation of the cow liver with a water cooling device and with no cooling at all. In finding which cooling method is most successful, we can draw conclusions about how we can create the most efficient device to ablate tumors.

Methods (cont.)

Figure 2: Equipment

Figure 3: Circuit Setup

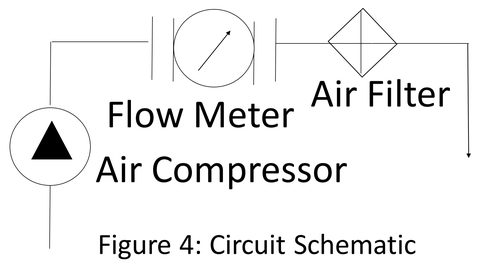

Figure 4: Circuit Schematic

Design

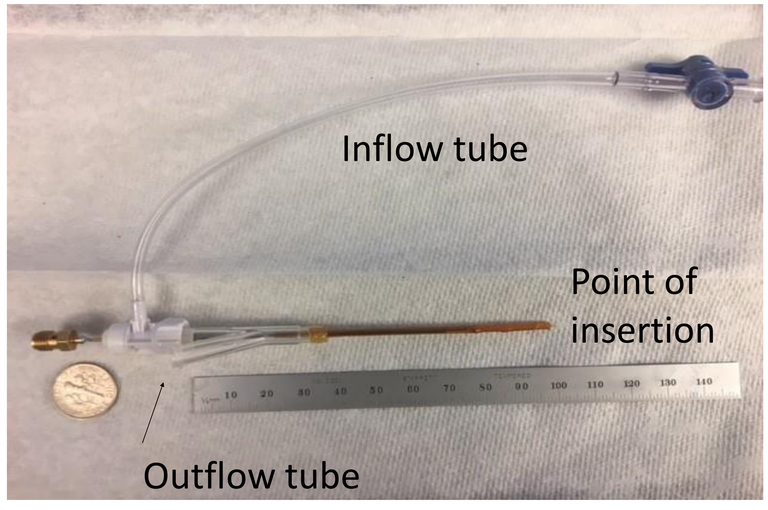

Figure 5: Applicator

Ongoing Efforts

Thus far, the applicator has been made and tested to make sure that it will operate correctly. All of the materials have been gathered and are ready to use in conjunction with the devices. Testing to see how these air-cooling devices compare to water cooling and non-cooling will begin soon.

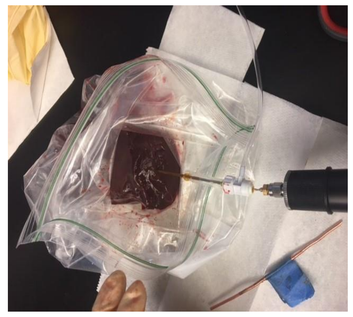

Figure 6: applicator testing

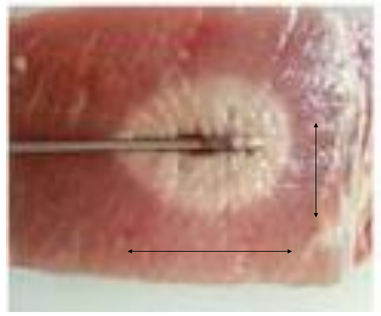

Figure 7: ablation zone

Future Applications

In discovering that air-cooling holds a greater advantage while ablating tissue over water-cooling, doctors will be able to provide better treatment to a patient. The operation is presumed to be less invasive, more efficient, and able to treat more difficult tumors.

Acknowledgments

- Hojjat Fallahi (Grad. Student in Computer/Electrical engineering)
- Deardorff, Dana L., Chris J. Diederich, and William H. Nau. "Air-cooling of Direct-coupled Ultrasound Applicators for Interstitial Hyperthermia and Thermal Coagulation." *Medical Physics.* U.S. National Library of Medicine, Dec. 1998. Web. 31 Mar. 2017.