Determining effect of high-level disinfection on the sensitivity of an endorectal MRI coil

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Introduction

Magnetic resonance imaging is a powerful tool that can be used to diagnose and visualize different medical conditions. These scans use strong magnetic fields and radio waves to produce three dimensional images. Like any tool, there are limitations that researchers can try to mitigate.

For example, with prostate cancer, it can be difficult to visualize the tumor precisely due to its positioning within the body and inconsistent contrast between tumor and normal tissue. For this reason, an endorectal coil was developed, producing higher signal to noise imaging and therefore producing clearer images for diagnosing and therapeutic purposes.

However, if the endorectal coil is to be used on multiple patients, it must undergo high level disinfection to avoid contamination and spread of bacteria from patient to patient. High level disinfection can be done via the Trophon device which uses a hydrogen peroxide disinfectant and high temperatures to clean the coil.

The purpose of this experiment, therefore, is to ensure that the Trophon machine disinfects the coil properly and to determine if it impacts the coil's physical properties of its signal to noise imaging abilities.

Methods

Bacteria

To determine if the HLD in Trophon device was efficient, bacterial cultures were inoculated onto the coil. Direct contact between petri dishes and coil was made before and after a HLD cycle to see if there was a difference in bacterial growth.

Coil Properties

The coil was introduced to 100 HLD cycles within the Trophon. To determine any physical changes of the coil from, images were taken before and after 100 HLDs.

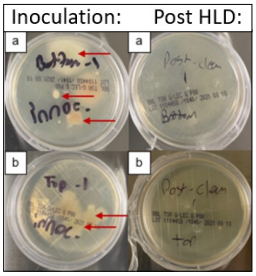
To determine if the coil's signal to noise ratio (SNR) imaging abilities images of a 50 mL conical tube filled with milli-q water was image in the MRI.

After receiving 100 HLDs, this process was repeated and the results were compared.

SNR Calculations

$$SNR = \frac{Signal}{deviation\ of\ noise}$$

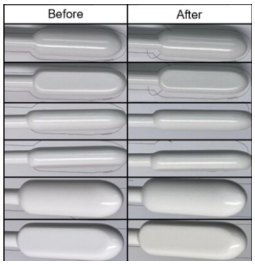
Results



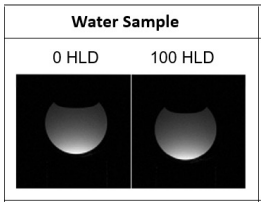
On the inoculation plates, high bacterial growth was observed.

On post HLD plates, no bacterial growth was observed.

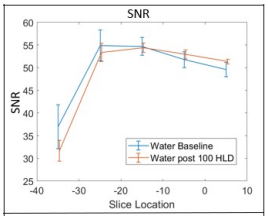
This was repeated 3 times. On the other two plates, colonies were observed on the edge.



This picture gives a comparison of the coil before and after the cycles. In the before pictures, no chips, cracks, or bumps are observed. After 100 disinfection cycles, no chips, cracks or bumps are observed.



Here, the signal images look very similar. The coil was placed below the water sample and in this image, the highest signal is seen near the coil – as expected.



This graph displays the SNR calculations plotted. No significant changes are seen from 0 HLD to 100 HLD

Conclusion

Although some plates had colonies near the edge, it was determined that the colonies are contaminants due to their placement and morphology. It can be attributed to possible grazing while plating or due to the coil extended being the recommended line. From the data, it can be concluded that the Trophon efficiently achieved HLD.

Since no chips, cracks, or bumps were observed after HLD, we can see that the coil's physical properties were not altered.

From the images gathered, we can see that the HLD cycles did not impact the signals received from the coil. No changes observed within the image can allude to the coil working equally well before and after the cycles.

From the SNR calculations, no significant changes were observed which allows for the conclusion that the Trophon device did not impact the SNR and imaging abilities.

Future Directions

From the experiment, no changes in physical properties and SNR imaging were observed. Further research can be based on developing a Trophon device that is proven to disinfect the whole coil efficiently. More research would allow this coil to be used in clinical practice as it has been shown to have better SNR than the endorectal coil that is currently being used. If proven successful, another coil for cervical/uterine cancers could also be developed to enhance diagnostic imaging for other types of cancers.