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A Study of Mosquito Nets Used in Hernia Repair Surgery

This summer, I studied the use of mosquito nets in hernia repair. A hernia is a protrusion of tissue or organs through a wall of muscle; it is one of the most common medical conditions worldwide. In developed countries such as the United States, a commercially produced surgical mesh is used to repair hernias. However, this mesh is very expensive, and many patients in developing countries cannot afford it. As a result, physicians in developing countries often use mosquito nets to repair hernias. Multiple studies have shown that mosquito nets produce short-term outcomes that are comparable to those of commercially produced mesh, but the long-term effects of leaving mosquito net inside the body are unknown. Additionally, physicians worry that autoclave sterilization, a necessary process for anything that enters the body during surgery, could damage the structural integrity of mosquito nets because they are not manufactured to endure such high temperatures. This summer, Professor Sinniah's lab analyzed the heavy metal content of polyester, polyethylene, and polypropylene mosquito nets to see if their contents were comparable to that of commercial surgical mesh. We also analyzed the effects of autoclave sterilization on the tearing force of the mosquito nets.

To analyze the mosquito nets for heavy metal content, we used a technique called Microwave Plasma Atomic Emission Spectroscopy. We heated the mosquito nets in solutions of concentrated acid to extract their metal content, and then we sprayed the solutions into a plasma torch. The MP-AES instrument analyzed the solutions for certain elements that were present based on the light that the burning solution gave off at specific wavelengths. Our results demonstrated that the heavy metal content in the mosquito nets was comparable to that of commercially produced surgical mesh. Thus, heavy metal content in mosquito nets does not appear to pose a threat to patients. One limitation of this study is that the heavy metal content is highly dependent on the manufacturing processes that the nets underwent. As a result, we cannot generalize our findings by claiming that they apply to all mosquito nets worldwide – they only apply to the specific mosquito nets studied.

To study the effects of autoclave sterilization on the tearing force of the mosquito nets, we cut samples in the warp and the weft direction from each mosquito net. Half of the samples were sterilized in the autoclave at 121°C. We then measured the force required to tear all of the samples using a Starrett FMS500 Tensile Strength Tester from Grand Rapids Metrology. We observed that autoclave sterilization increases the amount of force required to tear the polypropylene and the polyethylene mosquito nets, while it does not significantly change the tearing force of the polyester mosquito net. Autoclave sterilization also increases the elongation ability of polyethylene mosquito net. It is important to note that we did not compare the different types of mosquito nets to each other in this part of the experiment because we did not know the fiber thickness of all of our samples; this confounding variable makes it impossible to draw any conclusions from comparisons between different net types. Instead, we only compared each type of mosquito net to itself with and without autoclave sterilization.

This opportunity to conduct research at Calvin has benefitted me in many ways. I have gained experience in scientific research and have learned about the diligence and creativity required to work around problems in the experimental process. I've also experienced the satisfaction and joy that come with obtaining trustworthy results. Finally, I have gained insight into how the work that I do at Calvin as a researcher and as a student can help those in need. Hopefully, my work this summer will enable physicians around the world to gain much-needed knowledge about financially sustainable care for patients in resource-poor situations.