



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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Project Title Transdermal Lactate Collection with Agarose Gels for Noninvasive and Painless Monitoring of Patients	
<p style="text-align: center;">Abstract</p> <p>Objectives Biomarkers are extremely important in medical diagnostics, as they can help monitor a patient's medical status. Heart disease and sepsis, for example, can be identified by a spike in the concentration of the lactate biomarker. Previous biomarker assimilation has been limited to invasive, painful, or expensive blood and sweat collection methods such as blood tests, iontophoresis, and microneedles. The objectives of this project were to consistently and noninvasively collect transdermal lactate with hydrogels, test transdermal glucose collection, and establish a correlation between transdermal lactate and blood or sweat lactate.</p> <p>Methods Agarose gel solutions were created and molded to a single hydrogel in an elliptical orientation with constant major and minor axis measurements. Before testing the method on volunteers, in vitro studies were conducted using lactate and glucose stock solutions, a diffusion cell, porcine skin, and agarose gels. A constant sterilization procedure was established for each volunteer to reduce the possibility of sweat lactate interference. After collection, samples were diluted with a phosphate buffer solution and sonicated. Hydrogels were then removed from the vials and the diluted samples were placed in the YSI machine. Lactate and glucose concentrations were measured, and results were recorded. To evaluate trends in blood lactate as well as transdermal, trials were taken before and after eating and blood samples were also drawn.</p> <p>Results The results show that transdermal lactate collection with hydrogels is an excellent alternative to invasive and painful methods. Glucose concentrations were below the limit of detection, therefore transdermal collection of glucose with hydrogels would require a more sensitive glucose sensor. Blood and sweat lactate concentrations increase just after eating, and transdermal samples showed similar trends.</p> <p>Conclusions Transdermal biomarker collection with hydrogels is a noninvasive and painless method for monitoring a patient's status. Due to the apparent correlation between blood and transdermal lactate, the lactate collected with hydrogels can be used to diagnose septic shock and heart disease early on after conducting successful clinical studies.</p>	
Summary Statement I sought to turn invasive medical diagnostic procedures into a noninvasive procedure by using agarose gels to transdermally collect biomarkers and diagnose illnesses early on.	
Help Received I conducted research at UCLA's Integrated and Interconnected Bioelectronics Lab with my mentor Shuyu Lin. My mentor discussed ideas with me, collected blood from my volunteers, and allowed me to use lab equipment to conduct my experimentation.	