A Wireless Intramuscular Near-Infrared Spectroscopy Device Detects Muscle Oxygenation Changes in Swine Model of Leg Compartment Syndrome

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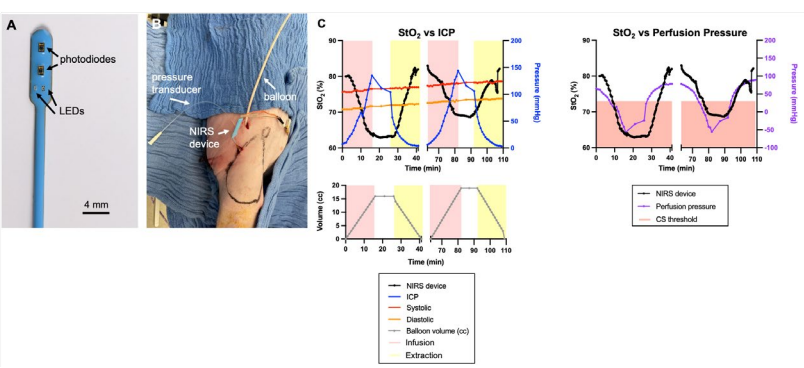
Purpose: Compartment syndrome (CS) can be a devastating, limb-threatening condition that is difficult to accurately diagnose. Near-infrared spectroscopy (NIRS) has demonstrated promising diagnostic potential in both animal and human studies. However, in a recent multicenter clinical trial, a transcutaneous NIRS device was unable to reliably collect muscle oxygen saturation (StO2) data in a clinical setting due to technical issues with the device and possible interference with fracture hematoma. Recognizing the challenges of muscle perfusion assessment using transcutaneous NIRS, our group has developed a novel wireless, percutaneously introduced implantable intramuscular NIRS sensor that is capable of reliable continuous measurement of StO2 of intracompartmental muscle (Fig. 1A).

Methods: Experiments were conducted in 4 swine to demonstrate reproducibility. After induction of anesthesia, a balloon model of leg CS was utilized as previously described by Kalns et al (Fig. 1B). Balloon inflation was performed in order to achieve a perfusion pressure of less than 30 mm Hg for 10-minute intervals. Muscle StO2, intracompartmental pressure (ICP), and compartment perfusion pressure (PP) were recorded simultaneously.

Results: The observed StO2 decreased with increasing ICP and decreasing PP and then recovered following pressure reduction (Fig. 1C). Cross-correlations describing correspondence between StO2 and ICP were >0.73.

Conclusion: This novel intramuscular NIRS device demonstrated reliable and continuous measurement of oxygen saturation directly within muscle tissue in a controlled animal model of acute CS. This study demonstrates that intramuscular NIRS may improve our diagnostic accuracy in patients with CS, but additional testing in the setting of trauma will be necessary to further evaluate its potential as a diagnostic modality.



The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device they wish to use in clinical practice.