

Is Continuous Near-Infrared Spectroscopy (NIRS) Reliable to Monitor Development of Compartment Syndrome in Patients with Lower Leg Injuries?

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Purpose: Tissue oximetry using near-infrared spectroscopy (NIRS) is a potential diagnostic tool for acute compartment syndrome (ACS). We obtained continuous NIRS and intramuscular pressure (IMP) data in a study to develop models for predicting ACS in lower leg injuries. We report our experience with NIRS and explore factors affecting data capture.

Methods: 191 patients were enrolled in an IRB-approved trial. Patients had continuous IMP recording in the anterior and deep posterior compartment of the leg, and continuous NIRS measurement in the anterior compartment of the injured and a control limb. Data were recorded for a prescribed time period starting at enrollment. For IMP and NIRS, the percent of valid data was defined as the ratio of observed data points within a valid physiological range to the total number of expected data points. Clinically useful NIRS data required simultaneous data from injured and control legs to calculate the ratio of the two. Paired Wilcoxon signed rank test was used to compare the two methods. A multiple beta-regression model was used to explore factors affecting NIRS data capture.

Results: Clinically useful NIRS data were available 9.1% of the expected time. In contrast, clinically useful IMP data were observed 87.6% of the expected time ($P < 0.001$). Excluding 46 patients who had no NIRS data at all, these percentages were 31.6% for NIRS versus 87.4% for IMP data ($P < 0.00001$). Fractures with an associated hematoma were less likely to have valid data points (odds ratio [OR] = 0.53, $P = 0.04$). Gustilo open fracture types I and II were more likely than Tscherne closed fracture type 0-I to have valid data points (OR = 1.97, $P = 0.03$). No factors were significantly associated with variation in NIRS data capture in the control limb.

Conclusion: In this study, NIRS data were not collected reliably. Assessment of muscle perfusion using NIRS depends on the ratio of oxygen saturation in the injured limb to a control limb. Useful NIRS data were collected less than 10% of the expected time in our overall group, and less than a third of the time in the subgroup of patients that had at least some NIRS data recorded. In contrast, IMP measurements were collected in over 85% of the expected monitoring period. Clinicians responsible for treating ACS should be aware of these limitations when choosing how to monitor their patients. Furthermore, it appears that NIRS monitoring may not be sufficiently reliable in developing models for diagnosing ACS.