



Near-Infrared Spectroscopy With A Provocative Maneuver To Detect Critical Limb Ischemia

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BACKGROUND

- The ankle-brachial index (ABI) is the most common diagnostic test used to evaluate the presence of peripheral arterial disease (PAD).
- However, ABIs can be falsely elevated because of medial calcinosis and do not measure tissue oxygenation of the foot.
- Near-infrared spectroscopy (NIRS) measures superficial tissue oxygenation.
- NIRS technology shows promise as a quick, non-contact, and non-invasive vascular assessment tool, however currently there is little evidence for how to interpret the images as a vascular assessment.
- We propose a technique that can detect critical limb ischemia (CLI) utilizing NIRS and suggest guidelines for interpretation

METHODS

Patients suspected of having PAD were assessed using NIRS with a provocative leg raising maneuver performed by elevating the leg at 45 degrees for 60 seconds. Patients were imaged with a non-contact NIRS camera while resting supine and after transient leg elevation. Tissue oxygen saturation (StO₂) values were obtained at supine and leg elevation positions. When possible, ABI and TBI were also recorded. Patients were further classified via clinical assessment into groupings of normal, mild, moderate, and severe PAD.

RESULTS

There was no discernable difference in the baseline supine images between all groups. The average value for the mild PAD group was $74 \pm 6.8\%$ and the severe PAD group was $76 \pm 10\%$.

There was a discernable difference between all groups for the delta change from baseline to elevation (Figure 1).

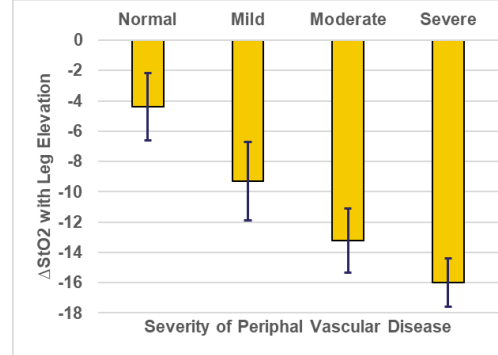


Figure 1. Average change in StO₂ with provocative maneuver. Data is represented as means ± SEM. Normal (n = 6), mild (n = 5), moderate (n = 8), and severe (n = 6).



Figure 2. Representative case that healed after being screened for PAD via NIRS. The patient was able to receive revascularization which resulted in a healed wound.

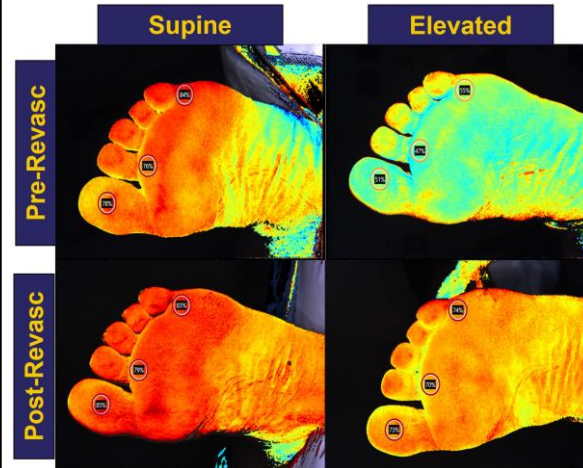


Figure 3. NIRS images from a single subject who underwent provocative testing before (top) and after (bottom) vascular intervention. Oxygenation was preserved in the elevated limb state after revascularization compared to pre-revascularization. A repeat of NIRS following revascularization can document adequacy of revascularization

DISCUSSION

- Evaluating for CLI using NIRS was not possible using a single supine image.
- Baseline images show no evidence of ischemia in the oxygenation images for subjects with severe PAD, likely due to stasis.
- Using a simple leg elevation maneuver in combination with NIRS imaging proved to be an effective way to detect CLI.
- This suggests that even if an initial NIRS image appears normal, if there is a suspicion of CLI from history, signs and symptoms, a leg elevation should be used to interpret the NIRS data.
- In addition, NIRS imaging provided a way to evaluate PAD in patients that could not be assessed through standard techniques (i.e., ABI) due to calcification.
- Next steps would require a larger sample size and determination of cutoff values for different levels of CLI.

CONCLUSION

- NIRS is a beneficial point-of-care tool that quantifies tissue oxygenation and may be a useful tool in assessing PAD.
- Future work may be comparable or superior to ABI for detecting PAD when used in conjunction with a provocative maneuver as it can work with calcinosis.