This is a repository copy of Last Word on Viewpoint: Principles, insights, and potential pitfalls of the noninvasive determination of muscle oxidative capacity by near-infrared spectroscopy.

White Rose Research Online URL for this paper:
http://eprints.whiterose.ac.uk/121482/

Version: Accepted Version

Article:

https://doi.org/10.1152/japplphysiol.00856.2017

© 2018 the American Physiological Society. This is an author produced version of a paper published in Journal of Applied Physiology. Uploaded in accordance with the publisher’s self-archiving policy.

Reuse
Unless indicated otherwise, fulltext items are protected by copyright with all rights reserved. The copyright exception in section 29 of the Copyright, Designs and Patents Act 1988 allows the making of a single copy solely for the purpose of non-commercial research or private study within the limits of fair dealing. The publisher or other rights-holder may allow further reproduction and re-use of this version - refer to the White Rose Research Online record for this item. Where records identify the publisher as the copyright holder, users can verify any specific terms of use on the publisher’s website.

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

Alessandra Adami and Harry B. Rossiter

Rehabilitation Clinical Trials Center, Division of Respiratory and Critical Care Physiology and Medicine, Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center, Torrance, CA, USA

CORRESPONDING AUTHOR:
Alessandra Adami
Division of Respiratory & Critical Care Physiology & Medicine
Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center
1124 W Carson St., CDCRC Building
Torrance, CA 90502
USA

E-mail: aadami@labiomed.org
TO THE EDITOR: We thank the authors for their insightful contributions to the discussion on use of the NIRS muscle oxidative capacity test. Several good points were raised: here we develop three general themes that emerged.

There is ongoing concern about the potential influence of skin blood flow (BF) on the measurement and the ability of NIRS to assess skeletal muscle in obese individuals. Naturally, the NIRS muscle oxidative capacity test relies on sufficient diffusion of light to reach muscle tissue. Skin BF, melanin content and adipose thickness may each affect the validity of this assumption (1). However, the method is effective in isolating the muscle compartment, because it relies upon oxygen consumption ($\text{mVO}_2$) recovery kinetics that is induced by brief, low intensity, muscle contractions. Thus, if these conditions are met, they obviate the potential influence of skin BF on the $\text{mVO}_2$ recovery rate constant ($k$) estimation. High-power time-resolved (TRS) NIRS (4) is a developing method that increases the depth sensitivity of NIRS. This technique may overcome difficulty in assessing $\text{mVO}_2$ in muscles where light absorption or the covering adiposity is large. In addition, as deeper muscles have greater type I fiber expression (3), high-power TRS NIRS provides the opportunity to assess $k$ in wider range of muscles and fiber compositions compared to other NIRS systems.

The influence of muscle BF on $k$ remains another concern. The NIRS muscle oxidative capacity test requires that BF is occluded, such that measurement validity depends on: a) ceasing convective $\text{O}_2$ delivery and; b) a $\text{PO}_2$ that does not limit $\text{mVO}_2$ (1). We, as others, believe that the method benefits from its simplicity, especially in the clinical setting. The addition of, for example, Doppler ultrasound to verify BF occlusion is unlikely to bring significant improvement. The question remains open, however, of what is the necessary $\text{PO}_2$ (or tissue saturation) to ensure that the method effectively ‘isolates’ the intramuscular compartment, and that it is not influenced by capillary-myocyte $\text{O}_2$ diffusion. It is typically recommended to maintain tissue saturation $>50\%$ of the physiologic normalization range (1,5). On the other hand, the method could be effectively adapted to investigate the integrated muscle $\text{O}_2$ transport and utilization response, providing additional
information in disease states or interventional studies beyond muscle oxidative capacity alone.

Muscle oxidative capacity is one property of muscle that has heretofore been complex to assess. The ability to quantify $k$ using a simple, potentially automated, system provides an advance in our ability to investigate the strong associations among muscle mitochondrial function, health and longevity. Oxidative capacity is, however, a single piece in the puzzle that drives this association, together with phosphorylative capacity, coupling (P/O ratio) and reactive oxygen species production, among other mitochondrial functions. These latter currently require more complex methods, including biopsy or combined optical and magnetic resonance spectroscopy approaches (e.g. 2). Nevertheless, the relatively simple, validated and reproducible, NIRS-based assessment outlined in the Viewpoint offers a first step towards a widely-applicable analysis of muscle mitochondrial function in health, aging and disease.
DISCLOSURES
No conflicts of interest, financial or otherwise, are declared by authors.

AUTHORS CONTRIBUTIONS
A.A. drafted manuscript; A.A. and H.B.R. edited and revised manuscript; A.A. and H.B.R. approved final version of the manuscript.
REFERENCES


