Reviewer’s report

Title: The effects of hypoxia on muscle deoxygenation and recruitment in the flexor digitorum superficialis during submaximal intermittent handgrip exercise

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Reviewer: Stéphane Perrey

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The effects of hypoxia on muscle deoxygenation and recruitment in the flexor digitorum superficialis during submaximal intermittent handgrip exercise

The topic of this study is on the measurement of muscle oxygenation during handgrip exercise under hypoxia. Authors argued their choice for a handgrip exercise (local muscle group) to avoid a too large cardiovascular strain as encountered during whole-body tasks (cycling, running). Combined measures of muscle activation (EMG) and oxygenation (NIRS) were carried out during a submaximal (50% maximal voluntary contraction) intermittent (duty cycle 2:1) handgrip task in twenty subjects during hypoxia (FIO2 of 12%) or normoxia conditions; muscle of interest was the flexor digitorum superficialis (FDS).

Patients were not recruited and tested. This is out of scope of the present study. Thus, this should not be discussed especially in the abstract. Rather conclusion on the main result (hypoxia alters muscle activation and oxygenation in healthy adults) should be proposed.

Abstract. since only hypoxia induced only lower SmO2 value, the conclusion (muscle oxygenation term) should be revised. See later some comments on that.
Introduction

Page 4, Lines 10-18. Some topical review (e.g. doi: 10.1089/ham.2008.1093.) can be proposed line 12 in addition to Fulco's reference. Effects of acute or prolonged exposure to hypoxia on human skeletal muscle performance and contractile properties were reported. We know that the adaptations to chronic hypoxia minimize the effects on skeletal muscle dysfunction (i.e., impairment during fatigue resistance exercise and in muscle contractile properties) that may occur during acute hypoxia for local muscle exercises as used in the study. This section as well as others should only deal with small muscle mass and performance during acute hypoxia. Of note it is important to reveal to readers that compared with normoxic conditions, acute hypoxia leads to a more rapid decline in endurance time associated with submaximal intermittent isometric contractions.

Page 4, lines 29-42. This section as the previous one has to focus on the muscle mass investigated (FD). To this regards, literature on climbing activity has investigated muscle oxygenation profiles during submaximal / intermittent exercise (see for instance Table 1 in the review doi: 10.1007/s40279-017-0820-1).

From the review of literature it is clear that different muscles, different types of exercise protocol (e.g., duration, intensity), and different experimental protocols used partly explain the inconsistency of observed results. Authors aimed to characterize the effects of acute hypoxia during submaximal intermittent handgrip exercise (at 50 % MVC with a duty cycle of 2:1 s) to task failure on muscle activation and oxygenation. In this case, the rationale of their study has to be targeted mainly on the next modulating factors: intensity of 50% (intermittent mode) and a mismatch duty cycle. As currently stated, the novelty of the first hypothesis is questioned. The rationale of the second hypothesis was not presented. Altogether, introduction should be revised for better highlighting the originality of the study and the possible added value to combine EMG and NIRS techniques to characterize in different way the muscle function.

Methods.

Overall, this section is clearly presented and detailed enough.

Page 5, L 44. Did authors assess the laterality of the hand?

Page 6, L 1. Please indicate the sampling frequency.

Page 6, L 4. "dominant". See the previous comment on that point.

Also, what were the landmarks for placing the NIRS device?
"were placed distal to the NIRS optode". Did authors follow the SENIAM recommendations? At the end, the priority was put on EMG electrodes or NIRS probes placement. Finally, the localisation of NIRS and EMG sensors on the same muscle area may be an issue. Please comment.

What was the lower limit of impedance?

Please give more information on how changes in NIRS parameters were quantified as compared to the baseline. The latter is an important criteria that deserves dedicated analysis. Since the portalite has 3 inter-optode distances, authors have to clarify what they analysed/did.

Discussion

The novelties and major findings have to be reported first, with regards to the hypotheses of the introduction.

NIRS results in Figure 2 show the effects of time and/or FIO2 conditions.

Extraction (HHb) time course (% task duration) are similar between normoxia and hypoxia. This is also true for the O2 perfusion (tHB). Only SmO2 trace shows significant results (lower value in hypoxia) that can be explained by the baseline condition (time course is identical, the delta being the same); but again profiles during the task were the same. Second, EMG results (Figure 3) follows the same schematic for the RMS values: no real impact of hypoxia, only the effect of time / exercise. For MPF, as SmO2 change occur at the beginning of the task.

In conclusion, although FIO2 had no significant effect on endurance time and NIRS patterns based on modified beer lambert law, only SmO2 (TOI) in hypoxia differed from normoxia since the beginning of the task. This means that hypoxia has an influence on muscle oxygenation in resting only; exercise induced thereafter the same "stress" in both FIO2 conditions. Altogether, these findings are not so new, except the muscle mas investigated.

Authors should also comment on the only parameter (SmO2) that shows significant difference between hypoxia and normoxia.

Combined EMG-NIRS techniques for investigating muscle function is not really highlighted. In what both techniques can be complementary? Any added-values to suggest?
Are the methods appropriate and well described?  
If not, please specify what is required in your comments to the authors.  

Yes

Does the work include the necessary controls?  
If not, please specify which controls are required in your comments to the authors.  

No

Are the conclusions drawn adequately supported by the data shown?  
If not, please explain in your comments to the authors.  

No

Are you able to assess any statistics in the manuscript or would you recommend an additional statistical review?  
If an additional statistical review is recommended, please specify what aspects require further assessment in your comments to the editors.  

I am able to assess the statistics

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Please indicate the quality of language in the manuscript:  

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