Unexpected cardiovascular response during ultra-endurance exercise

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SUMMARY AND CONCLUSION

During ultra-endurance exercise the drift in heart rate does not progress continuously, but is instead reversed when exercise duration exceeds 6 hours.

Concomitantly oxygen uptake increases, leading to an increment in oxygen pulse, which is explainable by elevated arteriovenous oxygen difference.

INTRODUCTION

It is well established that during exercise at fixed work rate heart rate (HR) increases slowly with concomitant decrease in stroke volume (SV) in order to maintain cardiac output.

METHODS

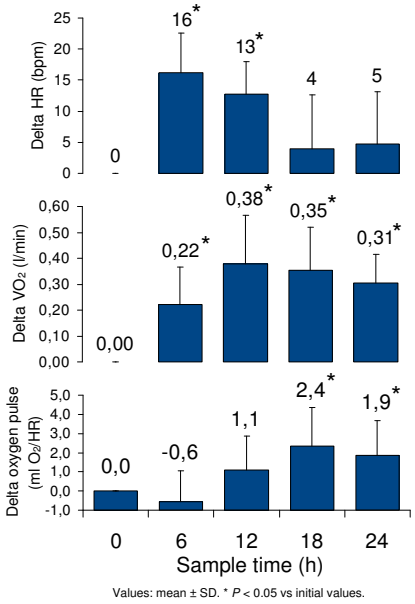
Nine well-trained male athletes performed 24-h exercise in a controlled laboratory setting with altering blocks of kayaking, running and cycling. Each block consisted of 110 min of exercise and 10 min of rest.
Measurements of HR and VO_2 were conducted during cycling at fixed work rate every 6th hour. The average work intensity was 55 % of respective VO_{2peak}.

RESULTS 24-h

HR was, as expected, increased with 13 % compared to initial values, but thereafter the drift was reversed.

VO_2 was increased with 10 % at 6 h and 17 % at 12 h compared to initial values, and then remained stable.

This implies an increased oxygen pulse (VO_2/HR) with approx. 10 % during the later half of the exercise.



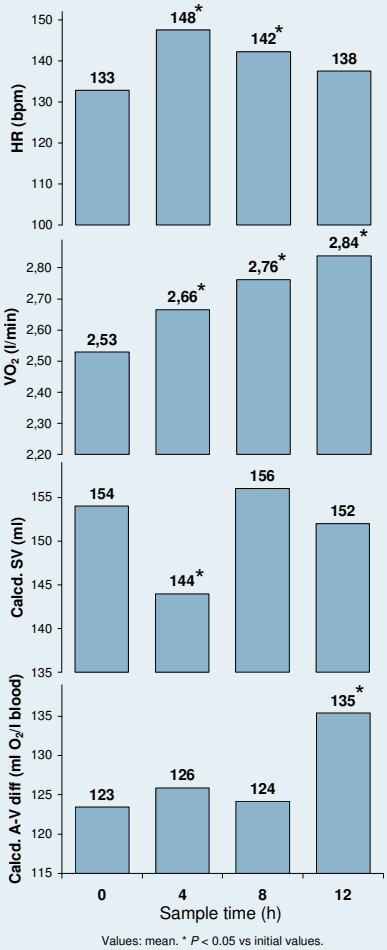
Values: mean ± SD. * $P < 0.05$ vs initial values.

RESULTS PILOT

HR, VO_2 and oxygen pulse changed in similar ways as in the 24-h exercise. SV decreased at 4 h but then normalized. Hence, the increased oxygen pulse was due to increased a-v difference.

PILOT STUDY

In a recent pilot study (4 males, 12-h exercise) cardiac output was measured using acetylene rebreathing-method, with the purpose to evaluate if the increased oxygen pulse should be ascribed increased stroke volume (SV) and/or arteriovenous oxygen difference.



Values: mean. * $P < 0.05$ vs initial values.

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