Anaerobic capacity of the upper arms in top-level team handball players

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Introduction
Team handball is a sport with high anaerobic demands (Delamarche et al. 1987). Although the legs' anaerobic capacity of team handball players (THP) in the Wingate anaerobic test (WAnT) is high (Rannou et al. 2001), data concerning anaerobic performance in the upper extremities are limited. Izqueirdo et al. (2002) observed that THP and weight lifters had similar peak power (1RM) in bench press, significantly higher from runners, cyclists and control subjects. The aim of this study was to investigate the anaerobic capacity of the upper extremities in top-level handball athletes using the WAnT. A second purpose was to explore their capability to utilize oxygen during the WAnT, via near infrared spectroscopy (NIRS), which provides intramuscular oxygenation measurement, even during supramaximal exercise (Bae et al. 1999).

Methods
21 male top class THP and 9 university students serving as control subjects (CON) participated in this study. Peak and mean power outputs were recorded during an arm 30-sec WAnT performed in a modified cycle ergometer (Monark 827E). Local muscle oxygenation profiles of the triceps brachial muscle were recorded using NIRS (InSpectra™ 325). Muscle cross sectional area (CSA) of the upper arm was computed using skinfolds and circumferences. Heart rate (HR) was monitored with a telemetric system (Polar S810). Blood lactate concentration [La⁺] was measured at the 3rd, 5th, and 7th minute of recovery (Accutrend) in order to detect a peak value. A pilot study was initially conducted (n=6) to ensure the repeatability of both power output and oxygenation measurements (r=0.82-0.94). The level of significance was set at p<0.05.

Results
THP attained significantly higher peak and mean power output in the WAnT than CON (p<0.01; Fig. 1). The values in the 1st and 2nd min of recovery in oxygenated haemoglobin (ΔHbO₂) were kept at higher levels for THP (p<0.05; open arrow and right bold arrow in Fig. 2). Also, THP had higher muscle saturation in the 2nd min of recovery (Δsat O₂; in THP: 6.73±2, in CON: -1.04±0.7; p<0.01) that the THP had at this minute. ΔHbO₂ had a strong tendency for higher values in THP at the end of exercise (p=0.07; left bold arrow in Fig. 2). THP had greater CSA (p<0.05) and tended to have lower values in peak HR and [La⁺] (p=0.08 and 0.06, respectively).

Discussion/Conclusion
This is the first study examining the arm anaerobic capacity of THP during a WAnT in conjunction with their capability to utilize oxygen in such supramaximal effort. THP had greater anaerobic capacity and used more intensively this mechanism during activities with high anaerobic demands. This was in part due to greater muscle mass as well as to differences in the metabolic properties of the arm muscles between THP and CON subjects.

References
Izqueirdo M et al. (2002). Eur J Appl Physiol 87:264-71