Is abnormal muscular response to exercise correlated to antioxidant status in young trotters: a retrospective study

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Introduction

Intense exercise is a strong inducer of oxidative stress, which has been implicated in disturbances in muscle homeostasis, fatigue and possibly injury. In endurance horses, associations between increased muscle leakage and decreased antioxidant status have been reported (Hargreaves et al., 2002, Williams et al., 2004). However, horses with exertional myopathy are infrequently deficient in antioxidants like selenium and vitamin E (Valberg, 2012). Abnormal muscular response (AMR) is defined as a greater than three-fold increase from basal creatinine kinase (CK) three to four hours after exercise (Valberg, 2012) and is not uncommon in healthy young trotters.

The aim of this study was to evaluate the frequency of AMR and the resting and post-exercise oxidative balance variables of a group of horses presenting AMR.

Materials and Methods

• One hundred and fifty three Trotters of 2 and 3 years of age submitted to 350 standardized exercise tests on the track. All were healthy, in full training with no history of muscle disorders.
• An estimation of selenium (Se) and vitamin E (Vit E) intakes was calculated.
• Evaluation at rest for haematological and biochemical analysis (liver, kidney and muscles enzymes), antioxidant markers: plasma vitamin E, erythrocyte glutathion peroxidase (GPx), reduced glutathione (GSH) and plasma uric acid (UA) and lipid peroxides (POXL) as an oxidative marker.
• Exercise test: three sets of three minutes at 500, 560 and 620 m/min followed by an acceleration at maximal speed.
• After exercise, plasma uric acid, GSH [15min post-exercise] and CK [3h post-exercise] measured.
• Abnormal Muscular Response (AMR) to exercise defined as a more than a three-fold increase from basal CK three hours after exercise with no clinical sign of stiffness. Horses exhibiting AMR associated with stiffness (n=3) were excluded from analysis.

Results

• A total of 26 AMRs (7 %) involving 25 horses (16 %) was observed.
• Resting and post-exercise antioxidant and muscular status data are presented in Figure 1 and Table 1.
• As expected, Δ CK was significantly higher in AMR than in control horses.
• Significantly higher resting muscular enzymes CK and AST were observed in the AMR group compared with the control group.
• However, resting values of plasma vitamin E, GPx, GSH, UA and POXL were similar in both groups (p>0.05).
• UA and GSH response to exercise were not different between the two groups.

Discussion

Oxidative balance and antioxidant exercise response were similar in both groups suggesting that abnormal muscular response as defined in the current study is not related to insufficient antioxidants levels or abnormal antioxidant response to exercise. In the control group, the negative correlation between plasma vitamin E and lipid peroxides observed here is in accordance with the low thiobarbituric acid-reactive substances (TBARS) associated with vitamin E supplementation (Rey et al., 2013). Finally, the positive correlation between plasma lipid peroxidation markers and CK, already described in endurance horses (Williams et al., 2004), was also observed in our young trotters.

Conclusion

This study suggests that abnormal muscular response was not related to insufficient antioxidants levels or abnormal antioxidant response to exercise. However, in the control group, some antioxidant levels appeared negatively correlated to lipid peroxidation, the latter being positively correlated to muscular enzymes.

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