

Is serum CK related to muscular fatigue in long-distance running?

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Elevation in serum levels of creatine-kinase (CK) activity following various forms of exercise are well documented (Hortobágyi & Denaham 1989). Plasma CK activity has been used as an indicator of muscle damage, especially after eccentric exercise (Schwane et al. 1983). Exercise-induced damage has been assessed using changes in motor performance, i.e. muscular fatigue (Clarkson & Tremblay 1988). The mechanisms by which exercise results in loss of functional capacity has not been clearly identified (Appell et al. 1991; Soares et al. 1992). The purpose of the present study was to examine the serum CK in response to 2 long-distance runs during 2 consecutive days.

Material and methods

Nine fully informed, consenting and healthy male long-distance runners (mean age 31.1 yrs) participated in this study. All subjects performed 2 runs of 12 km each at their personal competition intensity during 2 consecutive days. Blood samples were obtained before the first run (B1R), 60 min after the first run (A1R), before the second run (B2R), i.e., 24h after the 1R, 60 min (A2R) and 24h after the 2R (24hA2R). Standard venipuncture techniques were used to obtain samples from the antecubital vein. CK activity was measured enzymatically using a commercial kit (CK NAC Activated, Boehringer).

Statistics.

Differences in CK activity among the different moments of evaluation were tested with ANOVA repeated measures. Post hoc comparison was done with the Scheffe F-Test at an alpha of 5%.

Results

The mean \pm SD of the CK activity are shown in Table 1. The results evidenced significant intraindividual differences ($p < 0.001$). The CK activity before the 1R was slightly higher than the normal clinical values and increased significantly 60 min after the 1R. The augmentation after the 1R was more pronounced than the increase observed after the 2R (186.8 vs 110%, respectively).

Among the subjects, two different response patterns were observed, one group showed a low CK response, another showed a high CK response (Figure 1).

Table 1. Creatine-kinase activity (U/l), before and after the two consecutive runs.

	B1R	A1R	B2R	A2R	24h2R
Mean	110.2	205.9*	254.2*	282.3*#	165.2
SD	25.4	58.7	71.4	80.9	39.1

* Significant increase compared to the values B1R. # Significant increase compared to the values A1R.

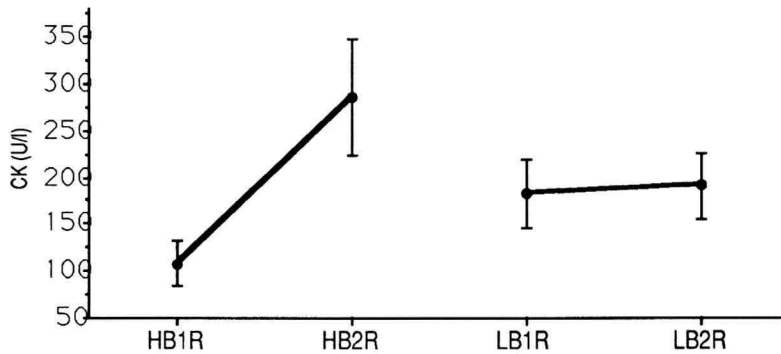


Figure 1. CK activities for the high CK responders before the 1R (HB1R) and for the low CK responders before the 2R (LB2R). Values are means \pm SD. All differences are statistically significant, except LB1R to LB2R.

Discussion

Several studies have shown that serum or plasma CK activity increases dramatically after strenuous or novel physical exercise (for ref. see Ebbeling & Clarkson 1989) and this increase has provided evidence of exercise-induced muscle damage. A problem with the use of CK in the blood is that CK demonstrates a large intersubject variabilities, particularly for the evaluation of muscle injury (Clarkson et al. 1986). The evaluation of serum CK as a measure for muscle damage shows large intraindividual variability, and three classes of subjects have been described concerning the CK responses to exercise (Clarkson & Ebbeling 1988). The subjects of the present study were attributed to low and high responders, based on expert criteria concerning a cut-off line.

In spite of the large increase in serum CK observed after the 1R, the athletes were able to perform the 2R with high intensity and good performance, suggesting that: (i) either the CK it is not a fiable indicator of muscle damage, (ii) or the muscle damage induced by the 1R (as demonstrated by CK) was not severe enough to impair performance substantially. Recently, however, the prophylatic effect of a single initial exercise bout has been described (Newham et al. 1987). We also assume that the 1R gave some protections to the 2R because the increase observed after the 2R was less pronounced than that registered after the 1R, suggesting a rapid training effect.

The results suggest, that in spite of high serum CK activities, athletes can perform long-distance runs with high intensity. Moreover, a preparative run on a similar track may give certain protection to skeletal muscle.

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