Plasma LDH Isozyme after 400-m Sprinting in Long-distance Runners and Untrained Subjects

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Summary Plasma LDH activity and LDH isozyme following 400-m sprinting were determined in 8 long-distance runners and 7 untrained subjects. There is a significant correlation between the mean velocity of the 400-m sprint and LDH-5 or LDH-4+5 in the long-distance runners, but not in the untrained subjects.

Key words: plasma LDH isozyme, 400-m sprinting, long distance runners.

The blood lactate concentration is generally considered an indicator for evaluating anaerobic work capacity in man. It has been reported that the peak blood lactate concentration measured after supramaximal exercise lasting for about 1 min highly correlated with running time for the 400-m sprint in untrained subjects and long-distance runners (FUJITSUKA et al., 1982; OHKUWA et al., 1984a). We observed recently that, in well-trained sprint runners, there is a significant relationship between mean velocity in the 400-m sprint and lactate dehydrogenase (LDH) isozyme in the plasma, but the mean velocity did not correlate with the peak blood lactate concentration or plasma LDH activity (OHKUWA et al., 1984b). However, there are no available data concerning the relationship between mean velocity of the 400-m sprint and LDH activity or LDH isozyme in the long-distance and untrained subjects. The purpose of this study was to confirm whether LDH activity after the 400-m sprint is correlated with the physical performance of the 400-m sprint run in long-distance runners and untrained subjects.

The subjects in this study were 8 male long-distance runners and 7 untrained male students. Their mean ages, height, and weight were 20.1 yr, 170.1 cm, and 58.1 kg for the long-distance runner group and 22.8 yr, 170.0 cm, and 67.6 kg for the untrained group, respectively. The long-distance runners regularly trained 3 to 4 h daily, 6 days a week throughout the year and continued training for at least 4 years. The experiments were conducted approximately 3–4 h after the last meal. All
subjects were briefly informed about the experimental procedures before the sprint run, which was performed on the en-tout-cas 400-m track after warming-up for about 30 min. Each individual was asked to run as fast as he could, and then to lie down immediately on a simple bed in the supine position for blood sampling. In order to obtain venous blood, a 21-gauge butterfly needle with a sampling vinyl tube was inserted into the antecubital vein immediately after the 400-m run. About 5 ml of venous blood was withdrawn into a disposable syringe at intervals of 5, 7.5, and 10 min following the 400-m run. The activity of LDH in the plasma was measured spectrophotometrically by a slightly modified Wroblewski procedure (WROBLEWSKI and LADUE, 1955). Electrophoretic separation of the LDH isozyme was performed using agar gels as described by HELM (1962), and the percent of isozyme distribution was estimated from the densitometer tracing. Blood lactate concentration was determined by the enzymatic method (HOHORST, 1962). A probability value of less than 0.05 was considered to be statistically significant.

Average values and standard deviations of the 400-m running velocity in the long-distance runners and untrained subjects were 7.13±0.26 and 5.29±0.25 m·s⁻¹. Running velocity of the long-distance runner was significantly higher than the untrained group. Plasma LDH activity when the values of blood lactate concentration was at its peak was also significantly higher in the trained group compared with the untrained one. The increment of plasma LDH activity after the 400-m run may indicate cellular damage in active muscles. At the present time, higher plasma LDH activity in the long-distance runners can not be explained

Fig. 1. Relationship between mean velocity of 400-m sprinting and plasma LDH activity in long-distance runners and untrained subjects.

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on the basis of physiological ground. However, it has been reported that enzyme leakage from the cell into extracellular fluids is minimal until ATP has markedly declined or has become exhausted (Wilkinson and Robinson, 1974; Thomson et al., 1975; Speckermann et al., 1975). Since it is possible to assume that the athlete's ran for 400-m with full force in respect to intensity compared with the untrained group, higher LDH activity in the long-distance runners may be due to a greater reduction in the amount of ATP than that in the untrained group. However, this possibility must be confirmed by further investigation.

Figure 1 shows the relationship between mean velocity in the 400-m run and plasma LDH activity. No significant relationships were seen both in the untrained ($r = 0.10, p > 0.05$) and the long-distance runner ($r = -0.32, p > 0.05$) groups. These results basically agree with data obtained from the well-trained sprinter (Ohkawa et al., 1984b). The mean and standard deviations of LDH isozyme 1, 2, 3, 4, and 5 were $27.2 \pm 5.3$, $41.3 \pm 3.5$, $21.9 \pm 4.1$, $4.4 \pm 1.5$, and $5.0 \pm 1.6\%$ for the long-distance runners, and $25.9 \pm 4.3$, $39.2 \pm 1.5$, $25.0 \pm 3.5$, $6.6 \pm 2.0$, and $2.2 \pm 2.2\%$ for the untrained group, respectively. Furthermore, it was found that the mean and standard deviations of the heart-specific LDH isozyme (H-type LDH: LDH-1 + LDH-2) for long-distance runners and the untrained groups were $69.1 \pm 4.9$ and $65.2 \pm 4.2\%$. The muscle-specific LDH isozyme (M-type LDH; LDH-3 + LDH4 + LDH-5) was $30.1 \pm 4.0\%$ for the long-distance runners and $34.9 \pm 4.1\%$ for the untrained group. There are no significant differences in the LDH isozyme between long-distance and untrained groups. On the other hand, it was found in the previous study that in the sprinters there was a significant negative correlation between the mean velocity of 400-m and H-type LDH isozyme activity, and a significant positive correlation with the M-type LDH isozyme activity (Ohkawa et al., 1984b). As shown in Table 1, the relationship between mean velocity and LDH

<table>
<thead>
<tr>
<th>LDH isozyme</th>
<th>Long-distance runner</th>
<th>Untrained subject</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>400-m mean velocity</td>
<td>p value</td>
</tr>
<tr>
<td></td>
<td>(r)</td>
<td></td>
</tr>
<tr>
<td>LDH-1</td>
<td>-0.49</td>
<td>NS</td>
</tr>
<tr>
<td>LDH-2</td>
<td>0.27</td>
<td>NS</td>
</tr>
<tr>
<td>LDH-3</td>
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<td>NS</td>
</tr>
<tr>
<td>LDH-4</td>
<td>0.22</td>
<td>NS</td>
</tr>
<tr>
<td>LDH-5</td>
<td>0.84</td>
<td>$p &lt; 0.01$</td>
</tr>
<tr>
<td>LDH-1+2</td>
<td>-0.33</td>
<td>NS</td>
</tr>
<tr>
<td>LDH-3+4+5</td>
<td>0.32</td>
<td>NS</td>
</tr>
<tr>
<td>LDH-4+5</td>
<td>0.92</td>
<td>$p &lt; 0.01$</td>
</tr>
</tbody>
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NS, not significant.
isozyme activity shows a similar tendency to that obtained in the previous study, while correlation coefficients were not statistically significant except LDH-5 and LDH-4+5. Papadopoulos et al. (1968) have reported that an increase of LDH-1 and LDH-2 in plasma was prevented after severe exercise by training for 6–8 weeks. Since Rose et al. (1970a, b) found that an increase in plasma LDH-5 activity in well-trained subjects after the 10,000 m run and of plasma LDH-3, LDH-4, and LDH-5 activities following a 41.87 km marathon run, the difference in the effects of physical training on the plasma LDH isozyme might be due to a reverse in the negative or positive sign of the correlation coefficient between the mean velocity of 400-m sprinting and the H and M types of plasma LDH isozymes. Of interest is the finding that the 400-m running velocity of long-distance runners significantly correlates with that of LDH-5 \( (r = 0.84, p > 0.01) \) and LDH-4+5 \( (r = 0.92, p < 0.01) \), but the mean velocity of the untrained group did not correlate with the LDH isozyme (Table 1). From these results, it is suggested that plasma LDH levels after the 400-m sprinting would not appear to be useful as an indicator of anaerobic work capacity, not only in the sprinters, but also in the long-distance runners and untrained subjects. However, plasma LDH-5 or M-type LDH isozymes measured after maximal sprint running for about 1 min might prove to be such an index in well-trained long-distance runners, but not in the untrained subjects.

REFERENCES


Thomson, W. H. S., SweETING, J. C., and Hamilton, I. J. D. (1975) ATP and muscle