Plasma IL-6 responses to high-intensity cycling exercise

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**BACKGROUND**

Interleukin-6 (IL-6) belongs to a family of cytokines, which are proteins secreted from various cell types in response to stimuli. IL-6 is typically reported as a pro-inflammatory cytokine, but it has also been seen to partially mediate an anti-inflammatory response. In metabolism, IL-6 increases the availability of blood glucose and free fatty acids by increasing lipolysis in adipose tissue and glycogenolysis in the liver. It is believed that IL-6 expression and release from contracting skeletal muscle may play a vital role in systemic metabolism by its regulation of substrate availability and use (Figure 1). Such coordination has important implications for defining how physical activity protects against, and inactivity promotes, the development of chronic metabolic disorders. The exercise-induced elevation of plasma IL-6 has created an interest for its role in initiating biochemical signaling pathways in skeletal muscle, regulating metabolism in healthy individuals, as well as the potential for altered IL-6 function in states of metabolic disease such as type 2 diabetes and obesity. However, IL-6’s influence on specific aspects of energy metabolism remains a topic of considerable debate.

Because IL-6 is produced in and released from skeletal muscle during exercise, some scientists have termed it a “myokine.” As a result, skeletal muscle is now seen in a new role: an endocrine organ that produces and secretes myokines in response to exercise. Exercise intensity is known to be an important factor in plasma IL-6 concentrations. Higher intensity levels elicit higher concentrations of IL-6, but the specific mechanisms and reasons for this finding remain a topic of debate. Peak levels of IL-6 are reached at the end of the exercise, or shortly thereafter. Although several studies have evaluated the IL-6 response to endurance exercise, the literature lacks a thorough study of how repeated bouts of high-intensity exercise affects IL-6.

**RESULTS:**

1. **IL-6 Plasma Volume (PV) Shifts**

   **Time Interval Key:**
   - 1. Pre- to 1.5 min
   - 2. Pre- to 6 min
   - 3. Pre- to 10.5 min
   - 4. Pre- to +1 min
   - 5. Pre- to +15 min
   - 6. Pre- to +30 min
   - 7. Pre- to +60 min

   Figure 2. Blood draw schedule during for exercise bouts with running clock. Graph begins at the warm-up and concludes with the 60-min post-exercise sample.

   - **Table 1.** Subject details. Values are displayed as mean (SD).

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Height (in)</th>
<th>Weight (lbs)</th>
<th>VO₂ Max (mL/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (n=5)</td>
<td>20.6 (1.1)</td>
<td>65.9 (7.7)</td>
<td>15.4 (16.5)</td>
</tr>
<tr>
<td>Males (n=5)</td>
<td>20.8 (0.8)</td>
<td>71.8 (3.5)</td>
<td>165.6 (33.0)</td>
</tr>
<tr>
<td>Total (n=10)</td>
<td>20.9 (0.8)</td>
<td>69.4 (4.1)</td>
<td>166.1 (26.6)</td>
</tr>
</tbody>
</table>

   - **Table 2.** IL-6 concentrations at each time point for both exercise bouts.

   - **Figure 3.** Plasma volume shifts during each time interval for both exercise bouts.

   - **Figure 4.** Mean plasma IL-6 concentrations at each time point for both exercise bouts.

   - **SUMMARY:**
   - The continuous bout of exercise provided a good control for the high-intensity Wingate protocol since both tests accomplished the same amount of work.
   - Observed exercise-induced elevations of plasma IL-6 were relatively small and were quite close to normal resting values.
   - Physical characteristics and fitness levels of subjects were variable and could have affected the results (especially due to values from one untrained subject).
   - Greater plasma volume shifts were observed during the Wingate tests than during the continuous bout.
   - Data from only 7 of 10 subjects has been analyzed, so this is a preliminary report.

   - **CONCLUSION:**
   - The relative contributions of the anaerobic and aerobic energy systems differ between the two exercise bouts: The Wingate tests are primarily anaerobic while the continuous bout is predominantly aerobic. It appears that brief stints of maximal cycling exercise (i.e. Wingate tests) may be a stimulus for IL-6 release.

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