Hematological and biochemical changes during a short triathlon competition in novice triathletes

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Summary. Short-course 'sprint' triathlons have become popular in recent years, often as a precursor to the longer full-course triathlons. We undertook a study investigating the haematological and biochemical changes that occur in novice triathletes between the start and finish and after each of the three legs of a short sprint triathlon involving swimming, cycling and running. The changes that occurred in the triathlon included a significant (P<0.003) decrease in weight from 71.7 kg, SD 7.9 to 70.3 kg, SD 7.6. Throughout the time span of the triathlon, the white blood cell count increased significantly (P<0.001), as did the platelet count (P<0.005) and plateletcrit (P<0.001). There were no significant changes during the period of the race in any of the other haematological variables measured. The biochemical variables measured were glucose, triglycerides, sodium, potassium, calcium, lactate dehydrogenase, creatinine and aspartate aminotransferase. Triglyceride, calcium and potassium values did not change between the pre- and post-race samplings. All other biochemical parameters showed a significant change (P<0.05 or better). Changes that occurred in the haematological and biochemical parameters between stages were many and varied. There was also a significant change in plasma volume during the swimming event (P<0.001), but this returned to normal during the later stages of the triathlon. In conclusion the changes that occurred during the triathlon were many and were similar to those reported elsewhere in the literature for longer events. The novice triathletes who participated, found this short triathlon to be as stressful as the full-course triathlon is for the more experienced athlete. We feel, however, that this type of event is useful as a precursor to the longer type of events.

Key words: Novice - Short triathlon - Blood profile - Biochemical variables - Plasma volume

Introduction

Triathlon competitions have become very popular in the last 10 years. The original triathlon was the Hawaii Iron Man Competition held in 1978, which started with 14 competitors and now boasts more than 1200 participants. In most cases these endurance athletes must participate in swimming, cycling and running but on some occasions other activities have been used such as canoeing, skiing and running or cycling, running and skiing (van Rensburg et al. 1986). The popularity of the sport can be gauged by the number of participants in the United States alone, an estimated 800000 in 1984 (O'Toole et al. 1987).

'Sprint' triathlons, which are shortened versions of the longer triathlons, usually involve swimming distances of 1–1.5 km, cycling 30–40 km and running 10 km. These events have become popular as they are a 'half-way' stage for the less well trained and the highly trained triathlete and allow the less well trained athlete to become accustomed to the rigors of competition. Some work has been undertaken to investigate the physiological responses of triathletes (Kohrt et al. 1987) to exercise of various types and profiles of typical triathlons (Holly et al. 1986) and ultraendurance triathlons (O'Toole et al. 1987). Much has been written recently of the physiological and biochemical changes that occur in triathlons (O'Toole et al. 1987; van Rensburg et al. 1984, 1986), as well as the haematological changes that take place during triathlons (Davidson et al. 1987). The aim of this study was to determine the physiological and haematological changes that occurred in novice triathletes during a short sprint triathlon.

Methods

Subjects. Ten men participated in this study and gave written informed consent after being informed of the risks involved. These athletes had never performed a triathlon prior to this date and had never taken part in any competitive running, cycling or swimming event. However, they had trained specifically, for at least 3 months prior to the event taking place. The sprint triathlon took place within the city of Launceston, Tasmania, Australia. The first leg consisted of a 1.0-km swim, the second being a 30.0-km cycle ride, and finally there was a 10.0-km run. The physical characteristics of the subjects are described thus (mean and SD), age 26.2
years, SD 4.3, height 179.3 cm, SD 6.4, weight 71.7 kg, SD 7.9 kg. The weather on the day of competition was overcast with periods of showers. There was little wind and the temperature was 19°C.

Protocol. Prior to the start of the triathlon 10 ml blood was taken from the antecubital vein and the subjects were weighed. Blood was again taken after the swim stage, the bicycle stage and at the end of the running stage. The subjects were again weighed at the end of the triathlon. Blood samples during the course of the triathlon were taken in the following positions: pre-race, standing; post-swim, lying; post-cycle, sitting; post-run, standing.

Analysis. Haematological analysis, consisting of a 12-parameter profile, was performed using a Coulter counter (model S Plus II). This was performed immediately after blood collection.

Biochemical analysis of the following parameters was carried out: calcium, glucose, sodium, potassium, creatinine, triglycerides, lactate dehydrogenase and aspartate aminotransferase. The sodium, potassium and creatinine analysis was performed using a Beckman Astra 4. This has electrodes selective for sodium and potassium ions and measures creatinine using the alkaline picrate method. All other blood chemistries were performed on a Roche Cobas Mira.

Statistical analysis was performed on all of the collected data. Comparisons between means were undertaken with Student's t-test and, where multiple comparisons were carried out, an analysis of variance (ANOVA) with repeated measures was used. The Scheffé test was used as a correction for multiple comparisons (Keppel 1982).

Results

The completion time for the short-course sprint triathlon was 130.8 min, SD 8.9 min, the swim stage taking 23.4, SD 7.7 min, the cycle stage 61.4 km, SD 5.6 and the running stage 49.5 min, SD 7.9 years, SD 4.3, height 179.3 cm, SD 6.4, weight 71.7 kg, SD 7.9 kg. The weather on the day of competition was overcast with periods of showers. There was little wind and the temperature was 19°C.

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The completion time for the short-course sprint triathlon was 130.8 min, SD 8.9 min, the swim stage taking 23.4, SD 7.7 min, the cycle stage 61.4 km, SD 5.6 and the running stage 49.5 min, SD 3.6. There was a significant (P<0.003) decrease in weight during the course of the event with weight decreasing from 71.7 kg, SD 7.9 kg to 70.3 kg, SD 7.6 kg.

Haematological variables

All of the ten subjects showed a normal blood profile prior to the start of the triathlon.

The blood indices (mean and SEM) of the ten subjects before the short-course triathlon and after each leg are shown in Table 1. There was a highly significant change in while blood cell (WBC) count across the total triathlon, all stages being significantly different from each other (P<0.001). There was a significant change in platelet count from the start to the finish of the triathlon (P<0.005) and this was also the case for plateletcrit (P<0.001). There were no changes in mean cell haemoglobin (Hb) or mean cell Hb concentration. All other measures had highly significant (P<0.01 or greater) differences between subjects indicating that subjects behaved differently during the triathlon to such an extent that the results varied greatly. The following breakdown analyses the results between each stage of the triathlon.

Pre-race post-swim. WBC increased significantly (P<0.05), as did red blood cells (P<0.05). Hb levels increased by 2.4%, which was a significant increase (P<0.05) and there was a 4.2% and 6.5% increase in haematocrit (haematocrit/packed cell volume, P<0.05) and mean cell volume respectively (P<0.01). All subjects showed a small increase in platelet count and also in plateletcrit with a mean increase attaining statistical significance (P<0.05). Values for the red cell distribution width decreased significantly during this time (P<0.05).

Post-swim post-cycle. The increase in WBC between the post-swim and post-cycle blood collection stages was significant (P<0.05). The red blood cell count, however, decreased significantly (P<0.05) during the same period of time and attained its pre-race level. There was a similar occurrence for Hb, which decreased significantly (P<0.05), but this value was still higher than the initial pre-race level (P<0.05). Mean cell Hb and mean cell Hb concentration values did not change during this time but red cell distribution width increased significantly (P<0.05) after an initial decrease, and at this point was similar to initial pre-race values. Haematocrit or the packed cell volume decreased by 8.2% from the

<table>
<thead>
<tr>
<th>Blood indices*</th>
<th>Pre-race</th>
<th>Post-swim</th>
<th>Post-cycle</th>
<th>Post-run</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^-6 x WBC (l^-1)</td>
<td>6.01 (0.7)</td>
<td>9.86 (1.4)</td>
<td>10.36 (3.1)</td>
<td>15.08 (4.1)</td>
</tr>
<tr>
<td>10^-6 x RBC (l^-1)</td>
<td>5.03 (0.3)</td>
<td>5.23 (0.3)</td>
<td>5.02 (0.3)</td>
<td>5.03 (0.3)</td>
</tr>
<tr>
<td>Hb (g dl)</td>
<td>14.84 (0.8)</td>
<td>15.79 (0.8)</td>
<td>15.30 (0.7)</td>
<td>15.36 (0.6)</td>
</tr>
<tr>
<td>Hct (l/l)</td>
<td>0.47 (0.03)</td>
<td>0.49 (0.02)</td>
<td>0.45 (0.01)</td>
<td>0.47 (0.02)</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>93.0 (3.6)</td>
<td>93.96 (3.6)</td>
<td>93.0 (3.6)</td>
<td>93.4 (3.6)</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>30.5 (2.6)</td>
<td>30.30 (1.1)</td>
<td>31.3 (2.1)</td>
<td>30.5 (1.2)</td>
</tr>
<tr>
<td>MCHC (g dl)</td>
<td>31.8 (1.7)</td>
<td>32.34 (0.4)</td>
<td>32.9 (1.2)</td>
<td>32.63 (0.3)</td>
</tr>
<tr>
<td>RWD</td>
<td>10.24 (0.8)</td>
<td>9.67 (0.5)</td>
<td>10.29 (0.7)</td>
<td>10.6 (0.8)</td>
</tr>
<tr>
<td>10^-9 x PLT (l^-1)</td>
<td>240 (39.5)</td>
<td>309 (49.0)</td>
<td>303 (47.6)</td>
<td>312 (36.7)</td>
</tr>
<tr>
<td>Pct (%)</td>
<td>0.29 (0.02)</td>
<td>0.33 (0.03)</td>
<td>0.32 (0.05)</td>
<td>0.33 (0.02)</td>
</tr>
<tr>
<td>MPV (fl)</td>
<td>7.1 (0.2)</td>
<td>7.02 (0.4)</td>
<td>7.1 (0.3)</td>
<td>7.1 (0.3)</td>
</tr>
</tbody>
</table>

* WBC, White blood cells; RBC, red blood cells; Hb, haemoglobin; Hct, haematocrit; MCV, mean cell volume; MCH, mean cell Hb; MCHC, mean cell Hb concentration; RDW, red cell distribution width; PLT, platelets; PCT, plateletcrit; MPV, mean platelet volume; PDW, platelet distribution width

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