Carbohydrate supplementation alleviates neuromuscular fatigue during prolonged cycling

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Introduction

Prolonged cycling exercise induces neuromuscular fatigue with a reduction in carbohydrate (CHO) availability a possible source of peripheral fatigue, and / or central fatigue. We assessed the effect of CHO supplementation on exercise tolerance, rate of perceived exertion (RPE), cognitive function, and corticospinal and neuromuscular functions during heavy-intensity exercise.

Methods

Nine trained cyclists (age: 29 ± 9, weight: 78 ± 5 kg, peak VO_2: 3.9 ± 0.6 $l.min^{-1}$) exercised to exhaustion at 69 ± 4% of peak VO_2 (SRM ergometer, Germany) twice (single-blinded): Ingestion of 1) a non caloric sweet placebo solution (PLA), 2) a 12% CHO solution (90g $CHO.h^{-1}$ in 150 ml per 15 min; 2:1 glucose:fructose ratio). Before, at minute 60 and 90, at exhaustion for PLA (EXH: 130 ± 31 min) but matched EXH time for CHO (ISO), responses to transcranial magnetic stimulation and supramaximal electrical femoral nerve stimulation were obtained to assess corticospinal and neuromuscular function, respectively. Capillary blood glucose and lactate concentrations, RPE, and cognitive function (n-back working memory task) were also recorded.

Results

No trial-difference was found pre-exercise. Blood glucose was systematically greater (+1-1.5 $mmol.l^{-1}$) with a lesser decrease throughout CHO (end values: 4.0 ± 0.3 *vs* 3.0 ± 0.3 $mmol.l^{-1}$). RER was also greater during CHO (.89 ± .04 *vs* .88 ± .03). With no trial-difference, blood lactate concentration decreased significantly from minute 60 (~ 2.3 $mmol.l^{-1}$) to 90 (~ 1.9 $mmol.l^{-1}$) and did not change thereafter (~ 1.5 $mmol.l^{-1}$ at end-exercise). With similar RPE values at minute 60 (~13), RPE increased more slowly during CHO (End values: 16 ± 1; EXH-PLA: 18 ± 2). For the right knee extensors, exercise induced reductions in maximum voluntary contraction (MVCs; CHO:-7%; PLA:-13%), potentiated twitch force (CHO: -18%; PLA: -17%) and voluntary activation (CHO: -5%; PLA: -7%) with greater MVCs for CHO ($P<0.05$). Results for voluntary activation and cortical excitability from stimulation of the motor cortex, and cognitive function tests are yet to be analysed.

Discussion

Exogenous CHO supplementation increases CHO availability and utilisation during exercise, and reduces the perception of effort for a given sub-maximal work rate. With no difference in peripheral fatigue, exercising muscles can produce greater maximal voluntary contraction suggesting for some fatigue mechanisms distal to the

neuromuscular junction to play a role in the enhancement of exercise tolerance under CHO supplementation.

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