IMCL CHANGES DURING MODERATE ENDURANCE EXERCISE AS MEASURED BY THREE DIFFERENT METHODS

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Objective

The use of IMCL as a substrate during prolonged endurance exercise has been a controversial issue (1). This controversy persists because most studies that used biochemical analyses in muscle biopsy samples reported no IMCL breakdown during exercise (2) whereas the majority of ^{1}H-MRS (3,4) and ORO studies (5,6) reported IMCL utilization. Different authors therefore suggested that it would be useful to directly compare the three methods. This study is the first to compare IMCL utilization during prolonged moderate-intensity exercise as measured by the three aforementioned methods.

Materials and Methods

Protocol - Briefly, the study was a balanced and randomized cross-over study (approved by the local Ethics Committee (K.U.Leuven)) in which all nine subjects participated in two experimental sessions, with a 3-week period in between. After an overnight fast, half of the subjects received a standardized carbohydrate-rich breakfast whereas the others remained fasted. A ^{1}H-MRS scan was performed and a biopsy sample was taken from the right vastus lateralis muscle. Immediately after subjects started to cycle for two hours (178 Watt). In the first condition, subjects received 1g maltodextrine per kg bw per hour whilst the others received an equal amount of water. At the end of the exercise bout a 2nd biopsy sample was taken and a second ^{1}H-MRS scan was performed.

Image guided, localized, single-voxel 1H-MRS (voxel volume 11x11x18mm³; acquisition time 5.5min) was performed on a whole body scanner (1.5 T) with a flexible surface coil wrapped around the upper leg with the leg placed in the parallel position. To reproduce the same voxel position, longitudinal distance from the voxel to the most distal point of the medial femoral epicondyl was determined. The reproducibility of the IMCL quantification in the same voxel (n=5; one subject) resulted in a coefficient of variation of 7%. Spectra were analyzed with jMRUI software using four peaks for IMCL and four for EMCL (6,7) Muscle biopsy samples were used for biochemical and histochemical analysis. The biochemical analysis for IMCL concentration was performed as described by Kiens and Richter (8). The oil-red-oil staining was done as described earlier (9). Slides were examined using a Nikon E1000 fluorescence microscope. The biochemical analyses and ORO method were performed on the same muscle samples.

Results & Discussion

Figure 1 displays the IMCL content of all individuals before and after exercise (letters correspond to different individuals). Values are expressed as a percentage of the pre-exercise mean IMCL content. Eight subjects showed an increased IMCL content after exercise using the biochemical analysis (not shown), three using ORO and none whenever IMCL content was measured via 1H-MRS. Only ORO-staining and 1H-MRS showed substantial IMCL breakdown following a 2h exercise bout (1H-MRS: -48 ± 7%; ORO: -39 ± 9%, biochemical: +2 ± 7%; relative to the average pre-exercise IMCL level). Although mean relative decrease was similar between ORO and ^{1}H-MRS, individual values were not correlated (r=0.36; p=0.18).

The use of IMCL as a substrate during exercise has been controversial for quite some time. Although most authors do now agree that there is in fact IMCL breakdown during exercise, this study for the first time clearly shows that the magnitude of the decrease is not only dependent on exercise intensity and duration, diet, training status and gender (for review see (1)) but also on the methodology used for IMCL quantification.

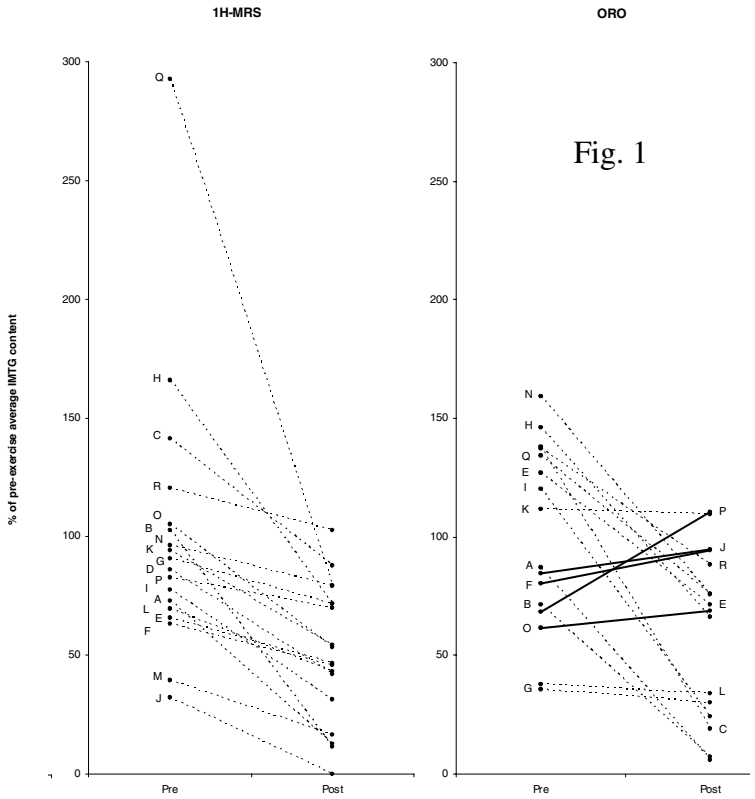

Fig. 1

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