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Letter to the Editor

# Changes in muscular proteins during simulated microgravity

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*Dear Sir,*

We report here changes of muscle protein concentrations in plasma of 5 healthy male volunteers who stayed for 5 days in dry water immersion (foil-covered water basin) in order to simulate microgravity. In addition, the volunteers were exposed to standardized isometric load of the quadriceps femoris muscle 2 h after and 14 days before or after immobilization. Forty isometric contractions with maximal force were performed each lasting for 5 sec with 10 sec rest in between. Force generation was monitored by use of a computer interfaced dynamometer (CYBEX II+).

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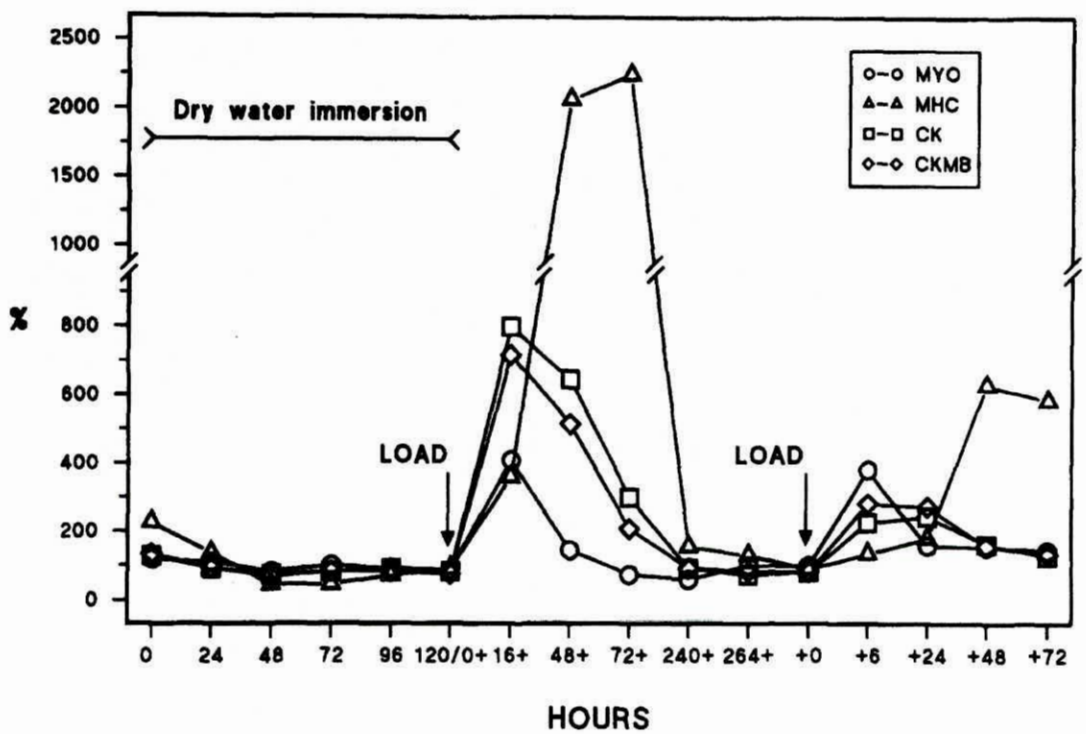


Fig. 1. Pattern of skeletal muscle proteins (myoglobin: Myo; myosin heavy chain fragments: MHC; creatine kinase enzyme activity: CK; creatine kinase MB isoenzyme enzyme mass: CK-MB) which were measured in the plasma of a healthy male volunteer. The concentrations are shown as percent increase from baseline values. Total immobilization (dry water immersion) lasted for 5 days followed by a standardized isometric muscle load. After a regeneration period of 14 days the same procedure of muscle load was performed but with a 2-fold increased isometric load.

Plasma concentrations of slow twitch skeletal (cardiac $\beta$ type) muscle originating myosin heavy chain fragments (MHC), myoglobin, creatine kinase (enzyme activity) and creatine kinase MB isoenzyme (enzyme mass) were measured before and daily during exposure to dry water immersion. Screening of muscle protein release was performed 6 h after isometric exercise and a daily follow up was conducted for 5 days. In contrast to muscle load 14 days before or after immobilization, exercise 2 h after dry water immersion exposure lead to a dramatic increase of muscle protein in plasma (Fig. 1). Especially the contractile protein MHC, mostly present in slow muscle fibers (Diederich 1989) which are responsible for reaction to gravity, increases dramatically with a peak 72 h after loading. Maximal efflux of soluble proteins as CK, CK-MB, also released by skeletal muscle (Siegel 1983) and myoglobin was observed earlier, mostly 16 h after exercise. Even twice as high isometric loads 14 days before or after immobilization showed a significant lower response to loading.

Mair (1992) reported localized injuries demonstrated in the vastus medialis muscle by MRI after it was exposed to high force excentric exercise. Such findings could not be reported after dry water immersion.

In our study all cardiac-specific troponin T concentrations were within the reference interval indicating that the observed muscle protein increase is exclusively due to skeletal muscle alteration (Mair 1991).

The increase of MHC suggests that total immobilization leads to temporary hidden and diffuse lesions of slow twitch fibers mostly found in antigravitational muscles. This process is detectable and can be discriminated only secondary to muscle load. The changes reported may be the consequence of a functional adaptation process indicating regeneration rather than permanent damage of slow skeletal muscle fibers. Recent studies show that similar changes can be expected in patients who are mobilized after long-lasting bed rest.

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