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THE CONCEPT AND PRACTICE OF FASTING HYPOMETABOLISM ON THE PROLONGED
MANNED SPACEFLIGHT MISSION

Abstract

Abstract: Facing the future prolonged manned spaceflight such as interplanetary flight to MARS, the major aerospace countries are gradually programming advanced technologies and strategies on the bottleneck problems of spaceflight load and human healthy survival. Hypometabolic regulation technologies, such as hibernation, torpor, fasting etc, show great advantages and become the focus research area. In present study, we aimed to evaluate the healthy safety and physiological effects of prolonged fasting and its applicable feasibility for spaceflight. Two human fasting hypometabolic experiments of 10-day or 21-day prolonged completing fasting with 13 healthy participants respectively were performed under the controlled and medical supervision conditions. The classic physiological parameter, resting energy metabolic rate, subjective sensation and basic cognitive ability, blood biochemistry indexes were collected at the pre, during and post fasting period. First, all the participants completed the whole experiment, which suggested that adult human could tolerance a 21-day prolonged water-only fasting without significant side effects. Second, there was a time-dependent decrease of resting energy metabolic rate, which implied fasting could decline the energy expenditure. As expect, the prolonged fasting induced a significant quicker decrease of fat mass during fasting and a slower restore process in the diet recovery, when compared with the loss and resume of lean mass. In the aspect of physiology, completing fasting result in a continuous decrease of body weight with a quick decline in the first 3-day, accompanied by an increase of pulse during the whole fasting period and a decrease of systolic pressure after 7-day fasting. Interestingly, there was energy metabolic substrate shift: from glucose to ketone presented as a higher and steady ketone level coupled with a lower blood glucose concentration. On the other hand, there was a slight increase of the total cholesterol, LDL-C and ApoB level at the first stage of fasting, which was gradually decline from 10-day fasting and no marked alternation was occurred in the TG, HDL-C, lipase A and LDH. These

results means the body could maintain a new energy homeostasis also showed by no changes of ATP concentration during the whole fasting period. The most important, the internal environment indexes such as total protein, ALB and GLB were stable, although the nutrition indexes of prealbumin, transferrin and retinol binding protein presented a constant decline during the fasting period, which could not back to the baseline level of prefasting after 10-day diet recovery. It was worth noting and expecting that no significant effects of fasting on the basic cognitive ability was observed. Taken together, our results provide a reference for the layout of related hypometabolic technologies and prolonged fasting was an effective treatment for the emergence state during the subsequent prolonged and interplanetary manned spaceflight or in the outer planet base.