Exercise Biochemistry Review

Proceedings of IBEC 2018, Beijing, China, October 23-25
PO-209

Effects of aerobic exercise on oxidant/anti-oxidant indexes and gut microbiota in young obese volunteers

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Objective The mean body mass index (BMI) and the prevalence of obese and overweight individuals increasing substantially worldwide during the previous three decades. Variation in gut microorganisms might play an important role in the pathogenesis of obesity, but the mechanisms by which gut microbiota promote metabolic disturbances are not well understood. Exercise is associated with altered gut microbial composition, but few studies have investigated whether the gut microbiota and associated metabolites are modulated by exercise training in humans. We explored the impact of 8 weeks aerobic exercise on serum oxidant and anti-oxidant indexes and gut microbiota.
Methods All 40 young male volunteers are enrolled in the study, the lean ones (n=11), which BMI≤22 are as control group. And the obese ones (n=29), which BMI > 28 participated in the 8 weeks aerobic exercise. The body weight and BMI of each volunteers were recorded. The serum malondialdehyde (MDA), superoxide dismutase (SOD), glutathione peroxidase (GPx) and total antioxidant capacity (TAOC) were measured by ELISA. The composition and diversity of gut microbiota were analyzed with 16S rDNA sequencing.
Results ① Compared with the control, the level of serum GPx, SOD and TAOC decreased significantly ($P < 0.001$), and the MDA increased significantly ($P < 0.001$) in the obese group. After the 8 weeks aerobic exercise intervention, the MDA level decreased significantly ($P < 0.01$), the TAOC level increased significantly ($P < 0.01$), and there were no significant changes in the level of GPX and SOD.
② Compared with the control, the ratio of Bifidobacteriaceae, Alcaligenaceae, Erysipelotrichaceae, and Verrucomicrobiaceae decreased significantly($p < 0.05$) in the obese group, and the ratio of Ruminococcaceae, Helicobacteraceae increased significantly ($P < 0.05$). After the 8 weeks aerobic exercise intervention, the ratio of Bifidobacteriaceae, Alcaligenaceae increased significantly ($P < 0.05$)， and the ratio of Ruminococcaceae reduced remarkably ($p < 0.05$). The ACE index was significantly increased after the intervention ($P < 0.05$).
③ Through the correlation analysis of the data above, there was a certain correlation between the serum oxidant/anti-oxidant indexes and gut microbiota composition. After the aerobic exercise, there was a positive correlation between MDA and Ruminococcaceae、TAOC and Bifdobacteriace ($P < 0.05$)；a negative correlation between MDA and Bifdobacteriace、TAOC and Ruminococcaceae ($P < 0.05$). After 8 weeks of aerobic exercise, MDA level was negatively correlated with ACE index (r=-0.466，$P < 0.05$).
Conclusions ① Compared with the control, there was a significant increase of serum oxidation index and the serum anti-oxidation index dropped significantly among the obese subjects, which indicated that the accumulation of serum free radicals might be one of the causes of obesity. The 8 weeks aerobic exercise intervention can enhance the antioxidant capacity effectively.
② Compared with the control, the proportion of Bifidobacteriaceae in the obese group was significantly decreased, and the proportion of the bacteria with direct correlation to obesity, such as Ruminococcaceae increased significantly. 8 weeks aerobic exercise could inverse these changes among the obese subjects, suggested that the improvement of body phenotype of obese subjects was

closely related to the effective regulation of their gut microbiota structure.The change of ACE index indicated that aerobic exercise could increase the diversity of gut microbiota.
③ Combined the correlation analysis of gut microbiota diversity index showed that there were tight correlation between the serum oxidant/anti-oxidant indexes and the gut microbiota composition and structure. It might caused metabolic disorders and eventually increased fat accumulation and changed the host body phenotype.