鉄欠乏状態の改善による全身持久力と酸化ストレスの変化

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【目的】
鉄欠乏状態の改善が全身持久力および酸化ストレスに及ぼす影響を明らかにする。

【方法】
女子大学生バスケットボール選手15名(介入群:8名、対照群:7名)を対象とした。介入前後に空腹採血を施行し、酸化ストレス (d-ROMs: Diacron- Reactive Oxygen Metabolites) および抗酸化能 (BAP: Biological Antioxidant Potential) 測定、自転車エルゴメーターによる心肺運動負荷試験、自律神経機能評価、ストレスチェック、質問紙調査を実施し、二群間で比較検討を行った。介入期間は8週間とし、介入群は病院受診後、経口鉄剤または鉄の医薬品を服用した。統計解析は、服薬コンプライアンス不良であった介入群2名を除外した計13名で実施した。

【結果】
血清鉄およびフェリチンは二群間で交互作用を認め、介入群においてのみ、介入後に血清鉄 ($p< 0.01$) とフェリチン ($p< 0.05$) が増加した。また、交互作用は認めなかったものの、群内比較にて、介入群のd-ROMs ($p< 0.05$) が介入後に上昇し、潜在的抗酸化能 ($p< 0.05$) が低下した。また、血清鉄とd-ROMsに正の相関関係がみられた ($r= 0.454$, $p< 0.05$) 。心肺運動負荷試験においても、交互作用は認めず、群内比較にて、介入群の最高酸素摂取量 (VO_{2peak}, $p< 0.01$)、嫌気性代謝閾値時の酸素摂取量 (VO_{2AT}, $p< 0.01$) および負荷量 (WR_{AT}, $p< 0.05$) が介入後に増加した。自律神経機能、ストレスチェック、質問紙に関しては、両群とも介入前後に統計学的に有意な変化は認めなかった。

【結論】
鉄欠乏状態の改善により、全身持久力が向上または改善した。また、鉄の過剰摂取を認めなくても服薬により酸化ストレスが増加する可能性があり、鉄の摂取量には注意する必要性が示唆された。

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Effects of iron deficiency treatment on exercise tolerance and oxidative stress

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[Purpose]
Iron deficiency is the depletion of the body's iron store despite the absence of anemia. It has been suggested that iron deficiency may reduce exercise tolerance as with iron deficiency anemia. Recently, evaluation of oxidative stress biomarkers has attracted attention as an objective index of athletes' condition, and it has been suggested that they may be useful in inferring athletic performance. There are few reports that have examined changes in exercise tolerance and oxidative stress when iron deficiency is remedied in athletes. This study aimed to examine the effects of iron deficiency treatment on exercise tolerance and oxidative stress.

[Methods]
In this study, 15 female college basketball players were included and assigned to the intervention (n= 8) and control (n= 7) groups. Iron deficiency was determined by screening of serum iron and serum ferritin. Serum concentrations of the diacron-reactive oxygen metabolites (d-ROMs) and biological antioxidant potential (BAP) were measured using assay kits. In addition, we estimated oxidative stress index (d-ROMs/BAP×8.85) and potential antioxidant ability (BAP/d-ROMs/7.541). Oxygen uptake (VO_2), work rate (WR), and heart rate (HR) at exhaustion (peak) and submaximal exercise (anerobic threshold; AT) were measured by cardiopulmonary exercise testing (CPX) with an ergometer. We also evaluated autonomic nervous function, subjective fatigue (stress check) and questionnaires. The intervention group saw a doctor and ingested oral iron supplements or iron medicine for 8 weeks. All data were obtained before and after intervention and compared between groups. In the analysis, 13 participants were included, excluding two who were non-compliant.

[Results]
After intervention for 8 weeks, the results showed the following only in the intervention group: (1) serum iron ($p< 0.01$) and ferritin ($p< 0.05$) were significantly increased, (2) d-ROMs ($p< 0.05$) was significantly increased and BAP/d-ROMs/7.541 ($p< 0.05$) was significantly decreased, and (3) VO_{2peak} ($p< 0.01$), VO_{2AT} ($p< 0.01$), WR_{AT} ($p< 0.05$) were significantly increased. An interaction between groups was observed with serum iron and ferritin, but not with the other factors. Besides, there was a positive correlation between serum iron and d-ROMs ($r= 0.454$, $p< 0.05$). No statistically significant changes were seen in autonomic nervous function, stress check, and questionnaires before and after intervention in both groups.

[Conclusion]
Treatment of iron deficiency may improve exercise tolerance. However, it is necessary to watch iron intake because oxidative stress can be enhanced even if excessive iron ingestion is not observed.