

EFFECT OF IMMOBILIZATION STRESS ON THE FUNCTION OF UNCOUPLING PROTEIN-1 IN RAT BROWN ADIPOSE TISSUE

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Brown adipose tissue (BAT) is the major site of nonshivering thermogenesis (NST). The BAT-specific mitochondrial protein, uncoupling protein-1 (UCP-1) is the key molecule in NST in this tissue, and the amount and activity of UCP-1 change according to the physiological requirements for thermogenesis in BAT. It has been shown that chronic nonthermal stress, that is, repetitive immobilization, improves the cold tolerance through an enhanced NST in the stressed rats. Furthermore, the removal of interscapular BAT led to a loss of improved cold tolerance and significant reduction of NST in the stressed rats. These findings suggest that such cross adaptation between cold and nonthermal stress may be caused by, at least in part, stimulation of BAT thermogenic function. However, whether UCP-1 is involved in the functional activation of BAT thermogenesis in the nonthermal stressed rats remains unknown. To answer this question, we determined both the amount and activity of UCP-1 in BAT of the stressed rats. Male Wistar rats were subjected to either acute (3 hours) or chronic (3 hours/day for 4 weeks) immobilization stress by being immobilized with wire mesh on a wooden board. We measured GDP binding and expression of mRNA and protein as index of UCP-1 activity and amount, respectively. In acute group, we measured above parameters immediately after 3 hours immobilization. In the chronic stress groups, we measured in both the resting stage (24 hours after last immobilization stress) and the stressing stage (0 hour after last immobilization stress). After the rats were sacrificed by decapitation, interscapular BAT were excised quickly. Mitochondria were isolated for GDP binding experiment and Western blot analysis, total RNA were prepared for Northern blot analysis. Immobilization stress increased GDP binding in both of acute and chronic groups, but the increment in GDP binding from resting to stressing stage was significantly enhanced in the chronic groups than in the acute stress group. UCP-1 expression (both mRNA and protein) only increased in the chronic groups. These results indicate that repetitive immobilization stress can enhance thermogenic capacity through increasing both of amount and activity of UCP-1 in BAT. It is thus suggested that repetitive immobilization stress would endow with cross adaptation to cold through an increased function of UCP-1.

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