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Continuous mild heat stress induces differentiation of human myoblasts, shifting fiber-type from fast to slow

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Local hyperthermia is clinically applied in order to improve blood and lymphatic flow to decrease swelling of tissues (e.g., skeletal muscle). As for muscle repair following injury, the mechanisms underlying the beneficial effects of hyperthermia-induced muscle repair are unknown. We examined the direct effects of continuous heat stress on the differentiation of cultured human skeletal muscle myoblasts (HSMMs). Compared to control cultures grown at 37°C, incubation at 39°C (continuous mild heat stress; CMHS) enhanced myotube diameter, whereas myotubes were poorly formed at 41°C by HSMMs. In HSMMs exposed to CMHS, mRNA and protein levels of myosin heavy chain (MyHC) type I were increased compared to the control cultures. The mRNA level of MyHC IIx was unaltered, compared to cells that were not exposed to heat stress. These results indicate a fast-to-slow fiber-type shift in myoblasts. We also examined upstream signals which might be responsible for the fast-to-slow shift of fiber-types. CMHS enhanced the mRNA level of peroxisome proliferator-activated receptor-gamma coactivator (PGC)-1α, but not the activities of MAPKs (ERK1/2 and p38 MAPK) in HSMMs. These data suggest that CMHS induces a fast-to-slow fiber-type shift of HSMMs through PGC-1α. CMHS induced differentiation and fast-to-slow fiber-type shift were observed in C2C12 mouse myoblasts. These observations might be a general characteristic of mammalian myoblasts.

Biography

Tetsuo Yamaguchi has completed his Ph.D at the age of 35 years from Tokyo University. He is an orthopedic surgeon and postdoctoral researcher at Clinical Research Center, National Hospital Organization Sagamihara Hospital in Japan. He specializes in sports medicine and basic research of muscle differentiation. At present, his interest is to reveal the effect of heat stress on cell differentiation. Recent publication is "Continuous mild heat stress induces differentiation of mammalian myoblasts, shifting fiber-type from fast to slow" (American Journal of Physiology, Cell Physiology 2010;298:C140-148).