Microwave hyperthermia at 434 MHz is a highly innovative and reliable modality for treating acute sport muscle injuries. Although further study is required to clarify the mechanisms of healing, one of the reasons for its effectiveness may be related to heat shock proteins (HSPs), which can be induced by heat stress, because HSPs may play a role in preventing muscle damage and/or assisting in muscle recovery. Previously, we examined the changes in muscle temperature during 434-MHz microwave hyperthermia treatment; muscle temperatures reached at least 42.8°C, with a maximum of 45.4°C. Therefore, 434-MHz hyperthermia treatment should effectively induce HSPs in human skeletal muscle. To examine this hypothesis, we investigated the response of HSP72 to 434-MHz microwave hyperthermia in human skeletal muscle.

Three healthy adult males (28–46 yr old) participated in the study. All procedures were performed with the approval of the Juntendo University Human Ethics Committee and complied with the Helsinki Declaration. All subjects provided written informed consent. The subjects underwent 30 min of hyperthermia treatment at 434 MHz using a direct-contact microwave hyperthermia device that uses an integral system of flowing water to cool the skin while simultaneously heating the deeper tissues with microwaves. The applicator was placed on the lateral side of one thigh (HEAT). Twenty-four hours after treatment, biopsy specimens were obtained from the belly of the vastus lateralis muscle at 2 cm in depth using a 14-G disposable biopsy instrument. The control muscle samples (CON) were taken prior to the hyperthermia treatment. The muscle tissues were immediately frozen in liquid nitrogen and stored at −85°C until subsequent analysis. A standard Western blot was performed for HSP72 using an antibody specific for HSP72 (SPA-810, StressGen). The bands on the immunoblots were quantified using computerised densitometry.

The HSP72 levels in HEAT were higher than those in CON in all subjects. The augmentation of HSP72 was 37, 208, and 344% in the three subjects. Thus, 434-MHz hyperthermia treatment can induce HSP72 in human skeletal muscle, although there was a wide variation in the augmentation among subjects. These findings support the effectiveness of 434-MHz hyperthermia treatment for muscle damage. Further studies are required to clarify the relationship between the effectiveness in clinical studies and the induction of HSPs.

Reference


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