An official website of the United States government
Here's how you know

FULL TEXT LINKS

FULL TEXT OPEN ACCESS MDPI

Int J Mol Sci. 2023 Nov 23;24(23):16631. doi: 10.3390/ijms242316631.

Pulsed Electromagnetic Fields Induce Skeletal Muscle Cell Repair by Sustaining the Expression of Proteins Involved in the Response to Cellular Damage and Oxidative Stress

Silvia Maiullari [1], Antonella Cicirelli [1], Angela Picerno [1], Francesca Giannuzzi [1], Loreto Gesualdo [2], Angela Notarnicola [3], Fabio Sallustio [2], Biagio Moretti [3]

Affiliations

PMID: 38068954 PMCID: PMC10706358 DOI: 10.3390/ijms242316631

Abstract

Pulsed electromagnetic fields (PEMF) are employed as a non-invasive medicinal therapy, especially in the orthopedic field to stimulate bone regeneration. However, the effect of PEMF on skeletal muscle cells (SkMC) has been understudied. Here, we studied the potentiality of 1.5 mT PEMF to stimulate early regeneration of human SkMC. We showed that human SkMC stimulated with 1.5 mT PEMF for

four hours repeated for two days can stimulate cell proliferation without inducing cell apoptosis or significant impairment of the metabolic activity. Interestingly, when we simulated physical damage of the muscle tissue by a scratch, we found that the same PEMF treatment can speed up the regenerative process, inducing a more complete cell migration to close the scratch and wound healing. Moreover, we investigated the molecular pattern induced by PEMF among 26 stress-related cell proteins. We found that the expression of 10 proteins increased after two consecutive days of PEMF stimulation for 4 h, and most of them were involved in response processes to oxidative stress. Among these proteins, we found that heat shock protein 70 (HSP70), which can promote muscle recovery, inhibits apoptosis and decreases inflammation in skeletal muscle, together with thioredoxin, paraoxonase, and superoxide dismutase (SOD2), which can also promote skeletal muscle regeneration following injury. Altogether, these data support the possibility of using PEMF to increase SkMC regeneration and, for the first time, suggest a possible molecular mechanism, which consists of sustaining the expression of antioxidant enzymes to control the important inflammatory and oxidative process occurring following muscle damage.

Keywords: PEMF; cellular damage; skeletal muscle cells.

PubMed Disclaimer

Figures

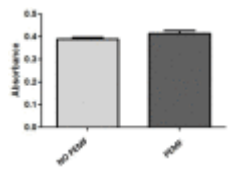

Figure 1 Effect of pulsed electromagnetic fields...

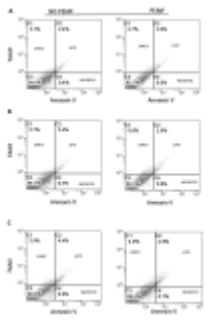

Figure 2 Effect of pulsed electromagnetic fields...

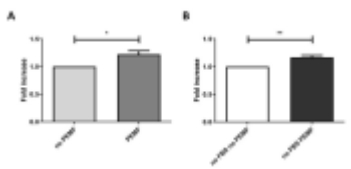

Figure 3 Effect of pulsed electromagnetic fields...

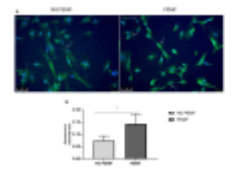

Figure 4 Effect of pulsed electromagnetic fields...

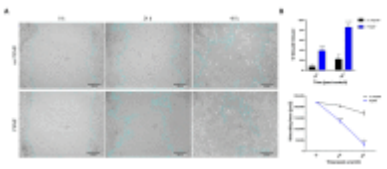

Figure 5 Effect of PEMF exposure on...

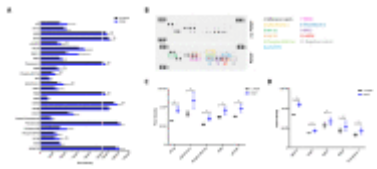

Figure 6 Effect of PEMF exposure on...

All figures (7)

Related information

MedGen

LinkOut – more resources

Full Text Sources

Europe PubMed Central

MDPI

PubMed Central

Medical

MedlinePlus Health Information