

## Low frequency electromagnetic field reduces $\beta$ -adrenergic response in murine cardiomyocytes

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In the modern society, concerns have been raised about possible adverse effects of exposure to low frequency electromagnetic field (ELF) on biological systems. Many research groups are working in this field, but the obtained results are often contradictory and cannot be reproduced by an experimental point of view in different laboratories, preventing definitive conclusions (Kheifets L. et al., 2007). In this work, the ELF was generated by a bioreactor that produced a variable magnetic field of 0-3.3 mT at a frequency of 75 Hz. The ELF was applied to cultures of murine neonatal cardiomyocytes to study several biological parameters.

Neonatal cardiomyocytes are able to form spontaneously beating syncytia (Fassina L. et al., 2011). In basal conditions and after a  $\beta$ -adrenergic stimulation with Isoproterenol, a short exposure to ELF induced a decrease of contraction rate, Ca<sup>2+</sup> transients, force of contraction and energy consumption. ELF did not modify frequency of contraction after stimulation with Forskolin and Norepinephrine, suggesting a specific effect of ELF on  $\beta$ -adrenergic receptors.

Isolated cardiomyocytes were cultured in monolayer for 48 hours in the presence or absence of ELF, to investigate the effects of the ELF exposure on cell viability, cell size and differentiation. Immunofluorescence experiments showed that the ELF decreased the percentage of mature cardiomyocytes without having effects on cell size and morphology. Moreover, the ELF caused a decrease of binucleated cardiomyocytes, indicating possible differentiation defects.

In conclusion these data show that a short exposure to ELF induces a decrease on  $\beta$ -adrenergic response while a long exposure to ELF influences the cell viability and the differentiation of cardiomyocytes.

### References

- [1] Kheifets L. et al. (2007). Extremely low-frequency magnetic fields and heart disease. *Scand J Work Environ Health*, 33:5-12.
- [2] Fassina L. et al. (2011). Video evaluation of the kinematics and dynamics of the beating cardiac syncytium: An alternative to the Langendorff method. *Int J Artif Organs*, 34 (7): 546-558.

### Keywords

ELF,  $\beta$ -adrenergic receptors, contraction rate.