Healing Mechanisms of Pulsed EM Therapy: Insights from a pilot Genome Wide Expression Regulation Study on Human Gastrointestinal Stem Cell-Derived Epithelial Cells.

Summary/Abstract:

Healing effects of pulsed electro-magnetic frequency (PEMF) treatment are well documented in the literature. However, the underlying mechanisms of PEMF action in treating various pathological conditions, are not clearly understood. Therefore, in-order to gain insights on how the PEMF influences the cellular, molecular, and genetic properties of cells in human body, we utilized a novel human gastrointestinal stem cell-derived epithelial cell system *in-vitro*. The normal physiological cellular homeostasis was altered by stimulating the cells with lipopolysaccharide (LPS) to simulate a scenario of inflammatory/disease response while in, another condition the same cells with LPS stimulation was subjected to the exposure of electro-magnetic wave by using Ondamed EM device for examining its effect on the genomic and transcriptomic profiles. Therapeutic mechanisms of EM therapy were determined by analyzing the reversal of LPS induced alterations in gene expression profile as well as in the transcriptome of the cells. The untreated cells (cultured in medium only) were used as the baseline control. Expressions of both human genome, as well as the transcriptome profile, were examined by RNA-seq analysis. The results were compared between untreated control vs. LPS treated cells to define the homeostatic alteration by changes in gene expression (RPKM value) profile caused by LPS stimulation (simulated diseased condition). Then, further comparison of LPS treated vs LPS + EM treated cells were made to examine the effect of EM frequency in reversal of the LPS caused alterations in both genome and transcriptome profiles on the same cells. A total number of 60,448 genes and 173,113 transcripts were tested in each sample. For simplicity purpose, only the gene expression data is summarized here. Over 38,162 genes (out of 60,448 tested) were constitutively expressed in the untreated control cells. Stimulation with LPS (1mg/ml) altered the expression profile by means of de-novo-expression induction of at least 1,950 genes (that were not originally expressed) and silencing 2,486 genes that were expressed (RPKM > 0.00) constitutively in the untreated cells. Additionally, LPS treatment also contributed in altering the expression levels (increased or decreased RPKM value) in a large panel of genes. Interestingly, exposure to electromagnetic wave of 100 Hertz for 30 seconds by using Ondamed device to the same LPS treated cells showed a reversing effect toward normalization of altered gene expression profile caused by LPS treatment. These results provide new insight on genomic homeostasis regulatory mechanisms mediated by electromagnetic frequency treatments on human cells. To the best of our knowledge, this is the first study to investigate a genome wide regulatory effect of electromagnetic field in human cells. We expect that the further analysis of results from the present study, as well as the outcomes from additional new investigations, will delineate specific pathways and EM dosimetry for treating multiple health conditions.