Coupled impedance field potential data analysis of in vitro cardiomyocyte assays
Levy Batista, Leo Doerr, Matthias Beckler, Niels Fertig, Thierry Bastogne

To cite this version:

HAL Id: hal-01669436
https://hal.archives-ouvertes.fr/hal-01669436
Submitted on 20 Dec 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Background. One goal of the Comprehensive in vitro ProArrhythmia Assay initiative is to predict more accurately potentially torsadogenic compounds in an earlier stage of drug development. To that aim one of the CiPA component is to assess capabilities of label-free in vitro assays (impedance and extracellular field potential signals) applied to human stem cell-derived cardiomyocytes.

Objectives

Impedance and extracellular field potential signals belong to the class of high-content data for which the most challenging issue to be addressed is to identify predictive biomarkers of cardiotoxicity in a large amount of data. To that aim, new statistical signal-processing methods are needed and the objective of this study is to develop a non-supervised technique able to rank the contractility and electrophysiological effects of tested compounds.

Methods

The CardioExcyte 96 (Nanion Technologies Gmbh) is used to measure both impedance and extracellular field potential signals on two CiPA compounds applied to cardiomyocytes. The developed method for data processing firstly computes nine numerical indicators. They characterize the time variations of frequency, amplitude, shape and irregularity of cell impedance and field potential signals. The ninth parameter is the cardiomyocyte viability index. In a second phase, statistical tests are applied on each characteristics to evaluate the concentration effect of the tested compounds. Finally, results of the previous statistical results are aggregated in a cardio-effect score, graduated from 0 (no influence) to 18 (highly disturbed beating). This innovative approach was tested using in vitro data obtained from two molecules (1 cardiotoxic and 1 non-cardiotoxic compounds).

Results

Results have emphasized some correlations but also some differences between the cardio-effects detected between the two types of signals. For the first tested compound, the absence of effects is detected by the two measurements. For the second compound, effects are detected but the modified characteristics are different in impedance and field potential signals.

Conclusion

The proposed computation method automates the combined analysis of impedance and extracellular field potential measurements on cardiomyocytes. Complementary effects have been detected by the data analysis for the impedance and field potential signals. This comparative study will be soon extended to a larger batch of molecules for validation.