Analysis of Unipolar Electrograms

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Analysis of Unipolar Electrograms and the Detection of the Arrhythmogenetic Potential of Reference Drugs Recorded in a Langendorff Rabbit Heart Preparation

Background

The Safety Pharmalogy Department of Novartis investigates the influence of known torsadogenic drugs on a Langendorff in vitro rabbit heart preparation. In particular the transmural dispersion and the apico-basal dispersion of the repolarization wave as well the beat to beat variability of consecutive beats preceding Torsades de Pointes (TdP) is examined. In the experimental setup three needles, each containing 8 electrodes, are inserted in the left ventricular wall. After the atria is removed and the His-Bundle was cut, the heart is getting stimulated with an electrode placed in the ventricular septum where the His-Bundle is cut and the electrical propagation is recorded over these 24 electrodes.

Rabbit Heart with Inserted Needles; The Picture is Provided by Dr. Nicolas Guérard, Novartis Pharma

Project Scope

The goal of this thesis was to define and develop tools analyzing these recorded transmural electrograms. This signal analysis can be split up into two parts. On the one hand the filtering of the signal and on the other the parameter extraction of the electrocardiograms. The biggest challenge here was the detection of the parameters within the T-wave, because this repolarization phase can assume every possible shape.

Results

The new signal analysis of the recorded unipolar electrograms is the main part of this thesis. In addition a graphical user interface was generated to facilitate the statistical analysis of one or more experiments. Thanks to the new much more reliable signal analysis, the added parameters and the developed visualization tools, a much better basis for an eventual deeper pattern detection is realized.

Plot of the QT-Intervals of 60 consecutive beats before a TdP develops.

Discussion

Cause of the new closer look to the signals we know now that it is not possible to just look at sequences right before a TdP, then in most of the cases there are already so much ectopic beats around, that a detection of halfway reliable parameters is not possible. Another thing that one have to take into account with the 0.2 Hz sequence is that the steady state, after the pacing rate change from 1 Hz to 0.2 Hz is reached earliest after 30 beats and so it is not possible to look at more than 20 beats at steady state.

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