Tri- and Quadriphasic Waveforms are Superior to Biphasic Waveforms for Cardiomyocyte Synchronisation

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Introduction
Multielectrode arrays (MEAs) offer electrophysiological non-invasive screening of cardiomyocytes in an intact cellular environment. The electrodes can also be used for electrical stimulation of the cardiomyocyte cultures and shapes of stimulating pulses can be tailor made to fit the purpose.

Materials and Methods
The murine cardiomyocyte cell line HL-1 was cultured in MEAs until confluence. The cells were stimulated with a biphasic, a triphasic and a quadriphasic waveform and the amplitudes required for synchronisation was determined. The statistical analyses were performed with the Mann-Whitney test and results considered significant at p<0.05.

Results
Triphasic and quadriphasic waveforms were more efficient in synchronizing the HL-1 cells compared to the biphasic waveform, since they allowed for significant reductions in synchronizing voltage amplitudes (A) (see table 1.). They also allowed for significant reductions in the supplied energy.

<table>
<thead>
<tr>
<th>Waveform</th>
<th>Biphasic</th>
<th>Triphasic</th>
<th>Quadriphasic</th>
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<tbody>
<tr>
<td>Relative A mean±std dv.</td>
<td>1.00</td>
<td>0.92±0.065</td>
<td>0.85±0.069*</td>
</tr>
</tbody>
</table>

*significant (p<0.05) compared to biphasic waveform.

Table 1. Relative stimulating voltage amplitudes required for synchronization of the HL-1 cells.

Cell death was seen at the stimulating electrodes (see figure 1.). The cell death was seen at the same voltage amplitudes for all three investigated waveforms.

Discussion and Conclusions
The increase in number of phases in a stimulation waveform seems to be the major reason for the reduction in synchronizing amplitudes. The in vitro MEA system allows for mimicking of the in vivo situation and we thus believe that the MEA system may be used for preliminary screening and optimization of stimulation waveforms.

References List references cited in text as

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Disclosures
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