Biological Pacemakers as Alternatives/Adjuncts to Electronic Pacing Devices

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Heart Block and its Current Method of Treatment

Sinoatrial node (Natural Pacemaker)

Artificial Pacemaker
Drawbacks of Electronic Pacing Devices

i) No pediatric-sized pacemaker available

ii) Dislodging of lead wire

iii) Battery replacements

iv) Risk of infections

v) Electronic shock with 10-50x larger than natural electrical signal

vi) Non reversible
BioPacer

Gene reprograms regular cardiomyocytes into pacemaker cells

- Nature Biotechnology, 2013
- Science Translational Medicine, 2014

Small molecule (Epithelial-to-Mesenchymal Transformation (EMT) inhibitor) stops the migration of new pacemaker cells and stabilizes their synchronous pacing.
In Vitro Electrophysiology Studies using Rats Cardiomyocytes

New pacemaker cells are less rhythmic & synchronous

New pacemaker cells are highly rhythmic & synchronous
## BioPacers vs. Pacemaker Devices

<table>
<thead>
<tr>
<th></th>
<th>BioPacers</th>
<th>Pacemaker devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware free?</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Pacing with required energy?</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Less expensive?</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Minimally-invasive?</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Reversible?</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Minimum infection risk</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>
Commercial Opportunity

Market
- Global pacemaker market was valued at $4.9 billion in 2015
- Expected to grow at CAGR of 9.2%
- Pediatric patient make up about 0.5-1% of all pacemaker implantations & the pediatric market estimated at $30 million.

Next Steps
- IND-enabling preclinical studies
  - In vitro & in vivo functional validation of BioPacer as a cardiac pacemaker

IP status
- PCT applications filed

Commercialization
- Seeking interested parties to discuss business opportunity and funding
Thank You!