Abstract:

Aims: The main objective of this work was to analyze in detail the effects of acute temperature changes on the function of isolated chick embryonic heart *in vitro* in comparison with natural conditions *in ovo*.

Methods: The effects of temperature change (34 °C, 37 °C and 40 °C – hypo-, normo- and hyperthermia, respectively) on calcium dynamics in four days old isolated chick hearts *in vitro* were investigated by high-speed calcium optical imaging. For comparison and validation of *in vitro* measurements, experiments were also performed *in ovo* using videomicroscopy. Artificial electrical stimulation experiments were performed *in vitro* and *in ovo* to uncover conduction limits of different heart segments.

Results: We observed almost linear dependence of sinus frequency on temperature in our temperature range. Sinus frequency during hypothermia and hyperthermia *in vitro* and *in ovo* changed about 20% in comparison with normothermia. We observed no significant changes in amplitude of calcium transients during temperature change to hypothermia but hyperthermia caused a significant decrease in amplitude of calcium transients (atria 35%, ventricles 38%). We observed a wide spectrum of arrhythmias, which occurred spontaneously even during normothermia *in vitro*. Occurrence of arrhythmias *in vitro* significantly increased during hyperthermia and was reduced during hypothermia, while almost no arrhythmias occurred *in ovo* under all temperature conditions. The most common arrhythmia *in vitro* was atrioventricular (AV) block (2nd and 3rd degree together comprised 56% of all observed arrhythmias). Electrical pacing experiments *in vitro* and *in ovo* suggested that the AV blocks were likely caused by relative tissue hypoxia and not by the tachycardia itself. We described variability of AV block locations. We localized ectopic pacemaker in the transition of AV canal and the ventricle. We described atrioventricular re-entry using epicardial activation maps.

Conclusion: The pacemaker and AV canal were the most temperature-sensitive segments of the embryonic heart. AV canal was particularly sensitive to stress of *in vitro* conditions. We suggest that the critical point for conduction is the connection of the fast conducting ventricular trabecular network to the slow conducting tissue of AV canal.

Key words: arrhythmias, AV canal, chick embryo, conduction block, heart development, optical mapping, temperature.