# ABSTRACT

Cardiovascular diseases are the most common cause of death in the world. They include abnormal heart rhythm, otherwise known as arrythmias, which make a significant group of diseases contributing to the morbidity and mortality.

Research in the area of cardiac conduction system (CCS) morphology has over 100-year history, but the area of ontogeny has not yet been thoroughly explored. It is possible that understanding of the signaling mechanisms involved in the CCS development may be the key to opening doors to new possibilities of diagnosis and therapy of diseases in this area.

The goal of this research is to understand the influence of mechanical loading on the development of CCS. I would like to prove, that mechanical load on heart caused by blood circulation in embryonic development plays an essential role in differentiation of CCS.

For our research we chose the chicken heart. In comparing bird heart with mammal heart it is possible to find dissimilarities in details, nevertheless, the main principles and mechanisms appear to be the same. Chicken embryo develops for 21 days and it is possible to divide this period into 46 stages according to Hamburger & Hamilton. At first, the heart is only a primitive tube, which then loops and finally develops into a mature four-chamber organ specific for higher vertebrates. These morphological changes correlate with changes of spread the activation wave through heart tissues. The aim of this work should be the prove that without mechanical load from blood in cardiac chambers the CCS will not develop further normally.

We have compared three groups - chicken hearts, which had developed naturally *in vivo* and hearts with and without artificial mechanical loading in cultivation medium for a period of 24 hours. We focused on monitoring the spread of the activation wave through the ventricles by high-speed CMOS camera. We corroborated these results also by the study of morphological changes evaluated by confocal microscopy and by immunohistochemical methods using antibodies MF- 20 against myosin heavy chains and anti α-Actinin against α -Actinin.

Ours results show that under specific conditions when we disconnect chicken embryo's heart from blood circulation (mechanical loading) for a period of 24 hours and leave it in cultivation medium, the CCS does not mature. On the contrary, development of the action potential degenerates to the most primitive form – from base to apex. These results correlated with the regression in development of the ventricle trabeculae, which was observable on confocal microscope.

Immunohistochemical analyses point mainly to trabecular disorganization and a change of the myofibril orientation in the outflow tract.

On the other hand, loading the ventricle with silicone oil that would cause mechanical stress, while maintaining the hearts under equal conditions, resulted in normal maturation of CSS comparable with in vivo ontogeny.

In conclusion, these results confirm the essential role of mechanical stretch of myocytes for differentiation of CSS.

**KEY WORDS:** CARDIAC CONDUCTION SYSTEM, CHICK EMBRYO, OPTICAL MAPPING