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Zebra fish heart slices: A new model to investigate contractile properties of the heart

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Introduction: Zebra fish are a popular model organism for cardiovascular research. They are easy accessible and allow insights into different development changes. Their genome is almost entirely sequenced and genetical modifications can be easily applied. Action potential morphology and ECG signals are similar to the human heart. However there are no data in regard of the contractile properties of Zebra fish hearts. Our aim was it to develop a model, which allows the functional characterization of contractile properties of zebra fish hearts.
Methods:
Hearts of adult Zebra fish were excised, low-melting agarose maintained was poured over the hearts. The agarose-embedded hearts were fixed onto a specimen holder. Ventricles were sectioned into 300-µm-thick slices along the short axis.
The slices were mounted on an isometric force transducer. Length was increased stepwise to the length of maximal force development. Contractions were recorded from spontaneously beating as well as from electrically stimulated preparations. Preparations were field-stimulated by silver electrodes. Force frequency protocols as well as pharmacological tests (Isoproterenol, Carbachol and Nifedepine) were applied. Electrical stimuli and analog signals from the force transducer were amplified with a bridge amplifier and analog signals were transferred to an analog to digital board.
Results:
From every heart 3 to 4 ventricular slices could be generated. More than 50 % of the slices were beating spontaneously. All slices developed force of contraction after electrical stimulation.
The slices displayed a negative force-frequency-relationship, (less amplitude at higher stimulation frequencies). Hormonal modulation of zebrafish slices by Isoproterenol lead foremost to an increased beating frequency and only to a slight increase in force of contraction. Nifedepine reduced the force of contraction significantly.
Conclusion:
Generation of ventricular slices from Zebra fish hearts is possible. We developed successfully a model to characterize the contractile properties of Zebra fish hearts. The differences of these properties compared to human hearts have still to be analyzed.This method could serve as basis to evaluate the role of different genes and their influence on the physiology during cardiac development by using hearts of "morpholino"-Zebra fishes, where almost every gene can be directly knocked down.