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THE USE OF FLOATING MULTICHANNEL ELECTRODES FOR MONITORING THE ELECTRICAL ACTIVITY OF THE MYOCARDIUM

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Introduction: The development of novel drugs necessitates meticulous monitoring of various critical aspects to mitigate the risk of cardiovascular complications. Researchers must consider a plethora of targets ranging from the molecular level of ionic channels to the systemic effects of novel compounds. Employing techniques of different scales, such as electrocardiogram (ECG) recordings and field potential recordings of cardiomyocytes with implanted electrodes, presents a challenging yet rewarding approach. This design can yield comprehensive insights into the state of cardiomyocytes within the heart chambers and the heart as a whole. By conducting measurements under conditions where other organs remain intact, researchers can assess the systemic effects of compounds and anticipate or confirm adverse effects during preclinical research. Moreover, this setup provides an opportunity for additional interventions and the simultaneous monitoring of other parameters in the same animal. Material and Methods: Xenopus frogs were utilized for the experiment. The animals were anesthetized with diethyl ether and decapitated. Following the opening of the thoracic cavity, the intact heart was exposed. Recordings were carried out under constant temperature conditions of 20°C within a Faraday cage. Four two-channel tungsten wire electrodes (diameter = 25 µm) were employed to record the electrical activity of the ventricular myocardium in an intact heart. To capture data from various locations, eight microelectrodes were arranged in four groups in a cross-like configuration. The electrode's design facilitated both rigid fixation to a micromanipulator and additional fixation to a holding frame with an electromagnet. After precise electrode positioning and implantation in myocardial tissue, it

transitioned from rigid to floating mode, preventing microelectrode deformation, heart tissue damage, and improving the signal-to-noise ratio. This electrode construction is suitable for long-term recordings, drug administration, and electrostimulation. Results: ECG recordings allowed clear detection of P-waves and R-waves, enabling the calculation of R-R intervals and heart rate. Field potential recordings yielded three distinct complexes, two of which coincided with P and Q waves. Conclusion: The proposed electrophysiological setup with floating multichannel electrodes enables rapid, efficient, and cost-effective evaluation of myocardial state during pharmacological interventions. The technique was validated using standard pharmacological drugs with well-known mechanisms of action. Field potentials from the intact heart were successfully recorded, and key myocardial parameters were calculated and analyzed. This technique facilitates the assessment of myocardial profiles during the preclinical stage of novel drug development, as well as during the action of various factors such as electrical, chemical, or genetic stimuli. Additionally, this method could be employed for parallel recordings of different organs and organ systems within a single animal.

References:

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Biography

ScD, PhD, MD, Oleg Vlasenko (1961) is a professor (since 2015) of the Department of Normal Physiology at the National Pirogov Memorial Medical University, Vinnytsia, Ukraine. He received his Doctor of Medicine degree from the Vinnytsia Medical Institute in 1984, a PhD degree and a Habilitation (ScD) in Normal Physiology from the National Pirogov Memorial Medical University, Vinnytsia, Ukraine in 1993 and 2013, respectively. He is the author of over 100 peer-reviewed scientific publications and several patents, and his current H-index is 4 in Scopus.

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