Interested in ECG Components, Intervals, or Timing? Check Out the Rodent Surgical Monitor+ for Seamless Acquisition of ECG!

Publication Highlight

Publication Highlight: ECG Marker Evaluation for the Machine-Learning-Based Classification of Acute and Chronic Phases of *Trypanosoma cruzi* Infection in a Murine Model

Overview

Researchers recently showed that Chaga's disease can be detected and the stage of infection, either acute or chronic, can be determined by evaluating ECG components using machine learning algorithms and the **Rodent Surgical Monitor+ (RSM+)**[1]. This disease has two phases, acute and chronic; in the acute phase, the parasite is found in the circulatory system with the patient expressing asymptomatic or with mild flu-like symptoms; however, in the chronic phase, the parasite enters the heart muscle and is estimated that 20 – 30% of infected people will develop severe complications such as electrical conduction abnormalities, arrhythmias, destruction of the cardiac muscle, and progression to heart failure[2].

If Chaga's disease is caught in the acute phase, it can be cured; however, the treatment efficacy diminishes the longer the patient is infected[3]. Being able to quickly detect and determine the stage of infection using ECG, could be potentially a quick phenotyping tool in locations where this disease is found and where the use of other tests may not be widely implemented or feasible.

Using the **Rodent Surgical Monitor+ (RSM+)**, the researchers monitored ECG Lead II by the non-invasive electrodes built into the surgical platform, a representative ECG of a healthy mouse highlighting the ECG components is shown in **Figure 1.** The researchers performed an ECG analysis focusing on the duration (ms) and voltage (amplitude in millivolts (mV)) of the ECG components P, Q, R, and S waves, the QRS
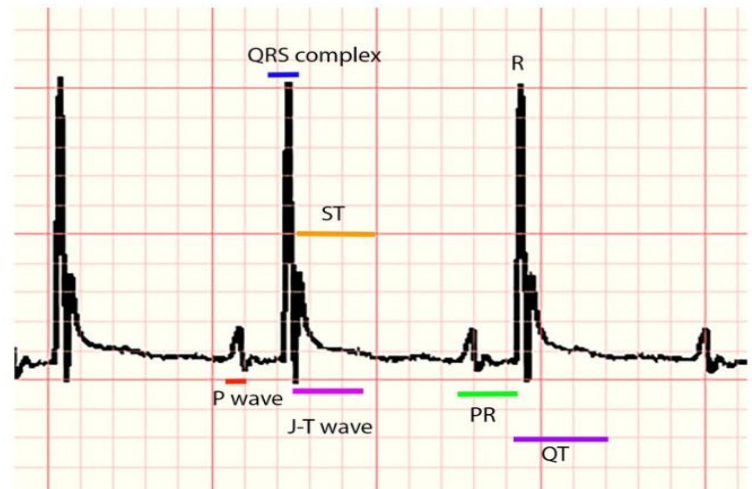

Figure 1. ECG components of a healthy mouse. The P wave (atrial depolarization), followed by the QRS complex (ventricular depolarization), the R wave (depolarization of the ventricles), the J wave (early ventricular repolarization), the T wave (ventricular repolarization), the PR interval (time for electrical conduction from the atria to the ventricle), the ST segment (ventricular repolarization), and QT (ventricular depolarization repolarization). *Figure adapted from Forsyth, C., et al. Tropical Medicine and Infectious Disease. 2023.*

complex, PR, QT, QTc intervals, and the segments PR and ST as well as the appearance of P, J, and T waves were noted.

The researchers were able to classify control mice vs. mice in the acute phase of infection vs. mice in the chronic phase of the infection from their ECG waveforms with an accuracy of 91.3%. Using their machine learning algorithms, certain ECG components were automatically selected as important indicators, such as the P wave voltage and the increased duration of PR and QTc intervals. This work establishes which ECG component changes are important for the diagnosis of Chaga's Disease as well as to determine the phase of infection.
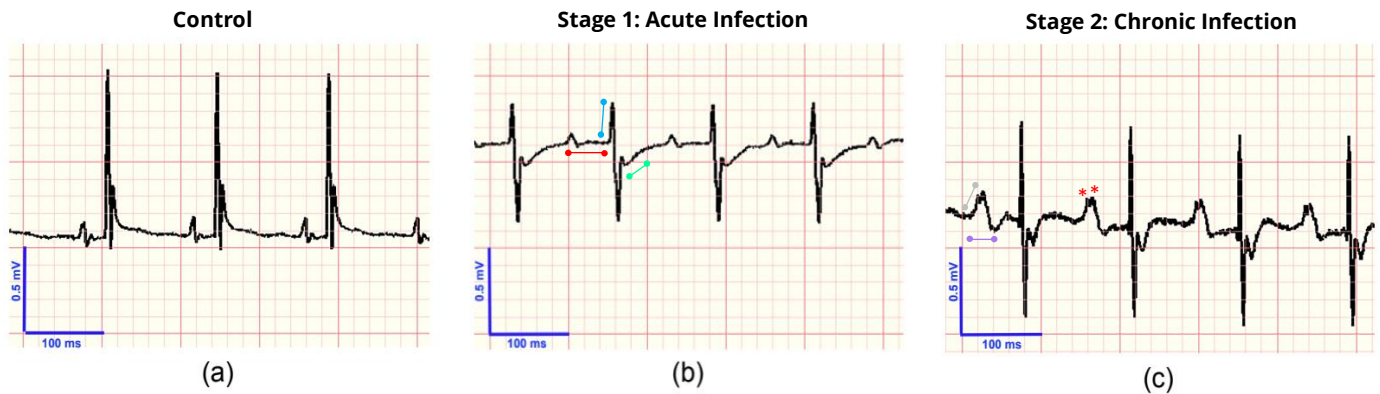
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Figure 2. Examples of ECG images from (**a**) a control mouse, a mouse infected during the (**b**) acute and (**c**) chronic phase. Relevant findings within the acute phase are the prolongation of the PR interval, highlighted by ↦ (often associated with a first-degree atrioventricular blockade), a low voltage of R, highlighted by ↦ (may reflect an inability of the myocardium to generate voltage due to myocarditis), and a negative T wave, highlighted by ↦ (may indicate subepicardial ischemia or a bundle branch block). During the chronic phase, an increase in the P wave voltage, highlighted by ↦ , and duration, highlighted by ↦, with a biphasic shape, highlighted by * can be observed. *Figure adapted from Forsyth, C., et al. Tropical Medicine and Infectious Disease. 2023.*

Conclusion

The **RSM+** is used in this study primarily to monitor ECG Lead II. However, the RSM+ is a heated surgical platform that allows for physiological monitoring of ECG (Lead I, Lead II, Lead III, aVR, aVL, aVF) and respiration via noninvasive electrodes built into the surgical platform. This group focused on ECG differences in *T. cruzi*; however, others have used the RSM+ to confirm arrhythmias, myocardial infarction, and other abnormal ECG waveforms[4–8].

Oxygen saturation, core body temperature, and ventricular or systemic pressures can also be measured. This surgical platform is commonly used with mice, rats, and other small animals, but external ECG leads are available if a larger animal model is used.

7.6 inches

11.6 inches

Check out the RSM+ website page for more information or contact Scintica Instrumentation if you would like to discuss your specific research needs and how the RSM+ may benefit your group!

If you have any questions which equipment best meets your research needs, feel free to contact us to discuss your research. We also have many resources available, from scientist webinars to journal citations, to help point you in the right direction.

To see the imaging systems and lab equipment that we offer, please visit our website (www.scintica.com) or feel free to reach out to us via email at info@scintica.com or by phone at 832-548-0895 and we would be glad to assist you.

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References

1. Forsyth, C., Cantillo-Barraza, O., Haro, P., Hevia-Montiel, N. & Perez-Gonzalez, J. ECG Marker Evaluation for the Machine-Learning-Based Classification of Acute and Chronic Phases of Trypanosoma cruzi Infection in a Murine Model. *Tropical Medicine and Infectious Disease 2023, Vol. 8, Page 157* 8, 157 (2023).

2. Cantey, P. T. *et al.* CDC - Chagas Disease - Disease. *Transfusion (Paris)* 52, 1922–1930 (2019).

3. Chagas disease (also known as American trypanosomiasis). https://www.who.int/news-room/fact-sheets/detail/chagas-disease-(american-trypanosomiasis).

5. Kelm, N. Q., Solinger, J. C., Piell, K. M. & Cole, M. P. Conjugated Linoleic Acid-Mediated Connexin-43 Remodeling and Sudden Arrhythmic Death in Myocardial Infarction. *International Journal of Molecular Sciences 2023, Vol. 24, Page 11208* 24, 11208 (2023).

6. Arias-Argáez, B. C. *et al.* Signature of cardiac alterations in early and late chronic infections with Trypanosoma cruzi in mice. *PLoS One* 18, e0292520 (2023).

7. Tan, Y. *et al.* Nanowired human cardiac organoid transplantation enables highly efficient and effective recovery of infarcted hearts. *Sci Adv* 9, (2023).

8. Hsueh, B. *et al.* Cardiogenic control of affective behavioural state. *Nature 2023 615:7951* 615, 292–299 (2023).

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