Non-invasive Holter Monitor Suit for Conscious Unanesthetized, Behaving Mice

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Electrocardiograms (ECGs) are commonly used to analyze heart rhythms and electrophysiology in mouse models of cardiovascular disease. Currently, several techniques are employed for recording *in vivo* ECGs, including anesthesia-aided ECGs, implantable telemetric devices, and surface paw recordings in restrained mice. However, these methods suffer from important drawbacks. Only surface paw ECGs allow for non-invasive recording in unanesthetized animals, but these recordings often suffer from increased noise (including motion and breathing artifacts) and sympathetic effects on heart rate. Thus, we aimed to develop a novel device for recording mouse ECGs. A custom mouse ECG suit (mECGs) was fitted with recording electrodes, which contact the ventral torso. The performance of the current design was tested relative to a surface paw recording device, the ecgTUNNEL (emka Technologies). Four mice underwent recordings using both methods and signal-to-noise ratio (SNR) was calculated for each recording. The mECGs outperformed the ecgTUNNEL in 3 of the 4 mice tested, with SNR being higher for the suit in those three mice. Relative to the ecgTUNNEL, we identified a trend of increased SNR (average SNR for the suit was 1.16-fold greater, \( p = 0.101 \)), significantly less baseline drift, and fewer motion artifacts. Currently, our mECGs method offers recordings equivalent to the ecgTUNNEL, with a trend toward outperformance of the tunnel. With ongoing design modifications including the use of 3D printing, we expect the mECGs to surpass the ecgTUNNEL. Additionally, the suit has the potential to collect ECGs without interrupting normal behavior or sympathetic tone of the mouse. Future plans include combining the suit with wireless data transmission to allow the mice more freedom of motion. Our mouse ECG suit will greatly improve the collection of ECGs for the investigation of mouse models of cardiac rhythm disorders.