Method for non-invasively recording electrocardiograms in conscious mice

ABSTRACT

The technology we developed enables non-invasive screening of large numbers of mice for ECG changes resulting from genetic, pharmacological, or pathophysiological alterations. Data we obtained non-invasively are not only consistent with what have been reported using invasive and expensive methods, but also demonstrate new findings regarding gender-dependent and age-dependent variations in ECGs in mice.

INTRODUCTION

Background Although electrocardiograms (ECGs) have been obtained in conscious mice, currently reported techniques require restraint or anesthesia and surgical implantation of telemetry devices. Anesthesia, however, may depress cardiovascular function, and adequate recovery after transmitter implantation in mice is nearly 3 weeks. Accordingly, we developed a non-invasive technique for obtaining ECGs in conscious mice by placing the animal on a platform embedded with paw-sized ECG electrodes connected to an amplifier. This method is much less traumatic, requires no anesthesia or surgery, and promotes rapid screening of large quantities of mice. ECG data we obtained non-invasively in conscious mice are comparable to those recently published using surgically implanted telemetry devices. To test the efficacy of our system, we evaluated ECGs in mice of either sex, of several strains, and of different ages. Moreover, we tested whether our system could detect ECG alterations in response to pharmacological challenge by isoproterenol. The baseline heart rate data and responses to the β-adrenergic agonist isoproterenol we recorded non-invasively in mice are comparable to data published using invasive methods. We developed an ECG signal processing, analyzing, and database Web portal, which we named e-MOUSE™, accessible to the biotechnology community. The advantages of the ECG recording and analyses paradigm we developed are clear, given the high cost of breeding, housing, and transporting mice, and the call for comprehensive yet widely available phenotyping tests.

CONCLUSION

Conclusions We developed a non-invasive technique for obtaining ECGs in conscious mice. We developed an Internet-accessible portal for analyses of mouse electrocardiograms. Using this system, we demonstrated significant strain, gender and age-dependent differences in electrocardiograms in mice. Moreover, we demonstrated significant gender-dependent differences in the cardiovascular response to β-adrenoceptor stimulation. Our results may suggest that the stimulatory effects of genes and drugs on cardiac function may be more profound in male or masked in female mice. This non-invasive and rapid ECG phenotyping technique may improve the quality and increase the quantity of data collected from mouse models.