

Mouse Blood Pressure and Heart Rate

Equipment: **Hatteras MC-4000 Blood Pressure Analysis System**
(manufactured by Hatteras Instruments, Cary, NC)
www.hatterasinstruments.com

General Information:

The Hatteras MC-4000 Blood Pressure Analysis System is a computer-automated tail-cuff system that can rapidly make multiple measurements on 4 awake mice simultaneously without operator intervention. The mice are contained in individual dark chambers on a heated platform with their tails threaded through a tail cuff. The system measures blood pressure by determining the cuff pressure at which blood flow to the tail is eliminated. A photoelectric sensor detects the specimen's pulse. The system generates results that we have shown correspond closely with mean intra-arterial pressure measured simultaneously in the carotid artery. We have shown in our laboratory that measurements can be obtained on almost all mice in the first trial and that "training" for up to 2 weeks has no significant effect on the measurements recorded. The coefficient of variation of the measurements are 8-10% for pressure and 6-10% for heart rate.¹

Procedure:

In order to increase blood flow to the tail, the mice are contained on a heated platform. The platform is preheated to 38 °C prior to installing mice in the measurement chambers. The temperature on the platform is monitored with a temperature microprobe (Physitemp Instruments, Inc., Clifton, NJ). The system is calibrated (50, 100, 150, 200 mmHg) using a mercury manometer.

The mice are placed one by one on the preheated platform. A maximum of 4 mice can be measured at one time. In order to enhance the reliability and reproducibility of the blood pressure measurements, the mice are handled gently. The room that the measurements are done in is kept quiet with no loud talking or noise (including music). The tail of each mouse is inserted through the appropriate tail cuff, the tail is laid down into the tail slot and is secured with a piece of masking tape. The tail cuff is positioned so it is directly touching the rump of the mouse. The mouse tail cover (which contains the LED which illuminates the tail) is then placed over the tail slot. An individual measurement chamber or cover is placed over each mouse to restrain and calm the mouse. The covers are opaque and are held in place on the platform with magnetic strips. Initially the mice may be restless or anxious but after a minute or two they usually calm down. When the mice are in place, the operator enters the experiment information, including specimen identification into the computer program.

Once contained in a measurement chamber, a mouse undergoes 10 preliminary cycles, for which data is not recorded. This take 5-7 minutes and allows the mouse time to warm up which improves blood flow to the tail. It also allows the mouse time to become accustomed to being in the chamber and to having the tail cuff inflate around its tail before measurement cycles begin. Each cycle consists of two distinct phases. In the first phase, the MC-4000 program monitors the pulsing of the blood in order to determine the pulse rate. When a sufficient number of successive pulses are observed, the program reports an averaged pulse value. It also calculates the averaged pulse amplitude at that time. Once a pulse has been detected, the program enters the second phase in which it seeks the arterial pressure. The program turns on the air pump and begins inflating the tail cuffs. The program analyzes the incoming data for each mouse in order to determine when the arterial pressure has been reached. When all mice have had their arterial pressure measured, the pump is turned off and the pressure released. This process is repeated until 10 measurement cycles are completed.

Following completion of the measurement cycles, the program generates a summarized results report and a measurement details report. The summarized report includes; specimen i.d., average arterial pressure (mmHg), arterial pressure standard deviation (mmHg), average pulse rate (beats per minute), pulse rate

standard deviation (beats per minute) and number of successful measurement cycles. The detailed report shows the arterial pressure and pulse rate for each of the measurement cycles for each mouse.

In our laboratory, a given mouse must have a minimum of 6 out of 10 successful measurement cycles for the data to be accepted. If not, the above procedure is repeated. A blood pressure/heart rate recording takes approximately 15 minutes or 25 minutes if it is necessary to repeat it.

To average out some day-to-day variation, mice are tested over 3-5 days. They are rotated through different chambers and tested for 10 measurement cycles each day as described above. The overall means and standard deviations are determined by averaging the means from all test days.

Reported Results:

For each mouse analyzed, a summarized results report is generated. It includes the mouse identification #, average arterial pressure, arterial pressure standard deviation, the average pulse rate, the pulse rate standard deviation.

Acknowledgements:

The CMHD requests that the users of our screening service acknowledge the technical assistance of our facility in any presentations or publications that report results generated by our services. A suitable acknowledgement for publications is as follows: "The authors would like to acknowledge the Samuel Lunenfeld Research Institute's CMHD Mouse Physiology Facility for their technical screening services (www.cmhd.ca)."

Additionally, please send reprints or information on such publications or presentations when they are submitted or available. Such acknowledgements will help promote the use of our service and assist us in obtaining continued financial support to help defray service fees.

¹Wong, A. Y. H., S. Kulandavelu, K. J. Whiteley, D. Qu, B. L. Langille, and S. L. Adamson. Maternal cardiovascular changes during pregnancy and postpartum in mice. In press, 2001.