STANDARD OPERATING PROCEDURES

DIVISION OF COMPARATIVE MEDICINE
UNIVERSITY OF SOUTH FLORIDA

TITLE:	**CODA Non-Invasive Blood Pressure (NIBP) System**
SCOPE:	Research and Animal Care Personnel
RESPONSIBILITY:	Facility Managers, and Professional & Administrative Staff
PURPOSE:	To Outline the Proper Procedures for Use and Maintenance of the CODA NIBP System

I. PURPOSE

1. The CODA NIBP system is a computerized system that automatically performs rapid, simultaneous, multiple measurements of (6) six physiological parameters: systolic blood pressure, diastolic blood pressure, mean blood pressure, heart rate, tail blood flow, and tail blood volume on up to two (2) animals.

2. The CODA system is designed for mice, rats, gerbils and other small animals with a tail.

II. RESPONSIBILITY

1. It is the responsibility of the Facility Manager to ensure that equipment is appropriately cleaned, maintained in good working order, and available for research personnel as requested.

2. It is the responsibility of the veterinary professional, administrative, and managerial staff to ensure that all research and technical staff are adequately trained to use the CODA NIBP system.

III. BACKGROUND

1. The CODA utilizes Volume Pressure Recording (VPR) sensor technology. VPR is the most accurate method to non-invasively measure blood pressure (BP) in mice as small as 10 grams to rats greater than 950 grams. VPR has reportedly correlated 99% with direct BP.

2. The non-invasive BP methodology consists of utilizing a tail cuff placed on the tail to occlude blood flow and a tail cuff incorporating the VPR sensor placed distal to the occlusion cuff to measure BP parameters. As the occlusion cuff is slowly deflated the VPR cuff measures the physiological characteristics of the returning blood systolic blood flow resulting in values for systolic and diastolic BP, mean BP, heart pulse rate, tail blood volume and tail blood flow.

3. A **proper size rodent restrainer** is essential for accurate BP measurements. Restrainers must comfortably restrain the animal while not creating stress and/or

impeding normal posture and relaxed breathing. A darkened nose cone is beneficial in reducing the animal's view and reducing stress.

4. **Core body temperature is important** for accurate and consistent BP measurement. The animal must have adequate blood flow to the tail for accurate measurement. Anesthetized animals may have lower body temperature than awake animals so additional care must be taken to maintain the animal's proper core body temperature. The animal should be warm and comfortable but never hot. Overheated animals will elevate rate of respiration and induce stress that can result in inconsistent and inaccurate BP readings.

5. **Proper environmental temperature is essential** for accurate blood pressure measurements. Ideally the room should be at or above 26^0C. If the room is too cool the animal will not thermo-regulate, tail blood flow will be reduced. Working on cool surfaces or nearby air conditioning ducts should be avoided.

6. **Appropriate animal preparation is necessary** for accurate BP measurement. The animal should be allowed to enter the restrainer freely, the restrainer adjusted to hold the animal comfortably (i.e., nose cone adjusted to hold the animal comfortably while not allowing excessive movement), and allowed to acclimate for 10-15 minutes prior to obtaining BP measurements. A nervous, stressed animal may have diminished circulation in the tail. While training rodents is not necessary it may be beneficial before beginning experiments.

IV. EQUIPMENT USE

1. When starting the CODA application it automatically opens the Device Manager and searches for attached CODA devices. Once a device is found, run selected device.

2. Restraint:
    a. When using the CODA restrain/warming system, slide nose cone to the front of the restrainer and remove rear gate. Place animal in restrainer preferably by allowing it to enter freely or using as little force as necessary. While ensuring the tail is extending out the rear of the holder replace the rear gate and tighten thumb nut. Place the animal on the V grooves on the Animal Warming Platform. Note: warming block may not warm animals sufficiently in a room below 26^0C (79^0 F) especially when placed in thick polycarbonate restrainers supplied with CODA unit.
    b. Using a restraining device with thinner walls to conduct heat from a warm water blanket (e.g., aerated 50ml conical tube for mice or pastry bag for rat covered in warm water glove/blanket) may improve tail blood flow and BP readings.

3. Adjust the nose cone so that the animal's movement is limited but the animal appears comfortable.

4. Slide Occlusion Cuff up near the base of the tail, it should slide freely, but fit closely when the not pressurized. If resistance is encountered when sliding the cuff up the tail, STOP, do not force the cuff further. Position the cuff as near the base of the tail as possible without force. Forcing the cuff will cause occlusion of vessels resulting in poor BP measurement.

5. When using the CODA restraint system, secure the Occlusion Cuff inside one of the grooves located in the back of the holder.

6. Slide the VPR cuff up the tail with the larger end first, until reaching the Occlusion Cuff. Do not force the cuff, if resistance is felt use the next size cuff. Secure the VPR cuff inside the groove opposite the one used for the Occlusion Cuff.

7. Personnel Manager-Allows researchers, technicians, specimens, and animals (mouse, rat, etc.) to be selected/added/deleted while setting up an experiment.

8. Set up a new experiment by following prompts for selecting researchers, technicians, and specimens.

9. New session will start the process for acquiring measurements.

10. For unanesthetized animals 10 acclimation cycles is recommended. Measurement cycles can be set to desired number of measurements at desired intervals.

11. Minimum tail volume is listed as 15 by default.

12. For best results set run-time to 20 seconds.

13. Cycles will begin after clicking on “Finish”.

14. Data can be displayed and saved as an excel spreadsheet for review.

V. MAINTENANCE

1. Cuff bladders for both the occlusion cuff and VPR cuff require periodic replacement. Always begin your BP measurement session by checking cuffs for possible leaks. Leaks can be detected audibly.

2. Cuffs are replaced by removing the O-rings and old bladder and inserting new bladder over cuff. Fold the new bladder over each end and secure with the O-rings being careful not to stretch or wrinkle the bladder material. The bladder on the VPR cuff should be loose enough not to hamper the expansion of the tail yet allow maximum contact with the animal’s tail. Properly installed cuff bladders ensure accurate and consistent BP measurements.

3. Occlusion cuffs can be gently rinsed with water and cleaned with germicidal or antiseptic soap and water. Do not use solvents or alcohol to clean cuffs.

4. Since cuffs cannot be adequately sanitized, they will be dispensed for use on an investigator’s own animals to minimize the spread of infectious agents throughout a facility.

5. Should the CODA Controller become soiled gently spot clean with a damp wipe or towel. Never use liquids on the controller.

6. The CODA Platform, animal warming platform, restrainers, and cuffs can be gently cleaned with a germicidal or antiseptic soap and water. DO NOT use organic solvents or alcohols.

7. Contact technical support at (860) 626-1172 if additional maintenance or trouble shooting is needed.

VI. REFERENCES

1. Refer to the CODA Multi Channel, Computerized, Non-Invasive Blood Pressure System for Mice and Rats operation manual for additional information.

Approved: **Date:**