Magnetic Resonance Imaging of rodents/rabbits
Suggested Procedures (LabAn SOP #2)

A large number of faculty on the UP Campus are interested in performing non-invasive Magnetic Resonance Imaging (MRI) studies, mainly in rodents (mice and rats) but also larger animals such as rabbits. The process of MRI is completely harmless to the animals, but does sometimes require anesthesia. MRI is advantageous because it is non-invasive and can be performed repeatedly, potentially reducing the number of animals used to track experimental progress.

This document describes suggested procedures for MRI imaging including: animal transport, housing, anesthesia, recovery and record keeping.

Responsibilities of the investigator using MRI to image live animals:
1. Consult with an ARP Veterinarian regarding the selection of anesthetic.
2. Procedures involving live animals must be covered by an IACUC approved protocol that includes the following information:
   a. An explanation of the purpose of the study;
   b. The number of animals, the expected number of imaging sessions and the frequency of imaging;
   c. A description of other procedures performed on these animals either prior or subsequent to MRI imaging;
   d. The investigator may indicate their plan to adhere to these suggested MRI procedures or provide an alternate description.

MRI systems (7 tesla horizontal and 14 tesla vertical magnets)
Location – Chandlee Laboratory
The rooms containing the magnets are locked at all times. Keys and use of the imagers are controlled by the MRI faculty and staff.

Record Keeping
Records will be maintained that documents each MRI study involving animals.

Transport of animals to the MRI Laboratory
During transport to and from the MRI facility, animals will be held in containers that provide adequate ventilation, protection from environmental extremes and designed to prevent escape. Examples of suitable containers include commercial pet carriers for rabbits and standard plastic caging with filter tops for rodents. If animals are to be transported from another building, to avoid exposure to temperature extremes, cages may be placed within an insulated secondary container such as a cooler with holes drilled to provide ventilation. Animals may be moved in temperature-controlled vehicles or hand carried from the animal facility if within walking distance. Containers with animals will not be allowed to sit in direct sunlight.
Anesthesia
Animals will be anesthetized with either inhalant anesthesia (isoflurane) or injectable
anesthetics as listed below.

**Mouse**
- Ketamine with xylazine* 80 to 120 mg/kg ketamine with 10 to 16 mg/kg xylazine
  (By intraperitoneal injection)

- Ketamine with Dexmedetomidine* 75 mg/kg ketamine with 0.5 mg/kg

**Rat**
- Ketamine with xylazine* 80-110 mg/kg ketamine with 5-12 mg/kg xylazine
  (By intraperitoneal or intramuscular injection)

- Ketamine with xylazine* and 50 mg/kg ketamine with 5 mg/kg xylazine and 1 mg/kg Acepromazine

- Inactin 80-100 mg/kg Inactin (by intraperitoneal injection)

**Rabbit**
- Ketamine with xylazine* 22-50 mg/kg ketamine with 2.5-10 mg/kg xylazine
  (By intramuscular injection)

- Ketamine with xylazine* and 35 mg/kg ketamine with 5 mg/kg xylazine and 0.75 mg/kg acepromazine

* Atipamezole 0.1 to 1mg/kg SQ, IP or IM May be administered to speed the recovery of
animals that have been anesthetized with xylazine or dexmedetomidine.

**Frequency of imaging:**
Rodents anesthetized with a ketamine combination should have a minimum of two days
to recover following imaging. Imaging under isoflurane anesthesia may be conducted
daily provided that the animals do not display any outward signs of illness, distress or
weight loss. The weight of intensely imaged animals should be monitored weekly.

The selection of anesthesia will be based on the expected duration and frequency of
imaging. A typical MRI scan lasts from between 15 minutes and 2 hours.
Isoflurane anesthesia recommended for longer imaging sessions (to avoid multiple
anesthetic injections) and when animals are to be imaged at frequent intervals.

Isoflurane will be delivered to rodents using a precision vaporizer via facemask in an area
equipped to scavenge anesthetic waste.
Continuous physiological monitoring of the animal will be performed via a commercial set up is capable of monitoring (MRI-compatible EKG), respiration rate (pressure sensor), and body temperature (rectal probe) and displays these values on a computer screen which is monitored at all times by the scanner operator.

The following events may trigger a termination of the scanning procedure:
  1. Movement of the animal associated with arousal from anesthesia;
  2. Unexpected changes in heart rate and/or rhythm or changes in patterns respiration that may suggest an anesthetic complication or some danger to the animal;
  3. A drop in body temperature of more than 4 degrees below normal temperature for the species (associated with prolonged anesthesia).

Recovery of the animals
After scanning, animals will recover in a warm dry area and will be continuously monitored until the animals are able to maintain sternal recumbency (position themselves on their chest without falling over) and then returned to the animal holding facility.

Facility procedures and housing:
Animals will be held in the cage used for transport prior to and following imaging. In order to prevent transmission of microbial agents between animals, all surfaces with which the animal comes into contact both outside and inside the magnet, will be thoroughly disinfected before and after scanning. All personnel involved with the animals will be gloved, and wear laboratory coats which will be laundered on a weekly basis.