

# UNC-Division of Comparative Medicine (DCM)

## Basic **RAT** Handling and Technique Guide

***“First do no harm”*** – Greek Hippocratic Oath, Great Watch Words of Medicine

### Basic Information about Working with Rats

Proper Personal Protective Equipment (PPE) is a requirement for working with animals. In DCM facilities, minimum requirements include a disposable gown and gloves. Please review requirements before entering any animal area! Requirements may change from room to room, so each door is posted with instructions. The use of a face mask reduces your risk of allergy to animals.

If Bitten: ***DO NOT PUNISH THE RAT FOR ITS NATURAL RESPONSE***

1. Calmly return the animal to its cage
2. Wash the wound with antibacterial soap and water
3. Bandage the wound
4. Notify your supervisor and contact the University Employee Occupational Health Clinic (UEOHC) 919-966-9119

### Training Information

*Training and certification may be obtained in two ways:*

1. Each laboratory must designate a Laboratory Animal Coordinator (LAC) who may train research personnel in their laboratory in various animal-handling techniques. The LAC must be certified by the Division of Comparative Medicine (DCM) and demonstrate proficiency before training others within their lab. Please note, there are certain techniques that LACs are not allowed to train in.
2. For additional training please contact the DCM Training Team via the IACUC office at 966-5569 or [iacuc@med.unc.edu](mailto:iacuc@med.unc.edu). We offer training in both one on one and classroom settings.

For a look at IACUC Guidelines and training information, visit our websites:

<https://research.unc.edu/iacuc/training/> OR <https://research.unc.edu/comparative-medicine/training/>

To register for classes, click this link, and search under ‘Office of Animal Care and Use’:

<https://apps.research.unc.edu/events/index.cfm>

### Network of Laboratory Animal Coordinators (NLAC)

Also, consider joining the Network of Laboratory Animal Coordinators (NLAC) listserv. This listserv is an internal avenue for laboratory animal coordinators at UNC to make contacts, exchange ideas, ask questions, and make suggestions. The goal is to enhance communication between animal research laboratory personnel, the Institutional Animal Care and Use Committee, and the Division of Comparative Medicine. See the following link for more information and to subscribe:

<http://research.unc.edu/offices/nlac/>

### Rat Behavior and Health

1. Rats are basically docile, curious animals that respond to quiet, gentle handling. They are not usually aggressive (except for some strains) but can inflict painful bites if frightened.
2. Rats are nocturnal animals. Activities such as eating, drinking, or mating are typically done at night.

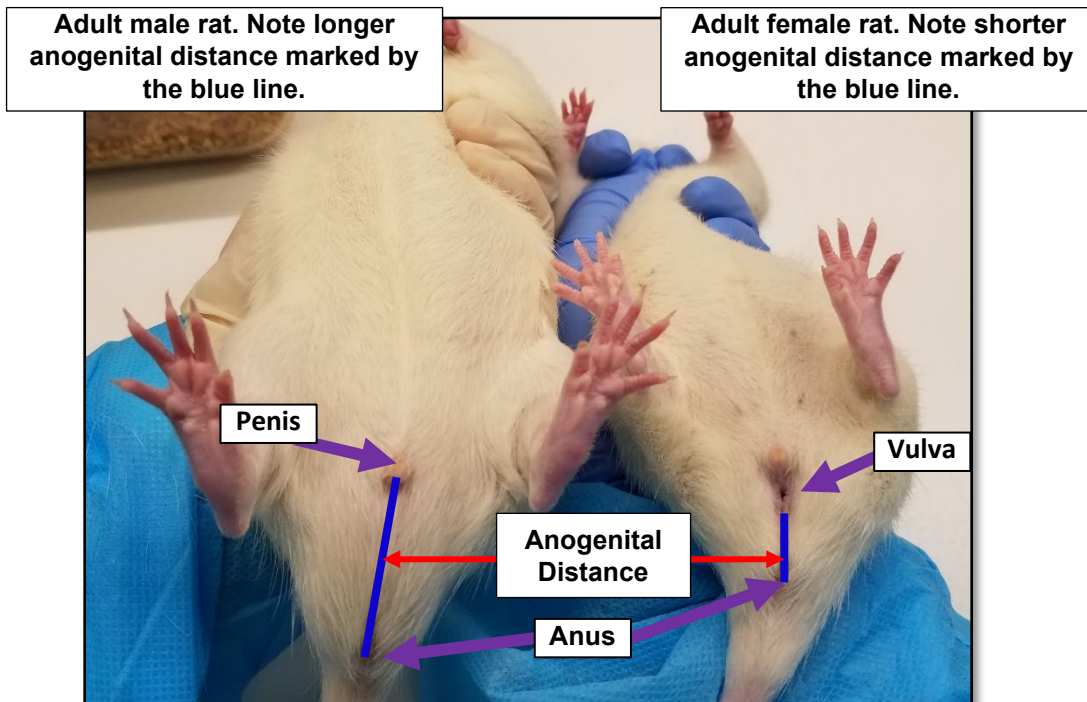
- Rats are creatures of habit. Every day events do not tend to stress or excite the rats. However, handling and restraint can be stressful and result in the rat being difficult to work with. Conditioning the rat to such handling (so they do not associate handling and restraint aversively) can make the animals much easier to work with. This reduces stress for both the animal and the handler.
- Healthy rats have a groomed appearance, with bright, alert eyes and a smooth hair coat (*Figure 1*). Unhealthy or rats demonstrating signs of illness or pain may be less alert, have a ruffled or unkempt hair coat and a hunched posture (*Figure 2*).



### Sex Determination

Gender in rats is determined by comparing anogenital distance, or the distance between the urogenital opening and the anus. Males typically have a larger anogenital distance when compared with the females. See Figure 3 below.

**Figure 3: Sex Determination in Adult Rats**



## Rat Handling & Restraint

When picking up adult rats, grasp them gently but firmly at the base or center of their tail. Do not pick them up by the tip of the tail. Place the animal on a surface such as the wire cage top or lid, or on your arm. It is best that the surface is not slick or smooth as rats will behave much more calmly if they have firm footing.

When restraining rats, take care how much pressure is placed on the chest cavity. You do not want to interfere with respiration. Look for gasping, blue color, bulging eyes or blood from the nose.

Gloves, either light leather, cloth or mesh greatly diminish sensitivity, increasing chance of injury to rodents. They also make it more difficult to perform delicate procedures. Rats can often bite through gloves.

Scruffing: It has been our experience that **most rats resent being scruffed**. They do not have as much loose skin in and around the shoulders as mice and hamsters.

1. **Restrainers** – If you are using a restrainer for your technique(s), it should be easy to disinfect, easy to place the animal in, and safe for both the animal and the handler. Commercial restrainers are available (see examples in *Figures 3 a & b*) or you can use an alternative method similar to *Figure 4*.

Figure 3 a & b: Restrainer Options

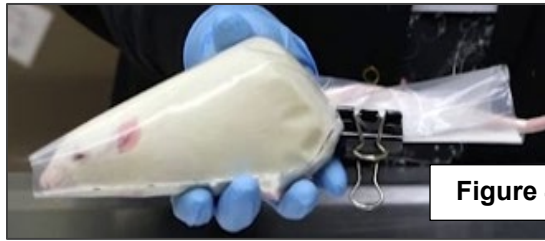
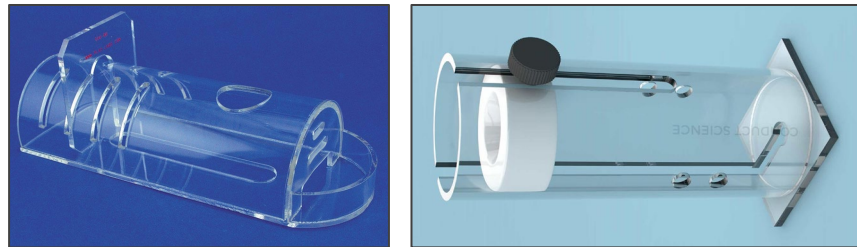


Figure 4: Decapicone Restraint

2. **Tail Hold** – For aggressive rats or rats you are not familiar with.
  - a. Grasp the animal at the base of the tail and lift (*Figure 5*).
  - b. Support the body weight at all times, do not dangle by the tail. This hold is safe for short periods of the time, and care must be taken not to damage the tail as it is easily broken and/or stripped of skin.
  - c. Place on arm of lab coat. This helps them to relax as they become tense on smooth surfaces (*Figure 6*).

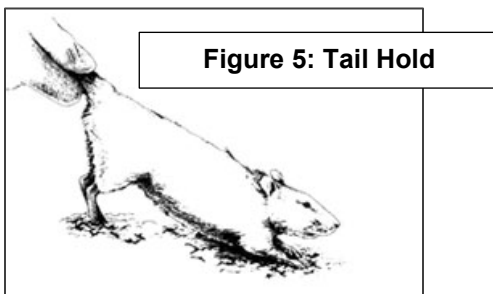


Figure 5: Tail Hold



Figure 6: Rat Acclimation

3. **Body Scoop/Shoulder/Two-Finger Hold\*** – This form of restraint is ONLY good for docile rats.
  - a. Grasp the tail base with the dominant hand and gently pull the rat backwards.
  - b. With the other hand, place the thumb and index finger on the shoulder blades, pushing together until the forelegs are crossed (either leg can be on the top) (*Figure 7*).
  - c. Backward tension must be maintained on the tail, gently stretching to maintain upward lift of the shoulders (*Figure 8*).

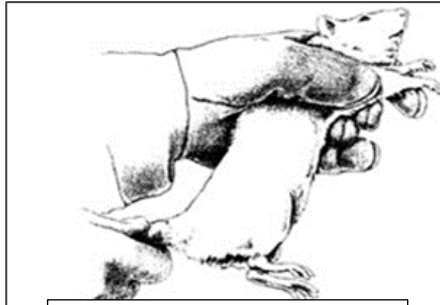


Figure 7: Body Scoop

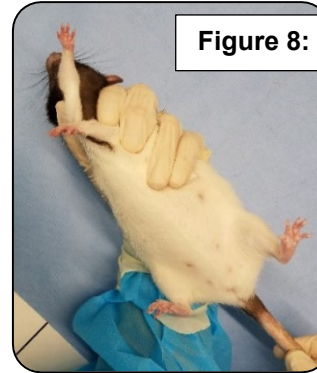
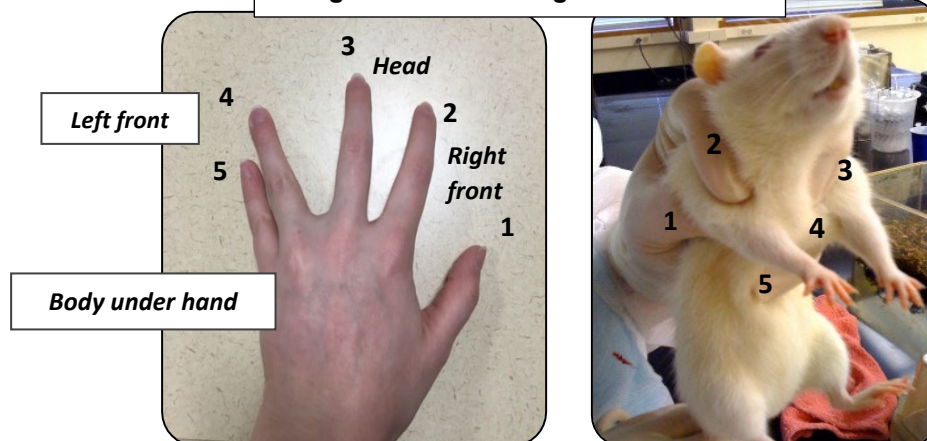


Figure 8: Recumbent Rat

4. **Basic/Four Finger/Roller-Coaster Hold\*:**

- a. While holding the tail base, place your non-dominant hand on the rat's back near the base of the tail and press down gently.
- b. Maintain pressure on the back and place the head between your index and middle finger, as close to the base of the fingers as possible.
- c. Then place your thumb and last 2 fingers along the body to support the chest. **DO NOT SQUEEZE** the thorax! Grasp the tail base with your other hand to support the body.

Figures 9 a & b: Finger Placement

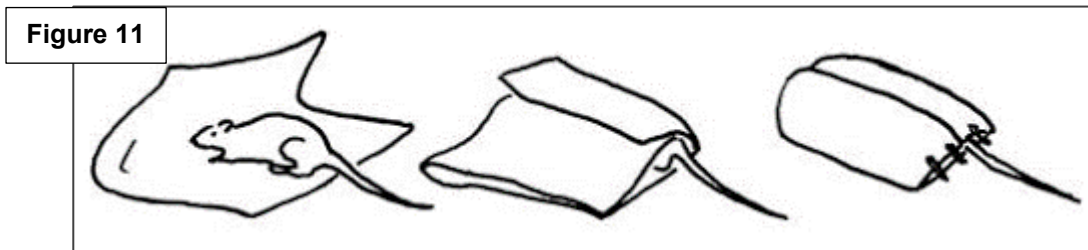


\*Tail pressure must be applied in both #3 & #4 holds. Pin tail around wrist onto the benchtop or press the rat against the handler to keep the whole body restrained.

5. **Combination/Three Finger Hold** – This hold is only applicable for techniques such as ear tag/notch, where the rat can remain on the work surface.
- a. Grasp the tail and while exerting gentle backward tension on the tail, slide the left hand forward, placing the thumb under the leg, and the index finger on top of the shoulder and along the right side of the neck. The ring and pinky fingers are placed under the left foreleg while you place gentle pressure on the rat to hold them into the table surface (*Figure 10*).



6. **Alternative Towel Restraint Options** – There are alternative holds that can be performed using a hand towel; the option used will be dependent on the temperament of the rat, as well as the technique needing to be performed (Figures 11-13).

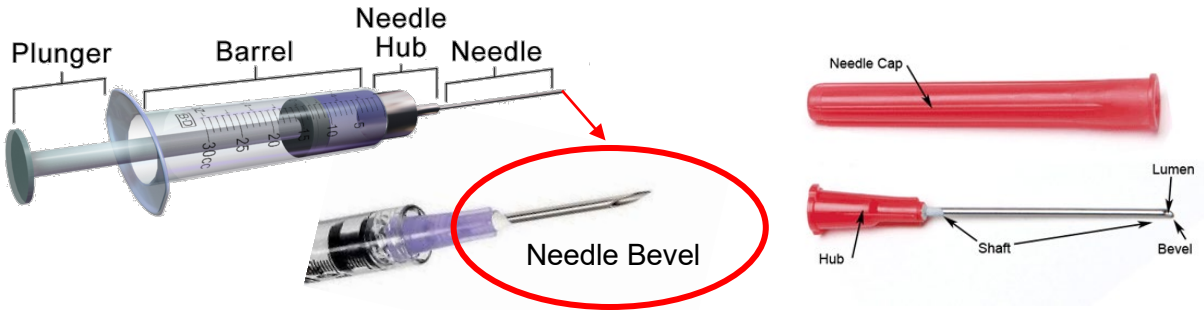


## **Rat Injections**

### *Basics and a few tips*

- Use a fresh, sterile needle for each injection; do not reuse needles between animals
- To avoid excessive leaking, keep the needle in the needle tract for a few seconds following injection
- Always inject with the bevel of the needle facing up
- When giving substances intravenously, inject slowly to avoid shock.
- Injecting slowly when giving substances intramuscularly will cause the least amount of pain.

**Figure 14: Needle Anatomy**



**Table 1: Recommended Volume and Needle Gauge by Injection Type**

Injection Type	Ideal Needle Size (Gauge)	Recommended Volume**	Maximum Volume (in ~ 300g rat)	Aspiration Required
Intraperitoneal (IP)	23-25G	10 ml/kg	10 ml/kg (3.0ml)	Yes
Subcutaneous (SQ, SC)	25G	5-10 ml/kg	10 ml/kg (3.0ml) 20ml/kg/total (6.0ml)	Yes, inject if no blood in the needle hub
Intramuscular (IM)	25G	0.01 ml/site (100µL)	0.2 ml total (200µl)	Yes, inject <u>slowly</u> if no blood in the needle hub
Intravenous (IV) (continuous)	21-23G	2.0-4.0 ml/kg/hr	4.0 ml/kg/hr (1.2ml)	No; inject <u>slowly</u>
Intravenous (IV) (bolus)	21-23G	5.0 ml/kg	5.0 ml/kg (1.5ml)	No

\*Adapted from "Formulary for Laboratory Animals, 3rd, Ed. Hawk, Leary and Morris, 2005.

\*\*Source for Volume: [University Of North Carolina at Chapel Hill Standard for Administered Agents](#)

### 1. Intraperitoneal Injections

*This injection is made into the lower abdominal cavity, penetrating the peritoneum of the animal. It is important to avoid the midline to prevent penetrating the bladder.*

- Scruff and hold the rat in dorsal recumbency (on the back/belly facing upwards) with the tail firmly restrained (under your wrist or by another person). Two people may be required to safely perform this procedure in large rats.
- Insert the needle bevel up in a position below the bend of the knee, and to either side of the midline. This allows for a safe injection avoiding the bladder and other organs such as the liver or spleen. (Figure 16).
- Angle the needle approximately 45° to the body. Aspirate – if no blood is observed in the hub of the needle, you may inject your medium. If blood is observed, remove the needle and re-insert, then aspirate again – if no blood is seen, you may inject. (Figure 15)

Figure 15: IP Injection Restraint

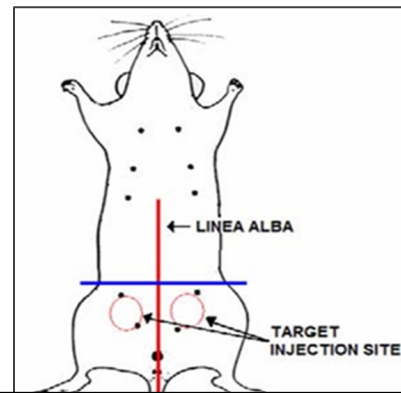
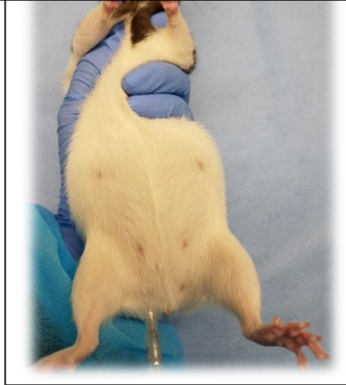
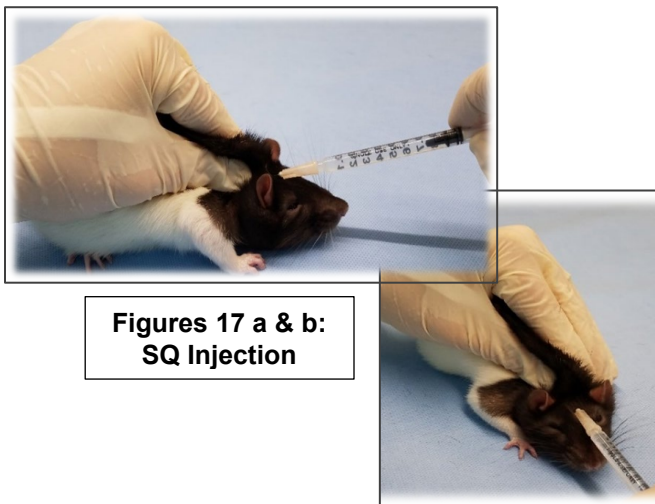


Figure 16: Target IP Injection Site

## 2. Subcutaneous Injections

*This injection is administered beneath the skin and above the underlying muscle (Figure 18). It may be performed in any area of loose skin along the back or flank.*

- Place the rat on solid surface, cup the butt of the rat with your non-dominant hand and use your thumb and index finger to scruff the rat to tent the skin. Press the head towards the surface for maximum restraint.
- Insert the needle bevel-up into the pocket or 'skin tent' you created by scruffing (Figures 17 a & b). This technique requires manipulating the syringe with one hand.
- Aspirate - if no blood appears in the hub of the needle, inject slowly. If blood is seen, remove the needle and re-insert, re-aspirate, then inject if no blood is observed in the hub.
- Large amounts of fluids may be administered but should be split over multiple locations to avoid distending the skin. The medium should be warmed to body temperature if giving more than a small amount so the rat does not become hypothermic.



Figures 17 a & b:  
SQ Injection

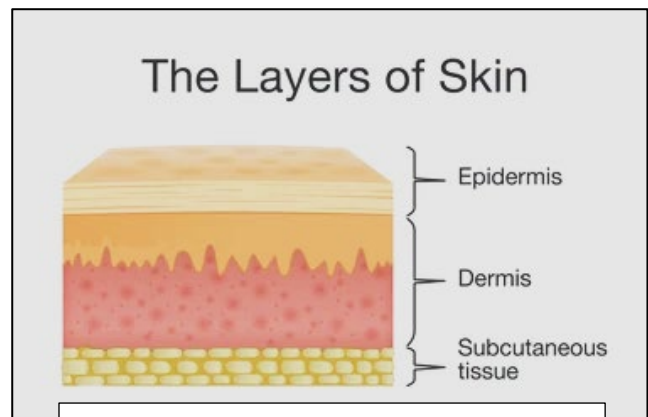


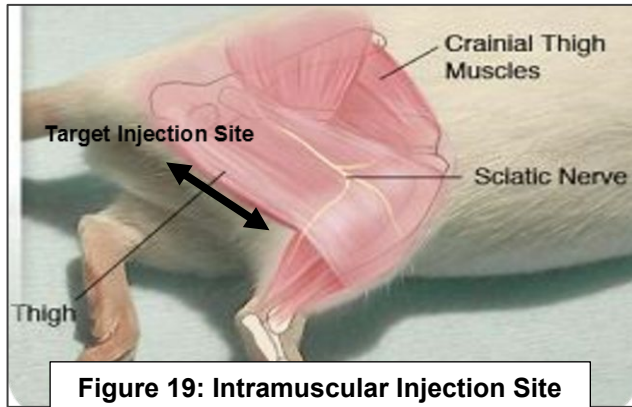
Figure 18: Subcutaneous Injection Site

## 3. Intramuscular injections

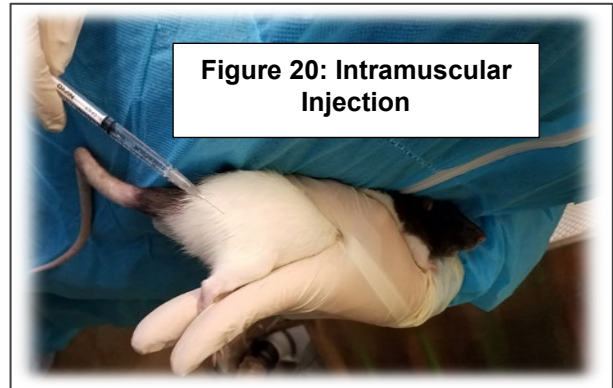
*This injection is made into the muscle mass of the posterior thigh of the mouse. It is only used in instances where the other injections are not appropriate since it is potentially more painful than other injection routes.*

- The muscle mass running along the back of the leg is used (Figure 19).
- Hold the rat against your body in the palm of your non-dominant hand. Press the rat into your body and roll the rat toward you with the belly facing away from you. Extend one of the rear legs outward with two fingers of the hand the rat is resting in (Figure 20).

- Insert the needle parallel to the femur and perpendicular to fur growth, at a shallow angle.
- Aspirate to ensure the needle is not in a blood vessel, then proceed with the injection if no blood is noted in the hub. If blood is seen, remove and re-insert the needle and try again.
- Care must be taken to avoid the sciatic nerve and the femoral vein, artery and nerve.



**Figure 19: Intramuscular Injection Site**



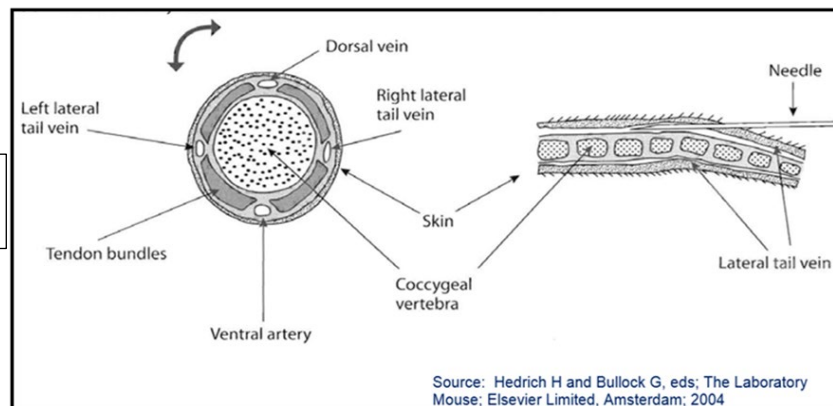
**Figure 20: Intramuscular Injection**

#### 4. Intravenous injections

*This injection is done into one of the lateral tail veins of the rat. It is one of the most difficult injection techniques to master.*

- Place the rat into a restrainer and locate the dorsal vein. When the rat is in an upright position it will be near the 12 o' clock position. Mark the dorsal vein with a marker, then locate the left and right lateral tail veins, in the ~10 and 2 o' clock positions (*Figure 22*).
  - Warm water, a heat lamp, or hand warmers *may* be used to dilate the blood vessels.
- Start as far away from the base of the tail as possible with the needle positioned horizontally to the vein. Insert the needle bevel up just until the bevel is under the skin. Needle should be almost parallel to the orientation of the tail and inserted shallowly to prevent passing through the vein (*Figure 23*).
- Depressing the plunger should be as easy as pushing it in open-air. The vein may clear from the injection site to the base of the tail if properly situated, whereas ballooning around the injection site will occur if the needle is inserted subcutaneously.
- If you suspect the injection was subcutaneous, withdraw the needle and try again, moving up the tail towards the base or using the other lateral vein. Note that as you move up toward the base of the tail the vein is located more deeply.

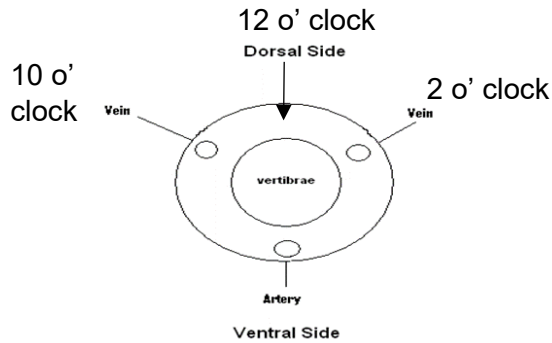
**Figure 21: Cross Section of Rat Tail**



Source: Hedrich H and Bullock G, eds; *The Laboratory Mouse*; Elsevier Limited, Amsterdam; 2004



**Figure 22: Lateral Tail Veins at 10 and 2 o'clock**



**Figure 23: Tail Vein Injection**



## 5. Oral Gavage

A blunt, ball-tipped gavage needle is used to deliver substances directly to the stomach (Figure 24) bypassing swallowing. A stainless steel, ball tipped gavage needle is recommended. It is very important the needle be the appropriate size and that you measure prior to administration to ensure that you insert the needle to the proper depth. If the tube is too short, the injected fluid may be aspirated by the mouse causing possible pneumonia and death. If the needle is too long, it may perforate the stomach. Improper gavage technique can cause tearing of the esophagus or asphyxiation.

Oral dosing should not exceed more than 10ml/kg.

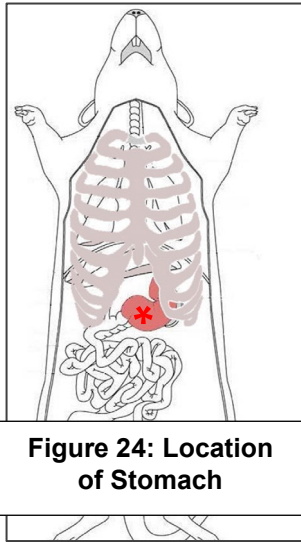
- Firmly restrain the rat and measure the needle before inserting. The needle should measure the distance from the corner of the mouth to the xiphoid process (near last rib) (Figure 25).
- Insert the gavage needle into the mouth at one side at about a 45° angle. When the needle-tip hits the roof of the mouth, slide the needle down the back of the throat while tilting the rat's head back, so that the neck is in a straight line (Figure 26).
- The needle should pass easily down the esophagus with little to no resistance. If resistance is met, gently twist the needle and pause to allow the rat to swallow. If the rat struggles or the needle will still not pass any further, stop, withdraw the needle, and start over.
- Observe the rat carefully after the gavage is completed. No fluid should be coming from the mouth or nose and the rat should not show signs of distress.

**Table 2: Gavage Needles – Appropriate Size\*\*\* and Volume by Rat Weight**

Rat Wt (g)	Gauge	Length (inches)	Ball Diameter (mm)	Oral Gavage Volume per weight* <i>Recommended: ≤ 5 ml/kg Maximum: 5 ml/kg</i>
50-75g	20	1-3"	1.9-2.25	50g: 0.25ml 75g: 0.375ml
75-120g	18	1 or 1.5	2.0-2.25	100g: 0.5ml
100-200g	18	2"-3.1"	2.0-2.3	200g: 1.0ml
	17	1"-3.3"	2.4	
	16	2"-3"	3.0	
150-300g	15-16	3"-4"	2.8-3.0	300g: 1.5ml
200-350g	13-14	2"-5"	2.9-4.0	350g: 1.75ml

\* Source for Volume: [University Of North Carolina at Chapel Hill Standard for Administered Agents](#)

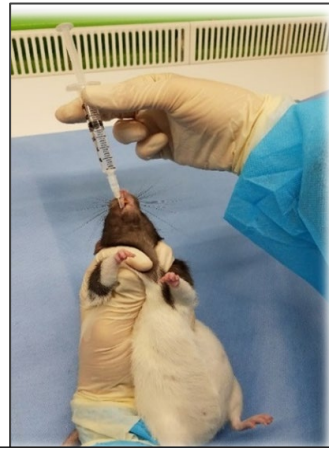
\*\*\*Source for recommended sizing: Braintree Scientific



**Figure 24: Location of Stomach**



**Figure 25: Measurement**



**Figures 26: Oral Gavage**

### **Anesthesia Injectables**

*Anesthesia injectables may be utilized for survival surgeries. Please see the IACUC Anesthetized Procedure Standards for Rats and Mice for more details about IACUC expectations for surgical procedures: [Anesthetized Procedure Standards for Rats and Mice \(Non-survival and Survival Procedures\)](#)*

- Weigh the animal to calculate the appropriate drug dosage.
- Administer IACUC protocol-approved anesthetic drug(s) based on weight and correct dose, via the approved injection route.
- Place animal into a clean, empty cage with no bedding, no other animals, and on a heat source.
- Animal (including tail) should stay on the appropriate heat source from initial drug administration through the procedure, until the animal is fully awake and recovered post-surgery.
- Care should be taken when using heat sources, to avoid overheating and burns.
- Monitor animal during induction (initiation of anesthesia) until it is in recumbency in the cage (lying down).
- Pick up animal and check for a blink reflex. When the blink reflex is absent, a pharmaceutical or veterinary grade ophthalmic ointment must be applied with a secondary applicator to retain moisture (*Figure 27*). Failure to apply the ointment may result in irritation, infection, and corneal ulcers.
- Check for pain response by performing a deep toe pinch on all 4 feet using a firm fingernail to fingertip pinch directly on the toe joints (*Figure 28*). No response from all 4 feet is required prior to performing painful procedures.
  - Response = visible or tactile muscle movement, change in breathing pattern, etc.
- Anesthetized animals must be observed at all times during anesthesia (including induction and recovery) and must not be left unattended until sternal and ambulatory (able to right itself and walk around normally).
- Return animal to housing room only when fully awake and ambulatory.



**Figure 27: Ophthalmic Ointment**



**Figure 28: Deep Toe Pinch**





**Figure 30: Ear Notch/Punch Tools**

- Firmly restrain the rat's head. The head should be immobile to avoid tearing the ear tissue.
- Place the flat side of the ear notching tool on the ear so that you can see the area you will be punching.
- Notch the outer edge of the ear to avoid vasculature and excessive bleeding (*Figures 31 a & b*).
- Firmly and quickly press down to punch the ear. Collect the tissue for genotyping if needed.



**Figures 31a: Ear Notch/Punch with Short Tool**



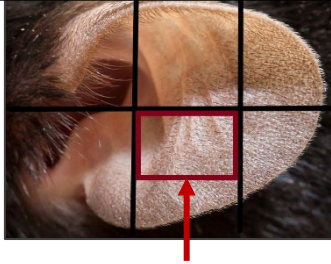
**Figures 31b: Ear Notch/Punch with Long Tool**

## 2. Ear Tag

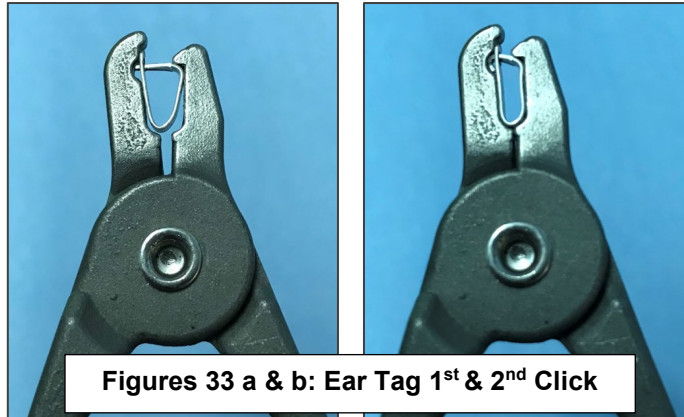
*Ear tags can be purchased with numbers and/or letters. Correct placement of the tag makes them easy to read. Note, proper placement of the tag is important. If the tag is placed within the vasculature of the ear (too far inward) the mouse may experience itching and irritation, which can lead to infection. If the tag is not fully closed, the rat may also get its front foot caught in the tag. To avoid these issues, be sure to fully close the tag and place it in the outer part of the ear.*

- Place the ear tag into the tagger making sure the hole lines up with the notch.
- Firmly restrain the rat's head with your non-dominant hand. As with ear notch/punch, the head should be immobile to avoid tearing the ear tissue.
- Position the ear tagger on the ear.
- Aim for the middle third, avoiding the vasculature, and towards the lower  $\frac{1}{2}$ , so the tag hangs appropriately after placement (Figure 32).
- Firmly squeeze the ear tagging tool until the tag is closed, you should feel 2 clicks (Fig. 33 a & b).

**Figure 32: Ear Tag Placement**



Tag within this area



**Figures 33 a & b: Ear Tag 1<sup>st</sup> & 2<sup>nd</sup> Click**

**Please note other forms of identification not discussed here:**

- Long-term
  - Microchip
  - Tattoo
  - Toe clips (see IACUC Standard: [Standard on Rodent Identification](#))
- Short-term
  - Hair clip
  - Permanent marker and fur dye

If you would like to inquire about equipment used in methods discussed above, please email the DCM Training & Care Assurance Team at [DCMTraining@unc.edu](mailto:DCMTraining@unc.edu). You may send other questions to the general IACUC email account [iacuc@med.unc.edu](mailto:iacuc@med.unc.edu).

### **Blood Withdrawal Techniques**

A variety of blood withdrawal techniques may be used in laboratory rats. The chosen route of blood collection should minimize pain and distress to the animal as much as possible while still achieving study objectives. Please see the **UNC Guidelines for Rodent Blood Withdrawal** for more details on the techniques described below: [Standard for Rodent Blood Withdrawal and Tail Biopsy](#)

- \* **Chronic Blood Withdrawal:** For sequential blood sampling (over a period of time), the maximum survival blood withdrawal for most mammals is 1.5% of lean body weight every 14 days. If blood is needed weekly, 0.5% body weight is a safe amount.
- \* **Acute or Single Blood Withdrawal:** The maximum survival amount of an acute blood withdrawal is 1% of the lean body weight. [e.g., For a 20-gram adult mouse, no more than 4 X 50 ul micro capillary tubes (200 ul), may be withdrawn]. The volume of blood in an adult mouse is about 78-80 ml/kg. This is approximately 10% of its body weight. Only about half of this can be recovered in a terminal blood withdrawal procedure

#### **1. Tail Nick Bleed (Artery / Vein)**

*Tail veins and artery can be used for serial bleedings. Use the central tail artery or lateral tail veins. Anesthesia is not required for tail nick.*

- Place the rat in a restrainer and mark the 12 o' clock position with a marker.
- Locate the left or right lateral vein.
- Start midway up the tail and nick the artery or vein by inserting a lancet or the bevel of a needle perpendicular to the tail (*Figure 34*).

- Gently twist and rotate the needle within this small hole to allow a few drops of blood to come out. You can milk the vein from the base towards the insertion site to retrieve a few additional drops if necessary.
- You may collect blood with micro capillary tubes, a micropipette or various microtainer collection tubes. Apply pressure to stop bleeding.



**Figure 34: Tail Nick**

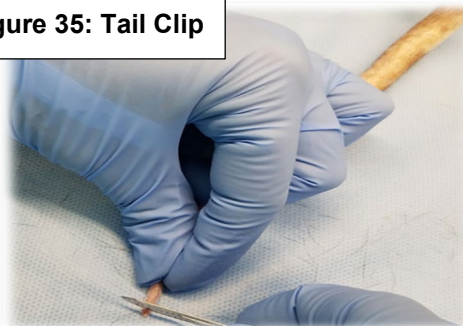
## 2. Tail Clip Bleed and/or Tail Biopsy for Genotyping

The IACUC has approved the tail cut method for both rats and mice to obtain blood and/or tissue. This method must be described in the animal use application and approved by the IACUC prior to use. It may be performed on un-anesthetized or anesthetized animals depending on amount of tissue needed. Please see the following document for IACUC guidelines on tail clips: [Standard for Rodent Blood Withdrawal and Tail Biopsy](#)

1. Place animal in restrainer
  2. Place the tail on a clean work surface (i.e. paper towel).
  3. Using a fresh scalpel blade, cut 1-2 mm\* of the tip of the tail (*Figure 35*).
  4. Apply firm pressure straight down on the tail to cut the tissue in a single motion. Avoid using the curved edge of the blade to prevent “sawing” the tail.
  5. You can milk the vein from the base towards the tip of tail to collect necessary amount of blood.
  6. Apply gentle pressure to the wound with a clean gauze pad or paper towel until the tail stops bleeding. A styptic powder can be applied to aid in stopping the bleeding.
  7. Return the animal to its cage only after bleeding has stopped.
- Serial blood samples can be obtained over a short time frame by gently removing the scab without performing an additional cut.
  - Only the fleshy portion of the tail tip should be cut. Cutting into the vertebrae is NOT permitted. As only a small portion of the tail does not contain vertebrae, the use of the tail cut procedure should be limited.

*\*Never more than 4mm over the lifetime of the animal without IACUC approval. Bone can NEVER be exposed as a result of this procedure.*

**Figure 35: Tail Clip**

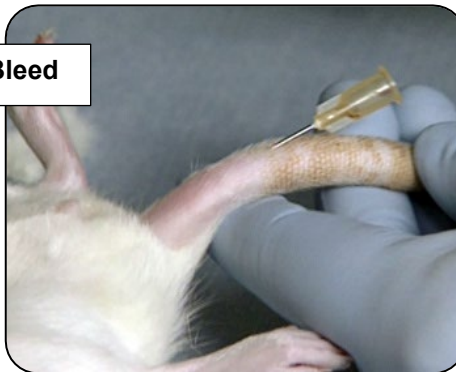


### 3. Tail Artery Bleed

Blood may be withdrawn from ventral tail artery using a plungerless syringe and a 22-gauge (or smaller) needle.

- It may be necessary to anesthetize the animal to facilitate this withdrawal technique, as the artery is located on the ventral surface of the tail, and access is easiest when the animal is laying on its back.
- Warm the tail to help in visualizing the tail artery. A tourniquet placed at the base of the tail may facilitate bleeding.
- Visualize the ventral artery and insert a 22-gauge plungerless needle. (Figure 36).
- Let the blood drop into the collection vessel.

Figure 36: Tail Artery Bleed



### 4. Saphenous Vein

This method of obtaining blood is often used when a series of small samples is required. This method of blood withdrawal does not require anesthesia; however, the method of restraint is cumbersome.

- Place the rat in a conical tube and shave the caudal surface of the thigh. The saphenous vein can be seen in this area (Figure 37).
- Apply a lubricant or shave the leg to prevent wicking. Place a tourniquet above the knee and enter the vein with a 25-gauge needle.
- Micro-hematocrit and microvette tubes may be used to collect the blood (Figures 38 a & b).

Figure 37: Saphenous Vein

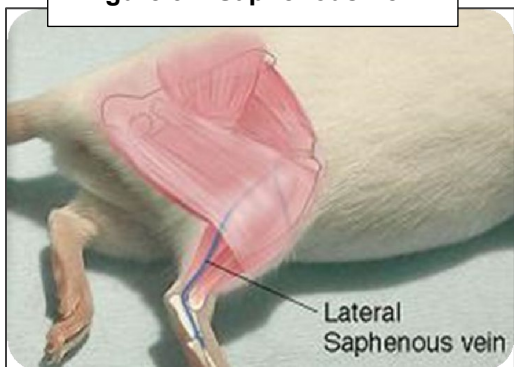
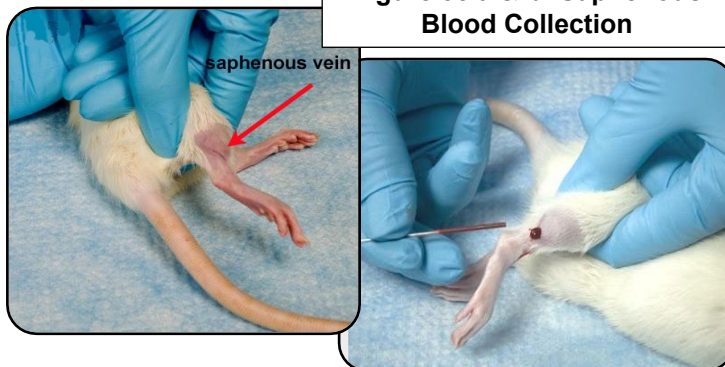


Figure 38 a & b: Saphenous Blood Collection

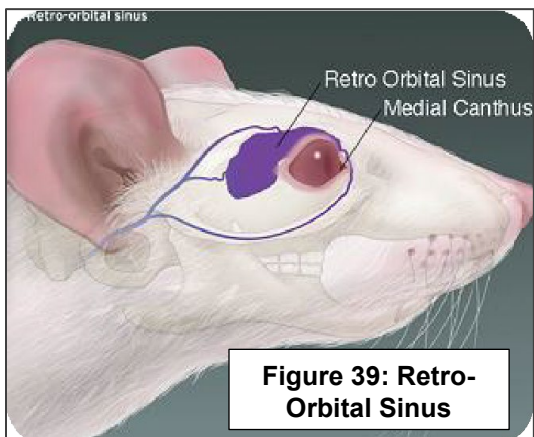


## 5. Retro Orbital Bleeding

Retro-orbital or orbital sinus/plexus bleeding (permitted in rats, mice, gerbils, guinea pigs, hamsters) must be proposed to and approved by the IACUC before implementation. The IACUC will permit orbital sinus bleeding when it is scientifically justified, performed with appropriate technique and anesthesia. Veterinary staff experience indicates that this method may lead to orbital damage, blindness and potentially death if not performed correctly. The IACUC encourages the primary use of the submandibular, tail artery or veins; specifically, the nick or cut techniques. These methods are less likely to harm the animal and may be used repeatedly for bleeding. LACs may not train in this technique so training and certification must be obtained from the DCM Training & Care Assurance Team or DCM Veterinary Services.

Alternating eyes for each bleeding is **mandatory**, and a week must separate each bleeding. A maximum of two (2) bleedings per eye is permitted. Maximum volume withdrawn within a two-week period is 1.5% body weight. Orbital sinus bleeding requires training and must be performed on anesthetized animals only with IACUC approval.

- On an anesthetized rat, secure the head between the thumb and the forefinger. The eye should protrude slightly (Figure 40).
- Using a hematocrit tube at the medial canthus of the orbit of the eyeball, gently direct the tube towards the back of the eye socket and rotate it to puncture the sinus and collect blood (Figures 39 & 40).
- Following blood collection, hold the eyelids closed to allow the punctured blood vessel to clot and apply ophthalmic ointment to the eye.



## 6. Cardiac Puncture

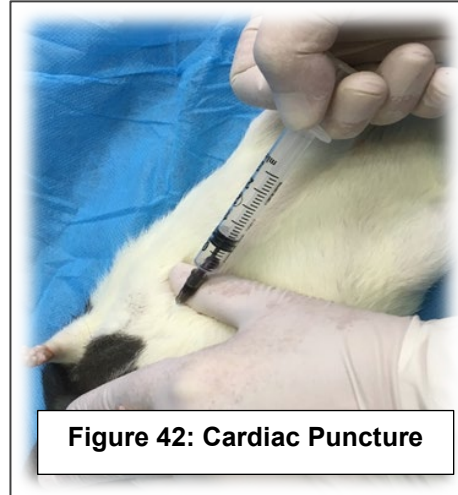
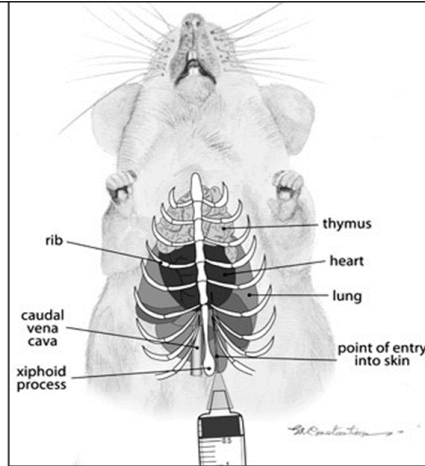
This is always a terminal procedure conducted under anesthesia (or shortly after death)! Cardiac puncture as a method of blood withdrawal is permitted in all species provided the following conditions are met:

- Animal must be under a surgical plane of anesthesia when procedure is conducted.
  - Animal is NOT allowed to recover from anesthesia following the puncture.
  - If the animal is euthanized prior to cardiac puncture, training and certification in the technique is not required.
  - A secondary physical method is required to ensure death after blood collection is complete.
1. Place the animal in dorsal recumbency on a flat, firm surface.
  2. Hold the animal securely by placing the fingers immediately below the xiphoid process, or on the abdomen to prevent the mouse sliding.
  3. Break the seal of the syringe and then insert the needle bevel up, going beneath the ribcage and puncturing the diaphragm.



4. Gently draw back on the syringe and direct the needle towards the heart, remaining vigilant for any blood in the hub of the syringe (*Figure 42*). Small needle adjustments can be made under the skin, but care should be taken to avoid rapid movements to prevent organ laceration.
5. As soon as blood is visualized, stop moving the needle and gently continue to draw back on the plunger waiting for the syringe to fill.
6. Ensure euthanasia by immediately performing a secondary physical method.

**Figure 41: Cardiac Puncture Location**



**Figure 42: Cardiac Puncture**

### **Euthanasia**

Performing euthanasia correctly is an ethical imperative. Proper euthanasia is quick, minimizes pain/distress and reliably causes death. Practical issues such as degree of technical difficulty, time required to perform the procedure, readily available equipment/resources to perform the procedure, as well as aesthetics and human emotion must be considered. Sick or injured animals that cannot be successfully treated or relieved of pain and distress should be euthanized promptly. Research personnel are responsible for euthanizing sick, injured or moribund animals as soon as these conditions are noted. Ensure appropriate emergency contact numbers for all research personnel are posted in the animal facility.

Please see the Rodent Euthanasia Standard on the IACUC website for more important considerations for euthanasia as well as information on neonate euthanasia. [Standard on Rat and Mouse Euthanasia](#)

### **Euthanasia Methods**

There are 4 primary forms of euthanasia that are used on rats at UNC: 1) CO<sub>2</sub> euthanasia, 2) inhalational anesthesia, 3) injectable anesthesia and 4) unanesthetized physical euthanasia (requires scientific justification). These methods are described in detail below. Note, a secondary physical method is required by the IACUC to ensure death for the first 3 forms of euthanasia listed. One of the following secondary physical methods must be performed on animals that have been anesthetized with approved agents:

1. Cervical dislocation (**ONLY rats ≤ 200 grams**)
2. Decapitation
3. Thoracotomy [open the chest cavity using sharp scissors or scalpel]
4. Collection of vital organs.

Note: In addition to DCM personnel, only research personnel who have been properly trained and are listed on the approved ACAP can perform these physical methods.

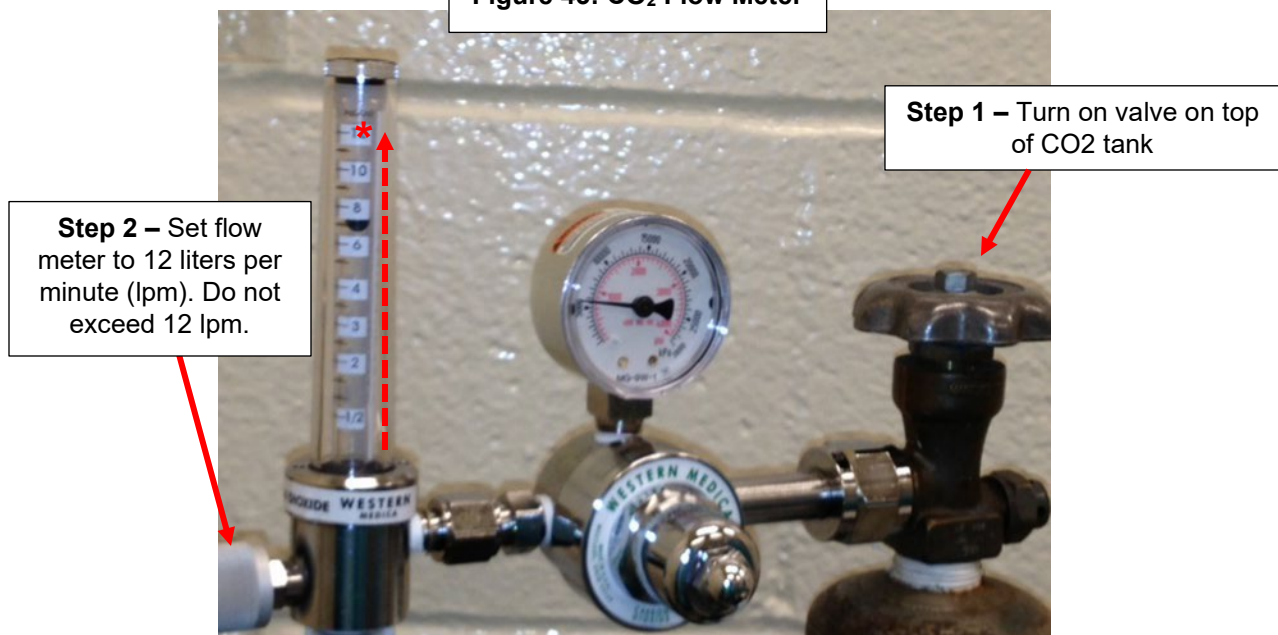
## 1. Gaseous Carbon Dioxide (CO<sub>2</sub>)

CO<sub>2</sub> must be supplied using a compressed gas tank. The use of dry ice as a source of CO<sub>2</sub> for euthanasia is not permitted. The 2020 AVMA Guidelines on Euthanasia recommends that the gradual displacement rate of CO<sub>2</sub> into the euthanasia chamber should be 30-70% to minimize pain and distress. All calculations described below are for a DCM shoe box style rat cage at 45% displacement.

Note: DCM procedure rooms have dedicated CO<sub>2</sub> euthanasia chambers equipped with acceptable flow meters. Investigators who wish to perform CO<sub>2</sub> euthanasia outside of DCM facilities must adhere to all of the following principals and must purchase the same equipment utilized by DCM. Appropriate flow meters must be purchased from VWR and can be found through the UNC purchasing system, E-Pro, or at the following website: <https://us.vwr.com/store/> (part number: 89012-426). To purchase appropriately sized euthanasia chambers, contact DCM at (919-843-7992).

1. Invert the cage before placing animals in, to remove residual CO<sub>2</sub> that may be left from previous users.
2. Remove each animal from the housing chamber and place into the euthanasia chamber. Never place the housing chamber into the euthanasia chamber. Never pre-charge the chamber. Do not place different animal species in the chamber at the same time. Do not overcrowd the chamber. Each animal should have enough floor space available to lie down.
3. Place the stainless-steel lid over the plastic cage. The lid should be connected to a CO<sub>2</sub> tank via a plastic hose.
  - a. Make sure the two holes on the top of the lid are not blocked, as these holes allow air to be pushed out by the heavier CO<sub>2</sub>.
  - b. Make sure the plastic cage does not have an automatic watering opening.
4. Turn on the valve located on top of the CO<sub>2</sub> tank. Next, set the flow meter by adjusting the regulator valve on the left side of the flow meter (see photo on the next page):
  - a. Standard DCM Shoebox style RAT cage: 12 liters per minute (lpm)
  - b. Standard DCM Shoebox style MOUSE cage: 2.8 liters per minute (lpm)
  - c. Other CO<sub>2</sub> Chambers: Use the following formula to calculate the appropriate flow rate:  
$$\text{Height} \times \text{width} \times \text{length} / 61 = \text{liters} \times 0.45 = \text{flow rate/minute (units = cm)}$$
5. Continue to allow CO<sub>2</sub> to flow into the chamber for one minute after breathing stops (approximately 6 minutes for mice and 8 minutes for rats). Young animals, certain strains of mice, and sick animals may require more time to become deeply anesthetized.
6. Once animals are fully anesthetized, immediately perform a physical method of euthanasia (i.e. cervical dislocation, thoracotomy, major organ harvest, or decapitation) to confirm death. Refer to the full Standard for more details on acceptable physical methods.
7. Note: If a terminal procedure (i.e. cardiac puncture, tissue collection) must be performed before the secondary physical method, ensure that animals remain deeply anesthetized and that a physical method of euthanasia is performed following the terminal procedure.
8. Place dead animals into a non-PVC containing bag. DCM provides these bags in a variety of sizes. Label the bag with the IACUC protocol #. Seal the bag securely. Place the bag with dead animal(s) into the DCM carcass freezer available in each animal facility. Please see the Policy on Rodent Carcass Disposal for more information. [Standard on Disposal of Rodent Carcasses](#)
9. Disinfect the euthanasia chamber bottom after each use.

Figure 43: CO<sub>2</sub> Flow Meter



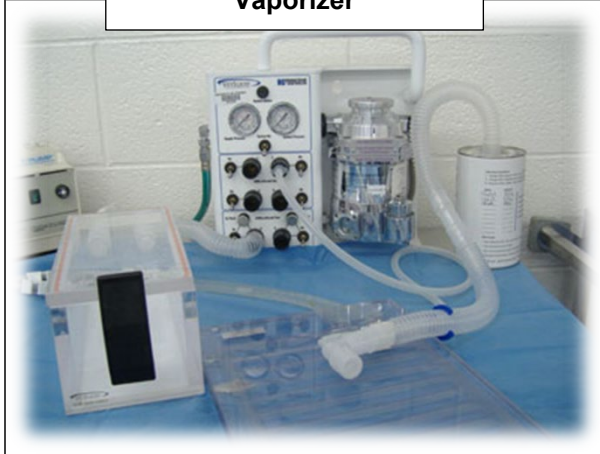
## 2. Inhalant Anesthetics (e.g. Isoflurane)

*This occurs when anesthetic agent(s) are delivered as a volatile gas to the respiratory tract to induce anesthesia. Isoflurane may be used with a vaporizer machine or in the liquid form via the “drop method.” Personnel should minimize their exposure to these agents as some are considered chemical hazards. These agents should only be used in a chemical fume hood, ducted biosafety cabinet or in a system with an active gas scavenging device.*

*Induction chambers for inhalational anesthetics must allow animals appropriate floor space without being too large. Chambers that are too large require increased volumes of the anesthetic agent and may result in slow induction time. Where applicable, induction chambers must prevent animals from coming into direct contact with an anesthetic soaked material. The lid should fit snugly, and the chamber must be used in a fume hood, a ducted biosafety cabinet, or with a properly functioning active scavenging system.*

1. Pre-charge the anesthetic chamber by placing two to three pieces of absorbent material on the bottom of the chamber (isoflurane drop method). Add approximately 3-5mls of isoflurane liquid to the absorbent material (amount of isoflurane is determined by the size of the chamber). Close the lid and wait 5 minutes for the liquid to form a volatile gas within the chamber.
  - a. Note – When using a vaporizer, anesthetic chamber cannot be pre-charged. See the [“DCM Isoflurane Vaporizer Training”](#) section on the DCM website for more details.
2. Remove the lid of the chamber, quickly place the animals in the chamber, ensure the absorbent material is not in direct contact with the animal, and immediately close the lid.
3. The animals should become anesthetized in 2-5 minutes. Neonates require a longer period of time to anesthetize and should remain in the chamber for at least five (5) minutes.
4. When animals are completely recumbent and obviously deeply anesthetized, remove them from the chamber.
5. **Immediately** perform a physical method of euthanasia. Isoflurane is highly volatile, and animals will quickly regain consciousness once removed from the chamber. Therefore, it is imperative that physical euthanasia be performed immediately.
  - a. Note: If a terminal procedure (i.e. cardiac puncture, tissue collection) must be performed before the secondary physical method, ensure that animals remain deeply anesthetized and that a physical method of euthanasia is performed following the terminal procedure.

**Figure 44: Inhalational Vaporizer**



**Figure 45: Isoflurane Drop Chamber**



### **3. Injectable Anesthetics**

*This is a chemical agent(s) administered by injection with a needle and syringe to induce anesthesia. Common routes of injection include, but are not limited to, intraperitoneal (IP), intramuscular (IM) or intravenous (IV).*

*Injectable anesthetics are easy to administer, require minimal equipment, and avoid safety concerns associated with inhalants.*

*Injectable anesthetics can be effectively used to anesthetize animals prior to performing physical euthanasia. The agent should be an anesthetic recommended for the species, and the dosage used should be equal to or greater than the standard published reference dose for anesthesia (e.g., a common dose of pentobarbital for euthanasia is 100 mg/kg, which is approximately twice the anesthetic dose for rats and mice). Once the injectable anesthetic is administered, allow sufficient time for the animal to lose consciousness. The drugs that provided the most effective anesthesia are available only to veterinarians and as a result were considered impractical for use by the scientific community. Contact a DCM veterinarian for more information about appropriate doses of injectable anesthetics.*

### **4. Unanesthetized Physical Euthanasia**

*Individuals who perform physical euthanasia on unanesthetized animals must first be trained and certified by IACUC approved designees. Physical euthanasia on unanesthetized animals, irrespective of age, can only be done if the procedure is described in the approved ACAP. There are two accepted methods of unanesthetized euthanasia, with requirements for each described below. Note, LACs are not allowed to certify others for this technique, training must be done by DCM veterinary services or the DCM Training & Care Assurance Team.*

- **Cervical Dislocation**

*Cervical dislocation in unanesthetized neonatal and adult rodents is permitted only if it is performed correctly by a trained person, and it is described in an approved ACAP. Manual cervical dislocation is a humane method of euthanasia when limited to rodents weighing less than 200 grams. Personnel using cervical dislocation must be adequately trained, demonstrate their technical proficiency, and must consistently apply this method humanely and effectively.*

- **Decapitation**

*Decapitation in unanesthetized neonatal and adult rodents is permitted only if it is performed correctly by a trained person, and it is scientifically justified in an approved ACAP. When performed properly this technique is nearly instantaneous and is considered humane. Guillotines that are designed to accomplish decapitation in adult rodents in a uniformly instantaneous manner are commercially available. Sharp scissors can be used to decapitate neonatal rodents. Check*

guillotine and scissor blades frequently to ensure sharpness. The equipment used to perform decapitation should be maintained in good working order and serviced on a regular basis to ensure sharpness of blades. The use of plastic cones to restrain animals appears to minimize stress from handling, minimize the chance of injury to personnel, and improves positioning of the animal in the guillotine. *Note: The Physics Department's Instrument Shop, located in Phillips Hall 115A, will sharpen blades for a small fee (919) 962-1183.*

### **Supply and Vendor Information**

UNC-CH Hospital Pharmacy sells 100ml and 250ml bottles of isoflurane. All grant orders need to be submitted through online link below. Once ordered, it is reviewed by the pharmacy manager. If approved, orders are processed and shipped by the Shared Services Center in Durham.

<https://www.uncmedicalcenter.org/uncmc/patients-visitors/amenities/pharmacies/shared-services-center-pharmacy/>

#### **Braintree Scientific**

Phone: 781-917-9526

Website: [www.braintreesci.com](http://www.braintreesci.com)

Description: Instruments, lab equipment, isothermal pads, tattoo paste

#### **Fisher Scientific**

Phone: 800-766-7000

Website: [www.fishersci.com](http://www.fishersci.com)

Description: Lab equipment, chemicals, instruments, pharmaceuticals

#### **Covetrus (formerly Henry Schein)**

Phone: 800-872-4346

Website: <https://northamerica.covetrus.com> (redirects from [www.henryscheinvet.com](http://www.henryscheinvet.com))

Description: Veterinary supplies, instruments, pharmaceuticals

\*Needs Vet License or Researcher DEA license\*

#### **Kent Scientific**

Phone: 888-572-8887

Website: <http://www.kentscientific.com/>

Description: Surgical equipment, telemetry equipment

#### **Med-Vet International**

Phone: 800-544-752

Website: <http://www.shopmedvet.com>

Description: Veterinary supplies and instruments (discounted)

\*Need Vet License\*

#### **National Band and Tag**

Phone: 859-261-2035

Website: <https://www.nationalband.com/>

Description: ID tags, ear tags

**Patterson Veterinary**

Phone: 800-225-7911

Website: [www.pattersonvet.com](http://www.pattersonvet.com)

Veterinary supplies, instruments, pharmaceuticals including Pentobarbital

\*Needs Vet License or Researcher DEA license\*

**Plas Labs**

Phone: 800-866-7527

Website: [www.plas-labs.com](http://www.plas-labs.com)

Description: Rodent restrainers, equipment

**Roadrunner Compounding Pharmacy**

Phone: 1-877-518-4589

Contact (as of 2/17): Coy Privette

[CoyP@Roadrunnerpharmacy.com](mailto:CoyP@Roadrunnerpharmacy.com)

**Roboz**

Phone: 800-424-2984

Website: [www.roboz.com](http://www.roboz.com)

Description: Specialize in instruments

**UNC-CH Materials Management and Distribution**

Phone: 966-5671

Description: Scientific Storeroom, General Storeroom, Chemical Storeroom

**Vetamac**

Veterinary anesthesia service and manufacturer

Phone: 800-334-1583

**Southern Anesthesia Surgical Inc.**

Phone: 800-624-5926

<https://www.sasrx.com/>

This is a human source company that has a Veterinary division, will set up an account without a vet license.

**DCM Vet Services**

Phone: 919-843-3407

Email: [hjoyce@email.unc.edu](mailto:hjoyce@email.unc.edu)

Description: Contact Heather Joyce (Vet Services Manager) if you need help finding and/or ordering drugs/veterinary supplies.

**UNC Physics Dept Instrument Sharpening**

\*Note: they do not sharpen to surgical grade requirements; will do guillotines Phone: 962-1183

Phillips Hall, Room 115, walk-ins are welcome <https://physics.unc.edu/instrument-shop/>

## Acknowledgements

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The AALAS Learning Library  
Oregon State University  
National Centre for the Replacement, Refinement & Reduction of Animals in Research  
Jackson Laboratories  
University of Minnesota, Research Animal Resources  
McGill University  
University of Texas Medical Branch at Galveston

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