

**University of Cincinnati  
Animal Care and Use Program**

## Fluid Administration and Blood Collection

Common routes of parenteral administration are subcutaneous (SC), intraperitoneal (IP), intravenous (IV), intramuscular (IM), and intradermal (ID). Alternatively, substances can be given by mouth (PO) via oral gavage, food, or drinking water. The route chosen for administration will depend upon the species, weight/size of the animal, volume to be administered, characteristics of the material to be administered (e.g., solubility, viscosity), and rate of absorption.

To calculate administration volume (ml): multiply animals' weight (kg) x dose (mg/kg) and divide by the concentration (mg/ml).

**Note:** It is recommended to use the smallest injection volume and needle size possible to minimize discomfort to the animal.

### Recommended maximum injection volume by species and route

Route		Mouse	Rat	Guinea pig	Gerbil	Rabbit	Pig
IP	Volume (mL/kg)	10-30	10-25	10-20	5-10	3-5	10-15
	Needle Size	25-27 G	25-26 G	25 G	23-25 G	21-25 G	19-23 G
IM	Volume (mL/site) Maximum of 2-4 sites	0.05	0.05-0.1	0.3	0.1	0.5-1	0.05-0.5
	Needle Size	26-27 G	26 G	25 G	23-25 G	22-25 G	18-23 G
SC	Volume (mL/kg)	10-30	10-25	2.5-10	5-10	2.5-10	2
	Needle Size	25-26 G	25 G	25 G	23-25 G	22-25 G	18-23 G
IV	Volume (mL/kg)	5	5	1-5	1-5	1-5	2-5
	Needle Size	25-30 G	24-27 G	26-27 G	25 G	25 G	18-22 G
ID	Volume (mL/site)	<0.05	<0.05	0.05	0.05	0.1	0.1
	Needle Size	26-27 G	26 G	25 G	25 G	21-25 G	25-27 G
PO	Volume (mL/kg)	5-10	10-20	10-20	5-10	10-20	10-15
	Needle Size/Length	18-24 G 1-2"	16-18 G 2-4"	16-18 G 3-4"	18-20 G 1-2"	8-10 Fr feeding tube	

### Other administration routes and volumes for mice

- Retro-orbital injections:** The retro-orbital route of administration into the medial canthus can be used in mice. Anesthesia is required for this procedure. Use an insulin syringe with a 27-gauge (or smaller), ½ -in hypodermic needle for injections. Cell suspensions must be filtered prior to injection to prevent cell clumping. Recommended injectable volume is ≤

200 µl. Perform the procedure on only one eye at a time. The frequency and maximum number of injections must be reviewed and approved by the IACUC.

2. **Intracranial:** Anesthesia is required for this procedure. Hamilton syringe with a <27-gauge with an injection volume of  $\leq 2 \mu\text{l}$  is recommended.
3. **Intranasal:** These are usually performed under light anesthesia. Recommended volume for an adult mice is  $\leq 20 \mu\text{l}$  per nostril.
4. **Intrarectal:** Recommended administration volume is <0.5 ml.

## Routes of administration and sites

### Intravenous

1. Mice and Rats: lateral caudal tail or saphenous vein (mice/rats), retro-orbital (medial canthus), penile vein (rats)
2. Guinea pigs (difficult): ear vein, lateral saphenous vein
3. Gerbils: lateral metatarsal vein
4. Rabbits: ear vein, cephalic vein
5. Pig: ear vein, external jugular vein, cranial vena cava, cephalic vein, superficial cranial epigastric vein, femoral vein, coccygeal vein

### Subcutaneous:

1. Rodent/Rabbit: intrascapular, neck, shoulder, flank
2. Pig: Rear legs, flank

### Intramuscular: quadriceps, dorsal lumbar, caudal thigh muscles

1. Rabbits and Guinea pigs: lumbar muscles
2. Pig: Rear legs (gluteal, semimembranosus, and semitendinosus), flank

**Intraperitoneal:** lower right abdominal quadrant away from the midline to avoid inadvertent injection into the urinary bladder or cecum

**Intradermal:** dorsum along flank

## Blood collection volumes

The total blood volume in an adult mammalian laboratory animal species is approximately 7% of body weight. Circulating blood volume (CBV) should be determined from species-specific volume and weight data. Estimated CBV for laboratory rodent species are as follows:

CBV for a 25gm mouse:  $0.025 \text{ kg} \times 75 \text{ ml/kg} = 1.9 \text{ ml}$

CBV for a 200gm rat:  $0.2 \text{ kg} \times 65 \text{ ml/kg} = 13 \text{ ml}$

**General Rule:** It is recommended that no more than 10% of the blood volume should be removed at one sampling. If the maximum amount (10% of the CBV) must be drawn all at once or via multiple draws over a 24-hour period, lukewarm replacement fluids (sterile 0.9% saline or lactated ringers solution) should be administered. The volume/amount of fluid replacement recommended is equivalent to the volume of blood drawn.

% CBV removed (single sample)	% CBV removed in 24 hours (multiple samples)	Approximate recovery period
7.50%	7.50%	1 week
10%	10-15%	2 weeks
15%*	20%*	4 weeks

\*If 10-15% of total blood volume is to be collected at one time due to scientific needs, it must be done slowly, and warm replacement fluids are administered IP or IV to replace the blood volume collected.

## Common blood collection sites

Species	Anatomical Site	Needle Size	Notes
<b>Mouse</b>	Lateral saphenous vein	3-5.5 mm lancet or 22-25 G needle	Most commonly used
	Lateral tail vein	25-30 G, 3/8-1" needle	
	Retro-orbital sinus	Micro hematocrit capillary tube	Medial (preferred) or lateral canthus and must be performed under anesthesia; alternate eyes for repeated sampling; apply ophthalmic ointment following blood collection
	Tail clip	Scalpel blade	Clip ≤1 mm of distal end of tail (no bone); apply topical analgesic
	Facial vein (submandibular)	4.0-5.0 mm lancet or 20-25 G needle	Limited to adult mice
	Cardiac	22-25 G, 1" needle	Terminal procedure only – collect under deep anesthesia followed by euthanasia or collected immediately after euthanasia
<b>Rat</b>	Lateral saphenous vein	5.5-8 mm lancet or 20 g needle	Puncture the vein with a lancet or needle
	Dorsal metatarsal vein	5.5-8 mm lancet or 20 g needle	Puncture the vein with a lancet or needle
	Lateral tail vein	20-22 G, 3/4-1" needle	Most commonly used
	Median caudal tail artery	20-22 G, 3/4-1" needle	
	Tail clip	Scalpel blade	Clip ≤2mm of distal end of tail (no bone); apply topical analgesic
	Retro-orbital sinus	Micro hematocrit capillary tube	Medial canthus; must be performed under anesthesia; alternate eyes for repeated sampling; apply ophthalmic ointment following blood collection
	Cardiac	20-22 G, 1-1½" needle	Terminal procedure only – collect under deep anesthesia followed by euthanasia or collected immediately after euthanasia
<b>Guinea Pig</b>	Lateral saphenous vein	5.5-8 mm lancet or 20 g needle	Sedation recommended for restraint
	Cardiac	20-22 G, 1-1½" needle	Terminal procedure only – collect under deep anesthesia followed by euthanasia or collected immediately after euthanasia
<b>Gerbil</b>	Lateral saphenous vein	25-30 G, 1-1½" needle	Most commonly used method
	Retro-orbital sinus	Micro hematocrit capillary tube	Medial canthus; must be performed under anesthesia; alternate eyes for repeated sampling; apply ophthalmic ointment following blood collection

	Cardiac	22-25 G, 1-1½" needle	Terminal procedure only – collect under deep anesthesia followed by euthanasia or collected immediately after euthanasia
<b>Rabbit</b>	Marginal ear vein	22-25 G, 1" needle/butterfly	Common method; small volume; topical anesthesia is advised
	Central ear artery	22-25 G, 1" needle/butterfly	Common method; used for larger volumes; topical anesthesia is advised; greater risk of hematoma and bruising
	Lateral saphenous vein	22-25 G, 1" needle	Small volume
	Cephalic vein	22-25 G, 1" needle	Small volume
	Cardiac	20 G, 1" needle	Terminal procedure only – collect under deep anesthesia followed by euthanasia or collected immediately after euthanasia
<b>Pig</b>	Ear Vein	22-25 G, ½-¾"	Perform under anesthesia or sedation
	External Jugular vein	20 G, 1-2"	
	Cranial Vena Cava	20 G, 1-2"	Must be performed under anesthesia
	Cephalic Vein	22-25 G, ½-¾"	Must be performed under anesthesia
	Superficial cranial epigastric vein	22-25 G, ½-¾"	Must be performed under anesthesia
	Femoral Vein	22-25 G, ½-¾"	Must be performed under anesthesia
	Coccygeal Vein	22-25 G, ½-¾"	Must be performed under anesthesia

## References

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7. DeOrnellis et al. Techniques Training: Rat. AALAS 2011
8. Gad, SC, Spainhour CB, Shoemake C, et. al. 2016. Tolerable Levels of Nonclinical Vehicles and Formulations Used in Studies by Multiple Routes in Multiple Species With Notes on Methods to Improve Utility, *International Journal of Toxicology*, Jan 2016: 1-84. Table 2 includes Volume Guidelines for Administration of Compounds by Routes of Administration to Laboratory Animals and is referenced here.