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UC Davis
Institutional Animal Care and Use Committee (IACUC)

Title: Blood Collection: Volumes, Frequency, and Sites

I. Purpose:

This document is intended to provide guidance regarding safe volumes and common routes for blood collection from laboratory animals.

II. Background:

The volume of blood collected for research purposes from most mammals is generally not a problem. However, repeated blood sample collection in mice, rats, hamsters, guinea pigs, small cats, birds, and some fish can be problematic because of their small body size. In order to prevent anemia, electrolyte imbalance, hypovolemic shock, or other complications, the following guidelines should be followed.

III. Guidelines:

As a general rule, 1% of an animal's body weight (measured in grams) can be collected in blood (measured in milliliters) within a 24-hour period, every 14 days. For example, 0.3 ml can be collected once every two weeks from a 30-gram mouse. Alternatively, 0.05 ml of blood can be collected hourly for 6 consecutive hours from a 30-gram mouse, every two weeks (0.05 × 6 = 0.3 ml). Although blood *volume* is rapidly restored in an animal after blood collection, a two-week "rest period" is needed for blood *constituents* (e.g., red blood cells, platelets, clotting factors) to be regenerated by the body.

If blood samples need to be collected once a week, it is recommended that not more than 0.5% of the animal's body weight in blood be removed within a 24-hour period. For example, 0.15 ml can be collected once a week from a 30-gram mouse. This volume can be further divided if blood samples need to be collected more frequently. For example, 0.03 ml can be collected once a day for five days from a 30-gram mouse, provided the mouse is given a one week (or greater) "rest period" before blood is collected again. ***The key to determining how much and how frequently blood can be drawn depends on the "rest period" between blood collections.***

Table 1 provides a summary of sites and collection frequencies. Typical venipuncture sites may include but are not limited to jugular, cephalic, lateral saphenous (dogs), femoral (cats, nonhuman primates), tail vein (rodents, cattle) and auricular (rabbit, swine) sites. Blood collection frequency must take into account maximum blood volumes collected with an intended rest period (see above).

Table 2 provides examples of blood volumes and percentages that can be collected at the given weights. It is recommended that individual blood volumes and percentages be calculated for each specific animal. The recommended recovery periods for small mammals are also listed in Table 2. It is recommended that animals do not have additional blood collections completed earlier than the minimum recovery period after the described blood volumes have been collected.

Hemostasis can be achieved by using a silver nitrate stick, Quick Stop powder (or equivalent), or by applying a gauze sponge over the site with gentle pressure until bleeding stops.

Table 1. Blood Collection Sites for Small Mammals

Location	**Anesthesia**	**Frequency**	**Comments**
Retro-orbital sinus	Yes, general anesthesia	Same eye, once every 2 weeks or twice within 30 minute window.	Good for large blood collection on a weekly (monthly) basis
Saphenous vein	No	Multiple	Good for multiple collections of small volumes
Dorsal pedal vein	No	Multiple	Good for single collection of a small volume in smaller species; good for multiple collection of small volumes in larger species
Tail vein/nick	No	Multiple	Good for multiple collection of small volumes

Location	Anesthesia	Frequency	Comments
Tail snipping	No anesthesia but *analgesia* is required in mice/rats > 17 days of age.	Multiple (small volumes) e.g.: glucose measurements	<1 mm (mice), <2 mm (rat) distal tail the first time; for subsequent collections, only the scab/clot should be gently removed. If mice were genotyped by tail clipping, this method is not permitted unless approved in IACUC protocol.
Submandibular nick (Facial vein)	No	Multiple	Good for multiple small or single large blood collection volumes
Gingival vein	Yes, general anesthesia	Multiple	Good for multiple collection of small volumes
Cardiac puncture	Yes, general anesthesia, terminal procedure only*	Not applicable	Good for large, one-time collection

*Cardiac puncture in snakes is not considered a terminal procedure. Sedation or anesthesia of the snake is required for this blood collection technique.

Table 2. Total Blood and Blood Sample Volumes

Species (weight)	Blood Volume (mL)	7.5% of blood volume (mL)	10% of blood volume (mL)	15% of blood volume (mL)
Mouse (25 g)	1.8	0.13	0.18	0.27
Rat (250 g)	16	1.2	1.6	2.4
Syrian Hamster (115 g)	8.4	0.6	0.8	1.2
Gerbil (75 g)	5	0.37	0.5	0.75
Guinea Pig (850 g)	64	4.8	6.4	9.6
Ferret (1 kg)	75	5.6	7.5	11
Rabbit (4 kg)	224	16.8	22	33.6
Cat (4 kg)	160	12	16	24
Dog (10 kg)	850	63.7	85	127.5

Macaque, Rhesus (5 kg)	280	21	28	42
Macaque, Cynomolgus (5 kg)	325	24.3	32.5	48.7
Marmoset (350 g)	25	1.8	2.5	3.7
Swine (150 kg)	9,750	731	975	1,462
Goat/Sheep (30 kg)	2,400	180	240	360
Horse (500 kg)	35,000	2,625	3,500	5,250
Passerine Bird, ex. Zebra Finches (15 g)	1.5	0.11	0.15	0.22
Small Psittaccine Bird, ex. Cockatiels (100 g)	10	0.75	1	1.5
Large Psittacine Bird, ex. Amazons (400 g)	40	3	4	6
Recovery period for single sampling		1 week	2 weeks	4 weeks
Recovery period for multiple sampling		1 week	2 weeks	2 weeks

For assistance with blood collection sites in other species or for further assistance in tailoring blood volumes and blood collection frequencies to project needs or for animals of compromised health status, please contact Campus Veterinary Services at 530-752-0514, lahc@ucdavis.edu or the IACUC Office 530-752-2364, iacuc-staff@ucdavis.edu for species-specific training.

IV. Resources

1. Diehl, K., et al., A Good Practice Guide to the Administration of Substances and Removal of Blood, Including Routes and Volumes, J Appl Toxicol 21:15-23, 2001.
2. Laboratory Animal Medicine, Third Edition. Chapter 19 Biology and Diseases of Reptiles, 2015.
3. NIH Guidelines for Survival Bleeding in Mice and Rats, 2007.
4. Teixeira de Oliveira, D., et al., Technical Report: Gingival Vein Punction: A New Simple Technique for Drug Administration or Blood Sampling in Rats and Mice, Scand J Lab Anim Sci 36:109-113, 2009.
5. The Care and Feeding of an IACUC, Second Edition 2015.
6. Valotta Rodrigues, M., et al., The Gingival Vein as a Minimally Traumatic Site for Multiple Blood Sampling in Guinea Pigs and Hamsters, PLoS ONE 12:e0177967, 2017.
7. University of Maryland, Recommended Standard Methods of Blood Collection: Swine, 2019