

**BLOOD COLLECTION: THE RAT IACUC
Guideline
Effective Date: November 2020**

General guidelines:

- The acceptable quantity and frequency of blood sampling is determined by the circulating blood volume and the red blood cell (RBC) turnover rate. RBC life span of the rat is 42-65 days⁷. The approximate total blood volume of a rat is 55-70 ml/kg (mean 64ml/kg) of body weight. The total blood volume for a 300 g rat this is approximately 17-21 ml. Of the circulating blood volume, approximately 10% of the total volume can be safely removed every 2 to 4 weeks, 7.5% every 7 days and 1% every 24 hours^{3,7}.
- For optimal health, blood draws should be limited to the lower end of the range. Maximum blood volumes should be taken only from healthy animals.
- Excessive blood collection may result in hypovolemic shock, physiological stress and even death.
- **Single sample:** Without fluid replacement, the maximum blood volume which can be safely removed for a one-time sample is 10% of the total blood volume or 5.5-7 ml/kg. With fluid replacement (LRS or sterile physiologic saline), up to 15% of the total blood volume or approximately 8.3-10.5 ml/kg can be removed. Fluid replacement (volume approximately equal to amount of blood collected) should be warmed and given subcutaneously.
- **Multiple samples:** If it is necessary to take multiple samples, smaller blood volumes should be drawn. The maximum blood volume that should be drawn per week is no more than 7.5% of the total blood volume or 4-5.3 ml/kg. If sampling will occur every 2 weeks, up to 10% of the total blood volume may be drawn or 5.5-7 ml/kg. For a 300 g rat, this is equivalent to about 1.7-2.1 ml every 2 weeks. For repeated blood collection, fluid replacement does not allow for a larger blood volume or more frequent blood collection.

Example for a 300 g rat

Single sample	1.7-2.1ml (no fluid supplement)	2.5-3.2ml (with fluid supplement)
Multiple samples	1.2-1.6ml per week	1.7-2.1ml every 2 weeks

For different weights, please refer to:

https://oacu.oir.nih.gov/sites/default/files/uploads/arac-guidelines/b2_blood_collection_in_mice_and_rats.pdf

- **Exsanguination:** Approximately half of the total blood volume can be collected by exsanguination and must be performed under general anesthesia. This is equivalent to about 35 ml/kg or approximately 11 ml for a 300 g rat.
- Take into account the total blood volume yielded from the chosen blood collection technique when calculating frequency and volume of blood collection.

- If you are not experienced in blood collection technique and would like training contact: trainerIACUC@ucsf.edu

Collection Site	Advantages	Disadvantages
Lateral Tail Vein Sampling	<ul style="list-style-type: none"> • Anesthesia not required • Vein is easily accessed • Allows for repeat collection 	<ul style="list-style-type: none"> • Must be securely restrained • Yields only small quantities • Requires some specialized equipment
Ventral Artery Sampling	<ul style="list-style-type: none"> • Moderate volume of blood can be collected • Allows for repeat collection 	<ul style="list-style-type: none"> • Anesthesia required • Requires some specialized equipment
Jugular Vein Sampling	<ul style="list-style-type: none"> • Medium to large volumes of blood can be collected • Results in a high quality sample 	<ul style="list-style-type: none"> • Does not lend to repeated sampling • Anesthesia required • More technical skill required. Please contact the IACUC Trainer at IACUCTrainer@ucsf.edu for training.
Lateral Saphenous Vein Sampling	<ul style="list-style-type: none"> • Anesthesia not required • Repeated sampling is possible • Moderate volume of blood can be collected 	<ul style="list-style-type: none"> • Requires specialized training and some specialized equipment • Variable sample quality/quantity
Cardiac Puncture	<ul style="list-style-type: none"> • Maximum volume of blood can be collected • Requires deep anesthesia 	<ul style="list-style-type: none"> • Non-survival procedure only

References:

1. Mitruka BM, Rawnsley HM. 1981. Clinical, biochemical and hematological reference values in normal experimental animals and normal humans. New York: Masson Publishing; 413 p.
2. Harkness JE, Wagner JE. 1989. Biology and husbandry. In: Harkness JE, Wagner JE, editors. The biology and medicine of rabbits and rodents, 3rd ed. Philadelphia: Lea & Febiger; 372 p.

3. McGill MW, Rowan AN. 1989. Biological effects of blood loss: implications for sampling volumes and techniques. *ILAR News* 31:5-20
4. Parasuraman S, Raveendran R, Kesavan R. Blood sample collection in small laboratory animals *J Pharmacol Pharmacother*. 2010;1(2):87-93. doi:10.4103/0976-500X.72350
5. <https://www.nc3rs.org.uk/rat-decision-tree-blood-sampling>
6. <https://oacu.oir.nih.gov/animal-research-advisory-committee-guidelines>
7. Koch, M. A. in *The Laboratory Rat (Second Edition)* (eds Mark A. Suckow, Steven H. Weisbroth, & Craig L. Franklin) 587-625 (Academic Press, 2006). Removal of blood from laboratory mammals and birds. First report of the BVA/FRAME/RSPCA/UFAW Joint Working Group on Refinement. *Laboratory animals* 27, 1-22, doi:10.1258/002367793781082412 (1993).
8. <https://www.jove.com/t/266/drawing-blood-from-rats-through-saphenous-vein-cardiac>