GUIDELINES FOR THE MAINTENANCE OF FLUID HOMEOSTASIS IN RODENTS

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The principles described in this document for maintaining fluid homeostasis are applicable to maintenance of fluid homeostasis post-operatively, during experimental drug administration or when rodents are anorexic and dehydrated as a result of other experimental procedures. RARC's Veterinary Services staff is available for consultation and may be contacted @ (646)888-2430 (MSKCC) or (212)746-1079 (WCMC) for clinical assessment of animals requiring fluid replacement.

Evaluation of Fluid Homeostasis

- **Evaluation -** Evaluate fluid homeostasis by pulling gently at the animal's skin over the back. If skin turgor is reduced, i.e., the skin does not fall back into place immediately and remains "tented",then the animal is severely dehydrated. Other clinical signs of dehydration include eyes that appear sunken or the facial fur can appear "fuzzier" due to piloerection (bristling or erection of hairs). In nude mice and other mouse strains lacking fur, dehydration may be observed by severe wrinkling of the skin. Dehydration does not cause detectable loss of skin turgor until the animal is at least 6% dehydrated. If dehydration is suspected, estimate dehydration at 10% for fluid replacement. A mild degree of dehydration is not easily detectable clinically; institute fluid replacement therapy when there is any reason to believe dehydration may exist.
- An estimate of hydration status may also be made by observation of the urine. Most mice will urinate after being picked up or restrained. An example of the normal color of mouse urine is illustrated below. A mouse that is severely dehydrated may have very dark yellow urine. A mouse that has very dilute or clear urine may either be over-hydrated or have kidney damage.

% Dehydration	Clinical Signs
<5%	Not detectable

5%	Subtle loss of skin elasticity
6-8%	Definite delay of return of skin to normal position
10-12%	Tented skin stands in place, eyes are sunken
12-15%	Signs of collapse and depression, moribund

- **Replacement requirements** - The volume of fluid to be replaced can be determined by:

  *Fluid volume needed replacement **(mls)** = animal's body weight (grams) X % dehydration (decimal).*

  Thus a 300 gram rat which is estimated to be 10% dehydrated would need to have 300 g X 0.10 = 30 mls of fluids replaced. Replace 50% of the calculated volume immediately by the administration of warmed (to approximately 100^{o}F) fluids subcutaneously (SC) at multiple sites. Replace the remaining fluid volume with warmed replacement fluid after 1 - 2 hours. The maximum volume delivered per site is species (animal size) dependent. In mice the volume per site should not exceed 1- ml SC, whereas up to 5 mls per site SC may be delivered to an adult rat. Fluids can also be replaced by intraperitoneal (IP) administration provided there is no respiratory distress present. In mice the volume of an IP injection should not exceed 2 ml; in rats the volume should not exceed 5 ml. . It is extremely important to warm fluids to normal body temperature (~100.0°F), especially when administered IP, to prevent hypothermia. Fluids can be warmed in a microwave, water bath, or incubator; temperature gradients within the bottle or bag should be distributed by shaking gently and confirming the appropriate temperature by placing several drops on the back of your wrist.

- **Maintenance fluid requirements** - If an animal is not drinking on its own, its daily maintenance requirement will have to be replaced to prevent dehydration. The maintenance requirement in rodents is approximately 40-80 ml/kg/day or 4-8 ml/l00g body weight per day. Thus a 300 gram rat would require 24 mls maintenance fluid every 24 hours. Twenty four hour fluid volume replacements should be divided into 2 or 3 treatments, injected in multiple sites, over the 24 hour period. Frequently both replacement and maintenance fluids will have to be administered.

Fluid Administration

- **Fluid choice** - Body fluids should be replaced with warmed physiological solutions, e.g., Lactated Ringers Solution (LRS), Normosol-R, or 0.9% saline solution. These fluids are isotonic and will quickly replace losses during and after surgical procedures. Colloid solutions such as Dextrose can be useful in situations of acute blood or protein loss during surgery, or for an anorectic animal post-surgery Supply half of the total calculated fluid volume as Dextrose 5% in water (D5W) and half of the volume as LRS mixed in the same syringe when treating an anorexic animal. Replacement fluids can be obtained from RARC's Veterinary Services section.

- **Methods for fluid replacement -** Use a sterile 22 (rats) or 23 (mice) gauge needle or an equivalent size butterfly catheter. A new sterile needle should be used for each animal. A sterile 5 - 60 ml syringe is recommended. Syringes can be reused if not contaminated. Fluids should be labeled with the date they are first used and must be used by their expiration date. Store fluids in a refrigerator when not in use. Unused fluids should be discarded 30 days after opening or if they turn cloudy. The total volume to be administered should be deposited at a 2 - 3 sites over the animal's back when administering fluids subcutaneously, so that the animal's skin does not become uncomfortably stretched and conforms to the previously stated guidelines. When administering IP, the animal should be restrained with its head down and injections made lateral to the midline in the right caudal abdomen to reduce the likelihood of injecting an abdominal viscus. Aspirate first, to ensure the needle has not been placed in the intestines or urinary bladder. Used contaminated needles should not be recapped. All spent needle must be collected in a sharps waste container for safe and proper disposal.

- **Post-fluid administration -** Verify that the animal is urinating. If renal failure is present, due to severe dehydration or drug effect, the animal will not be able to compensate for over hydration. Over hydration may cause pulmonary edema and respiratory distress. This may be observed as rapid and labored breathing. Rehydration should continue until the animal's fluid intake and skin turgor returns to normal. Contact RARC's Veterinary Services for assistance.

Bibliography

Simplified Fluid Therapy. Kirk RW and Bistner SI. In*: Veterinary Procedures and Emergency. 4th* ed. pp. 591-623. 1985. Philadelphia: WB Saunders Co.

General Guidelines for Fluid Therapy. Senior DH. In: *Textbook of Veterinarv Internal Medicine.* Ettinger SJ, ed. 3rd ed. pp. 431-435. 1989. Philadelphia: WB Saunders Co.

Foltz CJ, Ullman-Cullere M. 1999. Guidelines for Assessing the Health and Condition of Mice. Lab Anim. 28:28-32.

Harkness JE, Turner PV, Van de Woude S, Wheler CL. 2010. Biology and Medicine of Rabbits and Rodents. 5th ed. Wiley-Blackwell. Ames, IA.

Pritchett-Corning KR, Girod A, Avellaneda G, Fritz PE, Chou S, Brown MJ. 2010. Handbook of Clinical Signs in Rodents and Rabbits. Charles River.