FLUID THERAPY: What is New?

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Overview

Fluid therapy is one of the most vital aspects of patient management in small animal practice. When using fluids, they are many important concepts to consider, these include patient characteristics, underlying disease, hospital or clinic characteristics, and fluid types. Normal fluid balance in an individual is based upon adequate food and water intake. The reported "maintenance" fluid rates for healthy animals are 40-80 m/kg per day; however this can vary widely depending up the size of the patient. As a guideline, 2-3 ml/kg/hr is a reasonable IV fluid rate in a patient that is adequately hydrated, but not able to maintain hydration for whatever reason. In animals that are dehydrated, a higher fluid rate will be required to provide for maintenance needs as well as rehydrating them. Animals with excessive fluid losses, including polyuria/polydipsia, vomiting/diarrhea, panting or wound /body cavity exudate will require more fluid support to prevent dehydration and/or hypovolemia.

Types of fluids

Fluids can be crystalloids or colloids. *Crystalloids* are fluids that are made up of electrolytes in water that are freely diffusible across the vascular space. These include replacement fluids, which are fluids that have a sodium concentration similar to that in the vascular space (eg. sodium 130-154 mEq/L) and are the fluid type most commonly used in veterinary medicine. Examples of crystalloid replacement fluids include 0.9% saline, lactated Ringer's solution, Plasmalyte 148 and Norm-R. Crystalloids may also be maintenance fluids, with lower sodium levels, such as 0.45% saline or Norm- M. These have sodium levels that are about ½ what is in the plasma, and are used for animals are hydrated, but are expected to have on-going fluid needs. It is occasionally confusing as fluids given for fluid therapy are almost always replacement fluids, but occasionally there are referred to as fluid therapy in multiples of maintenance (eg. 3X maintenance). While beyond the scope of this lecture, parenteral nutrition products (eg. Procalamine, PPN, TPN) are also crystalloids. Crystalloids leave (equilibrate) with the extravascular space quickly when given IV, and are absorbed quickly when given subcutaneously.

Colloids are fluids that contain water, electrolytes and large molecules that do not easily move out of the vascular space. Colloids made be natural such as whole blood or plasma, or concentrated albumin, or may be synthetic such as hetastarch or Voluven. A veterinary specific colloid (VETSTARCH) was recently released by Abbott. Colloids will stay in the vascular much longer than crystalloids, unless there is vasculitis, which may permit extravasation. Importantly, synthetic colloids may be associated with an acquired coagulopathy in higher concentrations, and may interfere with some laboratory assays. Specifically, hetastarch may increase serum amylase, total protein (as measured by a refractometer or chemistry analyzer) is lower than what would have been predicted with serum colloid osmotic pressure (COP) and urine specific gravity is increased in the presence of hetastarch (*Smart et al J Vet Intern Med. 2009 Mar-Apr;23(2):388-91*)

Assessing the need for fluids

Animals presented for veterinary care may need fluid support for several reasons, these include 1) Hypovolemia/Shock 2) Dehydration 3) Planned lack of adequate intake. We will first consider assessing hypovolemia, or inadequate circulating blood volume. Hypovolemia may be associated with shock (inadequate oxygen delivery to tissues) if untreated. Hypovolemia may develop from either acute loss such as that associated with blood loss (eg. trauma or spontaneous hemorrhage) or in association with untreated excessive losses (eg. severe vomiting and diarrhea or PU/PD). Hypovolemia may be life-threatening if untreated. Clinical signs of hypovolemia include tachycardia, pale mucous membranes, weak pulses, quiet mentation and occasionally tachypnea. Biochemically, shock is appreciated by increased lactate (> 3 mmol/dl) and increased base deficit. Treatment of hypovolemia is directed at restoring circulating volume and treatment of the underlying disease. Most commonly, hypovolemia is treated by a bolus (rapid infusion over < 15-20 minutes) of a specific volume of fluids. The "shock" dose of fluids, which is classically considered a circulating blood volume, is, when using crystalloids, 90 ml/kg in dogs and 60 ml/kg in cats. If using colloids (which is rarely indicated!) the proposed dose is 20 ml/kg in dogs and 10-15 ml/kg in cats due to colloids greater ability to stay within the vasculature. In a clinical setting, treatment for shock typically starts with giving ¼-1/3 the "shock" dose, and then assessing for a response. Practically, it is easily to round to the nearest 50 ml in all but the smallest patients. If there is no response, the same volume may be repeated, as the search for the underlying clinical source continues.

Dehydration is defined as the loss of sufficient body water, most commonly due to inability drink enough water to maintain hydration. This may occur due to vomiting, or excessive diarrhea; PU/PD, excessive painting/anxiety or fluid cavity losses. Dehydration is appreciated clinically by dry mucous membranes (if not panting or salivating heavily), decreased skin turgor, and progressively by sunken eyes and tachycardia and collapse. Older cats in particular often feel dehydrated even when normal, and young puppies may have good skin turgor despite have marked dehydration. Thus is it hard to really sort out the percentage hydration although charts as below are popular and may give a reasonable starting point.

Percentage dehydration	Clinical signs
<5%	No signs on physical examination, but historical finding consistent with a volume loss
5%	Dry mucous membranes (in the absence of panting)
7-8%	Dry mucous membranes, decreased skin turgor, slight tachycardia
10%	Dry mucous membranes, decrease skin turgor, moderate tachycardia
12-15%	All of the above, and collapse

Calculating a percentage dehydration is helpful in determine a fluid rate, so while there are inherent flaws in doing so, it is helpful clinically to pick a number. The crystalloid dose is calculated by multiplying the weight in kilos by the percentage dehydration. For example, a 20 kg (44 #) dog that is assessed to by 8% dehydration would require the provision of 20 X 0.08= 1.6 kg (or 1600 ml) fluids in order to rehydrate the dog. Importantly fluid therapy needs to provide for on-going losses as well as normal maintenance needs in order to keep the patient from re- dehydrating. Fluids are sometimes given only to a patient at risk of dehydration, where routine NPO cold be risky such as elderly pets awaiting a dental procedure or in animals that are unable to prehend (jaw fracture, etc).

Summary for routine fluids:

1) Determine if the patient is in shock, dehydrated, or simply at risk of dehydration.
2) For shock, place IV catheter and bolus ¼-1/3 the shock dose of fluids up to a total of 4X while searching for the underlying cause. Common causes include traumatic or spontaneous hemorrhage, or gi losses. In the ER setting, collapsed dogs often have pericardial effusion as a source of shock. Colloids or BLOOD may be given if warranted by the specific case.
3) For dehydration, provide the best estimate of the % dehydration, and then add 60 ml/kg/day for "maintenance" and some amount for excessive on-going losses. For example, a 10 kg dog that is 10% dehydrated for bad vomiting and diarrhea, could be treated using the following fluid scheme
   a) Dehydration 10 kg X 0.1 = 1 liter= 1000 ml
   b) Maintenance per day 10 kg X 60 ml/kg/day= 600 ml
   c) On-going losses estimated at 200 ml /day
      total= 1800 ml/day ; divided by 24 hours= 75 ml/hr.

   It is **essential** to carefully monitor the patient, some may need more fluids and some may need less fluids. Recall that a bolus does not correct dehydration.
4) For "patients at risk" on-going fluid needs are dependent why the fluid need is anticipated, for example, the little old kitty with renal failure may need a fairly aggressive fluid support pre-procedure, while the cat with a mandibular fracture may be fine with a "maintenance" rate of fluid.

Other considerations

1) It is ESSENTIAL to determine if a pet has a PU/PD condition, such that the ability to concentrate the urine is decreased or absent. While renal failure is an obvious cause, other common causes are diabetes mellitus, Cushing's syndrome, diabetes insipidus, and drug therapy, notably prednisone and furosemide. Pets that can't concentrate urine are at risk of being inadequately fluid resuscitated, and can be inappropriately accused of not responding to fluid therapy.
2) TAPERING fluids is wise with chronic diseases (eg. renal failure) but unneeded in most other cases
3) SQ fluids may be adequate for dehydrated smaller pets

4) Dogs with mitral regurgitation tend to tolerate fluids fairly well when dehydrated. Other pets with heart disease are more variable, however, a "murmur" is not reason to withhold fluids.

So, what has really changed in the last 25 years?

1) Colloids have come and gone
2) Fluid rates have lowered!
3) Saline is out of favor
4) The glycocalyx has been recognized.
5) Fluid "diuresis" for renal failure has been abandoned
6) Dopamine for renal support has been abandoned.