Fluid therapy

As for the fluid therapy, the following is kind of a general guideline to consider:

1. Surgical rate (for an elective procedure or otherwise CV stable patient):

-healthy patients: dogs 5/ml/kg/hr, cats 3 ml/kg/hr

-goal is 20mls/kg TOTAL fluid received

If you have a normovolemic, stable animal under anesthesia (not super sick or dehydrated) then the idea is 5ml/kg/hr for dogs, 3ml/kg/hr in cats for the first hour - then reduce after that (by 25% per hour until maintenance)

b. If patient becomes hypotensive during surgery then consider the following stepwise approach:

-- reducing inhalant concentration if possible, ± adding in a pure mu opioid bolus or CRI to maintain the plane of anesthesia.

-- adminstering a 10-20mL/kg crystalloid challenge bolus and if the patient responds favorably, then increasing the fluid rate to as high as 20ml/kg/hr for a short period.

-- If patient hasn't responded to above, then adminstering a 5-10mL/kg HES bolus and then possibly maintaining a HES CRI at 20mL/kg/day. If that is done you will need to reduce your crystalliod dose by 40-60%.

-- As a last resort, although some will do this sooner, if the patient is volume replete but is still hypotensive despite the above efforts, then adding in a vasopressor (e.g. dopamine) or a dobutamine CRI.

**Hemodynamically unstable animals from the get go - it is hard to give a guideline as the underlying disorder and surgical procedure required will dictate choices, e.g., for a GDV a usually have a crystalloid and HES running from the start.

NOTE: Now there is also mounting evidence in human literate that these typical surgical rates that we use are even too high, and actually end up causing more harm than good by causing interstitial volume overload leading to cellular, organ, and immune dysfunction. Some human physicians are promoting a more restricted fluid plan with using typical maintenance fluid rates alone; basically; enough to achieve euvolemia but no more, and in cases where euvolemia is achieved and a state a hypotension occurs some are advocating earlier institution of vasopressors. Very interesting info.

2. "Shock" doses to restore EFCV

For intravascular or perfusion deficits a general guideline may include higher rate and higher volume fluid doses to restore EFCV. There are different approaches and the fluid plan will need to be tailored to the individual patient, but in general:

a. For hypoperfused (non-hemorrhaging) dogs I start off with infusion of 20-40mL/kg isotonic balanced crystalloid (Norm-R or Plasmalyte-148) over 5-15 minutes (sometimes as fast as feasible) ± 5-10mL/kg HES bolus over 10 - 15 min. After each bolus I will recheck my perfusion parameters, and I will repeat these boluses until I have met my end-points of resuscitation (HR, CRT, MM, BP, **lactate, **BD, etc).

NOTE: Again, the goal is to achieve euvolemia not hypervolemia - once you achieve you endpts tailor your fluid rates down to avoid hypervolemia and overhydration.

b. For the subset of dogs presenting with head trauma, pulmonary contusions, or oliguric renal failure that need volume resuscitation then implementing "small volume resuscitation" 5-15mL/kg crystalloid ± 2-5mL/kg HES may be warranted - or for head trauma HTS/colloid 4-6mL/kg over 5-10 minutes.

c. Ongoing / uncontrolled closed cavity hemorrhage then consider hypotensive resuscitation or permissive hypotension with the goals of: achieving/maintaining a SBP ~80 mm Hg or MAP 40-60 mmHg until definitive hemostasis is achieved or for at least the first 60- 90 min of resuscitation; use fresh whole blood or blood products in a 1:1 ratio of pRBC: FFP to restore EFCV; limit crystalloid use; avoid over aggressive fluid resuscitation until definitive hemostasis is achieved; if blood products are not available then use 5-15mL/kg aliquots of a synthetic colloid to achieve above mentioned endpoints of permissive hypotension.

d. For cats I tend to be more conservative considering they most often present hypothermic and bradycardic; therefore, in general I'll start with 5-15mL/kg crystalloid boluses ± 2-3mL/kg HES boluses; again, I will repeat until I have met my end-points of resuscitation. Really hypothermic cats (<95F) a I use even lower boluses or fluid rates until the body temp is normalized; in these latter cases I usually titrate my fluid administration until I achieve a Doppler of ~70mmHg, and then use a more aggressive fluid administration to achieve a Doppler of >90mmHg once the body temp reaches 98F.

3. Correcting Dehydration:

Once perfusion is addressed correcting the Dehydration Defict is a slower process as you are basically trying to maintain / replace water in all fluid compartments (interstitial, intravascular, etc). When formulating the replacement/maintenance plan you should take into consideration the degree of dehydration (e.g., 5% vs 10%), the type of dehydration that is primarily involved (hypotonic vs isotonic vs hypertonic), the rate/rapidity of fluid loss, as well as the patient's CV status. This component of fluid therapy consists of mentioned consists of 3 main areas:

A. Deficit volume - BWkg x % dehydration x 1000mL/L x 80% = volume recommended to give over 1st 12 - 24 hours

B. Daily maintenance - many formulas (roughly 1 ml/lb/hr)

1. [30*BW(kg) + 70] for patients 2 – 50kg, and [BW(kg)^0.75]*70 for animals <2kg or >50kg.

2. dogs = 132*BW(kg)^0.75 ; cats = 70*BW(kg)^0.75

3. 55-60 ml/kg/day for cats/small dogs and 40 - 50ml/kg/day for larger dogs

for dogs I use [BW(kg)^0.73 x 140] and for cats 70*BW(kg)^0.75 = volume in mL /24 hrs

C. Ongoing lossess (vomiting, diarrhea, etc)

In chronically dehydrated but hemodynamically stable patients I will usually correct dehydration over 24hrs; again taking into account the underlying condition of the patient, as it is important to hemodynamically optimize the patient first and tailor fluids for each individual patients. Also consider that in the their truist form, hypoperfusion and dehydration are two different issues; the former involving intravascular deficit requiring immediate volume administration and the latter involving interstitial deficits requiring gradual, slower volume replacement to allow for adequate redistribution of fluids between compartments.

Administering the volume calculated for the dehyrdation deficit as a rapid bolus most likely will not restore interstitial losses as effectively as giving that same volume over several hours; particularly in a already hemodynamically perfused patient. A rapid bolus in that situation will induce a pressure diuresis causing the animal to urinate out most of the fluid you gave instead of allwoing it to distribute out into the interstitial space where it is needed, and what you may end up doing is actually worsening the degree of dehydration.

For, intracellular dehydration characterized by marked hypernatremia and mentation changes than a slightly different approach using some degree of free water replacement (e.g., D5W) over a very long period of time (>24hrs) will probably need to be instituted. A general rule empirical guideline for correcting true hypernatremia indicative of free water loss is starting D5W at 3.7mLs/kg/hr and assessing e-lytes q2-4 hrs to avoid dropping Na+ >0.5mEq/hr. NOTE: Free water replacement (e.g., D5W) is adminstered in conjunction with isotonic maintenance requirements and ongoing losses replacement.

4. Optimal to routinely monitor:

--Perfusion parameters (HR, CRT, MM, pulse pressure, ABP, temp, etc) **Have not been shown to always be the most sensitive for assessing adequacy of resuscitation

--Daily Body weight q6-24hrs

--CVP

--Lactate and / or Base Deficit ** at least in humans are considered better predictors of effective resuscitation than traditional vital parameters (e.g., HR, BP, MM, etc)

--ABG for acid base

--PCV/TP, electrolyte status

--Urine output / USG

--"Ins" vs "outs"

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