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Essentials of Fluid Therapy Mini Series

Session Three: Wet, Dry or In-between?

Adam Auckburally BVSc CVA DipECVAA PGCAP MRCVS FHEA
European & RCVS Specialist in Veterinary Anaesthesia & Analgesia

Webinar 3 Study Notes

Fluid Therapy in Small Animal Practice: Part 3 – Wet, Dry or In-between?

Can Fluid Therapy Cause Harm?

The short answer to this is YES. Never think of fluids as benign – they are medicinal products, the administration of which can lead to harm. However, most healthy patients will tolerate mistakes and fluid overload to a certain extent. Nevertheless, this does not mean clinicians can be complacent when deciding on fluid therapy plans as the consequences of inappropriate therapy can be catastrophic.

Harm following crystalloid therapy includes:

- Increased lung water and altered lung function
- Increased bodyweight
- Reduced tissue oxygen delivery
- Increased infection
- Altered gut function
- Haemodilution
- Coagulopathy
- Damage to the endothelial glycocalyx layer (EGL) (flaking or shedding)
- Electrolyte and acid-base derangement
- Hypothermia

The Confidential Enquiry into Small Animal Fatalities (CEPSAF) revealed that aggressive fluid therapy in cats increases mortality. This is likely because the cat is much more at risk of fluid overload.

Brodbelt et al. (2007) **Risk factors for anaesthetic-related death in cats: results from the CEPSAF.** *Br J Anaesth*, 99, 617 – 623.

Current recommendations in people:

- Shorter periods of fluid restriction before anaesthesia
- Avoid fluid loading in euvolaemic patients
- Use sympathomimetics sooner
- Use BALANCED salt solutions for replacement therapy and avoid 0.9% NaCl where appropriate (hyperchloraemia reduces renal blood flow)
- Use hypotonic solutions with caution. Not appropriate for replacement therapy unless a large deficit of free water
- Carbohydrate-rich drinks 2 – 3 hours pre-induction improve patient well-being and recovery
- Excessive losses from vomiting should be corrected before surgery. Hypochloraemia is an indication for 0.9% NaCl, otherwise use Hartmann's solution
- Predetermined goals for cardiac output and oxygen delivery should be attained preoperatively with fluids and inotropes

- Hypovolaemia due to haemorrhage should be treated with a balanced crystalloid or a colloid until PRCs are available
- Details of fluid therapy must be clearly recorded and easily accessible
- Volume status should be reassessed before leaving ICU/recovery
- In stable and euvolaemic patients, return to oral fluids ASAP
- Maintenance fluid should be sodium poor
- High molecular weight HES should be avoided in patients with severe sepsis

Powell-Tuck et al. (2009) **Summary of the British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients (GIFTASUP)**

Current recommendations in animals:

- Replace ongoing normal losses to maintain total body fluid
- Counteract relative fluid loss (i.e. vasodilation due to anaesthesia)
- Replace surgical fluid loss (blood and other fluids)
- Continual monitoring of fluid status
- Administer < 10ml/kg/hr to avoid hypervolaemia (especially cats and patients undergoing lengthy procedures)

SUGGESTED INITIAL RATES:

- Dog – 5 ml/kg/hr
- Cat – 3 ml/kg/hr
- Reduce rate by 25% each hour until maintenance achieved

Davis et al. (2013) **2013 AAHA/AAFP fluid therapy guidelines for dogs and cats.** *JAAHA*, **49** (3)

Harm associated with colloids may be more likely than previously thought. These solutions are definitely not benign and are manufactured from animal by-products, bacteria, potatoes or maize.

Harm following colloid therapy includes:

- Hypervolaemia
- Anaphylaxis
- Coagulopathy
- Renal injury
- Increased mortality in critically ill patients given HES

Current colloid recommendations in people:

Do not use:

- HES with molecular weight > 200 kDa and/or degree of substitution > 0.4 in patients with severe sepsis or other intensive care patients with increased risk for AKI
- synthetic colloids in patients with head injury or intracranial bleeding
- gelatin in ICU patients who are at increased risk for renal failure or bleeding

- hyperoncotic solutions for fluid resuscitation

Do use:

- HES 130/0.4 in severe sepsis and other ICU patients with increased risk for AKI
- albumin in the resuscitation of severe sepsis patients
- solutions other than albumin in patients with head injury

Any new colloid should be introduced into clinical practice only after its safety parameters are established.

Reinhart K et al. (2012) **Consensus statement of the ESICM task force on colloid volume therapy in critically ill patients.** *Intensive Care Medicine*, 38, 368 – 383.

Rates of fluid therapy

If an animal has suffered acute fluid loss, e.g. haemorrhagic shock, then rapid fluid resuscitation is required. Often, in these cases, the rate is dictated by the diameter and length of intravenous catheter used to administer the fluids through. Fluid flow is slower if the diameter of the catheter is reduced, or if the length of the catheter is increased. So-called 'shock-rate' fluids are administered at one blood volume per hour. For dogs this constitutes 90 ml/kg, and in cats this should be reduced to 50 – 60 ml/kg. One quarter of this dose should be administered rapidly and then the patient reassessed. Administer further one-quarter doses until vital signs have normalised or are improving. Then the rate can be slowed. Higher rates should only be administered if intensive monitoring – such as central venous pressure - is available, and is not recommended. The fluid requirement for a patient rushed into the clinic that requires resuscitation because of acute haemorrhage is impossible to calculate. Usually, these animals are resuscitated as described above and are re-assessed at regular intervals.

In chronic conditions, the deficit can be calculated to which contemporaneous losses and maintenance fluid requirements can be added, and the total fluid volume administered over 24 hours. This technique facilitates the appropriate equilibration of fluid between compartments. Ongoing losses can be a result of blood loss, fluid within drains, vomiting or diarrhoea, polyuria or third space losses such as peritoneal or pleural effusions. Some of these are easy to measure, and some are not. Intraoperative bleeding should be accounted for when calculating ongoing losses. Soaked standard size swabs can be estimated to contain 10 to 15 ml of blood each. Alternatively, 1 millilitre of blood weighs approximately 1.05 g and so weighing swabs should give a rough estimation of surgical blood loss. Using closed suction devices facilitate the measurement of blood volumes lost during surgery but fluids used for flushing the surgical site should be accounted for.

Fluid therapy rates for patients undergoing anaesthesia and surgery should be between 5 and 10 ml/kg/hr. The rate chosen is dependent on the type of surgery performed, duration of anaesthesia and species. For invasive procedures of long duration, the lower rate should be selected. Fluid therapy in anaesthetised cats should be more cautious. Rates should be reduced over the course of the procedure (see AAHA Guidelines).

Maintenance requirements – such as fluids lost in urine, faeces and from the respiratory tract – are estimated as approximately 2 ml/kg/hr. This should be taken into account in the fluid therapy plan.

Ongoing losses such as vomiting can be measured directly, or estimated. 4 ml/kg/vomit is often use.

As an example we will calculate the fluid requirement for a 30 kilogram Labrador presenting at the clinic. She has been vomiting for 3 days and your assessment reveals an approximated 10 % dehydration. She is vomiting 6 times per day

First calculate the fluid deficit:
Percentage dehydration as a decimal multiplied by bodyweight
0.1 x 30 kg = 3 litres
Next calculate maintenance requirements:
2 ml/kg/hr, so for 24 hours this is
2 x 30 x 24 = 1.44 litres
Last estimate contemporaneous losses:
4 x 30 x 6 equals 720 ml
The sum of these volumes is 5.16 litres
Divide this volume by 24 to give 215 ml/hr for 24 hours

Once clinical signs of perfusion improve, volumes of fluids administered can be reduced, but monitoring should continue. The invasiveness of monitoring depends on the condition of the patient. Basic monitoring techniques rely on subjective clinical signs such as mentation and peripheral signs of perfusion – for example pulse quality, mucous membrane colour, capillary refill time and the temperature of extremities. More objective indices include heart and pulse rates, blood pressure, central venous pressure, blood gas and acid base analysis, lactate concentrations, packed cell volume and urine output. Many of these are difficult to measure and require intensive nursing to manage central venous and arterial catheters. However, it is relatively straightforward to place and manage a closed collection urinary catheter system. Urine output is a reliable indicator of tissue perfusion and therefore should be considered in all patients requiring acute fluid therapy. Fluid therapy should be maintained until the animal begins to eat and drink voluntarily

Case studies

Use these spaces to annotate appropriate case management in conjunction with the lecture

Routine ovariohysterectomy

Spinal surgery

Splenic rupture

Gastric dilatation and volvulus

Sepsis

Heart failure/cardiogenic shock

Hypokalaemia

Head trauma

Diabetic ketoacidosis