Fluid therapy, a mainstay treatment, is indicated in a variety of disease states that may result in mild dehydration to severe hypovolemic shock. Depending on the disease and its severity, fluids administered either subcutaneously or intravenously may be warranted. Fluids include crystalloids, synthetic colloids, and biological fluids (eg, red blood cells, plasma, concentrated albumin transfusions). This article focuses on crystalloid fluid therapy.

1 Dehydration
Dehydration, or the loss of fluid from the interstitial space, is most commonly caused by decreased intake and/or increased fluid loss from vomiting, diarrhea, or polyuria. The level of dehydration is often measured as a percentage of body weight via history and examination findings. Signs include decreased skin tenting, sunken eyes, depressed mentation, and tacky/dry mucous membranes. An estimate of dehydration is often not possible (or advisable) with just one variable; for example, false negatives may occur in very young patients, which have a higher percentage of total body water and tissue that is more elastic, and in obese patients. Signs often do not appear until dehydration is at least 5% of body weight; if a patient has a history of fluid loss and decreased intake but does not seem dehydrated, a 5% dehydration status should be applied.

To calculate daily maintenance fluid rates, the following equations can be used1:

- **Cats:** 80 x body weight [kg]$^{0.75}$ or 2–3 mL/kg/hr
- **Dogs:** 132 x body weight [kg]$^{0.76}$ or 2–6 mL/kg/hr

The deficit should be replaced over 8 to 24 hours, indicated by the patient’s clinical status, comorbidities (eg, heart murmur), and inpatient or outpatient status. For an inpatient, the deficit amount should be added to a base maintenance rate of isotonic crystalloid fluids and the patient monitored for ongoing losses that may require fluid rate adjustment. For an outpatient, the deficit may be administered subcutaneously and reassessed in 24 hours or as needed.

2 Hypovolemia
Hypovolemia, or fluid loss from the intravascular space, may be caused by hemorrhage or extreme fluid loss from vomiting, diarrhea, polyuria, or prolonged decreased water intake. Signs include changes in perfusion indices: pale pink mucous membranes, prolonged capillary refill time (>3 seconds), tachycardia, decreased femoral pulse quality, depressed mentation. Patients are often hypotensive (ie, systolic blood pressure <90 mm Hg) and may have a metabolic acidosis and hyperlactatemia from poor perfusion resulting in lactic acidosis.
When an intravascular fluid deficit occurs, tissue perfusion decreases, resulting in tissue hypoxia and a change from aerobic to anaerobic metabolism. Lactate, a product of anaerobic metabolism, can be measured, which helps the veterinarian understand if the patient is responding to fluid resuscitation. Patients presenting in hypovolemic shock should be treated with IV isotonic crystalloid fluids via a bolus dose calculated on the patient’s shock volume (ie, 90 mL/kg [dogs]; 50–60 mL/kg [cats]). The general shock volume is often given as a fraction (ie, one-fourth to one-third of the total shock volume, or 30 mL/kg [dogs] and 10–20 mL/kg [cats]) over 15 to 30 minutes. After the bolus, the patient should be reassessed for therapy response, including heart rate, pulse quality, mentation, and lactate.

If perfusion abnormalities persist, an additional bolus may be used. Continued fluid therapy is usually warranted, depending on the underlying cause. Blood product transfusions may be indicated (10–20 mL/kg of packed RBCs, fresh frozen plasma, or whole blood, over 2–4 hours), depending on cardiovascular stability.

Distributive Shock
Distributive shock is caused by extreme vasodilation, including sepsis, systemic inflammatory response syndrome (SIRS), anaphylaxis, Addisonian crisis, and severe transfusion reactions and results in decreased tissue perfusion and tissue hypoxia. Treatment typically includes shock doses of IV fluid therapy. Inflammatory mediators released into circulation may cause significant vasodilation, and isotonic crystalloid fluid therapy alone is often ineffective. Combinations of isotonic crystalloids, synthetic colloids, hypertonic solutions, and blood products may also be needed, as well as vasopressors if hypotension or signs of shock persist. Empiric antibiotic therapy pending culture results is indicated if sepsis is suspected.

Calculating Crystalloid Fluid Rate in a Dehydrated Dog*

The following example shows how to calculate the maintenance rate and dehydration deficit of a 10-kg dog presenting with vomiting and diarrhea and with normal heart, lung, and kidney function:

Dehydration deficit
8% dehydration
body weight (10 kg) x % dehydration (0.08) x 1000 = 800 mL

Maintenance rate
132 × 10 kg^{0.75} = 742 mL/24 hours = 31 mL/hr

Replace dehydration deficit over 12 hours = 800/12 = 67 mL. Add this to the maintenance rate of 31 mL/hr = 67 + 31 = 98 mL/hr for the first 12 hours, then decrease to maintenance rate = 31 mL/hr.

*Refer to Fluid Therapy for the Emergent Small Animal Patient: Crystalloids, Colloids, and Albumin Products for available crystalloid fluid formations.
Patients in polyuric kidney failure often require more fluids than the daily maintenance rate.

Administration of isotonic crystalloid fluids is common for patients with kidney disease. Newly diagnosed patients should receive IV fluid therapy to correct dehydration, improve perfusion, and promote diuresis while being monitored for body weight changes and urine output. Patients in polyuric kidney failure often require more fluids than the daily maintenance rate.

If the patient becomes oliguric (ie, urinates less than 1–2 mL/kg per hour after adequate rehydration) or does not urinate, fluid therapy may be contraindicated if the patient is overhydrated/edematous; depending on the underlying cause, diuretic therapy is usually indicated. Signs of overhydration include pleural effusion, pulmonary edema, abdominal effusion, increased body weight from decreased urine output, and excessive skin elasticity (ie, jelly-like movement when skin is tented). Intermittent subcutaneous fluid therapy is often prescribed for patients with chronic kidney disease and can be administered as an outpatient or at home, depending on the severity and stability of the disease.

Kidney Failure

Administration of isotonic crystalloid fluids is common for patients with kidney disease. Newly diagnosed patients should receive IV fluid therapy to correct dehydration, improve perfusion, and promote diuresis while being monitored for body weight changes and urine output. Patients in polyuric kidney failure often require more fluids than the daily maintenance rate.

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Certain Toxidomies

Many toxins are excreted, either fully or partially, via the kidneys, so fluid therapy with other treatment modalities is used to hasten toxin elimination. In some cases, such as NSAID toxicity (dogs and cats) and lily ingestion (cats), IV fluid therapy is recommended for 48 to 72 hours to help perfuse the kidneys and prevent acute kidney injury. The rate of administration should be 2 to 2.5 times higher than a typical maintenance rate to assure sufficient diuresis, as long as the patient’s clinical status does not contraindicate a high fluid rate.

Conclusion

In most small animal presentations, IV administration is ideal. Clinical status, including improvement of hydration status, normalization of hypotension, and improved perfusion parameters should be monitored frequently in patients receiving fluid therapy because administration rates may need to be adjusted.

See Aids & Resources, back page, for references & suggested reading.

Advantage Multi® for Dogs and for Cats (imidacloprid + moxidectin)

RAINFALL SUMMARY: Before using Advantage Multi® for Dogs (imidacloprid+moxidectin) or Advantage Multi® for Cats (imidacloprid+moxidectin), please consult the product insert, a summary of which follows:

CAUTION: Federal (U.S.A.) Law restricts this drug to use by or on the order of a licensed veterinarian.

Advantage Multi® for Dogs:

WARNING:

• DO NOT ADMINISTER THIS PRODUCT ORALLY.
• For the first 30 minutes after application ensure that dogs cannot lick the product from application sites on themselves or other treated animals.
• Children should not come in contact with the application sites for (two) 2 hours after application.

(See Contraindications, Warnings, Human Warnings, and Adverse Reactions for more information.)

INDICATIONS: Advantage Multi® for Dogs is indicated for the prevention of heartworm disease caused by Dirofilaria immitis and the treatment of Dirofilaria immitis-induced microfilaria in heartworm-positive dogs. Advantage Multi® for Dog Kill adult fleas and is indicated for the treatment of flea infestations (Ctenocephalides felis). Advantage Multi® for Cats is indicated for the treatment and control of sarcoptic mange caused by Sarcoptes scabiei and for the treatment and control of the following intestinal parasites species: Host-parasite (Anoplocephala helvola and Fascioloides buski) (Fasciola hepatica), Roundworms (Toxocara canis) (Toxocara cati) and Whipworms (Trichuris vulpis) (Trichuris suis).

Advantage Multi® for Cats is indicated for the prevention of heartworm disease caused by Dirofilaria immitis. Advantage Multi® for Cat Kill adult fleas (Ctenocephalides felis) and is indicated for the treatment of Cat infestations. Advantage Multi® for Cats is also indicated for the treatment and control of ear mite (Otodectes cynotis) infestations and the intestinal parasites species: Host-parasite (Anoplocephala helvola and Fascioloides buski) (Fasciola hepatica), New for ferrets†, Advanatge Multi® for Cats is indicated for the prevention of heartworm disease in ferrets caused by Dirofilaria immitis. Advantage Multi® for Cat Kill adult fleas (Ctenocephalides felis) and is indicated for the treatment of the infestations in ferrets.

CONTRAINdications: Do not administer this product orally. (See WARNING). Do not use in the depletion of zinc in dogs.

† Advantages for ferrets‡.

HUMAN WARNINGS: Not for human use. Keep out of the reach of children. Dogs: Children should not come in contact with the application site due to a mutation in the MDR1 gene. Dogs with this mutation may develop signs of severe avertin toxicity if they ingest this product. The most common breeds associated with this mutation include Collies and Cattle-cries.

‡ Advantages for ferrets.

CAUTION: Federal (U.S.A.) law restricts Advantage Multi® for Cats to use by or on the order of a licensed veterinarian. WARNING: Do not use on Sick, debilitated, or underweight cats (SEE ADVERSE REACTIONS).

Precautions: Avoid oral ingestion. HUMAN WARNINGS: Children should not come in contact with the application site for 30 minutes after application. Cause skin irritation. Humans with skin irritation. Do not get in eyes or on clothing. Avoid contact with skin. Wash hands thoroughly with soap and warm water after handling.

Conclusion

In most small animal presentations, IV administration is ideal. Clinical status, including improvement of hydration status, normalization of hypotension, and improved perfusion parameters should be monitored frequently in patients receiving fluid therapy because administration rates may need to be adjusted.

See Aids & Resources, back page, for references & suggested reading.

ADVANCED REACTIONS: Heartworm Negative Dogs: The most common adverse reactions observed during field studies were pruritus, mast cell-mediated, eosinophilic lung reactions, and hypereosinophilia. Heartworm Positive Dogs: The most common adverse reactions observed during field studies were cough, laryngitis, vomiting, diarrhea (including hemorrhagic), and inappetence. Cats: The most common adverse reactions observed during field studies were laryngitis, behavioral changes, discomfort, hyperesthesia, polyuria and coughing and gagging. Females: The most common adverse reactions observed during field studies were pruritus, scratching, swelling, redness, wounds and inflammation at the treatment site. Laryngitis and chemical odor.

For a copy of the Material Safety Data Sheet (MSDS) or to report adverse reactions call Bayer Veterinary Services at 1-800-432-8543. For consumer questions call 1-800-255-6246.

Advantage Multi® is protected by one or more of the following U.S. patents: 6,239,398 and 6,013,879.

NADA 141-251, 141-254 Approved by FDA

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