Emergency fluid therapy

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Matthew Gurney BVSc, CertVA, MRCVS, on when emergency fluid therapy is appropriate, routes of administration and monitoring

INITIAL assessment of the patient should focus on body systems and clinical signs, which will give the most information for triage purposes. A full clinical examination can be conducted at a later stage once the immediate life-threatening problems have been evaluated.

Patients requiring intravenous fluid therapy (IVFT) may have a variety of presentations, ranging from dehydration to hypovolaemia to shock. Hypovolaemia is defined as a reduction in circulating volume and is the most common cause of hypoperfusion.

A normal, unstressed dog in a veterinary clinic will have a heart rate of 80-120 beats per minute, pink mucous membranes, a capillary refill time (CRT) of less than two seconds, and easily palpable metatarsal pulses. A normal cat will have a heart rate of 160-200 beats per minute, with paler mucous membranes than a dog. Pulses may be slightly more difficult to appreciate in cats.

Clinical signs of hypovolaemia include an elevated heart rate, pinker mucous membranes, a capillary refill time of less than one second and bounding pulses.

Clinical signs of shock include an elevated heart rate, grey, cold mucous membranes, a slow CRT, poor pulse quality, cold extremities and collapse. Typically, shock is divided into several categories based on the underlying reason: hypovolaemic, maldistributive or cardiogenic. The clinical signs of shock are related to the compensatory responses, which are aimed at maintenance of cardiac output and delivery of oxygen to tissues with a high metabolic requirement.

Approach to fluid therapy

Emergency fluid therapy can be divided into stages, according to urgency:

• **First five minutes:**

– place IV catheter;

– start IV fluids;

– assess patient; and

– briefly evaluate underlying causes.

• **The next half hour:**

– monitor response to fluid therapy;

– place further IV catheters if necessary; and

– re-evaluate fluid choice.

• **The next few hours:**

– monitor the patient and continue diagnostic evaluation.

A fluid therapy plan is specific to that patient and so it is difficult to be prescriptive about rates and volumes. It is important to tailor the plan to the patient and, for this purpose, monitoring the patient's response to fluid administration is key, hence the first five minutes, next half hour, next few hours approach. Appreciation of the underlying disease is important and is considered later in this article.

Preparation is essential to emergency fluid therapy. Clippers, scrub, a selection of catheters, IV fluids and giving sets should be easy to locate in a hurry.

When choosing an IV catheter, the largest possible gauge is desirable. For rapid administration venous access at several sites may be necessary. The most common sites are the cephalic veins. Lateral saphenous veins are easily accessible in a recumbent patient, but difficult to maintain once the patient is mobile. Where these veins are difficult to catheterise, the jugular vein can be used. For ongoing fluid therapy and where central venous pressure (CVP) measurement is to be used, a central catheter placed via the jugular vein is necessary. A central venous catheter is pictured and has the advantage of two ports suitable for multiple infusions, CVP measurement and repeated blood sampling.

In the event of failure (repeated attempts, over more than five minutes) at percutaneous catheterisation, a venous cutdown should be performed. Briefly, an incision is made and the subcutaneous tissues dissected free of the vein. The vein is stabilised by passing a pair of haemostats underneath it and a catheter advanced into the vein under direct visualisation.

The catheter can either be sutured into the vein or secured with tape. An emergency venous cutdown is considered a dirty procedure and the catheter should be removed within 24 hours.

In puppies and kittens fluids can be administered via an intraosseous needle. Absorption via this route is rapid. Intraosseous needles are commercially available or alternatively a hypodermic or jamshidi needle can be used. Sites for placement include the trochanteric fossa of the femur, medial surface of the tibia and the wing of the ilium. When correctly placed the needle is firmly secure and moving the needle will cause the bone to move.

For rapid fluid administration a fluid pump will not provide a high enough rate as the maximum speed possible is 999ml/hour. A pressure infuser is more appropriate in this situation, or simply have an assistant squeeze the bag.

Monitoring IVFT

In an emergency situation, the patient's response to IVFT is the most immediate measure, highlighting the importance of the initial evaluation of heart rate, mucous membrane colour, CRT, respiratory rate and pulse quality. Values such as packed cell volume and total protein should be included in initial blood work and trends can be monitored to assess patient response. Other parameters to measure over the next hours to days include urine output and bodyweight.

Normal urine output is 0.5-2.0ml/kg/hour and varies with renal function. As well as monitoring volume of urine, specific gravity will assist in assessing whether the urine output is adequate for that animal's renal function. Specific gravity, as a guide, should be 1.026 for a dog and 1.035 for a cat receiving IVFT.

In a patient receiving IVFT an increase in bodyweight indicates that normal hydration is being achieved.

Central venous pressure is a measure of the fluid load within the central venous compartment. It requires a central catheter, the tip of which lies within the cranial or caudal vena cava. Such catheters are placed via the jugular, saphenous or femoral veins. CVP is measured either with a water manometer or electronically. A water manometer can easily be constructed in practice from drip tubing, a three-way tap and a ruler. A normal CVP is 0-5cmH_2O. A low CVP indicates hypovolaemia requiring further fluid treatment. A high CVP indicates hypervolaemia, either due to excessive fluid load or inadequate cardiac function.

If CVP is low and a fluid bolus is given the CVP should rise. If CVP remains within normal limits, that fluid bolus was adequate. If CVP then falls, further fluid therapy is indicated.

CVP measurement is, therefore, useful as part of the ongoing IVFT plan, rather than as a first line in emergency fluid therapy because of the time necessary to place the central catheter. For exact details of setting up a water manometer the reader is referred to the BSAVA *Manual of Canine and Feline Emergency and Critical Care* (2007).

Which fluid to choose?

By discussing several common emergency situations it is easier to illustrate the type of fluid necessary for different situations.

GDV

Dogs with gastric dilatation with or without volvulus will often present in a state of shock. The dilated stomach impairs venous return to the heart and therefore limits cardiac output. A decrease in cardiac output limits perfusion of all organs. This type of shock is described as maldistributive because the blood is unable to be distributed normally to the target organs.

Depending on the stage of the disease, there may be other types of shock present; for example, endotoxaemic shock, which results from damage to the gastric mucosal barrier.

These patients require correction of the underlying cause – that is, gastric decompression and replacement of lost volume before anaesthesia. In these cases the saphenous veins are less useful because the caudal vena cava is occluded, so cephalic or jugular catheters are necessary.

Isotonic crystalloids at shock rates (90ml/kg/hour or as rapidly as possible) are appropriate. Crystalloid solutions will distribute across the extracellular fluid space (ECF = intravascular space + interstitial space) so after one hour only 25 per cent of the crystalloid administered remains in the vascular space. Colloids can be administered to aid volume expansion, by adding oncotic pressure and “holding” the crystalloids in the vascular space. In a large dog, the use of colloids decreases the volume of crystalloid necessary. An initial dose of colloids is approximately 4ml/kg to a maximum recommended daily dose of 20ml/kg.

Diabetic ketoacidosis

These patients are often undiagnosed or unstable diabetics and will present collapsed. The diagnosis may be obvious from a brief history obtained at triage and a hyperglycaemia can be easily confirmed by blood glucose analysis. Initial fluid therapy with Hartmann's solution is appropriate at shock rates in the volume-depleted patient. Further correction of fluid defecits should occur over the next 24 hours once cardiovascular parameters have stabilised. Treatment of the underlying cause involves administration of insulin and subsequent monitoring of blood glucose levels.

Urethral obstruction

The cat with a urethral obstruction will often present in a state of collapse. This type of shock can be classified as cardiogenic and is due to high plasma potassium levels resulting from a decreased excretion of potassium. High levels of potassium impair the cardiac resting membrane potential and decrease cardiac contractility.

These cats are often painful and restraint for IV catheter placement can be tricky. Animals with a plasma potassium of more than 7mmol/L are unsuitable candidates for anaesthesia and require cystocentesis to drain the bladder, and IVFT to reduce potassium levels; 0.9 per cent sodium chloride is suitable for this purpose as it contains no potassium.

Addisonian crisis

Patients with Addison's disease can present as emergencies with collapse. Supportive treatment is necessary with IV fluids as these patients are unable to regulate their own blood volume due to a lack of aldosterone. Typical electrolyte changes include hyperkalaemia and hyponatraemia.

The priority in these cases is correction of blood volume and slower correction of abnormal electrolyte levels. This can be achieved with 0.9 per cent sodium chloride, which contains no potassium. Fluid rates can be guided by the patient's clinical response and electrolyte levels. Bolus administration of 10ml/kg with subsequent reassessment is initially appropriate for these patients.

Acute haemorrhage

The acutely bleeding patient may be very obvious or not obvious at all if the haemorrhage is intra-abdominal or intrathoracic, as is common following an RTA. Any trauma case should be suspected of having unrecognised bleeding until proven otherwise.

Once venous access has been established, volume support can be initiated with isotonic crystalloids in the first instance at shock rates. Ideally, the source of the haemorrhage should be treated before blood replacement is started but this is not always practically possible. Where whole blood is lost, the best replacement is whole blood. With the establishment of commercial blood banking in the UK more practices have whole blood available. Where whole blood is not an option, a haemoglobin-based oxygen carrier (HBOC) (oxyglobin) is the next best thing.

Ideally, patients should be blood typed prior to blood transfusion to minimise the risk of a transfusion reaction. In an emergency situation administration of DEA 1.1 negative ("universal donor") blood to a dog provides the lowest risk of a transfusion reaction, and the benefits of blood therapy far outweigh the risks.

During the time taken for blood typing, HBOC administration can help bridge the oxygen/time gap.

Trauma patients

Where there is no sign of obvious external injury, there is still potential for myocardial or pulmonary contusions and intra-thoracic or intra-abdominal bleeding. These cases require careful evaluation so as not to miss a diagnosis and care should be taken with fluid therapy in the meantime. If there is damage to the pulmonary vasculature, fluids at shock rates may cause pulmonary oedema.

Cats

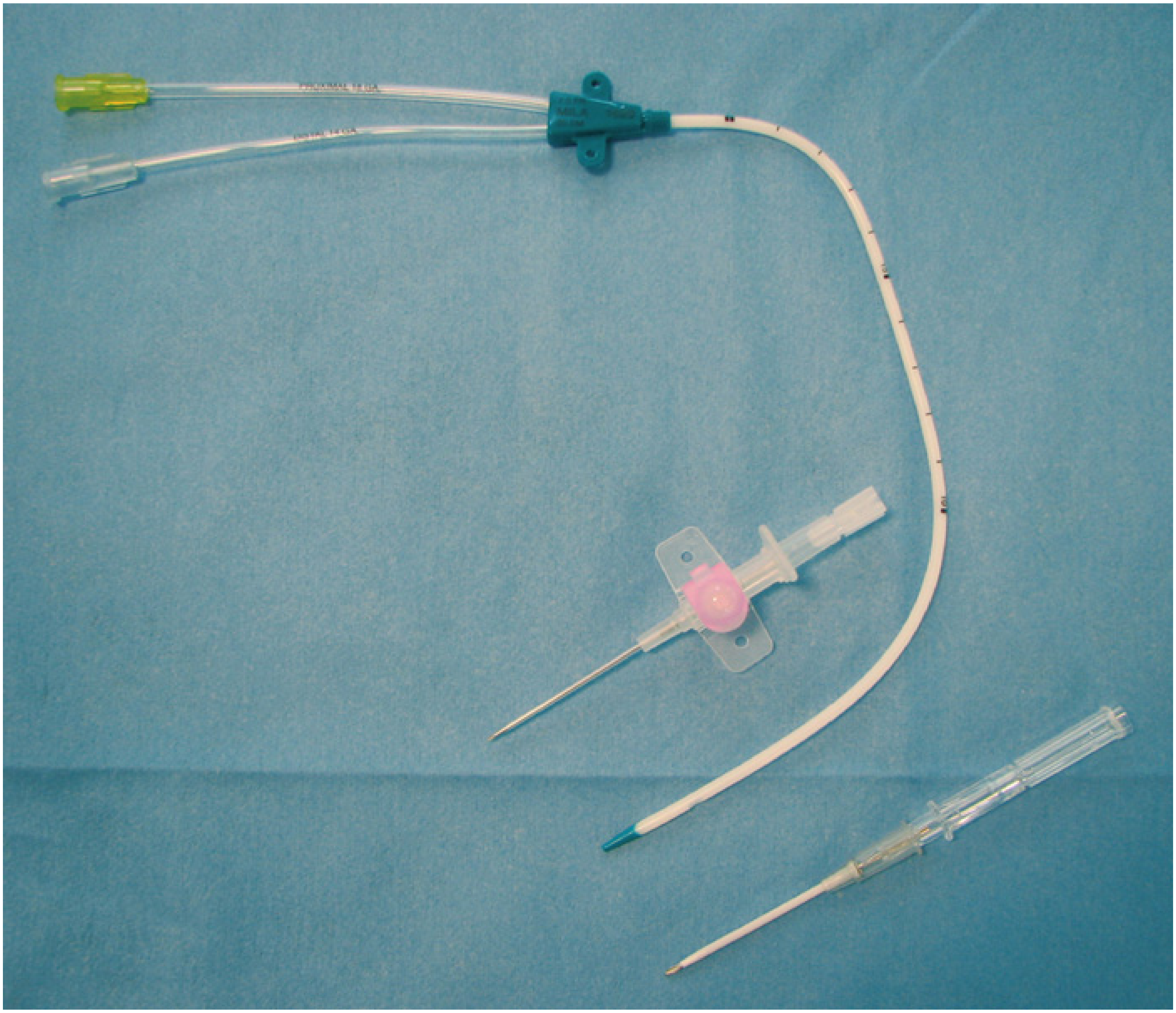
• Cats in shock may present with bradycardia.

• The blood volume of cats is smaller than dogs: 40-60ml/kg, hence a "shock rate" of 40-60ml/kg. Cats presenting in shock should be given fluid boluses of 10-30ml/kg over 20 minutes and reassessed, rather than fluids at shock rates.

• The medial saphenous vein is often easily accessible in cats.

• Oxyglobin is not licensed for cats, but use is widespread at doses of 15ml/kg.

• Cats should always be blood typed as there is no "universal donor".



A central venous catheter shown next to a 16G and 20G catheter for comparison. The bigger the better.


ANAESTHESIA DO NOT
999
ml/hr
PRI SEC
CLR
3
Alaris
GW
CardinalHealth

A pressure infuser set for rapid fluid administration.


pbb
pet blood bank
CANINE PACKED RED BLOOD CELLS IN CPD WITH SAGM
Donor ID:
Donor Type:
Date of Production: 08/07/2008
Date of Expiry: 19/08/2008
Amount:
See product insert for uses and cautions
Pet Blood Bank Services Limited
Units 21 & 22 • Loughborough Technology Centre
Epinal Way • Loughborough • Leicestershire LE11 3GE
Telephone: 0844 8009925
FOR ANIMAL TREATMENT ONLY
KEEP OUT OF REACH OF CHILDREN
Non-Food Animal Blood Bank Authorisation No. 30549/8000
RapidVet-H
(Canine DEA 1.1)
Dog
Date
Auto-Agglutination Saline Screen
DEA 1.1 Positive Control
Patient Test
dmslaboratories, inc.

A unit of blood and a blood typing card.

Fluid	Type
Hartmann's solution	Isotonic crystalloid
0.9 per cent saline	Isotonic crystalloid
7.2 per cent saline	Hypertonic crystalloid
Starch (Voluven)	Colloid
Gelatins (Haemacell/Gelofusin)	Colloid
Oxyglobin	Haemoglobin based oxygen carrier
Whole blood	Blood replacement
There are no starch solutions licensed for use in veterinary patients.	

TABLE 1. Fluid Choices