

# Emergency Fluid Therapy in Companion Animals

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The administration of appropriate types and quantities of intravenous fluids is the cornerstone of emergency therapy and critical care. The primary concern in a patient presenting as an emergency is to check for evidence of poor tissue perfusion. This is an indication of circulatory shock.

The aim of emergency fluid therapy is to re-expand the effective blood volume in order to maintain perfusion to the major organs and hence adequate oxygen delivery.

## Circulatory shock

There are three types of circulatory shock and they may occur simultaneously. All result in poor perfusion of body tissues and inadequate oxygen delivery.

1.Hypovolaemic Shock is the most common form of shock and occurs as a result of blood volume loss due to haemorrhage or severe dehydration.

2.Cardiogenic Shock can occur as a consequence of cardiac failure (*eg Dilated Cardiomyopathy*), with poor cardiac function resulting in hypoperfusion of body tissues.

3.Vasodilatory Shock is a result of generalised vasodilation resulting in pooling of blood in the vascular space and very low blood pressure.

*(causes include septicaemias and anaphylactic reactions).*

## Diagnosing Circulatory Shock

Regular examination of the cardiovascular system gives vital information.

There may initially be some compensatory responses by the body which may make the animal appear more stable than what they actually are.

For example in hypovolaemic and cardiogenic shock there is frequently marked activation of the sympathetic nervous system which results in elevations in heart

rate and peripheral vasoconstriction in an attempt to maintain blood pressure and perfusion. This protective response may make patients seem more stable than what they truly are.

## Nursing Care for Patients in Circulatory shock

Regular monitoring of all vital signs is essential to a successful outcome in order to differentiate those patients who are deteriorating from those that are responding to treatment. Most patients will have a depressed mental state which may continue to deteriorate. Hypothermia if present must be recognised and treated. Oxygen therapy is always indicated.

Clinical signs for the three forms of Circulatory Shock can be summarised in the following table.

CLINICAL SIGNS	Hypovolaemic and Cardiogenic Shock	Vasodilatory shock
Heart Rate	Tachycardia (rapid HR) and end stage severe bradycardia ( slow HR)	Tachycardia
Pulse strength	Weak becoming absent	Bounding ( due to dilated blood vessels)
Mucous Membranes	Pale becoming white	Bright red (hyperaemic)
Capillary Refill Time	Prolonged	Rapid ( as blood pooling in vessels)
Blood pressure	May initially be normal due to sympathetic response then decline	Low
Temperature of Extremities	Cool ( vasoconstriction)	Warm ( vasodilation)

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## Comparing Cats to Dogs

The basic principles of emergency fluid therapy apply to both with some important differences. Cats often don't present with tachycardia in response to circulatory shock and may be bradycardic without it suggesting a worse prognosis (bradycardia in dogs is suggestive of a worsening "shock" state).

Cats have small blood volumes so are at much greater risk of fluid overload so extra care is needed when calculating and administering fluid doses.

Cats are very prone to hypothermia (Active warming is essential in improving survival outcomes in cats ).

## Body Fluid Compartments

Before commencing intravenous fluids it is important to consider where that fluid will go. Roughly 60% of bodyweight consists of water of which 2/3 is intracellular and 1/3 extracellular ( Interstitial fluid and plasma). Total blood volume is roughly 8% of bodyweight and plasma roughly 5% of bodyweight.

Movement of fluid depends on how permeable (*ie permitting passage*) the barriers are and the concentration of molecules in each compartment. Water will tend to move into an area with a higher concentration of molecules ( called osmosis).

Blood vessel walls are permeable to water and electrolytes but not protein. The proteins (esp albumin) within blood vessels retain fluid with them and hence maintain blood volume ( oncotic pressure).

Cell membranes are only freely permeable to water. Across cell membranes the movement of water is dependent upon the relative concentrations of the fluids inside compared to around the cell.

## Administering Emergency Fluids

With patients in Circulatory Shock fluid administration should be rapid with an aim to complete fluid resuscitation within 10-15 minutes. In terms of intravenous access short length and large diameter catheters are ideal and normally the Cephalic or Lateral Saphenous veins are used. If vascular collapse makes

peripheral veins impossible to access then the Jugular vein may be used. In very small neonates an intraosseous route into the medullary cavity of the Humerus, Femur or Tibia may be considered if venous access is impossible.

## Types of Fluids

Three types of fluids may be used for emergency therapy and combinations of these may be used to enhance the benefits. They are:

- 1. Isotonic Crystalloids** which have the same concentration of solutes as the blood and hence the same osmotic pressure.
- 2. Colloids** ( synthetic and natural) which supply oncotic pressure.
- 3. Hypertonic Saline** which creates high osmotic pressure in the vascular space.

### Isotonic Crystalloids (example Hartmann's and 0.9% Sodium Chloride)

These are solutions containing small molecules that will pass freely out of the blood vessels and are capable of entering all body compartments. Due to the fact that these solutions "leak" from the blood vessels only about 1/5 of total volume given will remain in blood vessels. "Shock doses" of 90ml/kg given in bolus increments of 20-40ml/kg with regular reassessment are suggested. It is possible to give repeated boluses if a relapse is seen but consideration should be given to the possibility of ongoing blood loss. Rapid expansion of blood volume with crystalloid fluids may worsen blood loss.

#### Benefits of Isotonic Crystalloids –

They are inexpensive and readily available with a wide range of uses, not just in emergency resuscitation. In addition assuming renal function is adequate any excess fluid or solutes will be excreted in urine.

#### Potential Problems with Isotonic Crystalloids –

The benefit of intravascular expansion may be short lived with fluids redistributed within 1-2hrs. With repeated boluses there is a risk of interstitial oedema, dilution of RBCs and dilution of clotting factors.

**Colloids (Examples – Dextran 70, Hetastarch are synthetic colloids, whole blood and plasma are natural colloids).**

Colloids contain large molecules which do not pass out of normal blood vessels and as a result expand the intravascular space due to increasing the oncotic pressure. They are given in conjunction with isotonic crystalloids. “Shock doses” of 20ml/kg given as boluses of 5-10 ml/kg are suggested.

Benefits of Colloids –

Because of the low volumes used resuscitation can be achieved rapidly. In addition intravascular expansion lasts many hours beyond what is seen in crystalloids with benefits seen up to 12 hours later. Colloids may be of extra benefit if the patient is severely hypoproteinaemic in order to increase oncotic pressure.

Potential Problems with Colloids –

Despite in theory having many benefits for emergency fluid resuscitation there is no convincing evidence that colloids give better overall results for patients in circulatory shock compared to crystalloids. In addition synthetic colloids can cause an acquired coagulopathy. Colloids are also expensive and not multi-purpose.

**Hypertonic saline ( Example 7% saline).**

Hypertonic saline causes a very rapid expansion of the intravascular compartment after administration. It creates a huge osmotic gradient and draws water into the vascular space from the interstitial compartment and from endothelial cells (lining the blood vessel walls) and red blood cells. A “Shock dose” of 4-7ml/kg of 7% hypertonic saline over 20 minutes is suggested.

Benefits of Hypertonic Saline –

Very small volumes of hypertonic saline are needed to perform fluid resuscitation. Improvements may also be seen in cardiovascular function with better myocardial contraction, some peripheral vasodilation and improved peripheral blood flow. Hypertonic saline may also help normalise cell function to recover from the hypoxic events of Circulatory Shock. It may be of extra benefit in those patients who present with brain trauma injuries and penetrating wounds.

Potential Problems with Hypertonic Saline –

Hypertonic Saline is short acting if used alone with benefits lasting less than 1 hour. The administration of Hypertonic Saline may result in bradycardia and arrhythmias (abnormal heart rhythms). It CANNOT be used if the patient is

dehydrated as it pulls water from the interstitial and intracellular sites. Hypertonic saline should not be used if the patient has marked electrolyte disturbances due to its high sodium and chloride levels.

## Which Fluid is best for each type of Circulatory Shock ?

Isotonic crystalloids are most commonly used either alone or in combination due to the fact that they are readily available, cheap and are suitable for most patients presenting in Circulatory shock.

### Hypovolaemic Shock

Hypovoleamic shock occurs when more than 25% of intravascular volume is lost. Before commencing fluid therapy for Hypovolaemic shock we need to determine if the patient is also dehydrated. Dehydration refers to an insufficient amount of body water to maintain normal function affecting both the intracellular and extracellular fluid compartments. Severe dehydration can lead to Hypovolaemic shock but **Hypovolaemic shock can occur without dehydration.**

An accurate assessment of the hydration, electrolyte and total protein levels of the patient will determine our choice of fluids and the rate and duration of administration. After we treat an animal for Hypovolaemia shock there will still be a need for ongoing intravenous fluids if they are concurrently dehydrated.

In Hypovolaemic shock isotonic crystalloids are most commonly used and may be combined with hypertonic saline and colloids if the initial response to crystalloids is poor. If there is evidence of severe hypoproteinaemia ( eg haemorrhagic gastroenteritis) extra consideration should be given to using colloids. Patients who have had severe haemorrhage or ongoing blood loss will need blood products (fresh whole blood, stored whole blood or packed red blood cells).

The assessment of dehydration is summarised in the following table:

DEHYDRATION PERCENTAGE	PHYSICAL ASSESSMENT
< 5%	<b>Not detectable</b> May be history of water loss (vomiting or diarrhoea )or lack of water intake
6-8%	<b>Mild to moderate.</b> Positive skin tenting test and oral mucous membranes are dry
10-12%	<b>Marked.</b> Eyes appear sunken in orbits, all mucous membranes appear dry, pronounced skin tenting and early signs of shock
12-15%	Circulatory collapse/ hypovolaemic shock

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### Cardiogenic Shock

In Cardiogenic shock there is poor delivery of oxygen to tissues due to heart failure. Patients will often present with distended jugular veins. In patients with heart failure it is vital **not** to administer intravenous fluids if they have evidence that their circulation is already “fluid overloaded”. The classic indication of this

would be pulmonary oedema secondary to congestive cardiac failure. Giving “extra” fluids in this situation will make the oedema worse.

Small boluses of intravenous fluids may be given if there are no signs of fluid overload as may be seen in the initial stages of circulatory collapse with Dilated Cardiomyopathy.

In addition to the possible use of fluid therapy patients in cardiogenic shock need drugs to improve heart function (*Positive Inotropes eg Dobutamine*) as well as diuretics if there are indications of fluid overload (*eg Frusemide* ).

### **Vasodilatory Shock**

In Vasodilatory shock generalised vasodilatation results in poor tissue perfusion and may be seen as a consequence of septicaemias and anaphylactic reactions. Patients in Vasodilatory shock require very large doses of fluids due to the marked dilation of blood vessels that is occurring. Patients may also have protein loss through “leaking capillaries” due to the effect of septicaemias so colloids may help as part of the fluid resuscitation plan. In addition patients will often need drugs to help restore blood pressure (*eg Dopamine*).

### **In Conclusion**

In Circulatory shock there is poor perfusion of body tissues leading to inadequate oxygen delivery. For most causes of circulatory shock prompt and aggressive intravenous fluid therapy is the basis of treatment. Essential nursing care involves ongoing and regular assessment of the patient's vital signs. Oxygen therapy and active warming are other important nursing tools.

### **References**

- Hopper K: Shock Fluid Therapy. In “Urgency in Emergency”, Proceedings 358, 2005 .Post Graduate Foundation in Veterinary Science, University of Sydney(pg 295 302)
- Chan D : Challenges in Fluid Therapy. Proceedings of Southern European Veterinary Conference and Congreso Nacional AVEPA,2008- Barcelona ,Spain.
- Ruys LJ: Fluid Therapy: Theory and Cases. Abstracts European Veterinary Conference Voorjaarsdagen 2008 (pg 83-84).



➤ Hughes D: Advanced Fluid Therapy . Proceedings of North American Veterinary Conference 2006.

➤ Adamantos S: Fluid Therapy- Patient Assessment .Abstracts European Veterinary Conference Voorjaarsdagen 2008 (pg 60-61).