THE TYPES OF SHOCK AND THEIR TREATMENT

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Introduction

As wildlife carers, we tend to use the words 'that animal is in shock' on a regular basis, but what does being 'in shock' really mean. Do we understand what is happening inside the body when it is in shock? Without this understanding, as carers, we may fail to provide appropriate care to these animals.

Shock is the clinical state resulting from poor supply of oxygen to the tissues, or the inability of the tissues to use oxygen. Shock is a mechanism of the body to attempt to return itself to 'normal'. Shock progresses from a compensated stage, to decompensation and then becomes irreversible. Thus sensible intervention is likely to be successful in those animals in compensated and early decompensated shock. Wildlife does present in irreversible stages of shock and will die, despite the best efforts of the carer and veterinarian.

In considering the information in this paper, it is important to remember that not every animal can be saved. As a carer you may correctly identify the type of shock and commence suitable treatment, but you may not always be successful. Please remember that even in human hospitals with all of the best equipment and staff, humans still can die from severe shock. In the words of Teddy Roosevelt our aim must be "to do what we can, with what we have, where we are". If that is what we have done, then we have done our best, and that is all that we can do.

Causes of shock

The most common reasons for presentation are also the most common causes of shock.

- Vehicle trauma can result in a loss of blood through wounds or fractures.
- Predation may result in sepsis from bacteria in the blood stream, as well as loss of blood from wounds.
- Diarrhoea results in a loss of body water and electrolytes, and may also have sepsis associated with it.
- Poisoning – such as with Brushtail possums consuming anticoagulants (Warfarin) aimed at rat control suffer from a loss of blood.

What happens in shock

When the body recognises that it is progressing into shock, it proceeds to begin a host of specialized responses aimed at restoring itself.
To restore blood volume, the body will start to do the following:

1. Autotransfusion by taking blood from outside the blood vessels and putting inside the bloodstream. Thus we see cool extremities.
2. Increase the body's plasma glucose as this will attract body water into the blood vessels.

3. Most importantly, the kidneys start to resorb the body water that was transporting the body's waste through the kidney by concentrating the urine.

Decompensation begins when shock is not treated. Some of the consequences include:

- The liver starts to die as a consequence of low blood volume. Thus the immune cells in the liver do not clear bacteria. The liver cannot maintain normal glucose levels in the blood.
- The gut lining starts to die within one hour of lowered blood flow. Thus the gut cannot absorb food.
- Prolonged times with reduced blood supply to the kidney end up causing death of the kidney cells trying to conserve the body water as the concentrated waste damages these cells.
- If the blood supply to the heart is reduced, it contracts more weakly and thus is less able to effectively deliver oxygen to the body.
- Cells throughout the body start to die from a lack of oxygen.

Types of shock

There are some types of shock that it is extremely unlikely that wildlife carers will see in wild animals that present requiring care - primarily heart failure shock. However, shock that results in hypovolaemia (less blood in the bloodstream) is extremely common.

A summary of the different types of shock is made below

Table 1: Types of shock

Hypovolaemia	Distributive	Obstructive	Cardiogenic
Trauma Burns Vomiting Diarrhoea Dehydration	Burns Sepsis	Blood around the heart Thromboembolism	Valvular heart disease

Hypovolemic shock

This is the most common type of shock seen. In this type of shock, there is a loss of fluid (blood and plasma) from the blood vessels. The most common causes of this shock include:

- Haemorrhage, bleeding
- Burns
- Vomiting
- Diarrhoea

With there being less blood in the blood vessels, the ability of the body to deliver oxygen to tissues is reduced.

Septic shock

Septicaemia is the circulation of bacteria inside the bloodstream of the animal. This can occur on a progressive scale – from bacteria in the bloodstream as a

consequence of a small skin wound, to having a possum die as a consequence of the bacteria from a cat bite overwhelm the immune system of the animal.

The exposure of the body to the cell wall of the bacteria results in chemical messengers: cytokines and prostaglandins, being released by the body. These messengers stimulate the body to produce clotting and immune factors. But they also have an effect on the heart that reduces its ability to pump blood.
Septic shock is the only type of shock where the 'rules' can change.
The mucus membrane colour may be bright red and animal may be hyperthermic. However the heart rate will still be high. The glucose in the blood may also drop, rather than increasing.

Cardiogenic shock occurs as a consequence of heart muscle or heart valve disease. Examples include congestive heart failure in dogs and humans.

Obstructive shock occurs when the heart cannot work properly for a physical reason. The accumulation of blood outside the heart, but inside the sac of the heart, known as tamponade, is an example. The heart does not have the space to pump effectively.

Diagnosis of shock
Shock may be suspected based on the history given – predation, vehicle trauma or found out in the cold. Physical examination and the collection of some basic parameters, as shown below in Table 2, can be used to help you to determine if the animal is in shock.

The equipment that you require to perform these tests include: eyes, fingers and a watch. A stethoscope can improve your ability to hear the heart rate, but is not essential.

Some common findings on physical examination include:

- Depressed mentation – i.e.: lethargic, quiet, and non-responsive. This occurs as consequence of reduced blood supply to the brain. Increased depression is observed as decompensation occurs.
- Muscle weakness – the animal may move slowly, fall or stumble. This occurs as there is less oxygen being delivered to the muscles and may occur if the electrolytes are not normal as a consequence of vomiting or diarrhoea.
- Cool extremities occur as the blood supply to the periphery is reduced.
- Pale mucus membrane colour reflects poor blood supply to small blood vessels and indicate early decompensation. The colour may progress from pink to white or grey in late decompensatory shock.
- Slow capillary refill time. This is obtained by pressing on the gum mucus membranes to blanch the gum. In a normal animal, the pink colour returns in one second. In a shocked animal, the refill time may take two seconds or more. Prolonged time indicates poor blood supply to the small blood vessels.
- Hypothermia – the animal's core body temperature is below normal

- Increased heart rate occurs as the body tries to use a faster heart rate as a method of trying to improve the delivery of oxygen to body organs. If the heart rate is very low, then this is an indication of a poor prognosis.

Table 2: Physiological parameters of common wildlife marsupial species
Note that these parameters vary with the size and age of the animal.

Species	Heart rate (beats per min)	Respiratory rate (per min)	Cloacal body temperature (ºC)
Koala	65-90	10 – 15	35.5 – 36.5
Possums		16 - 40	35 - 36
Kangaroos	60- 150	10 - 30	35 – 36.5
Wombat	90-120	20	35.4 – 36.7
Echidna	83 - 109	8 - 14	28 - 32

Veterinarians may use pulse oximetry or blood pressure as aids to assist in the diagnosis of shock. Pulse oximetry measures the oxygen carrying capacity of the blood. Normal blood pressure ranges have not been established for many wildlife species. Pressure cuffs of a suitable size can be an issue. So blood pressure is used less commonly in veterinary practice.

Treating the different types of shock

The cornerstone of treating shock is to reverse the underlying condition that precipitated it in the first instance.
In short…you guessed it…WARMTH AND FLUIDS.

Hypothermia (low body temperature) limits the heart's ability to respond to fluids. Ideally, fluids should be warmed to body temperature to prevent further heat loss. The animal should be placed in proximity to warmth and the temperature next to the animal monitored.

Treatment of haemorrhage usually involves the administration of isotonic crystalloid fluids – such as Hartmanns or 0.9% saline for all stages of shock. The aim is to replace fluids quickly. Having the animal warmed prior to administration will result in subcutaneous fluids being able to be taken up quickly by the body. Subcutaneous fluid administration is cheap, easy, has reduced handling times and the volume administered is known.

Intravenous fluids are best performed in a veterinary clinic under supervision of a veterinarian. There is a high risk of fluid 'overload' in our small wildlife species. Complications of intravenous fluids include fluid on the lungs, introduced infection, stress for the animal and insufficient fluids given.

Other options are not routinely feasible in treating wildlife. Hypertonic saline could be used in severe cases, but can only be given intravenously. Colloids are used in people but have been associated with causing problems with blood clotting. Whole blood would also be suitable, but unfortunately, there

are no blood banks for native species. Blood loss greater than 30 – 40% of blood volume carries with it a very grave prognosis.

Cortisone does not have a role in hypovolaemic shock. In other words, for the majority of wildlife presenting into care, this drug may do more harm than good. Cortisone does not reverse the mechanisms of shock. It will, however, leave this immunosuppressed animal with even less ability to fight infections or respond to the supportive care given. The animal's own body will release an appropriate level of cortisone as a consequence of the trauma – it does not need humans to give it more again.

Discussion of the treatment of burns is beyond the scope of this paper. The reader is referred to the paper written by myself on burns for the 2006 NWRC.

Treatment of septic shock

Although fluids are required, care is needed to prevent over-hydration and thus the development of fluid in the lungs. As this condition may present with low blood glucose, the addition of glucose to the fluids is indicated with ongoing monitoring of blood glucose required to assist in getting the balance right.

Antibiotics that are effective against the causative bacteria are a cornerstone of treatment. Broad-spectrum antibiotics are indicated. There is much debate in the use of corticosteroids in the treatment of septic shock in humans and small animal patients. There may be argument for the one-off use of an anti-inflammatory dose of a short-acting steroid but the recommendations are not clearly beneficial in humans or dogs. In this instance, cortisone acts by altering the metabolism of glucose.

Monitoring shock

With effective treatment of shock, the parameters used to diagnose the condition return to normal:

- Mentation improves: animal becomes brighter, more responsive and starts to show normal fear behaviours expected by a wild animal
- Heart rate decreases
- Body temperature returns to normal and extremities feel warmer
- Capillary refill time returns to less than one second.

One of the key points to monitor is the commencement of urination. It is only by treatment of shock that the animal will commence urination and it is one of your key indicators that treatment is successful.

Conclusion

The aim of this paper has been to describe the different types of shock and provide some insights on how to recognise and treat these conditions in wildlife.

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