Incubator use in Small Animal Practice

An information sheet for veterinarians

Enhance Recovery and Care for Your Small Animal Patients

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Normal Body Temperature Ranges	
Dogs =	100.0 - 102.2°F (37.8 - 39.0°C)
Cats =	100.4 - 102.6°F (38.0 - 39.2°C)
Rabbits =	101.3 - 104.0°F (38.5 - 40.0°C)

Figure 1: *Orphaned kittens in a Vetario receiving warming treatment to support their start in life*

Figure 2: *Vetario digital readout*

Incubators in Practice

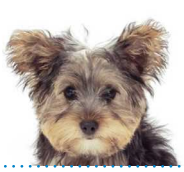
Incubators can be an invaluable piece of equipment to have in a veterinary practice and have uses in a variety of situations, where patients are unable to thermoregulate and hypothermia is an immediate concern. An incubator allows the ability to provide a temperature-controlled environment while stabilizing and managing critically ill animals. The environmental temperature can be more easily monitored and uniformly controlled in comparison to other warming aids, for example hot water bottles or microwaveable pads. In addition to controlling temperature, we can also provide oxygen therapy and humidification, if required, which prevents drying of skin and mucous membranes.

Body temperature

Measuring body temperature is an important part of the clinical exam. Most commonly, a digital thermometer is used to obtain a rectal temperature. Axillary and inguinal temperatures are options, but they tend to underestimate the rectal temperature (Zakari and Omontese, 2023). Axillary temperature, however, is a suitable alternative to rectal temperature in anxious/stressed animals as it has been shown to be better tolerated, especially in cats (Smith et al. 2015).

Normal thermoregulation

Animals kept in an environmental temperature within their thermo-neutral zone do not need to expend their energy in thermoregulation. This zone in mammals is generally between 59 - 77°F (15 - 25°C); however, this varies based on breed, age, and activity levels. For example, brachycephalic breeds struggle to cool down when exercised in temperatures in excess of 63 - 68°F (17 - 20°C) due to their conformation, whereas Arctic breeds can tolerate much lower temperatures due to their coats. Neonates are unable to effectively thermoregulate and often require external warming aids during the first few weeks of life (Fitzgerald and Newquist, 2011).



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Hypothermia and its effects

Hypothermia is a common complication in critically ill animals and can impact survival due to its effect on multiple bodily functions. Primary hypothermia is due to low environmental temperature and secondary hypothermia is due to a failure in the animal's thermoregulation mechanisms, which may be seen following trauma, illness, or toxin exposure (Oncken et al. 2001). Depending on the severity of hypothermia, there can be significant effects on the major body systems. It can result in cardiac arrhythmias, reduced cardiac output, respiratory depression, and acute kidney injury amongst others (Brodeur et al. 2017). Drug metabolism and clearance are also affected due to reduced blood flow to the liver and kidneys (Brodeur et al. 2017).

Figure 3: *Cat recovering in a Vetario post routine spaying*

Figure 4: *A litter of puppies receiving warming treatment after being born by caesarian section*

Treatment of hypothermia

The immediate action once hypothermia is identified is to prevent further loss of heat (passive warming) by providing insulation, e.g., wrapping in blankets or drying fur if wet. The underlying cause of hypothermia should also be managed alongside warming to be most effective in improving the patient's condition. Warming an animal that is dehydrated or in hypovolemic shock could worsen their situation if fluid support is not also provided. It is important, however, to be aware of the differences between cats and dogs with shock. Unlike dogs, cats in hypovolemic shock tend to have a true or relative bradycardia with hypotension. Hypothermia in cats can interfere further with their ability to vasoconstrict and in turn increases their risk of volume overload (Murphy and Hibbert, 2013). Core warming can be initiated by using a fluid warmer to administer intravenous fluid therapy. Active warming adult animals in an incubator set to within their thermo-neutral zone (68 - 77°F or 20 - 25°C or) will provide further temperature support. Ideally, animals should be warmed at a rate of 1.8 - 3.6°F (1 - 2°C) per hour (Oncken et al. 2001). Incubator use in specific situations is described in further detail below.

Neonatal resuscitation and incubators

Resuscitation of neonates by veterinary staff is most commonly required post dystocia or caesarian section because the dam is often recovering from medical or surgical intervention. Hypothermia can negatively impact our attempt to resuscitate the neonates. Aside from the higher surface area, neonates haven't developed their shivering or vasoconstriction reflex for the first two weeks of life (McMichael, 2014). Immediately following birth, the neonate must be cleaned and dried vigorously with a towel to stimulate normal respiration (Traas, 2008). Once the neonate is moving and breathing well, it can be placed in an incubator set at a temperature between 86 - 89.6°F (30 - 32°C) (Fitzgerald and Newquist, 2011). Oxygen can also be provided within the incubator as neonatal hypoxia can occur as a consequence of anesthesia or prolonged labor. Excessive oxygen supplementation can result in blindness from retinal vaso-obliteration or an oxygen-induced retinopathy so should only be considered if individual neonates are unable to effectively ventilate. Hypothermia can result in gastrointestinal ileus so warming is important prior to providing nutrition. Neonates can be placed with the dam in recovery to suckle under supervision. For those that are unable to suckle, tube feeding is an option but should be performed with care and ideally by an experienced team member to avoid incorrect tube placement (Fitzgerald and Newquist, 2011). See references for further information on neonatal resuscitation.

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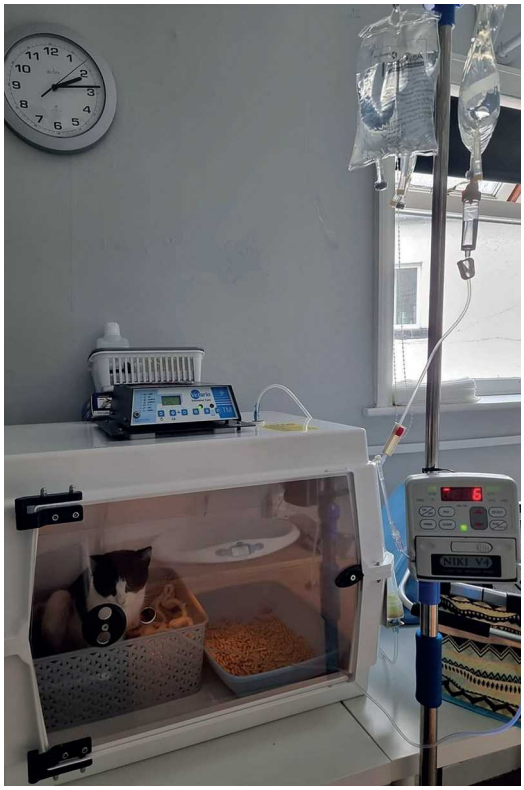

Figure 5: *Intravenous fluid therapy being administered to a cat while being treated in a Vetario for continued warming*

Figure 6: *A rabbit receiving warming treatment in a Vetario*

Post-operative hypothermia and incubators

During general anesthesia and surgery, animals can lose heat easily and hypothermia is a common complication that can significantly affect recovery times. Smaller animals have a larger surface area to volume ratio and are at higher risk of heat loss as a consequence. Hypothermia can reduce drug metabolism, result in coagulopathies, and increase the risk of surgical site infection (Armstrong et al. 2005). Warming aids should be used intra-operatively to reduce the incidence of postoperative hypothermia. Incubators can be used for smaller animals both pre- and post-operatively (de Vries and Putter, 2015). Forced air warming devices can be used in larger dogs. Close monitoring of body temperature must be performed during recovery, and active warming must be suspended once body temperature is 98.6°F (37°C) to avoid hyperthermia.

Traumatic injury and incubators

Following trauma, hypothermia is a negative prognostic indicator alongside coagulopathy, acidosis, and hypocalcemia, known as the trauma diamond (DeBot et al. 2022). These factors all have to be addressed and monitored immediately following presentation during stabilization. The incubator can be switched on while waiting for the patient to arrive to pre-warm. The animal should be triaged on arrival and covered in blankets to avoid further heat loss. Stabilization generally begins with intravenous fluid therapy, flow-by oxygen, and analgesia. Once the animal is stable and no longer requires close monitoring, they can be placed into the incubator for continued warming. As stated above, active warming should be suspended once body temperature is 98.6°F (37°C).

Rabbits and gastro-intestinal (GI) stasis

GI stasis in pet rabbits is a common presentation in emergency practice and can be primary or secondary to other causes. Although the underlying cause needs to be addressed, GI stasis needs to be concurrently managed to prevent further deterioration. Hypothermia at initial presentation has been demonstrated to carry a poor prognosis in these cases (Oparil et al. 2019). If a surgical obstruction is ruled out, medical management can be instituted with warmed intravenous fluid therapy, GI prokinetics, analgesia, assisted feeding, and warming (Oglesbee and Lord, 2020). An incubator is useful to provide a warm environment while treatment is continuing and facilitates active warming. GI ileus can be a consequence of hypothermia and as such, it is important to continue warming these patients until normothermic.

Humidity

Humidity for adult animals is, generally, set close to environmental levels between 40 - 50% at the author's institution. There is no specific evidence base in adult companion animals on the ideal setting required. These settings are maintained at similar levels when oxygen provision is required. If longer-term oxygen provision is required, humidified oxygen is provided via nasal prongs or cannulae to prevent hyperthermia (see below).

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Oxygen therapy

Animals in respiratory distress can be more challenging to manage as they require a quick approach, but extended handling can exacerbate their distress. Management and procedures may need to be staged with breaks in between to prevent this. Incubators can facilitate the provision of oxygen, similar to oxygen tents, while the animal is monitored in a hands-off approach. A key factor to consider, however, is that these animals can easily overheat in an enclosed environment, especially brachycephalic breeds. This is due to increased muscle activity from heightened respiratory effort and their inability to increase minute ventilation to dissipate generated heat. In this scenario, nasal prongs or cannulae may be preferable options for longer-term oxygen provision with humidification.

Figure 7: *A dachshund puppy recovered from multiple infections in a Vetario T50M*

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Acknowledgements

A special thanks to Dr. Stephanie Timmons MRCVS and
Dr. Neus Elias Santo-Domingo MRCVS
for their advice and assistance in writing this leaflet.



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