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Kelly qualified as a VN in 2001 and later completed the BSc top-up in veterinary nursing, gaining a first class honours degree. She has a keen interest in feline internal medicine and domestic animal behaviour. In 2005 she gained the Improve International Nurses Certificate in Animal Behaviour and in 2007 the Improve International Nurses Certificate in Advanced Anaesthesia. Kelly worked as a nurse, assessor and internal verifier in practice until 2008 when she left to pursue a career in teaching, and has since gained her DTLLS. Kelly recently returned to practice as a medicine nurse at the Queen Mother Hospital for Animals.

Hypothermia in Anaesthetised Rabbits

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ABSTRACT Many veterinary nursesencounter anaesthesia on a daily basis, and, as pet rabbits are the third most common pet in the UK (RSPCA, 2013), this may frequently include anaesthesia ofrabbits.It is therefore essential to consider the potential causes of hypothermia and the importance of monitoring body temperature during general anaesthesia. Nurses involved in providing the care required by these patients must be aware of the different methods available to prevent and correct hypothermia in anaesthetised rabbits.

Causes of hypothermia

It is considered normal for body temperature to decrease during anaesthesia if no control measures are used to prevent this (Sikoski, Young & Lockard, 2007). Monitoring hypothermia is an accepted, routine element of anaesthesia in all species, due to the cooling effects of inhaled gases and reduced muscular activity (Girling, 2003).

Self (2007)notes that many practitioners experience poor outcomes and high mortality rates when anaesthetising small mammals. Evidence of this appears in a study by Broadbelt (cited in Self, 2007) stating the 'risk of anaesthetic related death in rabbits to be 1 in 72'. Wenger (2012) and Self (2007) describe two main factors in this: stress on induction and increased risk of hypothermia, the latter being ascribed to a high surface area to volume ratio, allowing for more rapid loss of body temperature. Self (2007) also discusses the use of drugs that cause vasodilatation, and the depression of homeostatic mechanisms caused by anaesthetic agents.

Intramuscular (IM) administration of anaesthesia in rabbits is still commonplace, yet it is recognised that the IM route requires higher dosages compared with intravenous (IV) administration, and this causes slower recovery and increased hypothermic risks (Van Praag, 2003).

Rabbit body temperatures should be recorded before anaesthesia for baseline purposes. If hypothermic at this stage, correction prior to anaesthesia is necessary. Due to the known reduction in body temperature that occurs naturally with administration of anaesthetic drugs, failure to correct deficits initially would be considered dangerous for the patient (Girling, 2003).

Many anaesthetic candidates have fur removed and skin prepared with alcohol-based solutions. This aspect is discussed by Van Praag (2003), who states 'shaving and disinfecting should be minimal to avoid loss of body temperature' (**Figure 1**).

Importance of monitoring body temperature

Rabbit body temperature should be maintained at 39.0°C throughout anaesthesia and recovery (Flecknell, 2000; Self, 2007; Wenger, 2012).Hypothermia during anaesthesia can result in circulatory or respiratory collapse as well as increased recovery times and post-operative inappetence (Self, 2007).

Accurate measurements of body temperature must be obtained and rectal thermometers are effective in achieving this. Girling (2003) and Van Praag (2003) also discuss the use of a 'thermo-sensor inserted deeply in the rectum'. It is important to remember that **hyperthermia** can be irreversible and as critical as hypothermia itself, highlighting the importance of monitoring body temperature whilst using warming methods (Girling, 2003).

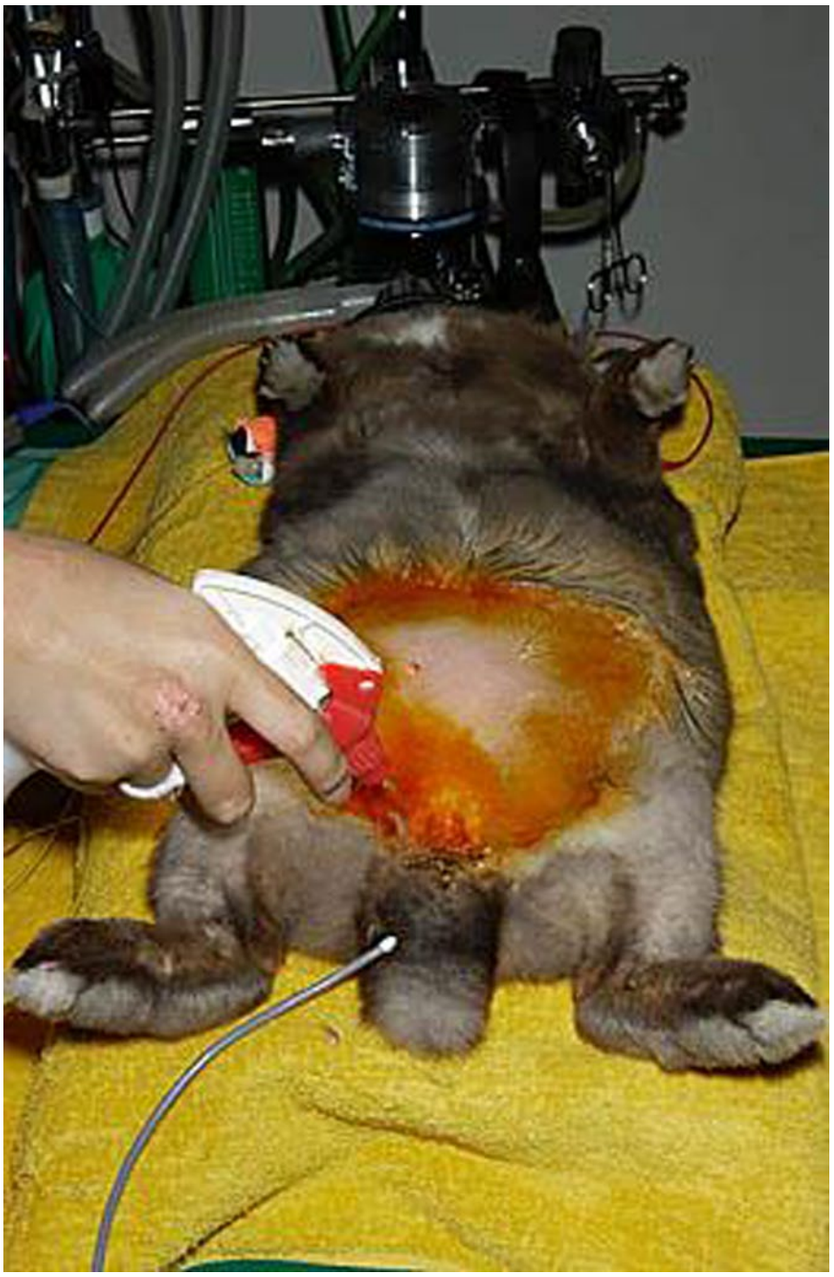

Figure 1. Disinfecting should be minimal if possible and excessive alcohol use avoided

Prevention of hypothermia

Removal of minimal fur whilst achieving asepsis is advocated (**Figure 2**), and excessive use of skin disinfectants/surgical spirit should be avoided (Flecknell, 2000; Girling, 2003). It is documented (Self, 2007) that clipping surgical sites can be undertaken prior to induction and using warm scrub solutions is beneficial to patients in preventing hypothermia. Body temperature can be maintained using external heat sources such as warming blankets. Wenger (2012) discusses the importance of external heat sources and how they should be provided throughout anaesthesia and until the patient is fully recovered.

Ensuring that the ambient room temperature is at the warm end of comfortable is a basic yet reliable addition to protocol (Girling, 2003). Turning off air-conditioning units and allowing recovery in warm, draft free areas of the surgery is essential post-operative care.The ideal ambient recovery temperature for rabbits is 32.0°C and this should be increased to 35-36.0°C if the patient remains unconscious for a prolonged period of time (Self, 2007). The ideal ambient temperature for the operating theatre is described by McHugh, Young and Johnson (2011) asbeing between 15 and 20°C, highlighting the different temperature requirements in theatre and recovery.

The use of Bair huggers, which circulate warm air close to the patient via a blanket, is considered good practice, whereas use of direct heat (hot water bottles) is controversial due to the potentialfor burn injuries (McHugh et al 2011) and should only be considered as a last resort. Self (2007) discusses the use of heat lamps and warm water bottles, but warns of potential injuries and the need for constant monitoring. It is considered bad practice for rabbits to be placed directly onto cold metal operating tables (Flecknell, 2000).

Bubble wrap is inexpensive and easy to obtain and is widely advocated to reduce risks of hypothermia. Flecknell (2000) and McHugh et al. (2011) discuss using bubble wrap to preserve body heat successfully. Self (2007) describes wrapping the entire body of the patient in bubble wrap immediately once anaesthetised; holes can be cut in the material allowing for clean, accessible surgical fields. If wrapping the entire body is impractical or resources are limited, patient limbs only can be wrapped, as this is also considered to be highly effective in maintaining core body temperature (Self 2007).

Administration of warmed isotonic fluids is advised prior to and during anaesthesia to assist in maintenance of body temperature and this is discussed by Girling (2003), Fisher (2010) and McHugh et al. (2011) (**Figure 3**).Use of subcutaneous fluid therapy in cases where only maintenance fluids are required and there is no fluid deficit, has been advocated by both Girling (2003) and Orcutt (2005), who observes that subcutaneous fluid administration is often well tolerated by rabbits.

A study by Sikosiet al. (2007) determined that forced-air warming devices (Bair huggers) and circulating warm water blankets were effective in maintaining normothermia. When no external heat sources were applied, rabbit body temperature decreased, highlighting the importance of such devices. The study revealed that the use of a circulating warm-water blanket could also increase body temperature if desired.

Figure 2. Shaving should be minimal to help avoid loss of body temperature

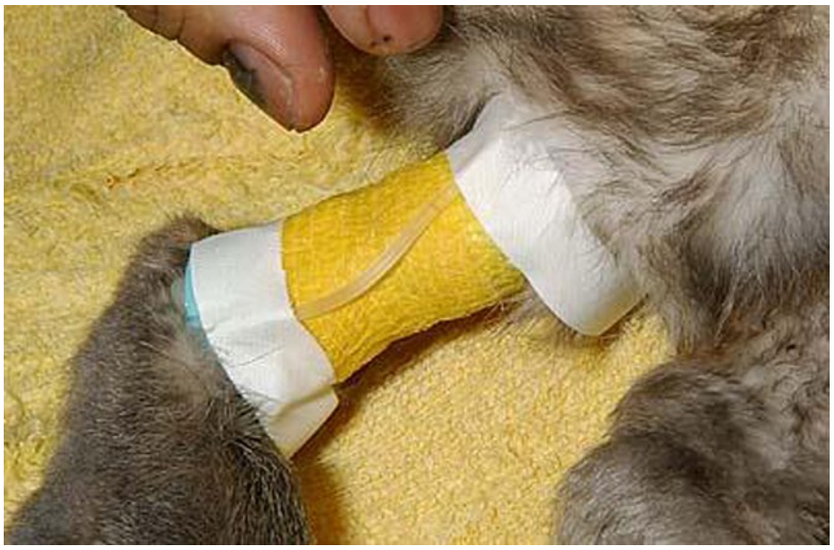

Figure 3. The administration of warmed, isotonic fluids are useful to help maintain body temperature

Current literature in the human medical field reiterates that forced-air warmers are the most effective means of warming patients. It is also suggested that these devices should be used pre-operatively as well as intra-operatively. This is because intra-operative warming does not prevent the initial fall in body temperature that is often seen when anaesthetic drugs are administered (Hart, Bordes, Hart, Corsino, and Harmon. 2011).

Conclusion

Serious problems can arise if body temperature is not adequately monitored before, during and after anaesthesia. Many preventative actions can be taken to control the severity of body temperature decline but external heating devices are necessary to maintain body temperature successfully in anaesthetised rabbits. Circulating warm water blankets are particularly indicated in cases of pre-anaesthetic hypothermia.

Ascertaining if the patient is hypothermic prior to administering an anaesthetic is good practice, as is the provision of pre-operative warmth to all patients, even those that are normothermic prior to induction. Further research may be beneficial in ascertaining the exact advantages of this in specific relation to rabbits but may well assist in minimising the risk of temperature decline following anaesthesia induction.

Practices that routinely accept rabbits for anaesthetic procedures should ideally invest in heating equipment, such as Bair-huggers and circulating warm water blankets,as these are documented to be of benefit, especially as this equipment is not species specific.

Acknowledgements

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