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Heatstroke in rabbits

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The rabbit is sensitive to heat and insolation, that is a too long exposure to heat and sun.

The wild European rabbit (*Oryctolagus cuniculus*) spends a great deal of time below ground. Environmental conditions inside the burrow remain fairly constant, with temperatures varying between 15-20°C/59-68°F and a humidity percentage ranging between 70 and 90%. Seasonal weather changes do not appear to affect rabbit skin temperature, which is constant year-round (Fayez et al., 1994). This is partly due to the adaptation of fur density to seasonal changes: the fur is thicker and denser in winter, thinner and sparser in summer. When temperatures change suddenly or when the temperature is higher than 28°C/82.4°F, for instance during a transport in a hot car or in a sunny environment without the possibility to get into the shade,

Figure 1: Too warm !!! Two year old female rabbit and orphan 4 weeks old rabbit enjoying the air flow of a ventilator while outside temperature is over 40°C/104°F).

like a pen placed in a sunny garden, rabbits can suffer from heat stroke (Figure 1).

Natural acclimatization mechanisms

Like many mammals that do not have sweat glands, rabbits have a few assets to adapt to high temperatures (Caputa et al, 1976a, b; Cheeke et al., 1982; and Fayez al., 1994; Johnson, 1980; Muller et al., 2001; Shafie et al, 1982). Different organs are involved in the regulation of body temperature when the ambient temperature is high:

- The sinuses contain an extensive system of lamellae that are filled with a large number of arteriovenous anastomoses and are drained via numerous small blood vessels (Bugge, 1968; Godynicki, 1975). The passage of respiratory air through the lamellae contributes to the cooling of the blood. This system works well in medium and large rabbit breeds, but not in dwarfs.
- Hyperventilation or increased breathing rate while decreasing the volume of inspired air (thermal polypnea) helps humidify the air in the lungs and, thus, to lower the body temperature (Figure 2).
- The ears help regulate body heat. The ear pinnae contain a complex and dense network of blood vessels and arteriovenous anastomoses that cool the blood through vasodilatation (Morris and Bevan, 2005). When the ambient air temperature is too warm for the rabbit, but still below the rabbit's body temperature (39.5°C/103.1°F), cooling of the blood, and thereby the body temperature, through convection heat transfer, radiation, and evaporation is

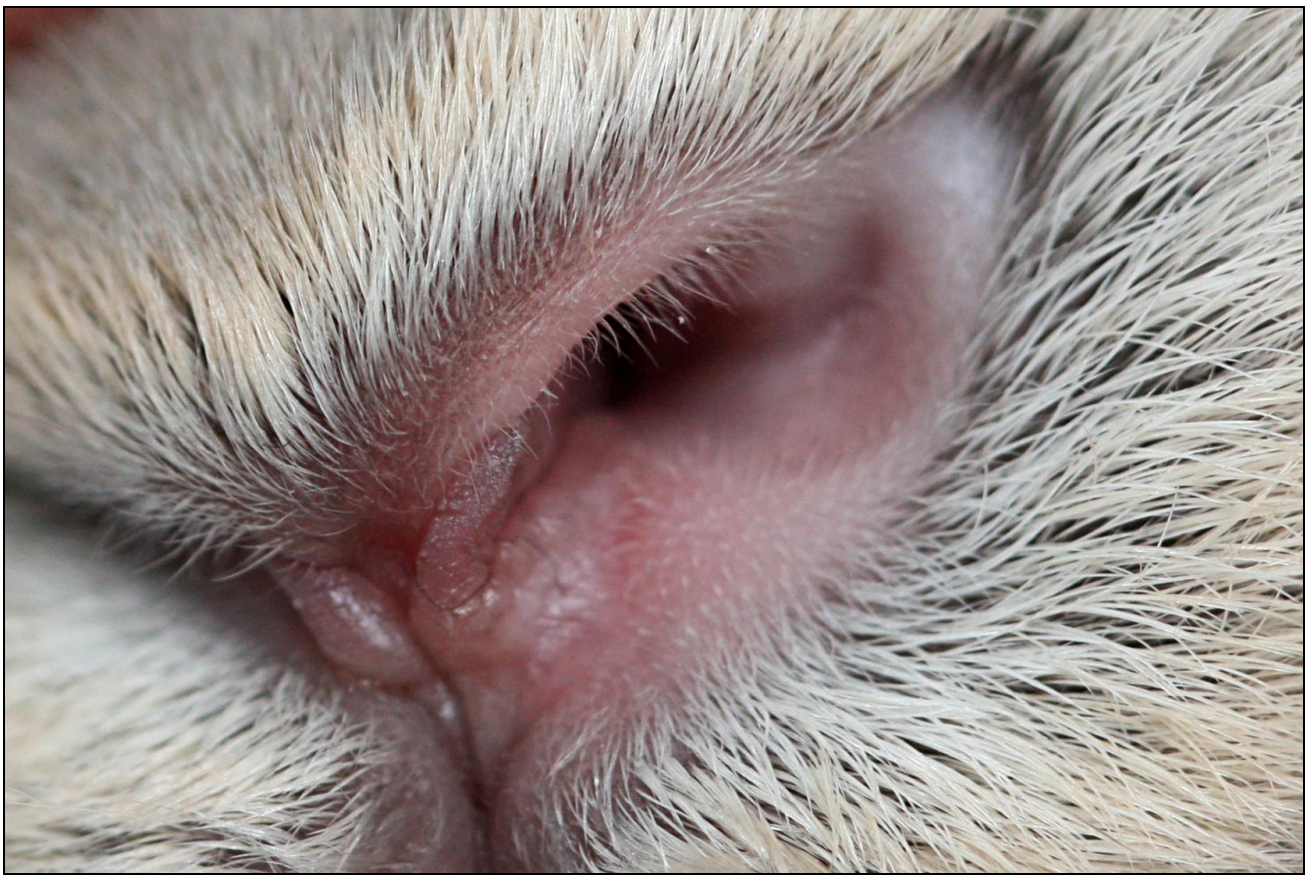

Figure 2: Condensation droplets appear on the hairs surrounding the nasal cavity and on the philtrum.

possible by keeping the ears erect and moving them slowly back and forth.

- An anastomotic system of arteries located at the base of the brain (circle of Willis) allows the transfer of heat by means of conduction between the internal carotid arteries, which contains warm blood, and the basal venous sinus, which drains blood that was cooled during its passage through the mucosal tissue of the upper respiratory system.

Unlike many carnivores and ruminants, the maxillary arteries do not participate in the cooling of blood in lagomorphs. When the temperature exceeds 39°C/102.2°F, these cooling mechanisms do not help anymore and the rabbit begins to suffer from hyperthermia. Female rabbits that are about to give birth are more susceptible to heat stroke (Hagen et Lund, 1963).

Some species of wild lagomorphs have undergone further adaptations for survival in hotter or colder areas (Stevenson, 1986). This is clearly evident in the dimensions of the ears. Hares living in cooler or mountainous regions (e.g. *Lepus timidus, Lepus arcticus, Lepus americanus*) have small ears, whereas hares that live in desert regions (e.g. *Lepus californicus, Lepus alleni, Lepus capensis*) have oversized ears (Figures 3, 4).

The ear size and form of middle-sized and giant breeds correspond to their function (Figure 5). Dwarf and lop-eared rabbits have, however, been selectively bred for their unusually small sized or shaped ears in disregard of function, which has resulted in an inefficient ear cooling system. These rabbits are thus at risk of developing hyperthermia in warmer weather when not provided a cool environment.

Figure 3: A young Californian hare (*Lepus californicus*) with oversized ears that enable to survive in the desert.

Helping a rabbit on hot days

To relieve and help the metabolism of the rabbit on hot days, it is possible to provide plants or medicinal/aromatic herbs like lemon balm (*Melissa officinalis*), common sorrel (*Rumex acetosa*), strawberry leaves (*Fragaria* sp.) of plantain (*Plantago major*) to obtuse or dock leaves (*Rumex obtusifolius*) (Glauser, 2012).

Figure 4: A Californian leveret (*Lepus californicus*) is born with huge ears. The latter are richly vascularized, which helps to regulate body temperature.

Clinical signs of hyperthermia

When the body temperature of a rabbit increases, the oxygen consumption increases. Breathing becomes rapid (tachypnea) and heart rate increases (tachycardia). Water droplets - formed by condensation, may appear on the periphery of the nostrils and the philtrum (Figure 2). It is accompanied by a serous nasal secretion. Rabbits suffering from hyperthermia are listless, have cyanotic mucosa and bloody secretions from the nose and mouth. When the rabbit does not respond to external stimuli, the situation becomes critical and it must be taken ASAP to a qualified veterinarian in veterinary emergency.

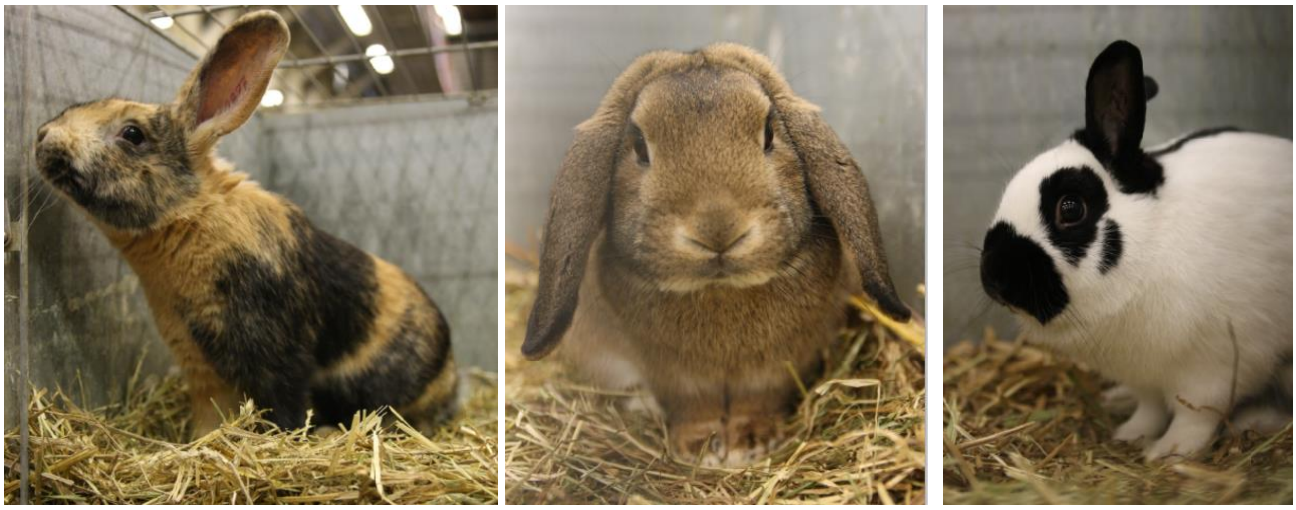

Figure 5: The size and position of the ears in a middle sized harlequin breed rabbit with erect ears, a lop rabbit and a dwarf rabbit.

Treatment

Heat stroke is a medical emergency. The affected rabbit must be placed in a calm, cool and airy room. Regular humidification of the ears with lukewarm water helps regulate body temperature when the ambient environment is warm. A bottle with ice water wrapped in a towel can be placed against the rabbit. In extreme cases, a damp cloth can be placed on the animal. In this case, it must be ensured that the body temperature does not drop too quickly, which may lead to hypothermia. If the rabbit is dehydrated, it needs fluids administered by perfusion, e.g. a saline NaCl 0.9% solution. Hypo-osmolar solutions such as Ringer's lactate should be avoided because they can worsen brain swelling. Immersion of the body of the rabbit in cold water should be avoided. This method certainly helps to lower the body temperature quickly, but side effects such as heart arrhythmia or cardiac arrest are common. The rabbit must remain under continuous monitoring during the days following the heat stroke or sunstroke.

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