

Heatstroke in Dogs

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Heatstroke is one of the most frightening emergencies a canine owner can ever confront. Understanding the risk factors, and the prevention and treatment of this serious medical condition may be life saving.

Definition

“Heatstroke is a rapidly progressive life threatening emergency resulting from direct thermal injury to cardiovascular, gastrointestinal, renal, hepatic, endothelial, musculoskeletal and central nervous tissues.”

Compendium of Continuing Education June 2003.

Temperature Parameters

- **Normal** canine rectal temperature is 101.0- 102.5° F
- **Hypothermia** = rectal temperature less than 98.0 °F
- **Hyperthermia** = rectal temperature 102.0-108.0 °F
- **Heatstroke** = rectal temperature greater than 105.8 accompanied by central nervous system dysfunction

Classification of Heatstroke

Classic heatstroke

Classic heatstroke is also known as **environmental heat stroke**. The cause is exposure to prolonged conditions of high heat and humidity.

Exertional Heatstroke

Exertional heatstroke is due to intense exercise. Exertional heatstroke can occur at any environmental temperature. It has been reported in sled dogs running at subzero temperatures on sunny days. It has also been reported in cases of intoxication with poisons such as strychnine or metaldehyde (snail bait), which cause seizure activity. Uncontrolled seizures can also lead to exertional heatstroke. In dogs with laryngeal paralysis or other impairments that compromise the ability to pant (ie get rid of excess heat generated), exertional heatstroke can occur with mild to moderate exercise.

How Heatstroke Occurs

Heat is a by-product of muscular contraction. About 75-80% of the energy used during exercise is converted to heat. Excess body heat is generated during vigorous exercise. Dogs, not having sweat glands (except in their feet), dissipate excess heat by evaporation through their respiratory tract. If heat production is greater than loss, body temperature will rise. Heatstroke occurs when the compensatory mechanisms to deal with excess body temperature are inadequate.

Higher Normal Temperatures for Working Dogs

There are a number of scientific studies comparing the body temperature, heart and respiratory rates of working dogs to household pets. One interesting finding is that canine athletes can perform their designated activity or job with an elevated body temperature and not exhibit signs of heatstroke or heat exhaustion.

In his newsletter, *The Athletic and Working Dog*, Dr. Robert Gillette reports the vital signs for dogs engaged in different levels of athletic activities.

- 🐾 Greyhounds, considered sprinters, had temperatures ranging from 104-106°F
- 🐾 Racing Labrador Retrievers, considered intermediate athletic performers, had temperatures between 102-107°F while hunting.
- 🐾 During a long race, sled dogs, the endurance athletes of the dog world, often had temperatures between 104-108°F

Risk Factors

Several factors, individually or in combination, have been associated with increased risk of developing heat stroke.

1. **Obesity** - according to one retrospective study, 82% of obese dogs with heatstroke died
2. **Brachycephalic breeds** – for example Pugs, Boston Terriers, English Bulldogs, and other short nose dogs
3. **Environmental conditions** - on the day of a heatstroke incident the temperature is usually higher than average, humidity is a contributing factor as is previous conditioning or exposure to high temperatures (for example vigorous exercise on the first warm day of Spring may be more likely to lead to heat stroke than on a similar day in the summer)
4. **Fatigue** - if an animal has been working for an extended period of time or on successive days, they are not moving as efficiently and have to work harder to perform the same job.
5. **Dark coat color** – sunlight is absorbed rather than reflected as with lighter hair coats
6. **Weight** - greater than 66 pounds (30 kg), not associated with obesity
7. **Previous episodes of heat exhaustion** – dogs that have experienced severe heat stress appear to be less tolerant of subsequent heat stress. (personal communication Arleigh Reynolds, DVM, PhD)
8. **Muzzling** – decreases a dog's ability to pant

Clinical Signs

1. **Rectal temperature** > 105.8 degrees F (may be lower if treatment is in progress)
2. **Fast heart rate** >120 beats per minute, with possible irregular heart beats
3. **Excessive panting**
4. **Mucous Membranes** – dark red, capillary refill time often < 1 sec
5. **Pulses- weak**
6. **Collapse**
7. **Central nervous system abnormalities** such as disorientation, coma, or seizures
8. **Bruising** - check the non-haired areas of skin such as the abdomen, ear flaps, or mucous membranes of the oral cavity
9. **Bloody diarrhea or Vomiting**
10. **Drooling**
11. **Laboratory abnormalities** including low blood sugar, abnormalities in the complete blood count, liver enzymes, kidney function tests and clotting tests

Treatment

1. **Early intervention**

- a. The longer the patient is exposed to high temperatures and the higher the body temperature, the poorer the chances are of recovery.
- b. If you think a dog may be in heatstroke, don't wait! Check temperature and heart rate

2. **Cool the patient with cool or tepid water, *not cold water***

- a. Transfer of heat from the body core to the environment takes place via blood flow through skin and extremities. Cold water causes peripheral blood vessels to constrict, (vasoconstriction), which will reduce the transfer of heat out of the body.
- b. Since conduction of heat from the body core to the environment is dependent on good blood supply to the skin and extremities, it is thought that cold water immersion will decrease blood supply to the skin making the skin an insulator instead of a conductor of heat causing the core temperature to ***actually rise***.
- c. Cold water also may cause the patient to shiver. Shivering generates heat, making it counterproductive to cooling efforts.
- d. In a field situation spraying a patient with cool or tepid water and placing them in front of fans or in air-conditioning prior to transport to a medical facility may be life saving. ***Evaporation of cool/tepid water and the conduction of heat from the body is the preferred treatment for all patients.***
- e. Some veterinary sources recommend a goal of decreasing body temperature one degree per hour, others suggest a faster rate.

3. **Monitor body temperature**

- a. Discontinue cooling when the rectal temperature reaches 103.0 degrees F. Body temperature continues to drop for a while beyond cooling treatment.
- b. If the temperature drops below 101.0 degrees F, the patient may become hypothermic and need re-warming

4. **Cooling by Other Means**

a. *Alcohol*

- i. Isopropyl alcohol has been used in the past for its evaporative property and ability to cause blood vessels to dilate. In human pediatric medicine it has fallen out of favor because it can cause toxicity if used in large amounts.
- ii. If used it should be applied in small amounts to the hairless parts of the body such as the armpits, ear flaps, abdomen and inner thighs using a cotton ball or gauze pads.
- iii. Alcohol has a noxious smell which may be stressful to some dogs and is painful if applied to cuts or abraded skin.

b. *Cold water enemas*

- i. Cold water enemas may not be effective and can hinder accurate monitoring of rectal temperature
- ii. Cool and cold water enemas have fallen out of favor as they cause vasoconstriction within the gastrointestinal tract, potentially causing serious complications and the worsening of GI signs

- c. ***Aspirin-like products***
 - i. Aspirin and other non-steroidal anti-inflammatory drug products are contraindicated.
 - ii. In normal circumstances they can be used to lower a fever but in heatstroke the mechanism responsible for the increased temperature is different from the mechanism that causes fever

 - d. ***Fluids***
 - i. Intravenous fluids are the preferred treatment to correct dehydration associated with heat stroke
 - ii. If the animal is in shock, intravenous fluids are the only recommended route of fluid administration
 - iii. Subcutaneous may be used in an attempt to help correct dehydration, especially in mild cases and if a means to provide intravenous fluids are not readily available
5. **Transport to a veterinary facility** for further evaluation and care ASAP but ***after emergency care in the field has been initiated*** by cooling, as described above.
- a. In one retrospective study by Bruchin et al, the overall mortality (fatalities) of heatstroke patients was 50%.
 - b. This study also noted 100% of heatstroke dogs survived that had been cooled by their owners and transported to a veterinary hospital within 90 minutes of the onset of clinical signs.

*Note on Treatment in the Field

The personnel on scene in any emergency determine the risk–benefit assessment associated with the patient. These treatment recommendations are guidelines based on such an assessment. The patient’s condition, medical personnel level of skill and experience, available resources, and other circumstances leave room for judgment calls by the treating personnel.

Prevention

“During prolonged periods of exercise in warm and humid environments, heat dissipation leads to a decrease in total body water and plasma volume. Approximately 60% of the heat dissipated during exercise is lost through fluid evaporation from the upper respiratory tract. Exercise in very cold, dry environments also increases evaporative fluid losses. Significant fluid loss during exercise may impair performance. Several studies indicate that hydration is the single most important determinant of endurance capacity.”

*“The Canine Athlete” in Small Animal Clinical Nutrition
by Philip W. Toll and Arleigh J. Reynolds*

1. **Hydration, hydration, hydration** - Frequent and adequate hydration can not be overstressed.

a. **Oral water intake** - to calculate the water intake of a dog on an average day for maintenance, use the following formula:

Water intake in milliliters should be about 30 x the body weight in kilograms (one kg equals 2.2 pounds) + 70. (*Dr. Carol Foil, The Dermatology Notebook Veterinary Information Network, 2002*).

A 50 pound dog weighs 22.7 kg. The daily water intake of that 50 pound dog is 30 x 22.7 + 70 or 751 ml.

If one cup of water is approximately 250 ml, a 50 pound dog needs a minimum of 3 cups of water per day to just survive.

The *North American Companion Animal Formulary, sixth edition (2004)* has a chart for determining daily water and calorie requirements for dogs. Their chart states the requirements are somewhat higher at 1149 milliliters or about 4 ½ cups per day. *These are just guidelines.***

**A working dog will need to fill his maintenance requirement plus extra amounts commensurate with his size, the work he is doing, the temperature he is working in, and for how long he is working.

**Encourage water drinking. Teach the dog to drink water when it is offered. One can also bait the water with treats or a palatable flavor.

b. **Oral electrolyte solutions**

- i. The electrolytes sodium, potassium and chloride are important in maintaining normal muscle and nerve function
- ii. Dogs do not sweat like humans and other species. They cool by conduction of heat directly off the body surface as well as by panting.
- iii. Panting is an evaporative process causing water loss. Panting for an extended period of time may cause the disproportionate loss of more water from the body than electrolytes. The supplementation of electrolytes that are not needed may be eliminated through the kidneys as long as the kidneys are functioning properly.
- iv. In some heat stroke patients, kidney function may be compromised (severe dehydration, heat damage to cells) causing electrolyte levels to rise higher than what is healthy.
- v. Supplementing healthy working dogs with oral electrolyte solutions is generally felt to be of questionable value and may be counterproductive if given to a dog that may be already dehydrated from excess panting.
- vi. ***Dogs that drool a lot while working may be an exception*** as they can lose a significant amount of sodium, chloride and bicarbonate in the excess saliva they generate. These individuals may benefit from electrolyte supplementation.

- c. ***Subcutaneous (SQ) fluids***
 - i. The benefits of SQ fluids as a preventative are unknown. It is suspected that the amount of SQ fluids needed to be effective in preventing heat stroke would be large, adding weight and possible discomfort to the canine.
 - ii. The decision to give SQ fluids should not preclude continuous monitoring of the canine for signs of dehydration (elevated temperature, elevated heart rate, excessive panting), and encouraging them to drink water.
 - iii. Be aware that if subcutaneous fluids are used in a highly contaminated work environment, care must be exercised to prevent infection such as cleaning the needle-site area and using aseptic technique
 - iv. How effective giving SQ fluids to an already well hydrated canine in an effort to prevent heatstroke is unknown and warrants further scientific investigation.
2. **Topical cooling** - Topical cooling can be achieved by a variety of simple measures.
 - a. A garden sprayer used to wet the coat before, during and after exercise is very effective at helping with evaporative cooling. Hose the dog with cool water if it is available.
 - b. A child's plastic swimming pool to step and/or lie down in.
 - c. Cool vests - The *Whole Dog Journal* in their August 2007 publication evaluated six cool vests and did not give high marks to any of the commercially available, reasonably priced vests.
 - d. Cool mat for a crate - As the ambient temperature rises, the mat takes on the ambient temperature, especially if left in a crate in a warm vehicle. These mats need to be frequently cooled to be effective.
 - e. Vehicle fans – these help maximize heat loss
 - f. Covering a dog with a towel or cloth soaked in cool water decreases heat loss through conduction and is inadvisable. Intermittent removal will allow for radiant heat loss.
3. **Shade** - including reflective tarps
4. **Larger crates** - larger more open crates provide better ventilation and allow the dog to stretch out and assume a more thermoregulatory efficient position
5. **Train in hot, humid conditions** - Acclimating to hot and humid weather with a training program that prepares the canine for working in these adverse conditions will produce a working dog better able to handle these conditions.
6. **Frequent rest periods**
7. **Fatigue Prevention** - Dr. Gillette, in the November 2006 newsletter of *The Athletic and Working Dog*, recommends using a 50% solution of dextrose at a dose of 10 milliliters per 60 pounds or a water sugar supplement (mix four cups of sugar per gallon of water) at regular intervals during strenuous exercise to maintain energy levels.

Conclusion

In summary, heatstroke is preventable with good management of the working canine in hot environments where they are required to perform a strenuous activity. If heatstroke does occur, early intervention and appropriate care is key to their survival. Having a canine that is fit and has been acclimatized to the conditions it will be working in as much as possible is also of the greatest importance in preventing this medical emergency.

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