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## Increased Mortality in Gray Wolves Captured with Acepromazine and Etorphine Hydrochloride in Combination

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Free-ranging gray wolves (*Canis lupus*) have been immobilized successfully with phencyclidine HCl (Sernylan®, Bio-ceutic Laboratories, Inc., St. Joseph, Missouri 64502, USA), ketamine HCl (Vetelar®, Parke-Davis Co., Detroit, Michigan 48232, USA), and etorphine HCl (M-99, D-M Pharmaceuticals, Inc., Rockville, Maryland 20850, USA), from a helicopter and after trapping (Seal et al., 1970, *Int. Zoo. Yearb.* 10: 157-170; Ballard et al., 1982, *J. Wildl. Dis.* 18: 339-342). Frequently, the use of immobilizing drugs is supplemented with tranquilizers to reduce excitability or convulsions during immobilization. This report examines the deaths of four wolves following immobilization with a combination of etorphine HCl (EH) and acepromazine (Acepromazine, Ayerst Laboratories, Inc., New York, New York 10017, USA) (AP) delivered from a helicopter.

All wolves were immobilized with either 2.5 mg EH or a combination of EH and 5 mg AP administered in 3 ml darts fired with a Cap-Chur gun (Palmer Chemical Equipment Co., Douglasville, Georgia 30134, USA) from a helicopter (Ballard et al., 1982, *op. cit.*). Mortality rates of wolves immobilized with either EH or EH/AP

were compared with those immobilized with phencyclidine HCl and promazine HCl (Sparine®, Wyeth Laboratories Inc., Philadelphia, Pennsylvania 19105, USA) (PP/HCl). All wolves were captured in the Susitna and Copper River Basins, an area which has been thoroughly described elsewhere (Skoog, 1968, *Ecology of the caribou (Rangifer tarandus granti)* in Alaska, Ph.D. Thesis, Univ. California, Berkeley, California, 699 pp.; Bishop and Rausch, 1974, *Nat. Can. (Que.)* 101: 559-593; Taylor and Ballard, 1979, *Proc. 15th N. Am. Moose Conf. Workshop*, Kenai, Alaska. pp. 169-186).

During the period 1982-83, 27 wolves were immobilized with the EH/AP combination. Of that total, four (15%) died immediately after immobilization. A juvenile female immobilized within 2 min after an injection of EH/AP with a total chase time of 20 min died in 5 min. A thermometer was not available, so exact body temperature was unknown, but it appeared elevated based on physical examination. Onset of rigor mortis was rapid, also indicating an elevated body temperature. An adult female receiving the same combination of drugs was immobilized within 4 min of drug injection. Chase time was 30 min. During anesthesia, the wolf had severe convulsions and died within 15 min. Rigor mortis also occurred

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rapidly in this wolf. Circumstances surrounding the other two deaths were similar.

At necropsy, both wolves had extensive areas of subcutaneous hemorrhage along the head, neck, abdomen, and extremities. The adult female had epistaxis before death. The intercostal muscles of the juvenile had extensive hemorrhage. In both wolves, the lungs were hyperemic, the spleen was contracted, and the urinary bladder was empty. There was hemorrhage in the interstitial connective tissue of the main muscle masses of the trunk and limbs. Both wolves had considerable amounts of pericardial, perirenal and omental fat and appeared in good physical condition with no evidence of prior debilitating injuries.

Histopathologic examination of selected tissues from the adult female indicated severe acute congestion of lungs, liver and kidneys. Necropsy and histological results were consistent with those of hyperthermia and shock.

Two of the four wolves that died received second injections of EH/AP because they did not respond to the first injection. Both ran long distances for up to 1 hr. Wolves captured with the use of other drug combinations also occasionally required second injections and were chased long distances, but deaths were not observed (Ballard et al., 1982, op. cit.). All four wolves that died were females, one of which was pregnant. All deaths occurred when capture operations were conducted in the spring or fall when ambient air temperatures ranged from  $-4\text{ C}$  to  $7\text{ C}$ .

The number of wolves that died after immobilization with EH/AP were compared with the number that died after immobilization with EH alone and PP/HCl in combination. Mortality rates were significantly higher ( $P < 0.05$ ) with EH/AP (4 of 27) than with either EH ( $\chi^2 = 5.5$ , 1 of 55) or PP/HCl ( $\chi^2 = 10.1$ , 0 of 65). There was no difference ( $\chi^2 = 1.2$ ,  $P > 0.05$ ) in rates between EH and PP/HCl.

Drug selection is extremely important in the capture of free-ranging wildlife. Ideally, drugs that rapidly immobilize the animal without increasing the severity of capture myopathy (CM) must be selected. This is especially important for wolves because a second dose is often given if they do not respond to the first. EH is a morphine derivative capable of producing rapid immobilization at low doses. After an excitatory phase, it produces a state of analgesia and catatonia with resulting respiratory depression, hypertension, and other adverse side effects (Soma, 1971, Textbook of Veterinary Anesthesia, The Williams and Wilkins Co., Baltimore, Maryland, 621 pp.). AP is a phenothiazine tranquilizer that was chosen to reduce the excitatory phase of EH anesthesia. However, AP also produces hypotension and depression and disturbs the hypothalamic regulatory process that results in either hypothermia or hyperthermia depending upon environmental conditions (Goodman and Gillman, 1970, the Pharmacological Basis of Therapeutics, 4th Ed., The MacMillan Co., New York, New York, pp. 155–169).

EH contributes to the etiology of acute shock and hyperthermia by causing respiratory depression. Heat exchange through respiration is extremely important in canine species, and the use of EH elevates body temperature after periods of muscular activity. However, use of EH alone has not resulted in high mortality (Ballard et al., 1982, op. cit.).

Heat exchange may be compromised further by employing AP in combination with EH because of disrupted hypothalamic temperature regulation. Wolf mortalities reported here probably resulted from thermoregulatory disruption and hyperthermia, a state that homeostatic mechanisms could not overcome, and death resulted. These observations are consistent with those of fatal malignant hyperthermia observed in fallow deer (*Dama dama*) immobilized with this com-

bination of drugs (Pertz and Sundberg, 1978, *J. Am. Vet. Med. Assoc.* 173: 1243).

Another possible diagnosis for the deaths of these four wolves was peracute CM. However, failure to obtain skeletal muscle and blood for histopathologic and serum chemistry examinations precluded confirming this diagnosis. CM accompanying capture stress is well documented in free-ranging ungulates (Chalmers and Barrett, 1982, *In Noninfectious Diseases in Wildlife*, Hoff and Davis (eds.), Iowa State Univ. Press, Ames, Iowa, pp. 84-94) but has not been reported in wild carnivores. All four wolves died immediately after anesthesia, a finding which is consistent with death from hyperacute and acute forms of CM, in which shock, acidosis, and hyperthermia are primary components. Because of frequent physical exertion necessitated by their predatory behavior and their physiological adaptation to it, wolves may not be as susceptible to the less acute forms of CM observed in ungulates.

In conclusion, our experience suggests

that EH in combination with AP should not be used for capturing wolves from a helicopter during periods of high ambient air temperatures. This drug and dose (2.5 mg EH/5 mg AP) combination resulted in a significant increase in capture mortality during these periods. Conceivably, the same thermoregulatory disruption could also occur at very low temperatures. EH alone, or possibly in combination with a different, less potent phenothiazine tranquilizer, appears satisfactory for immobilizing wolves from a helicopter during these periods.

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## **Hematologic and Serum Chemical Values for Free-ranging Bobcats, *Felis rufus* (Schreber), with Reference to Animals with Natural Infections of *Cytauxzoon felis* Kier, 1979**

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There is little information available on hematologic and serum chemical values for free-ranging felids. As a portion of a separate study, 16 free-ranging bobcats were live-trapped in Oklahoma. Animals were immobilized with ketamine hydrochloride (20 mg/kg) (Bristol Laboratories, Syracuse, New York 13201, USA) within

24 hr of capture. Blood samples were obtained from the jugular vein and placed into vacutainer tubes containing EDTA(K<sub>3</sub>) and vacutainer tubes without anticoagulant. Hematologic values determined included total red blood cells, packed cell volume, hemoglobin, total leukocytes and differential leukocyte counts. Serum chemical values determined were blood urea nitrogen, albumin, globulin, calcium, creatine, glucose, mag-

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