Journal of Wildlife Diseases, 24(4), 1988, pp. 691–694

The Use of Meperidine Hydrochloride for Chemical Restraint in Certain Cetaceans and Pinnipeds

Brian E. Joseph[1,2] **and Lanny H. Cornell,**[1,3] [1] Sea World, Inc., 1720 South Shores Road, San Diego, California 92109, USA. [2] Present address: Chicago Zoological Society, 3300 Golf Road, Brookfield, Illinois 60513, USA. [3] Present address: Pacific Research Laboratories, P.O. Box 1877, El Cajon, California 92022, USA

ABSTRACT: Meperidine HCl was administered intramuscularly by hand-syringe to a number of individuals representing several species of cetaceans ($n = 95$) and pinnipeds ($n = 36$). Dosage administered was 0.11 mg/kg, 0.23 mg/kg or 0.45 mg/kg, with the majority of animals receiving the middle dosage. Meperidine HCl provided moderate restraint in cetaceans without obvious deleterious effects. Restraint was achieved rapidly, with maximum effect occurring 20 min after intramuscular injection and lasting for 2 to 3 hr. Analgesia appeared to last as long as 4 hr and was sometimes accompanied by a restoration of appetite in animals suffering from physical discomfort. Higher doses produced increased sedation and analgesia without noticeably depressing respiration. Meperidine HCl provided moderate restraint for phocids and walrus (*Odobenus rosmarus*) without apparent detriment. California sea lions (*Zalophus californianus*) showed little restraint, but demonstrated profound respiratory depression.

Key words: Chemical restraint, meperidine HCl, cetaceans, pinnipeds, comparative immobilization studies.

The performance of clinical and therapeutic procedures on cetaceans and pinnipeds presents a challenge to zoological park personnel and investigators. Untrained small cetaceans often resist during such procedures and must be physically restrained and/or removed from the water (Sweeney and Ridgway, 1975). Likewise, the performance of such procedures on pinnipeds is often challenging due to their size, agility and strength. In addition, unless accustomed to such procedures marine mammals may become excited and may overheat (Ridgway, 1972; Sweeney, 1974). These problems make a safe, effective form of chemical restraint or tranquilization desirable for these species.

Meperidine HCl (Demerol HCl, Winthrop Laboratories, Division of Sterling Drugs, Inc., New York, New York 10016, USA) was administered intramuscularly by hand-syringe to 95 individuals of several species of cetaceans and to 36 individuals of several species of pinnipeds either in Sea World's permanent collection or to restrain stranded animals during recovery by Sea World personnel. During drug administration, cetaceans were restrained within soft canvas stretchers or hand-restrained in shallow water, while pinnipeds were restrained within restraint cages or throw nets. A portion of the data upon which this report was based has been previously reported (Joseph and Cornell, 1987).

In these cases chemical restraint was for physical examination, radiography, gastroscopy, cryosurgery, analgesia and facilitation of fluid therapy and transport. Surgery and dental extractions on cetaceans and skin biopsies on pinnipeds were performed under meperidine HCl restraint in conjunction with local anesthesia (lidocaine HCl, Elkins-Sinn, Inc., Cherry Hill, New Jersey 08034, USA). Pinniped surgeries and dental extractions were performed using meperidine HCl as a preanesthetic, followed by intravenous thiamylal sodium (Surital, Parke-Davis, Division of Warner-Lambert Co., Morris Plains, New Jersey 07950, USA) (0.74 mg/kg) and/or halothane (Halocarbon Laboratories, Inc., 82 Burlews Court, Hackensack, New Jersey 07601, USA) anesthesia.

Bottlenose dolphins (*Tursiops truncatus*) ($n = 2$), harbor seals (*Phoca vitulina*) ($n = 3$) and northern elephant seals (*Mi-*

TABLE 1. Species involved, number of restraints and dosages of meperidine HCl administered to marine mammals for the purpose of chemical restraint.

Species	Total number of restraints	mg meperidine/kg		
		0.11	0.23	0.45
Bottlenosed dolphin, *Tursiops truncatus*	74	2	62	10
Pilot whale, *Globicephala macrorhynchus*	4		2	2
Killer whale, *Orcinus orca*	4		2	2
White-sided dolphin, *Lagenorhynchus obliquidens*	3		3	
False killer whale, *Pseudorca crassidens*	10		9	1
Walrus, *Odobenus rosmarus*	23		10	13
California sea lion, *Zalophus californianus*	4		2	2
Harbor seal, *Phoca vitulina*	4	3	1	
Northern elephant seal, *Mirounga angustirostris*	5	4	1	
Common dolphin, *Delphinus delphis*	1		1	

rounga angustirostris) (n = 4) received 0.11 mg/kg meperidine HCl. Meperidine HCl at a dosage of 0.23 mg/kg was administered to bottlenose dolphins (n = 62), killer whales (*Orcinus orca*) (n = 2), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) (n = 3), pilot whales (*Globicephala macrorhynchus*) (n = 2), false killer whales (*Pseudorca crassidens*) (n = 9), a common dolphin (*Delphinus delphis*) (n = 1), walrus (*Odobenus rosmarius*) (n = 10), California sea lions (*Zalophus californianus*) (n = 2) and a harbor seal (*Phoca vitulina*) (n = 1). Meperidine HCl was administered at a dosage of 0.45 mg/kg to bottlenose dolphins (n = 10), pilot whales (n = 2), killer whales (n = 2), a false killer whale (n = 1), California sea lions (n = 2) and walrus (n = 13) (Table 1).

Naloxone HCl (Narcan, DuPont Pharmaceutical, Inc., E. I. du Pont de Nemours and Co. (Inc.), Manati, Puerto Rico, USA; 0.0039–0.0088 mg/kg) was administered intravenously to pinnipeds upon completion of clinical and surgical procedures as a narcotic antagonist; this was not given to cetaceans.

In cetaceans, mild restraint occurred within 10 min of injection, at all dosages administered, and reached a maximum effect within 20 min. Cetacean restraint was characterized by a decreased respiratory rate, decreased heart rate, increased depth of respiration, decreased responsiveness to visual and tactile stimuli and decreased responsiveness to manipulation, accompanied by mild to good analgesia. Restraint decreased over time, but generally persisted for at least 2 hr, but not 3 hr. Higher doses (0.45 mg/kg) produced slightly more pronounced sedation and analgesia with longer duration and were used for procedures which might have been accompanied by greater excitement. Cetaceans narcotized with meperidine HCl remained in water or were returned to water following completion of clinical procedures because sedation did not appear to interrupt either respiratory nor thermoregulatory homeostatic mechanisms.

Sedation and analgesia appeared more pronounced in pinnipeds at the above mentioned doses, except for California sea lions, and followed a similar time course. California sea lions appeared sedate, but were very responsive to manipulation. Greater respiratory depression was apparent in pinnipeds, especially in walrus, and might have persisted for several hours if the narcotics were not antagonized. The intravenous administration of naloxone HCl at the previously mentioned doses resulted in complete antagonism of restraint and respiratory depression within 2 min in pinnipeds, allowing a rapid return to water.

A variety of tranquilizers have been used

in marine mammals. Chlordiazepoxide HCl has been used in cetaceans (Ridgway, 1972; Sweeney and Ridgway, 1975) and pinnipeds (Heuschele, 1961; Hubbard, 1968, 1969; Ridgway, 1972) as a calming agent and to facilitate clinical procedures. Oral paraldehyde has also been used to calm excited male bottlenose dolphins (McBride and Kritzler, 1951). Diazepam facilitated gastroscopy in a bottlenose dolphin (Greenwood and Taylor, 1978) and in a grey seal (*Halichoerus grypus*) (Greenwood and Wild, 1977), but also has given inconsistent results in phocids (Hubbard, 1969).

Phenothiazine derivatives are contraindicated in marine mammals because they may produce thermoregulatory complications through peripheral vasodilation (Ridgway and McCormick, 1971; Sweeney and Ridgway, 1975; Hammond and Elsner, 1977). Fatal respiratory arrests have occurred in cetaceans following phenothiazine administration (Norris, 1966).

Ketamine HCl has been used in both cetaceans and pinnipeds. The use of ketamine HCl in *Tursiops* sp. resulted in the animal remaining motionless at the water's surface without apparent respiratory or thermoregulatory depression (Sweeney and Ridgway, 1975). Ketamine HCl has been used with mixed results in pinnipeds, alone and with other agents, primarily for complete immobilization rather than restraint (Geraci, 1973; Hammond and Elsner, 1977). Although good results have been achieved in healthy pinnipeds, resultant muscle tremors occasionally have lead to tonic-clonic convulsions, respiratory depression and fatalities (Geraci, 1973; Hammond and Elsner, 1977). Furthermore, although useful in phocids, ketamine HCl appears to have a lower margin of safety in otariids, especially those suffering from illness or injury (Geraci, 1973; Hammond and Elsner, 1977).

Narcotic restraint in pinnipeds has been previously reported (Hubbard, 1969; Cornell et al., 1987). Meperidine hydrochloride was reported to be of questionable usefulness in California sea lions due to resultant hyperexcitability (Hubbard, 1969). The use of a fentanyl-droperidol combination for bottlenose dolphin narcotization has been reported previously (Meshcherskii et al., 1978).

In our experience meperidine HCl has provided moderate restraint in cetaceans without obvious deleterious effects. Restraint is achieved rapidly, with maximum restraint occurring 20 min after intramuscular injection, lasting for 2 to 3 hr. Analgesia appears to last as long as 4 hr and may be accompanied by a restoration of appetite in animals suffering from physical discomfort. Higher doses produce increased sedation and analgesia without noticeably depressing respiration. Cetacean respiratory and thermoregulatory mechanisms do not appear to be affected and the animals may be safely returned to water following narcotic administration or at the completion of the procedure. Changes in respiratory quality and rate and changes in heart rate indicate a reduction in excitement, decreasing the possibility of life threatening complications during restraint. This calming effect greatly facilitates cetacean transport.

Meperidine HCl provides moderate restraint for phocids, such as harbor seals and elephant seals, without interfering with thermoregulation. Moderate restraint is produced in walrus facilitating procedures such as fluid therapy (Cornell et al., 1987). California sea lions show little restraint at the above mentioned doses, but demonstrate respiratory depression. Although effective for cetaceans, phocids and walrus, we do not recommend meperidine HCl alone for restraint in California sea lions.

LITERATURE CITED

CORNELL, L. H., B. E. JOSEPH, AND J. E. ANTRIM. 1987. Anesthesia and tusk extraction in walrus *Odobenus rosmarus*. Journal of the Zoo Animal Medicine 18: 3–6.

GERACI, J. C. 1973. An appraisal of ketamine as an immobilizing agent in wild and captive pinnipeds. Journal of the American Veterinary Medical Association 163: 574–577.

GREENWOOD, A. G., AND D. C. TAYLOR. 1978. Fibreoptic gastroscopy in dolphins. Veterinary Record 102: 495–497.

———, AND D. WILD. 1977. Fibreoptic gastroscopy in a grey seal, *Halichoerus grypus*. Aquatic Mammals 5: 67–68.

HAMMOND, D., AND R. ELSNER. 1977. Anesthesia in phocid seals. Journal of Zoo Animal Medicine 8: 7–13.

HEUSCHELE, W. P. 1961. Chlordiazepoxide for calming zoo animals. Journal of the American Veterinary Medical Association 139: 996–998.

HUBBARD, R. C. 1968. Husbandry and laboratory care for pinnipeds. *In* The behavior and physiology of pinnipeds, R. J. Harrison, R. C. Hubbard, C. E. Peterson, and R. J. Schusterman (eds.). Appleton-Century-Crofts, New York, New York, pp. 299–357.

———. 1969. Chemotherapy in captive marine mammals. Bulletin of Wildlife Disease Association 5: 218–230.

JOSEPH, B. E., AND L. H. CORNELL. 1987. The use of meperidine hydrochloride in cetaceans and pinnipeds. Proceedings of First International Conference, Zoological and Avian Medicine. Omnipress, Madison, Wisconsin, 400 pp.

MCBRIDE, A. F., AND H. KRITZLER. 1951. Observations on pregnancy, parturition, and postnatal behavior in the bottlenose dolphin. Journal of Mammalogy 32: 251–266.

MESHCHERSKII, R. M., N. V. MENYAILOV, I. S. SHEPELZA, I. I. KORENEV, Y. A. POPOROV, I. A. GORELOV, AND I. D. IVANOV. 1978. Narcotization of dolphins without arrest of natural respiration. Thurnal Evolyutsionnoi Biokhimii i Fiziologii 14(4): 410–411.

NORRIS, K. S. 1966. Whales, dolphins and porpoises. University of California Press, Berkeley and Los Angeles, California, 789 pp.

RIDGWAY, S. H. 1972. Homeostasis in the aquatic environment. *In* Mammals of the sea: Biology and medicine, S. H. Ridgway (ed.). Charles C Thomas, Springfield, Illinois, pp. 590–747.

———, AND J. G. MCCORMICK. 1971. Anesthesia of the porpoise. *In* Textbook of veterinary anesthesia, L. R. Soma (ed.). The Williams and Wilkins Company, Baltimore, Maryland, pp. 394–403.

SWEENEY, J. C. 1974. Procedures for clinical management of pinnipeds. Journal of the American Veterinary Medical Association 165: 811–814.

———, AND S. H. RIDGWAY. 1975. Procedures for the clinical management of small cetaceans. Journal of the American Veterinary Medical Association 167: 540–545.

Received for publication 10 August 1987.