ALPHA-CHLORALOSE AS A CAPTURE AND RESTRAINT AGENT OF BIRDS: THERAPEUTIC INDEX DETERMINATION IN THE CHICKEN

Authors: Loibl, Michael F., Clutton, R. E., Marx, Brian D., and McGrath, C. J.

Source: Journal of Wildlife Diseases, 24(4) : 684-687

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-24.4.684

Journal of Wildlife Diseases, 24(4), 1988, pp. 684–687

ALPHA-CHLORALOSE AS A CAPTURE AND RESTRAINT AGENT OF BIRDS: THERAPEUTIC INDEX DETERMINATION IN THE CHICKEN

Michael F. Loibl,[1] R. E. Clutton,[1,3] Brian D. Marx,[2] and C. J. McGrath[1]

[1] Virginia–Maryland Regional College of Veterinary Medicine, Blacksburg, Virginia 24061, USA
[2] Department of Statistics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, USA
[3] Author to whom reprint requests should be addressed

ABSTRACT: The median effective dose for capture (ED50) and the median lethal dose (LD50) of alpha-chloralose given orally to domestic chickens (*Gallus domesticus*) were determined by probit analysis to be 45 mg/kg and 300 mg/kg, respectively. The therapeutic index (TI = LD50/ED50) was 6.7. This indicates that alpha-chloralose is only a marginally safe capture agent in domestic species and particularly in field applications involving other wild avian species in which the amount of the drug ingested by an individual bird is not controlled.

Key words: Bird capture, therapeutic index, median effective dose, median lethal dose, probit analysis, alpha-chloralose, chickens, *Gallus domesticus*, wildlife model.

INTRODUCTION

Alpha-chloralose applied to bait has been used to capture free-ranging mourning doves (*Zenaida macroura*) (Martin, 1967), mallard ducks (*Anas platyrhynchos*) (Cline and Greenwood, 1972), Canada geese (*Branta canadensis*) (Crider and McDaniel, 1966), turkeys (*Meleagris gallopavo*) (Williams, 1966; Holbrook and Vaughan, 1985) and wood pigeons (*Columba palumbus*) (Murton et al., 1963). The drug has also been used for destruction of pest birds (Ridpath et al., 1961) and rodents (Lees, 1972).

A measure of drug safety is the therapeutic index (TI). This is the ratio of the median lethal dose (LD50) to the median effective dose (ED50); TI = LD50/ED50. The ED50 is the dose that produces a defined effect, such as capture, in half of the population to which the drug is administered. The LD50 is the ED50 for death. Another derived statistic useful in drug safety evaluation is the certain safety factor (CSF), which was defined in this study as CSF = LD01/ED99.

The objectives of this study were to evaluate the safety of orally administered alpha-chloralose in chickens and to observe the clinical effects of alpha-chloralose in this species. Information on the effects of this drug as an immobilizing agent in domestic chickens can be useful as a model for extrapolation to its use in wild free-ranging avian species.

MATERIALS AND METHODS

For the study, fully feathered, 70-wk-old female DeKalb XL chickens with an interpubic bone width of ≤4 cm were obtained from a commercial egg farm (Seaboard Foods, Inc., Bent Mountain, Virginia 24059, USA). The experimental birds were housed and managed in accordance with policies of the Animal Care Committee of Virginia Polytechnic and State University.

Initially, groups of 15 to 17 experimental birds were housed for 3 to 10 days in unheated 8-m^2 rooms liberally bedded with straw. Fresh water and food (Turkey Starter Mash, Big Spring Mill, Elliston, Virginia 24087, USA) were provided ad libitum.

Prior to drug administration five to 15 birds were held in a plastic crate (approximately 1.0 × 0.6 × 0.3 m), for a period of 1.5 to 2 hr. During this time, the birds were denied access to food or water and were weighed to the nearest 0.01 kg. Each experimental bird received a uniquely numbered tag for rapid identification.

The 15 dose groups were 0, 17, 33, 40, 50, 60, 75, 100, 200, 250, 275, 300, 350, 400 and 800 mg/kg body weight of alpha-chloralose (Sigma Chemical Company, St. Louis, Missouri 63178, USA). There were five birds in each dose group. The drug was weighed to the nearest 0.01 g and thoroughly mixed with 5.0 ml/kg body weight of propylene glycol (Vedco, Inc., Overland Park, Kansas 66204, USA).

Alpha-chloralose was administered to each bird by placing a red rubber urinary bladder catheter approximately 10 cm into the gullet as measured from the tip of the beak. The vehicle

TABLE 1. The doses and 95% fiducial limits of doses associated with several probabilities of capture in chickens dosed with alpha-chloralose.[a]

Probability of capture	Dose of alpha-chloralose mg/kg body weight	95% fiducial limits of dose	
		Lower	Upper
1	13.88	1.31	23.63
5	19.58	3.43	29.50
10	23.52	5.72	33.36
25	31.96	13.20	41.74
50	44.92	30.16	59.26
75	63.14	49.32	117.59
90	85.78	63.53	263.35
95	103.04	72.27	436.40
99	145.35	90.68	1,142.40

[a] The results of the Chi-square goodness-of-fit tests for normality were $\chi^2 = 1.52$, $P = 0.91$ for untransformed doses and $\chi^2 = 1.22$, $P = 0.94$ for log(base e) doses. $P > 0.05$ indicated a significant fit to the cumulative normal function. This table is based on the log(base e) analysis because of a better fit and the doses are back transformed.

TABLE 2. The dose and 95% fiducial limits of doses associated with several probabilities of death in chickens dosed with alpha-chloralose.[a]

Probability of death	Dose of alpha-chloralose mg/kg body weight	95% fiducial limits of dose	
		Lower	Upper
1	208.41	116.88	243.37
5	231.11	115.58	262.27
10	244.84	173.69	273.60
25	269.61	216.14	296.24
50	300.09	265.83	335.45
75	334.01	304.25	408.20
90	367.81	330.53	506.26
95	389.65	345.09	579.63
99	434.18	372.17	751.11

[a] The results of the Chi-square goodness-of-fit tests for normality were $\chi^2 = 9.12$, $P = 0.10$ for untransformed doses and $\chi^2 = 7.76$, $P = 0.17$ for log(base e) doses. $P > 0.05$ indicated a significant fit to the cumulative normal function. This table is based on the log(base e) analysis because of a better fit and the doses are back transformed.

and drug were slowly administered by means of a 10-ml syringe attached to the catheter after which the catheter was flushed with air to expel residual drug and vehicle into the animal. Immediately after drug administration, the birds in three dose groups were placed into an 8-m^2 room that was well bedded with straw. A kerosene heater enabled the temperature to be maintained at 14 to 20 C at a height of approximately 10 cm from the floor. Room ventilation was manipulated to regulate the temperature and to prevent accumulation of noxious gases.

At each 15-min interval for 4 hr after alpha-chloralose administration, a vigorous attempt was made to capture the birds. As each bird was approached, noise was made by shuffling through the straw and by vigorously waving sheets of paper in the air to minimize the effects both of domestication and of habituation to repeated capture attempts, and to stimulate those birds that were unresponsive to a quiet capture attempt but were able to escape.

The capture and the mortality quantal responses to doses of alpha-chloralose were examined by probit analysis (Finney, 1971) using a computer program (SAS Inc., 1985). The program computed the probability of a response at a given dose from the cumulative normal function to which the data were fitted. A Chi-square (χ^2) goodness-of-fit test for normality was performed based on the dose and on the log(base e) dose of the capture and the mortality data with $\alpha = 0.05$ and degrees of freedom = 5 for each of the four tests. The 95% fiducial limits of doses were computed by the program. The 95% fiducial limits of a dose, for example the LD50, indicated the upper and lower bounds of dose that resulted in death for half of the population with 95% probability.

RESULTS

The ED50 for orally administered alpha-chloralose in domestic chickens was 45 mg/kg and the 95% fiducial limits of the ED50 were 30 to 59 mg/kg (Table 1). The LD50 was 300 mg/kg and the 95% fiducial limits of the LD50 were 266 to 335 mg/kg (Table 2). The TI was 6.7.

An estimate of the lower limit of the TI for capture is the ratio of the lower 95% fiducial limit of the LD50 to the upper 95% fiducial limit of the ED50. Similarly, the ratio of the upper 95% fiducial limit of the LD50 over the lower 95% fiducial limit of the ED50 is an estimate of the upper limit of the TI. Based on this reasoning, the TI of alpha-chloralose for capture of chickens ranged from 4.5 to 11.1.

The CSF of alpha-chloralose for capture of chickens in this study was 1.4. The extreme case analysis of CSF based on 95% fiducial limits indicated that the CSF ranged from 0.1 to 2.7.

Several clinical effects of alpha-chloral-

ose were observed. Shivering was typically intermittent and occurred frequently in birds 1 to 3 hr prior to clinical recovery from the drug. Some birds that later died had shivered also. Ruffled feathers and reddening of the irides were common in captured birds. Torticollis and clonic convulsions were observed, particularly in birds in high dose groups. Convulsions consisted principally of vigorous wing flapping and were occasionally apparently elicited by handling. A seromucoid fluid in the oral cavity and respiratory distress with marked abdominal contractions and rough barking-like sounds occurred in deeply narcotized birds. Some of these birds died but others recovered without clinically apparent signs.

DISCUSSION

Based on the data from this study (ED50 = 45 mg/kg, LD50 = 300 mg/kg, TI = 6.7), chickens appear to be more resistant to the effects of orally administered alpha-chloralose than mallard ducks (*Anas platyrhynchos*) in which ED50 = 15 mg/kg, LD50 = 34 mg/kg, TI = 2.2 (Cline and Greenwood, 1972) or feral pigeons (*Columba livia*) in which LD50 = 131 mg/kg (Ridpath et al., 1961). The low TI of alpha-chloralose in mallard ducks and domestic chickens suggests that it is less safe in these species. The extreme case analysis of the TI based on fiducial limits indicates that if the TI was 11.1 in chickens, alpha-chloralose would be a marginally safe capture drug.

The CSF is useful to evaluate the safety of capture drugs particularly when it is required to catch an entire group of animals without mortality. A drug with a CSF < 1 is contra-indicated under such a requirement because LD01 is less than ED99. The extreme case analysis of the CSF based on fiducial limits indicates that if CSF = 2.7, the drug is at best marginally safe, particularly in field applications in which the amount ingested by an individual bird is not controlled.

In this study, the torticollis and convulsions observed in chickens given large doses are consistent with previous observations that alpha-chloralose may cause hypertonic spinal reflexes and strychnine-like tonic convulsions in toxic doses (Lees, 1972; Winters, 1976). The reasons for the clonic convulsions observed in the chickens in this study are unknown. It is thought that alpha-chloralose induces stages I and II but not stage III anesthesia. Effects proceed from stage II to myoclonus, then to seizures and then death (Winters, 1976) which appears to be due to stage IV medullary paralysis (Lees, 1972; Booth and McDonald, 1982). It may be possible to increase the safety of alpha-chloralose used to capture wild birds by vigorous application of proper anesthetic recovery techniques.

LITERATURE CITED

BOOTH, N. H., AND L. E. MCDONALD. 1982. Veterinary pharmacology and therapeutics, 5th ed. The Iowa State University Press, Ames, Iowa, 1134 pp.

CLINE, D. R., AND R. J. GREENWOOD. 1972. Effect of certain anesthetic agents on mallard ducks. Journal of the American Veterinary Medical Association 161: 624–633.

CRIDER, E. D., AND J. C. MCDANIEL. 1966. Technique for capturing Canada geese with alpha-chloralose. *In* The 20th annual proceedings of the Southeastern Association of Game and Fish Commissioners, J. L. Herring (ed.). Southeastern Association of Fish and Wildlife Agencies, Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana, pp. 226–233.

FINNEY, D. J. 1971. Probit analysis, 3rd ed. The Cambridge University Press, Cambridge, Great Britain, 333 pp.

HOLBROOK, H. T., AND M. R. VAUGHAN. 1985. Capturing adult and juvenile wild turkeys with adult dosages of alpha-chloralose. The Wildlife Society Bulletin 13: 160–163.

LEES, P. 1972. Pharmacology and toxicology of alpha chloralose: A review. The Veterinary Record 91: 330–333.

MARTIN, L. L. 1967. Comparison of methoxymol, alpha-chloralose and two barbiturates for capturing doves. *In* The 21st annual proceedings of the Southeastern Association of Game and Fish Commissioners, J. L. Herring (ed.). Southeastern Association of Fish and Wildlife Agencies, Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana, pp. 193–201.

MURTON, R. K., A. J. ISAACSON, AND N. J. WESTWOOD. 1963. The use of baits treated with alpha-chlor-

alose to catch wood pigeons. The Journal of Applied Biology 52: 271–293.

RIDPATH, M. G., R. J. P. THEARLE, D. MCCOWAN, AND F. J. S. JONES. 1961. Experiments on the value of stupefying and lethal substances in the control of harmful birds. Annals of Applied Biology 49: 77–101.

SAS INSTITUTE INCORPORATED. 1985. SAS® user's guide: Statistics, 1985 ed. Cary, North Carolina, 956 pp.

WILLIAMS, L. E. 1966. Capturing wild turkeys with alpha-chloralose. The Journal of Wildlife Management. 30: 50–56.

WINTERS, W. D. 1976. Effects of drugs on the electrical activity of the brain: Anesthetics. Annual Review of Pharmacology and Toxicology 16: 413–426.

Received for publication 23 October 1987.