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IMMOBILIZATION OF WHITE-TAILED DEER WITH SUCCINYLCHOLINE CHLORIDE: SUCCESS RATE, REACTIONS OF DEER AND SOME PHYSIOLOGICAL EFFECTS

by

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ABSTRACT

A total of 276 attempts was made to immobilize white-tailed deer (*Odocoileus virginianus*) using succinylcholine chloride (SC). SC was injected in powder form by dart in 256 deer (mostly free-ranging) and in solution in 20 deer (all captive). Details of dose levels, age, sex, bodyweight, whether immobilized, time interval injection to immobilization and survival rates were recorded. For the SC solution injected animals, packed cell volumes (PCV) were recorded prior to and at several intervals after injection. Among those deer injected with powdered SC, a 64.1 percent capture rate was obtained (63.6 percent for adults, 65.5 percent for fawns). Fatalities were recorded in 8.6 percent of attempts with adults and in 13.8 percent of attempts with fawns. The non-lethal, successful, dose range for adults was 0.078 to 0.265 mg/kg. The lethal dose range for adults was 0.141 to 0.298 mg/kg; the lethal dose range for fawns was 0.176 to 0.229 mg/kg. Reaction times varied from less than one minute to 23 minutes (mean = 6.19 + 0.31 S.E.). For SC injected as a solution, mean knockdown time was 9.35 minutes (Range = 4 to 23 minutes). Time from knockdown to recovery average 37.5 minutes (Range = 19 to 86 minutes). All injections ranging from 3.8 to 6 mg SC in solution successfully induced immobilization. PCV's tended to drop after injection of SC.

INTRODUCTION

The ability to use remotely-injected drugs to capture live animals is useful to the wildlife manager and to the researcher. Many drugs are available for capture of wild animals. Among these succinylcholine chloride (SC) has proved useful and Liscinsky et al. (1969) have developed a relatively simple method for delivering the drug. Despite the fact that a large number of reports are available on the use of SC few data are available on effective and lethal dose rates for Cervidae. A review of available literature indicates the following are effective dose ranges (expressed in mg/kg): Moose (*Alces alces*), 0.044 to 0.077 (Bergerud et al. 1964), 0.035 to 0.048 (Houston 1969); elk (*Cervus canadensis*), 0.088 to 0.264 (Flook et al. 1962); caribou (*Rangifer tarandus*), 0.055 to 0.143 (Bererud et al. 1964); red deer (*Cervus elaphus*), 0.113 to 0.293 (Taylor and Magnussen 1965); black-tailed deer (*Odocoileus hemionus columbianus*), 0.154 to 0.308 (Miller (1968); white-tailed deer (*Odocoileus virginianus*), 0.033 to 0.119 (Pistey and Wright 1961); and fallow deer (*Dama dama*), 0.066 (Pistey and Wright 1959). The above relate to solutions of SC. Data are available on effective dose rates for

powdered SC for white-tailed deer (0.066 to 0.132 mg/kg, Liscinsky et al. 1969) and for fallow deer (0.105 to 0.220 mg/kg, Scanlon 1973). An ineffective dose range was determined for fallow deer (0.088 to 0.220 mg/kg) which overlapped the effective dose range (Scanlon 1973).

MATERIALS AND METHODS

A total of 256 attempts was made to immobilize free-ranging deer at the Radford Army Ammunition Plant, Dublin, Virginia and to immobilize confined deer at Virginia Polytechnic Institute and State University. The majority of immobilization attempts involved free ranging deer. Darts containing powdered SC were utilized. These were the type described by Liscinsky et al. (1969). Data were recorded on the following: Dose of SC, whether the animal was immobilized, time injection to immobilization (latent period), sex of animal, whether adult or fawn, bodyweight, effective dose of SC (mg/kg), and whether animal survived. Immobilization attempts were made in all 12 months during the interval January 1971 to May 1974. Dose levels of SC used ranged from 4 to 12 mg.

A limited number of attempts was made to study the influence of SC on blood physiology. Blood was collected before injection of SC in solution in 20 adult deer and again at immobilization, at 30 minutes after injection and at 90 minutes after injection. Packed cell volumes (PCV) were determined for each blood sample. Blood was collected at comparable times from 12 non-treated adult animals. The timing of the second blood collection from non-treated animals was chosen to correspond with the mean time of immobilization. Data on latent periods and recovery periods were recorded for these animals also.

RESULTS

Data are presented in Table 1 on the success rate of immobilization attempts in immobilizing white-tailed deer. Success rates were comparable for both adult and immature deer. The overall success rate was 64.1 percent. Doses as low as 4 mg SC and as high as 12 mg SC were successfully used but failure of immobilization was encountered even at the higher dose levels. The above data are based on known strikes with darts.

Effective dose levels are shown in Table 2. From these data it appears that higher doses of SC (mg/kg) are necessary to immobilize immature animals.

Table 1. Success rate of immobilization attempts on white-tailed deer using darts containing powdered succinylcholine chloride (SC).

SC Dose (mg)	4	5	6	7	8	9	10	11	12	Other	All
Immature Deer	No. Attempts	6	10	10	13	4	3			2	58
	Percent Success	16.7	70.0	60.0	84.6	75.0	33.3			100	65.5
	No. Attempts	2	6	11	49	70	20	3	21	16	198
Adult Deer	Percent Success	50.0	100	90.9	67.3	51.4	65.0	100	52.4	81.3	63.6

Table 2. Effective and lethal dose ranges of powdered succinylcholine chloride for immobilizing white-tailed deer.

Animal Category	Non Lethal Effective Range (mg/kg)	Lethal Range (mg/kg)
Adult Male	0.078 - 0.265	0.132 - 0.204
Adult Female	0.117 - 0.176	0.136 - 0.225
Immature Male	0.141 - 0.298	0.176 - 0.299
Immature Female	0.155 - 0.263	0.210 - 0.295

Table 3. Fatalities due to powdered succinylcholine chloride injection in white-tailed deer in relation to dose level used and age of animal.

Dose (mg SC)	4	5	6	7	8	9	10	11	12	Other	All
Fawns	0/6(a)	4/20	2/20	0/13	2/4	0/3				0/2	8/58 (13.8%)
Adults	0/2	1/6	1/11	0/49	4/70	4/20	1/3		3/21	3/16	17/198 (8.6%)

(a) Fatalities all attempts.

Data on lethal dose levels are presented in Table 2 and data on frequency of fatalities are presented in Table 3. A higher fatality rate was observed in immature deer. The data on lethal dose ranges indicate considerable overlap between non-lethal effective doses and lethal effective doses.

Wide variation was evident in the time for individual animals to become immobilized. The data on this aspect are presented in Table 4. For animals injected with powdered SC the mean latent period was 6.19 minutes (Range 1 - 23 minutes). For liquid injected animals the range was almost as great but the mean was higher. Mean recovery interval for SC immobilized deer was 37.5 minutes (Table 4). The range was considerable (19-86 minutes).

Data on the PCV values of SC injected and non-injected animals are presented in Table 5. A trend toward lowered PCV values is evident in SC injected animals. These were lower at time of immobilization and significantly lowered ($P < 0.05$) at 30 minutes after injection but tended to return to normal at 90 minutes after injection. There were slight, non-significant declines in PCV values of non-injected animals but the decline was not as great as in SC injected animals.

Table 4. Interval injection of succinylcholine chloride (SC) to immobilization in white-tailed deer.

Injection Form	No. Animals	Mean Interval Injection To Immobilization (Mins)	Range Injection To Immobilization (Mins)	Mean Interval Immobilization To Recovery (Mins)	Range Immobilization To Recovery (Mins)
SC Powder	164	6.19	1 - 23	-	-
SC Solution	20	9.35	4 - 23	37.5	19 - 86

Table 5. Mean Packed Cell Volume (PCV) values (percent) in white-tailed deer before and after administration of succinylcholine chloride (SC).

Treatment	Sex	No. Animals	Before SC Injection PCV (+ SE)	At Immobilization PCV (+ SE)	Time of Blood Sampling	
					30 Min After Injection PCV (+ SE)	90 Min After Injection PCV (+ SE)
SC	Male	10	54.2 (+ 1.09)x	51.0 (+ 0.91)xy	49.8 (+ 0.98)y	50.2 (+ 1.03)y
SC	Female	10	57.7 (+ 0.60)x	53.2 (+ 0.68)y	52.0 (+ 1.65)yz	55.9 (+ 0.56)xz
None	Male	6	50.0 (+ 0.82)x	50.0 (+ 1.27)x	49.0 (+ 1.48)x	48.7 (+ 1.71)x
None	Female	6	55.8 (+ 1.40)x	51.0 (+ 1.77)x	49.8 (+ 1.99)x	50.2 (+ 1.77)x

a : Taken at average time of immobilization in non-treated animals.

x, y, z: Means with different superscripts in the same row were significantly different at the P = 0.05 level.

DISCUSSION

There was inconsistency in achieving immobilization for free-ranging deer even at the higher dose levels when using powdered SC. Immobilization was consistently achieved when using SC in solution with captive deer. Doses of SC solution ranging from 3.8 to 6 mg were injected directly into adult deer and all attempts to immobilize were successful. Evidence from the literature indicates that greater doses of powdered SC must be given to white-tailed deer to achieve immobilization. The successful dose-rate for SC in solution was 0.033 to 0.119 mg/kg (Pistey and Wright 1961) while that for powdered SC was 0.066 to 0.132 mg/kg (Liscinsky et al. 1969). The non-lethal effective dose ranges of powdered SC in this study was higher than that of Liscinsky et al. (1969). Differences in response of animals to the form of SC injected prompts speculation as to the reasons for these differences. Powdered SC may be less well absorbed by the injected animals.

A particularly frustrating aspect of the results of this study was the overlap between the non-lethal and lethal dose ranges for powdered SC. The mortality rate, while not overly high when compared to some other drugs, is nevertheless unacceptable. The overlap between the effective and lethal ranges probably precludes the possibility of choosing a completely safe dose level for immobilizing an individual animal. Mortality rates were higher among immature deer. This was probably due to the higher dose levels required to immobilize immature deer than was the case with adult deer.

The latent period before immobilization is of practical importance insofar as longer latent periods facilitate longer flight distances if the subject animals choose to flee. Wide variations in individual latent periods were evident in animals injected with powdered SC and in those injected with SC in solution. These observations are similar to those of wide variation in latent periods before reaction to SC of other Cervidae (Pistey and Wright 1961; Flook et al. 1962; Bergerud et al. 1964; Scanlon 1973).

The data on PCV values are of interest insofar as the effects of immobilization drugs on blood values may influence the usefulness of these drugs when sampling blood from free ranging animals. The data presented in this report indicate a trend for PCV values to drop significantly after SC injection. These data are not conclusive in regard to blood parameters other than PCV and further research is continuing.

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