New Zealand Veterinary Journal

ISSN: 0048-0169 (Print) 1176-0710 (Online) Journal homepage: www.tandfonline.com/journals/tnzv20

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To cite this article: B.R.CookPh.D.B.V.Sc.M.ScM.R.C.V.S. (1970) A field trial with bunamidine hydrochloride as an anthelmintic in the eradication of *Echinococcus granulosus, taenia hydatigena* and *Taenia ovis* in New Zealand, New Zealand Veterinary Journal, 18:8, 152-155, DOI: 10.1080/00480169.1970.33886

To link to this article: https://doi.org/10.1080/00480169.1970.33886

A FIELD TRIAL WITH BUNAMIDINE HYDROCHLORIDE AS AN ANTHELMINTIC IN THE ERADICATION OF *ECHINOCOCCUS GRANULOSUS, TAENIA HYDATIGENA* AND *TAENIA OVIS* IN NEW ZEALAND

B. R. COOK*

INTRODUCTION

THIS PAPER describes a field trial designed to determine the value of bunamidine hydrochloride† as an anthelmintic within the framework of the New Zealand hydatid eradication campaign and within an environment where there are no wild carnivorous animals host either to *Echinococcus granulosus* or to other Taeniidae with intermediate stages in sheep.

Four localities were selected for the trial, each representing a different type of environment (Table 1) and the domestic animals within these localities were effectively insulated from those in adjoining areas by natural physical barriers.

METHODS

All weaned dogs were dosed with bunamidine by the resident Hydatid Control Officer, at intervals of one calendar month. Each officer exercised his discretion regarding sick dogs, but oestrus, pregnancy and lactation were not considered reasons for failing to dose bitches. Owners were advised to give their dogs a light meal on the same day, prior to dosing, and to ensure free access to water. The dogs were not worked vigorously within 24 hours after dosing. Owners were encouraged to treat their dogs for concurrent nematode infection and to maintain them in adequate physical condition. They were warned that no raw sheep or goat meat and no raw pig or cattle offal should be fed.

At the beginning of the trial and one year later the dogs were dosed with arecoline acetarsol‡ at the rate of 2.5 mg per kg liveweight as a diagnostic measure to gauge the initial level of tapeworm infection and any progress achieved. Two hours later, each dog was dosed with bunamidine. All soft faeces passed were collected into plastic bags, fixed with 10% formalin, and later examined for worms (Cook, 1964).

The bunamidine salt used in this trial was the hydrochloride in 200 mg and 400 mg tablets. At the outset of the trial, two dose rates were used and each locality was divided into two regions, so that in one the dogs received 25 mg and in the other 50 mg per kg body-weight — the minimum and maximum dose rates recommended by the manufacturers. Dogs were weighed at the beginning of the trial and at the diagnostic dosing with arecoline acetarsol one year later.

The control officers were instructed to advise dog owners to maintain the same standards of hygiene as those practised

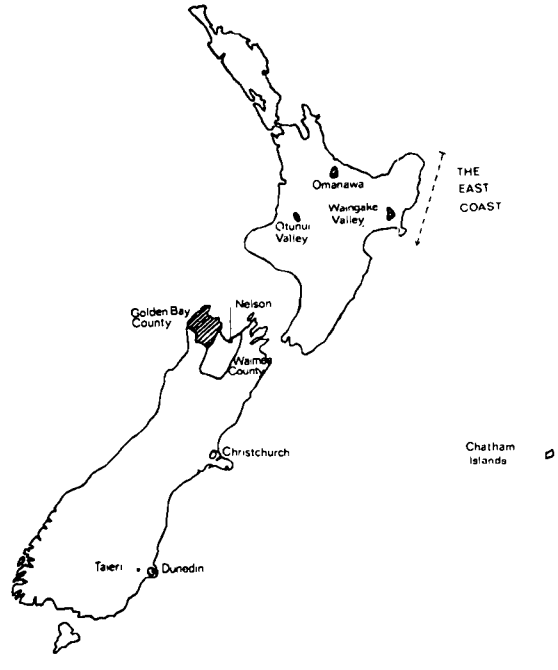

FIG. 1: *A map of New Zealand showing localities referred to in the text.*

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†Bunamidine Hydrochloride (Burroughs Wellcome).

‡"Tenoban" (Burroughs Wellcome).

TABLE 1: THE LOCALITIES OF THE TRIAL

Locality	*Role in the Design of the Trial*	*No. of Dogs Jul./Aug. 1966*	*Estimated No. of Sheep, 1966*
Golden Bay County	Main trial area	935	110,000
Otunui Valley (Taumarunui County)	High rainfall area (over 60 in. per annum)	113	25,000
Omanawa (Tauranga County)	Mixed dairying and sheep farming	82	10,000
Waingake Valley (Cook County)	Both Maori and European dog-owners	234	50,000

previously and that, in no circumstances, should these standards be relaxed.

In the final analysis, the ultimate proof that bunamidine is an effective anthelmintic in controlling tapeworms is the interruption of the passage of tapeworm eggs from dogs to sheep. It was therefore arranged that the incidence of *E. granulosus*, *T. hydatigena* and *T. ovis* in sheep should be estimated by veterinary surgeons in the abattoirs, from a sample of all sheep coming from each trial locality. Two animals were examined from each line of sheep coming from Golden Bay County and one sheep in every 8 to 10 from every line from the other areas, throughout the killing season. The following criteria were used (Cook, 1965). A cestode "white spot" was defined as a lesion that presented a precise, clearly defined margin. A "degenerated cyst" was defined as one that contained no fluid. Regular visits to the freezing works were made by the writer to ensure that consistent standards of inspection were maintained. Inspection was limited to the lungs and liver for *E. granulosus;* to the liver and other organs of the peritoneal cavity for *T. hydatigena;* and to the heart, diaphragm and masseter muscles for *T. ovis.*

All dogs visiting each locality were dosed as soon as possible. Notices were erected on all roads entering each trial area to warn visitors that they were approaching a special Hydatid Trial Area and requesting that accompanying dogs be dosed with bunamidine.

RESULTS

In July 1966, 660 faeces, and in July 1967, 839 faeces, were examined. A significant reduction occurred in every area in the incidence of all species of tapeworms during this 12 months (Tables 2 and 3).

The overall incidence of *E. granulosus* declined from 7.9% (52 infected dogs) to 0.1% (one infected dog). The incidence of infection with any cestode except *Dipylidium caninum* dropped from 15.6% (103 infected dogs) to 0.4% (3 infected dogs). The incidence of *D. caninum* dropped from 4.5% to 0.1%.

One individual *E. granulosus* was recovered from the single dog found to be infected in July 1967. Of the dogs infected with *T. hydatigena,* one was a newcomer to the locality and the other was known to vomit very readily and had possibly ejected the tablet on the preceding occasion it had been dosed. The dog infected with *D. caninum* was a valuable animal whose owner feared that bunamidine may have been responsible for losses during an outbreak of canine viral hepatitis. It is probable that the dog had not been dosed. In 1966 two dogs were found to be infected with *T. serialis* and one with *T. pisiformis.* In 1967 no worms of these species were identified.

A knowledge of the incidence of cystic tapeworms in sheep from the trial areas is essential in evaluating the merits of bunamidine and Table 4 shows this incidence in sheep slaughtered between July 1966 and July 1967.

DISCUSSION

To evaluate the effectiveness of bunamidine hydrochloride in the New Zealand hydatid eradication compaign, the first tasks, following the selection of suitable trial areas, have been to establish a dosing regime, to accustom dog-owners to the use of the drug, and to identify any problems that arise from its use.

TABLE 2: THE RESULTS OBTAINED FROM THE EXAMINATION OF FAECES FOLLOWING PURGATION WITH ARECOLINE ACETARSOL (JULY 1966)

No. of Faeces	*Golden Bay County*	*Otunui Valley*	*Omanawa*	*Waingake Valley*	*Total*
Examined	397	74	45	144	660
Containing *E. granulosus*	25	9	0	18	52
Percentage	(6.3)	(12.2)		(12.5)	(7.9)
Containing *T. hydatigena*	23	16	2	9	50
Percentage	(5.8)	(21.6)	(4.4)	(6.3)	(7.6)
Containing *T. ovis*	3	4	1	6	14
Percentage	(0.8)	(5.4)	(2.2)	(4.2)	(2.1)
Containing one or more cestodes of ovine origin	48	24	3	28	103
Percentage	(12.1)	(32.4)	(6.7)	(19.4)	(15.6)
Containing *D. caninum*	13	8	1	8	30
Percentage	(3.3)	(10.8)	(2.2)	(5.6)	(4.5)

TABLE 3: THE RESULTS OBTAINED FROM THE EXAMINATION OF FAECES FOLLOWING PURGATION WITH ARECOLINE ACETARSOL (JULY 1967)

No. of Faeces	*Golden Bay County*	*Otunui Valley*	*Omanawa*	*Waingake Valley*	*Total*
Examined	519	95	60	165	839
Containing *E. granulosus*	0	1	0	0	1
Percentage		(1.1)			(0.1)
Containing *T. hydatigena*	1	1	0	0	2
Percentage	(0.2)	(1.1)			(0.2)
Containing *T. ovis*	0	0	0	0	0
Containing one or more cestodes of ovine origin	1	2	0	0	3
Percentage	(0.2)	(2.1)			(0.4)
Containing *D. caninum*	1	0	0	0	1
Percentage	(0.2)				(0.1)

TABLE 4: THE RECORDED INCIDENCE OF TAPEWORMS OF CANINE ORIGIN IN SHEEP COMING INTO SLAUGHTERHOUSES DIRECTLY FROM THE TRIAL AREAS DURING 1966-1967

No Examined at Works	*Locality*	*% of Infection with: E. granulosus*	*T. hydatigena*	*T. ovis*	*White Spots*	*Any Species (including white spots)*
LAMBS						
8,280	Golden Bay County	1.0	15.5	1.0	22.3	34.1
2,540	Otunui Valley	0	29.9	1.6	17.3	44.5
316	Omanawa	0	6.5	3.0	0	10.0
3,579	Waingake Valley	1.0	16.2	1.0	17.3	31.0
ADULT SHEEP						
783	Golden Bay County	69.4	30.6	9.4	16.5	81.2
231	Otunui Valley	11.1	33.3	7.4	7.4	59.3
337	Omanawa	34.5	55.8	30.2	30.2	95.4
302	Waingake Valley	30.2	14.0	9.3	30.2	48.8

Note: Sheep under the age of six months are classed as lambs.

The writer believes that bunamidine alone can neither control hydatid disease at an acceptable level, nor eradicate it. On the other hand, he believes that bunamidine can be regarded as an agent, closing loopholes in the application of the hygiene measures inherent in the national hydatids eradication scheme. The thorough education of dog-owners remains the only foundation upon which an effective eradication programme can be constructed. The hygiene measures advocated should not only promise to be effective, they should also be acceptable to dog owners.

Arecoline salts are not echinococcicides and, until the introduction of bunamidine (Hatton, 1965), no drug merited that description. The continued use of arecoline in hydatid eradication and control schemes is justified only because it remains the most effective agent for the diagnosis of *Echinococcus* in living dogs.

In the writer's opinion it is probable that the present methods of extension work, supported by regular monthly dosing of all weaned dogs with bunamidine hydrochloride, could reduce the level of infection in dogs in New Zealand to a point (below 0.2%) where it will be extremely difficult to find an infected animal; it is also probable that all the present available resources of technology, organization and staff will be required to hold it at that point. Failure to implement farm hygiene vigorously to support bunamidine therapy may well be followed by a rise in the incidence of tapeworms in dogs, because dog-owners incline to place too much reliance on the drug and to abandon hygiene procedures altogether.

SUMMARY

In trials designed to evaluate the efficiency of bunamidine hydrochloride under field conditions in New Zealand, all weaned dogs in four selected localities were dosed at regular monthly intervals. Dogs were dosed with arecoline acetarsol as a diagnostic procedure at the beginning of the trials and again 12 months later, and a sample of all sheep coming directly from the trial areas was examined at freezing works for cestode infection.

By the end of 12 months the incidence of *E. granulosus* in dogs had fallen from 7.9% to 0.1%.

The argument is advanced that the basis of any eradication scheme must be adequate hygiene and that the role of bunamidine is the closure of any loopholes that may appear in the application of measures designed to improve the standards of hygiene.

ACKNOWLEDGEMENTS

It is a pleasure to thank Miss J. Miller, Mr I. Watt and Mr R. van der Wouden of the Department of Agriculture, together with their respective staffs, for the facilities and technical assistance they extended to me. I am very grateful to the Hydatid Control Officers at Golden Bay (A. Walker), Taumarunui (G. Dare), Tauranga (M. Philips and K. Pratt) and Gisborne (A. Gordon and S. Johannsen) and to the County Clerks of each of the Councils concerned.

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(Received for publication May 22, 1968)

(Accepted for publication February 20, 1970)