
Management of an Infestation of Sucking Lice in a Colony of Rhesus Macaques

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An outdoor cage of 19 juvenile rhesus macaques (*Macaca mulatta*) was found to have been infested with the sucking louse, *Pedicinus eurygaster* (Figure 1). This louse is common to a number of different species of Asian

macaques (1). Treatment consisted of dusting all of the animals with 3% malathion powder followed by a subcutaneous injection of ivermectin (IVOMEC®, Merck, Sharp and Dohme, Rahway, NJ) at 0.2 mg/kg, twice 14 days apart. At the time of treatment the cage was cleaned (2).

Initial evaluation of the above treatment regimen suggested that the control methods had been com-

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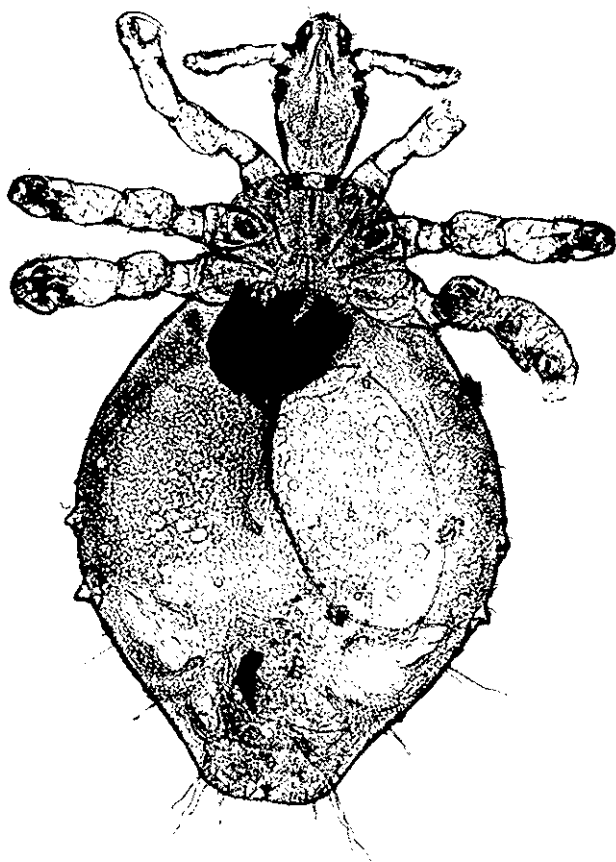


Table 1 Groups and treatments for each of the animals in the study

Treatment Group	Procedure	Number of Monkeys
A	Ivermectin only	19
B	Ivermectin plus ventrum shave	17
C	Pyrethroid bath	18
D	Pyrethroid bath plus ventrum shave	15

Table 2 Number of monkeys infested with nits or lice during each of the examinations

Group	monkeys/group	2 weeks	4 weeks	4 months
A	19	19	19 ^a	0
B	17	1	0	0
C	16	18 ^b	18 ^b	0
D	15	0	0	0

^aadult lice were only found on three animals; the remainder had only nits present
^bonly nits were present

tin at 0.2 mg/kg, subcutaneously. This treatment was repeated in 14 days.

Group B monkeys also were treated with ivermectin at 0.2 mg/kg, subcutaneously. In addition, each monkey was shaved on its ventral abdomen and the medial aspects of the extremities (hereafter referred to as "ventrums") to remove nits. The loose hair from the shaving process was continuously vacuumed into a canister containing 5% carbaryl powder. The ivermectin injection was repeated in 14 days.

Animals in group C were bathed with a pyrethroid shampoo (Dura Kyl®, D.V.M., Miami, FL) containing 0.25% resmethrin. The shampoo was diluted one part shampoo to three parts water. Each animal was manually bathed and the lather was allowed to stand for 10 minutes. After this time, the soap was rinsed off with fresh water and the animal was towel dried. This entire procedure was repeated in 14 days.

Group D monkeys were bathed as were the group C animals but, in addition, they were each shaved as per the procedure for the group B monkeys. Each monkey received a second bath 14 days later.

The monkeys were treated outside of their cages. During this time, the substrate, perch bars and other cage equipment were steam cleaned. An area 3 feet around each cage also was sanitized thoroughly using the steam cleaner.

The animals were examined at 2 weeks, 4 weeks and 3 months for the presence of lice or nits. Animals were considered infested if they met one of the criteria already described for inclusion in the study.

Each primate cage was placed in quarantine during the 3 months of the study so that movement of primates in or out of any of the cages was prohibited. Personnel working in the cages wore disposable protective outer garments when entering the cage.

All of the animals had evidence of active infestation at the start of the trial. The distribution of the lice and nits was predominantly ventral, with a small number of nits located on the medial aspects of the extremities. Table 2 summarizes the results of the four different treatments.

Of the four groups, only group D, the pyrethroid

Figure 1 An adult sucking louse (*P. eurygaster*) isolated from one of the rhesus macaques during the outbreak.

pletely effective. However, approximately 3 months later, the animals in that cage were infested again with the same louse. On further examination it was noted that animals in six adjacent cages also were infested with the louse. These animals had no history of previous lice problems. Due to the apparent ineffectiveness of the previous treatment, new treatment regimens were tried.

The monkeys ranged from 12 to 24 months of age and weighed 1 to 2 kg. All animals were immobilized with ketamine HCl (Vetalar®, Parke-Davis, Morris Plains, NJ) at 10 mg/kg, I.M. and had a topical ophthalmic lubricating ointment (Lacrilube®, Allergan Pharmaceuticals, Inc., Irvine, CA) placed in each eye. Each monkey was examined for the presence of nits and juvenile or adult lice. At least one of the three stages had to be present to include an animal in the study. If no juvenile or adult lice were found, then active infestation was confirmed by microscopic examination of plucked hairs for the presence of nits containing larvae.

The infestation involved 69 animals in seven cages. The attack rate was 100% in each cage. Each cage was assigned randomly into one of four different treatment groups (Table 1).

Animals in group A were treated with ivermectin

bathed/shaved monkeys, were louse-free by 14 days after their first treatment. One of the seventeen ivermectin treated animals had lice present 14 days after its initial treatment. The nits on this animal were present on the stubble of the new hair shafts growing in the inguinal region of the abdomen. All of the monkeys in groups A and C still had live nits present. Juveniles and/or adult lice were found only on three animals in group A, the ivermectin group.

The monkeys in groups B and D were louse and nit free by day 28, 14 days after their second treatment. There were no nits present on the hair which was growing on the shaven ventrums. All of the monkeys in groups A and C still had nits present. Adult lice were still present on the three animals that were infested during the previous examination.

All monkeys which were still infested with lice on day 28 (groups A and C), regardless of initial treatment group, were bathed with the pyrethroid shampoo and shaved. These animals were then rechecked 14 days later, at which time they were found to be free of lice.

The four treatment groups were examined for the presence of lice 3 months after the last treatment. All of the animals were negative for all three stages of lice.

The route of infestation was not identified in the initial outbreak (2). Since these lice do not live in the environment, the most likely explanation for the reinfestation 3 months later stems from incomplete eradication during the first treatment episode. The spread of the louse infestation to the adjacent six cages could have been by movement of monkeys between cages, or possibly by cross contamination of cages with animal caretakers acting as the vector.

Anopluran lice get their nourishment by taking blood meals from their hosts. In human pediculosis the lice take two blood meals. With repeated exposure, the host develops an inflammatory hypersensitivity reaction, pruritus, dermatitis and possible secondary infections (3). Chronic infestations can lead to anemia and debilitation of the host. Diagnosis of pediculosis is based on finding adult lice or nits on the host animal (3).

Pediculosis is more common in the winter months. The longer, thicker hair coats and the closer contact between animals in an outdoor setting are favorable conditions for the spread of lice from animal to animal (4).

Historical treatment in humans included repeated baths and shaving of the head or the entire body in hirsute individuals, to remove the nits. More recent treatments include using a 1% permethrin shampoo (NIX®, Burroughs-Wellcome, Research Triangle Park, NC). This drug kills both the adults and the nits, but the mechanism of action is unknown and few studies have been published on its use. The permethrin shampoo was not used in the primates because of its cost, which was approximately fifteen times more expensive than the resmethrin shampoo.

The treatment of choice in humans is still pyrethrins synergized with piperonyl butoxide (5). Pyrethrins

are a contact poison with a rapid kill and very low toxicity. They are effective against lice, fleas, flies and mosquitos. Formulations of the pyrethrin/piperonyl butoxide combination are available as shampoos, liquids, gels and sprays. One treatment is usually sufficient to rid the host of the lice, but a second treatment 10 to 14 days later is recommended to kill lice hatching from nits surviving the first treatment.

Resmethrins are a type of pyrethroid, which is a synthetic pyrethrin. Pyrethroids have several advantages over the natural pyrethrins including: (a) they are less expensive; (b) do not need a synergist; (c) are broad-spectrum; (d) have low mammalian toxicity; (e) degrade readily to non-toxic compounds; and (f) do not accumulate in the ecosystem (5). Resmethrins also have good residual activity.

Group D, the pyrethroid bathed/shaved group of monkeys, demonstrated the greatest effectiveness with all of the monkeys becoming louse free by the end of the treatment period. Group B, the ivermectin treated/shaved group, also had a good outcome with only one of the 17 animals not being effectively de-loused. All monkeys in both groups were louse free after the second treatment.

The least successful treatments were in groups Group A and C. The life cycle of *P. eurygaster* is not known but, if it is similar to human varieties, then hatching of the nits should take about 10 to 14 days, with the nymph maturing in an additional 2 weeks (3). Ivermectin requires that the louse feed off body fluids to be effective and, as such, has an initial slow kill. It is effective against the juvenile and adult stages, but has no effect on the nits. Resmethrin has a quick kill mechanism of action and is most effective against the juvenile and adult stages. Although the resmethrin has good residual activity, it does not act long enough to be effective against the nits which hatch out 10 to 14 days later.

Since neither the pyrethroid shampoo or ivermectin are effective against the nit stage of the louse, it appears that the shaving of the ventrum (thus, removing the nits) is the key to effective treatment, since both groups B and D (shaved) had better results than groups A and C (non-shaved). This may account for the apparent treatment failure during the first louse outbreak where shaving each animal was not part of the treatment.

Nit removal was attempted with a nit comb, but it was labor intensive and ineffective at removing all of the nits. Bathing with the shampoo was easily performed. Treatment with the injectable ivermectin was the least labor intensive and yielded excellent results.

Based on the findings, it appears that either the use of pyrethroid shampoo or ivermectin at 0.2mg/kg SQ, repeated at a 14 day interval, are equally effective in treatment of rhesus macaques infested with the sucking louse, *P. eurygaster*. These treatments, however, need to be combined with shaving of the animals' ventrums to remove the nits and concomitant steam-cleaning of the cage and the immediate surrounding environment.

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