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## INFECTION OF HEAD LICE WITH RICKETTSIA PROWAZEKI

[Following is the translation of an article by G. M. Dutova, Department of Rickettsioses, N. F. Gamaleya Institute of Epidemiology and Microbiology, AMN, USSR, Moscow, published in the Russian-language periodical Voprosy Virusologii (Problems of Virology); No 3, 1964, pages 364--366. It was submitted on 19 Mar 1964, Translation performed by Sp/7 Charles T. Ostertag, Jr.]

Up until recently the problem concerning the significance of head pediculosis in the epidemiology of typhus has not occupied a specific place, though already in 1912 Goldberger and Andersen /6/ established the possibility of the infection of head lice with typhus. In their turn, G. N. Novikova /2/ and A. V. Pshenichnov /4/ reported on the successful infection of head lice with Rickettsia prowazeki, showing at the same time that in this species of lice the infection proceeds benignly. However, in the works by the above mentioned authors there is no mention of the isolation of the causative agent with excrements in the surrounding medium.

The literature contains contradictory opinions on the problem of the species independence of Pediculus capiti and Pediculus vestimenti. Thus, N. A. Kholodkovskiy /5/ and Ye. N. Pavlovskiy /3/, in citing the morphological differences of each form of lice, consider them as independent species. Other investigators, including Martini (1923) and Alpatov /1/, define them as varieties of the same species. In any case, there is no doubt that the head louse, just as the body louse, is a haematophage.

We undertook the mission of studying typhus infection in head lice, particularly of the virus in the feces by infected lice, as a possible source of human infection.

It was necessary to have laboratory stock for the infection of head lice. It is known that the cultivation of head lice in the laboratory is complex, since it is necessary that they have a 4-stage feeding with human blood daily. In order to approximate the existence of the head lice to natural, the temperature of the incubator was set at 33° with a humidity of 47--50%. Under such conditions we were able to obtain from 35 head lice more than 1,000 specimens already in the third generation.

In studying the biological peculiarities of head lice, it was established that one female oviposits 3 times in 24 hours. The breeding of larvae comprises 72-83% with the maximum emergence on the 6--7th day. The cycle of transformation in adult lice occupies 18--20 days. The life span is 35--40 days. The length of the female of the head lice equals 3.7 mm, the male -- 3.2 mm, while for body lice of the same age the female reaches 4.9 mm, and the male -- 3.2 mm. Investigations, carried out for determining the amount of blood which was engorged from donors during a single feeding, showed that the head louse sucked out 0.5--0.65 mg of blood, and the body louse -- 1.4 mg. In observing head lice over a period of 6 generations, we noted that they

preserve those general differences from body lice which were described by N.A. Kholodkovskiy /5/, Martini /7/, and Pavlovskiy.

The infection of head lice with Rickettsia prowazeki, Breynl strain (dry, standard egg culture), was carried out by 2 methods: 1) with the help of a microsyringe according to Weygl; 2) by the membrane method -- through the dissected off pellicle of one-day old chick.

The percentage of infection of head lice by the method of Weygl was 56%, and of body lice -- 78%. By the membrane method the head lice are infected in 50--70% of the cases.

The rickettsia appear in the intestines of head lice on the 4--5th day (with an infecting dose of  $10^{-3}$  of the vitelline sac) with a maximum accumulation of the causative agent on the 9--11th day. The number of Rickettsia prowazeki in head lice is somewhat less than in body lice with the infective dose (see drawing).

The difference in the number of accumulated Rickettsia prowazeki in head lice in comparison with body lice apparently is influenced by the fact that the capacity of the gastro-intestinal tract of head lice is twice as small than that of body lice. Beginning with the 6th day following infection, Rickettsia prowazeki appear in the feces.

The study of the infected feces of infected head lice was carried out by several methods.

The white mice infected by intranasal method with a suspension of feces resulted in the production of complement-fixing antibodies with a titer of 1:20 in the blood of the test animals. There were no changes in the lungs. Following one sub-passage, some of the mice died on the 5th day. At autopsy, specific changes were noted in the lungs of mice receiving a heavy content of rickettsia. The remaining mice on the 14th day demonstrated the complement fixing antibodies in the blood, titer 1:40.

The repeated rubbing-in of dry feces into the mucous membrane of the eyes of guinea pigs caused a rise in temperature on the 3rd day, with an accumulation of complement fixing antibodies, on a titer of 1:320 in the sera of the test animals.

It was possible to infect cotton rats by the same method and by the single administration of dry feces.

Besides this, a quantitative study of rickettsia was made on fecal content of head lice. For this purpose we administered intraperitoneally to guinea pigs various doses \* of fecal virus, ranging from  $10^{-3}$  to  $10^{-8}$  in a quantity of 1 ml. With the animals which were infected with the fecal virus in the limits of  $10^{-3}$  to  $10^{-5}$ , fever was noted over a period of 3--4 days as well as a positive reaction of complement fixation in a serum dilution of 1:160

\* 0.01 g of feces in 1 ml was taken as a dose of  $10^{-2}$ .

### Conclusions

1. The cultivation of head lice in the laboratory is possible by their daily 4-stage feeding on human blood.
2. The infection of head lice with Rickettsia prowazeki is possible by the method of Weygl and by the membrane method with the accumulation of the causative agent in the intestine.
3. The feces of infected head lice contains a significant amount of Rickettsia prowazeki. The rubbing in of dry feces through the mucous membrane of animals causes experimental typhus in them.
4. In this manner, based on experimental data, head lice, just as well as body lice, may be the source of typhus infection.

### Literature

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Smear from the intestine of a head louse, made on the 11th day following infection.