Plasmodium vivax Transmitted from Man to Monkey to Man

Abstract. Blood forms of human vivax malaria infected splenectomized night monkeys (Aotus trivirgatus). Anopheles albimanus mosquitoes transmitted the infection from a monkey to two human volunteers; parasites and symptoms appeared 11 days later. Blood forms of vivax malaria from each of the two humans infected other night monkeys.

Panama monkeys are being tested to determine whether they can serve as hosts to human-malaria parasites. We now report that *Plasmodium vivax* will grow in night monkeys (*Aotus trivirgatus*).

A patient from Santa Rosa village on the Chagres River, Panama, was admitted to hospital suffering from a *Plasmodium vivax* infection; the parasite count was 6,290/mm³. Blood was drawn, heparinized, and inoculated intraperitoneally into two splenectomized night monkeys: monkey 773 received 56.6 × 10⁶ parasites; monkey 776, 62.9 × 10⁶ parasites (Fig. 1). At the time of inoculation they received orally an immunosuppressant drug, Imuran (1), at the rate of 5 mg per kilogram of body weight.

Before inoculation with human parasites the blood of the monkeys was examined repeatedly to exclude the possibility of a natural infection with malaria, although natural infections have never been reported from night monkeys (2); nor were we able to prove natural infections by provocative methods such as splenectomy or drugs.

A patent infection developed in both monkeys on the fourth day. Both showed two peaks of parasitemia: In the blood of monkey 776, at the second and highest peak, parasites reached a maximum of 47.030/mm³ on the 37th day of patency; after patency continued for 54 days the monkey died. At the second (also the highest) peak, parasites in monkey 773 attained a maximum of 24,680/mm³ on the 35th day of patency, at which time chloroquine was given; the parasites disappeared three days later but the monkey died 5 days after receiving the drug.

Anopheles albimanus, which have been in colony at Gorgas Memorial Laboratory for many years, were fed on monkey 773. Fourteen days later, when sporozoites were present in the salivary glands, the mosquitoes bit each of two human volunteers (J.P. and C.J.) and a night monkey (813) by the interrupted-biting method; all three were bitten by each of 181 mosquitoes. Five more mosquitoes also bit both volunteer J.P. and the monkey, so that both suffered a total of 186 bites. Dissection of 100 of the mosquitoes showed a gland-positive rate for sporozoites of 57 percent, so that an estimated 103 infected mosquitoes bit volunteer C.J. and an estimated 106 mosquitoes bit volunteer J.P. and the monkey.

Patent parasitemia and symptoms appeared in the two human volunteers 11 days later, but parasitemia was never patent in monkey 813. A liver biopsy and splenectomy performed on the monkey on the 24th day disclosed no exoerythrocytic bodies in the biopsied tissue, and patent parasitemia did not develop subsequently.

Blood was drawn from each of the two infected humans and inoculated intraperitoneally into other night monkeys (826 and 825): the monkeys were unaltered but were dosed orally with Imuran at 5 mg/kg. Monkey 826 received blood from J.P.; the parasite count was 2,010/mm³ and the inoculum was 20.1 × 10⁶ parasites; 16 days later it was splenectomized. Patent parasitemia appeared on the 41st day. The maximum parasite count was 680/mm³. The monkey died on the 5th day of patency.

Monkey 825 received blood from C.J.; the parasite count was less than 10 per cubic millimeter and the inoculum was less than 0.1 × 10⁶ parasites. Patent parasitemia appeared on the 7th day and parasites reached 69,380/mm³ on the 11th day of patency, at which time the parasitemia was terminated by administration of chloroquine.

Vivax malaria has been transmitted by blood from monkey 825 to a splenectomized night monkey, and from the latter to two other splenectomized night monkeys.

Apparantly this is the first successful transmission of *P. vivax* to monkeys. The only other animal reported to be susceptible to *P. vivax* is the chimpanzee *Pan satyrus* (3). Current work at this laboratory indicates that night monkeys may become useful hosts for the experimental study of human malaria.

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References and Notes

1. Burroughs, Welcome and Co., Inc., Tuckahoe, N.Y.


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