Effect of *Bordetella pertussis* Adjuvant on Parasite-Specific IgE Response in *Paragonimus ohirai*-Infected Rats

T.	Teruaki	Ikeda
K.	Koichiro	Fujita

Department of Medical Zoology, Kanazawa Medical University, Uchinada, Ishikawa; and Department of Medical Zoology, Tokyo Medical and Dental University, Tokyo, Japan

Abstract

Parasite-specific IgE response in rats infected with metacercariae of the lung fluke, *Paragonimus ohirai*, was enhanced about 8 times by *Bordetella pertussis* adjuvant. In rats infected by intraperitoneal transplantation of adult worms, the adjuvant markedly increased the usually low or absent parasite-specific IgE response. The most effective time of the adjuvant administration was different between the two modes of infections.

Correspondence to: Dr. T. Ikeda, Department of Medical Zoology, Kanazawa Medical University, Uchinada-machi, Kahokugum, Ishikawa-Ken 920-02 (Japan)

Helminth infection easily induces IgE antibody response against the parasite. Rats infected with metacercariae of *Paragonimus ohirai* elicited a relatively high parasite-specific IgE response, while rats infected by intraperitoneal transplantation with adult worms elicited little or no parasite-specific IgE response [1]. To obtain sera with a higher level of parasite-specific IgE induced during the migrating phase of immature worms and to obtain IgE antibody elicited by live adult worms alone, we examined the effect of *Bordetella pertussis* bacteria, which are known to enhance IgE antibody production [2–4], on the production of parasite-specific IgE antibodies. There are few reports about the effect of *B. pertussis* on IgE antibody response in helminth infection.

Outbred Wistar female rats (160–200 g) were used throughout. Rats were infected with 10 metacercariae or infected by surgical intraperitoneal transplantation with three adult (5-week-old) worms as described previously [1]. At various times after infection or transplantation, the rats were injected with 1×10^{10} killed *B. pertussis* i.p. Parasite-specific IgE was measured by the 48-hour passive cutaneous anaphylaxis assay using adult *P. ohirai* antigen, as described previously [1].

Figure 1 shows the effect of the *B. pertussis* adjuvant on parasite-specific IgE response in rats infected with metacercariae. An enhanced response was observed in the groups of rats receiving the adjuvant on day 0 or one week after infection. The peak titer in the latter group was clearly although not significantly

($0.05 < p < 0.1$; Student *t* test) higher than in the former group and was about 8 times higher than that in the group without the adjuvant. However, the group receiving the adjuvant at two weeks was unaffected. The finding that an ongoing IgE antibody response was not enhanced was inconsistent with the observation in rats immunized with ovalbumin [5]. The intravenous administration of the adjuvant was not as effective as the intraperitoneal administration ($p < 0.005$) when the groups of rats receiving the adjuvant one week after metacercarial infection

were compared (fig. 2). This difference might be related to the migration route of *P. ohirai* juveniles, which migrate into the peritoneal cavity and the liver during the first 3 weeks. Figure 1b shows the effect of the adjuvant in rats infected with adult worms. The administration of the adjuvant on day 0 of transplantation strongly enhanced the usually low or absent parasite-specific IgE response in the adult-worm-infected rats. The response was considerably weaker when the adjuvant was injected one or two weeks after transplantation. We indicated previously that worms of 4 weeks or older induced suppression of parasite-specific IgE formation. The enhancing effect of *B. pertussis* on IgE antibody formation was suggested to be T cell-dependent [5–7]. Therefore, the adjuvant may be thought to induce a T cell-dependent helper mechanism that overcomes the suppression induced by adult worms.

B. pertussis and Antiparasite IgE

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Weeks after infection Vfeeks after transplantation

Fig. 1. Effect of *B. pertussis* adjuvant on parasite-specific IgE response in rats infected intraperitoneally with 10 metacercariae of *P. ohirai* (a) and rats infected by intraperitoneal transplantation with three adult (5-week-old) worms (b). Groups of 6 infected rats were injected intraperitoneally with 1×10^{10} killed *B. pertussis* organisms at 0 (●), 1 (■) or 2 (▲) weeks after infection. Control groups (O) of 6 infected rats received no adjuvant. Each point is the geometric mean of PCA titers.

Fig. 2. Comparison of effects of *B. pertussis* adjuvant on parasite-specific IgE response between intraperitoneal (β) and intravenous (ϖ) injections with the adjuvant. Rats infected with 10 metacercariae were injected with the adjuvant one week after infection. The values ($\pm$ SD) are geometric mean titers of sera from 6 rats bled 3 weeks after infection.

Consequently, we could obtain sera with a PCA ti-ter of 1:2,000 in the metacercaria-infected rats and with a titer of 1:1,000 in the adult-worm-infected rats. These sera will be useful for studying the involvement of IgE antibody in host-parasite relationships and purification or characterization of *P. ohirai* allergen.

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