Veterinary Parasitology, 15 (1984) 165—168
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

Short Communication

THE PROTECTIVE EFFECT OF PRETREATMENT WITH KILLED *CORYNEBACTERIUM PARVUM* AGAINST ACUTE BABESIOSIS IN CALVES

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(Accepted for publication 25 October 1983)

ABSTRACT

Corrier, D.E. and Wagner, G.G., 1984. The protective effect of pretreatment with killed *Corynebacterium parvum* against acute babesiosis in calves. *Vet. Parasitol.*, 15: 165—168.

Yearling calves were pre-treated intravenously (IV) with a 0.20 mg kg^{-1} dose of *Corynebacterium parvum* and challenged after 30 days by IV inoculation of 3×10^9 *Babesia bigemina*. The relatively low 0.20 mg kg^{-1} dose of *C. parvum* enhanced resistance as indicated by lower mean *Babesia* parasitemias and less severe decreases in packed-cell volumes than in non-treated calves, but failed to stimulate a significant ($P \leq 0.05$) level of protection against *B. bigemina* challenge.

INTRODUCTION

Corynebacterium parvum has been reported to stimulate nonspecific resistance to viral- (Glasgow et al., 1977; Kirchner et al., 1977), bacterial- (Adlam et al., 1972; Miyaka et al., 1980) and protozoan- (Nussenzweig, 1967; Clark et al., 1977) diseases. Clark et al. (1977) reported that mice pre-treated systemically with killed *C. parvum* were completely resistant to infection with *Babesia rodhaini* and *B. microti*.

The purpose of the present study was to confirm the protective effect of pre-treatment with *C. parvum* against *B. rodhaini* infection in mice and to determine if similar protection could be induced against *B. bigemina* challenge in calves.

MATERIALS AND METHODS

Twelve adult male Swiss mice were divided into 6 principals and 6 controls. The principals were injected intraperitoneally (IP) with a 50 mg kg^{-1} dry weight dose of formalin killed *C. parvum* (Wellcome, Research Triangle

0304-4017/84/$03.00

Park, NC) as previously described (Clark et al., 1977). Thirty days later the 12 mice were challenged by IP inoculation of 10^6 *B. rodhaini*. Similarly, 8 yearling male Hereford × Angus calves were divided into 4 principals and 4 controls. The principals were injected intravenously (IV) with a 0.20 mg kg^{-1} dry weight dose of formalin killed *C. parvum* in 10 ml of sterile phosphate buffered saline. Thirty days later the 8 calves were challenged with 3×10^9 *B. bigemina* injected IV. The effect of challenge was monitored by the examination of Giemsa stained blood smears for the percentage of *Babesia* infected erythrocytes (parasitemia) and the determination of packed-cell volumes (PCV), pre-patent periods and mortality.

TABLE I

Mean parasitemias and packed-cell volumes of calves challenged with 3×10^9 *Babesia bigemina* 30 days after pre-treatment with a 0.20 mg kg^{-1} dose of *Corynebacterium parvum*. Data are expressed as Mean ± Standard Deviation

	Parasitemia (%)		Packed cell volumes (%)		
Day	*C. parvum* pre-treated (N=4)	Non-treated controls (N=4)	*C. parvum* pre-treated (N=4)	Non-treated controls (N=4)	Significance ($P \leq 0.05$)
0[a]	0	0	39 ± 3	38 ± 8	NS[b]
3	1.5 ± 0.7	3.1 ± 2.1	30 ± 10	25 ± 1	NS
5	1.2 ± 1.5	2.1 ± 2.3	27 ± 4	23 ± 4	NS
7	0.9 ± 0.6	1.3 ± 0.9	27 ± 3	24 ± 7	NS
10	0.3 ± 0.1	0.5 ± 0.6	28 ± 4	27 ± 6	NS
14	0.1 ± 0.2	0.3 ± 0.2	30 ± 2	29 ± 2	NS
21	0.1	0.1	37 ± 2	37 ± 3	NS

[a]Day 0 = Day of *B. bigemina* challenge.
[b]NS = Not significant.

RESULTS

The *C. parvum* treated mice developed transient *B. rodhaini* parasitemias of 3—5% and were completely protected against the lethal challenge which caused parasitemias in excess of 60% and the death of all 6 controls.

Erythrocytes infected with *B. bigemina* were present in the principal and control calves on Day 3 post-challenge (PC). Although the mean parasitemia remained markedly lower in the *C. parvum* treated calves than in the controls, the difference between the 2 groups was not statistically significant (Table I). The decrease in the mean PCV, during the period of high parasitemia on Days 3, 5 and 7 PC, was less marked in the *C. parvum* pre-treated calves than in the controls (Table I). However, the apparent differences in PCV between the principals and controls were not significant. The mean PCV of both groups returned to pre-challenge levels by Day 21 PC.

DISCUSSION

The present study indicates that pre-treatment of mice with killed *C. parvum* stimulates complete protection against lethal *B. rodhaini* challenge as was reported by Clark et al. (1977). Suspensions of *C. parvum* have been reported to alter such defense functions as antigen processing, macrophage activation, lymphokine release, lymphocyte traffic and tumor killing (Milas and Scott, 1978). However, the specific components of the organism which determines biological activity and the mechanism of increased resistance is as yet unexplained (Wood and Clark, 1982).

The consistently lower *B. bigemina* parasitemias and less marked decrease in PCV in the *C. parvum* pre-treated calves suggests that resistance was enhanced against *Babesia* challenge. However, variation within the small groups was large and the differences between the pre-treated and control groups were not significant. The failure of *C. parvum* to stimulate significant protection against *B. bigemina* may have been due to the low dose administered. Clark et al. (1977) reported that although the IV or IP injection of 0.1 mg *C. parvum* (approximately 4 mg kg^{-1} in a 25 g adult mouse) provided complete protection, the injection of a 10-fold lower dose (0.4 mg kg^{-1}) failed to stimulate significant resistance against *B. rodhaini* infection. The effect of different dosages of *C. parvum* on marrow macrophage progenitor cells was previously reported. A 46 mg kg^{-1} dose caused significant increases in the number of macrophage colonies in mice (Wolmark et al., 1974). A 100-fold lower dose (0.45 mg kg^{-1}) enhanced colony production, but failed to stimulate significant increases in the number of colonies in calves (Al-Izzi and Maxime, 1982). The data from the present study suggests that the low dose of *C. parvum* administered to the calves (0.20 mg kg^{-1}) did enhance resistance, but was insufficient to stimulate significant protection against *B. bigemina* challenge. Although Al-Izzi and Maxime, (1982) reported adverse side effects following the IV injection of a 0.45 mg kg^{-1} dose in calves, larger doses of *C. parvum*, which may be required to stimulate a significant immune response in the bovine, could perhaps be administered systemically by IP injection without adverse side effects.

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