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EXPERIMENTAL INFECTION OF CAPTIVE AXIS DEER WITH *BRUCELLA ABORTUS*

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ABSTRACT: Four captive-raised axis deer, *Axis axis* (Erxleben), which were negative serologically to *Brucella* were inoculated with 1×10^8 virulent *Brucella abortus* biotype 1 organisms (Texas #221 isolate) administered bilaterally into the conjunctival sac. Sera collected from each deer prior to inoculation and 30 days post-inoculation (PI) were examined for *Brucella* antibodies by the buffered *Brucella* antigen (card), the rivanol precipitation, the standard tube agglutination, and the cold complement fixation tube serologic tests. All four axis deer converted serologically as determined by all tests at 30 days PI. *Brucella abortus* biotype 1 was isolated from 26 of 32 tissue samples collected at necropsy and also from milk from the lactating female.

INTRODUCTION

The southwestern region of the United States and Texas in particular is occupied by an increasing number of exotic or non-native game species. These exotic species are generally of African or Asian origin but game animals from Europe are also present. As determined by the Texas Parks and Wildlife Department (Harmel, 1980), the exotic game population in Texas has increased from an estimated 13,000 in 1963 to more than 72,000 animals in 1979 and the number of exotic species from 13 to 51. The exotic game species are, in some cases, confined or enclosed in areas surrounded by "game-proof" fences. About one-third of the total number of the major exotic species, however, are free-ranging and occur in over 64 counties in the state (Harmel, 1980). These free-ranging exotics feed on and occupy areas with native game and domestic livestock. The health status and disease reservoir potential of these free-ranging and confined exotic species are not well known.

Axis deer are the most abundant and widespread non-native deer in Texas with population estimates in 1979 exceeding 22,000. Free-ranging axis deer occur in 20 counties, and in 59 counties axis deer are confined within "game-proof" fenced pastures (Harmel, 1980). In most cases the axis deer are held with other exotics, native game, and domestic livestock under crowded conditions conducive to intraspecific and interspecific transmission of diseases.

Brucellosis is a disease of economic, political, and public health importance in Texas. Several species of deer occurring in Texas have been shown to be either naturally or experimentally susceptible to *Brucella* infection. White-tailed deer (*Odocoileus virginianus* Zimmermann) were shown to be susceptible experimentally to *B. abortus* (Youatt and Fay, 1959; Baker et al., 1962), and serologic evidence indicates that on rare occasions they may be naturally exposed (Steen et al., 1955; Shotts et al., 1958; Youatt and Fay, 1959; Hayes et al., 1960; Trainer and Hanson, 1960). Only once has *B. abortus* been isolated from a wild white-tailed deer (Corey et al., 1964). Mule deer (*Odocoileus hemionus* (Rafinesque)) have also been shown to be experimentally susceptible to infection with *B. abortus* (Thorpe et al., 1967), and serologic evidence of natural exposure has been documented (Thorpe et al., 1965). McDiarmid (1951) found agglutinins to *B. abortus* in the sera of sika deer (*Cervus nippon* (Temminck)) and

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fallow deer (*Dama dama* (L.)). Rocky Mountain elk (*Cervus elaphus nelsoni* Bailey) in North America have been shown by both serologic and bacteriologic examinations to be infected naturally with *B. abortus* (Tunnicliff and Marsh, 1935; Corner and Connell, 1953; Adrian and Keiss, 1977; Thorne et al., 1978).

The effects of exposure of axis deer to *Brucella* have not been established. The purpose of the present investigation is to determine the susceptibility of axis deer to *B. abortus* infection, their serologic response, and their reservoir potential as non-bovine hosts for *B. abortus*.

MATERIALS AND METHODS

Four captive axis deer (three adult does, one yearling male) that had been raised in isolation on the Research Park of the College of Veterinary Medicine, Texas A&M University were used in this study. The deer were shown to be serologically negative for *Brucella* antibodies as determined by the buffered *Brucella* antigen (card), the rivanol precipitation (Riv), the standard tube agglutination (STA) (as described in the National Animal Disease Laboratory Diagnostic Reagents Manual 650 E and F), and the cold complement fixation tube (CCFT) (Jones et al., 1963) tests.

The axis deer were immobilized with xylazine hydrochloride, (2–3 mg/kg Rompun-xylazine HCl, Bayvet Division, Cutter Laboratories, Inc., Shawnee, Kansas 66231, USA) and inoculated individually with 100 μl of a PBS solution containing 1×10^8 virulent *B. abortus* biotype 1 organisms of bovine origin (Texas #221 isolate) administered bilaterally into the conjunctival sacs (50 μl each). Blood samples were collected from each deer via jugular venipuncture immediately prior to *Brucella* exposure and 30 days post-inoculation (PI). The deer were killed at 30 days PI and tissue samples were collected at necropsy and held at −20 C until inoculated on Farrell's medium (Farrell, 1974). Comparable tissue samples were fixed in 10% buffered formalin, paraffin embedded, sectioned at 4 μm and stained with hematoxylin and eosin.

RESULTS

All four axis deer were negative serologically for *Brucella* antibodies on the day of inoculation as indicated by all methods utilized. At 30 days PI, sera from all the deer were *Brucella* reactive at levels considered positive by criteria for bovine brucellosis (card positive, Riv ≥ 1:100, STA ≥ 1:100, CCFT ≥ 1:40) (Table 1).

TABLE 1. Serologic reactions of four axis deer 30 days post-inoculation with 1×10^8 *Brucella abortus* organisms.[a]

Deer no.	Age	Sex	Card[b]	Serum titer STA[c]	RIV[d]	CCFT[e]
1	6 yr	F	Pos.	200	200	1 + 80[f]
2	4 yr	F	Pos.	200	200	1 + 80
3	3 yr	F	Pos.	200	200	3 + 40
4	1 yr	M	Pos.	100	200	4 + 80

[a] All deer were seronegative for *B. abortus* antibodies by all tests prior to inoculation.
[b] Card—buffered *Brucella* antigen test.
[c] STA = standard tube agglutination test.
[d] RIV—rivanol precipitation test.
[e] CCFT = cold complement fixation tube test.
[f] 1 + 80 = a 1+ reaction observed at a serum dilution of 1:80.

Brucella abortus biotype 1 was isolated from 26 of 32 tissue samples collected at necropsy and also from milk collected from a lactating doe (Table 2).

Morphologic evaluation of the reproductive systems failed to disclose significant lesions. The suprapharyngeal, mandibular, internal iliac, and inguinal or supramammary lymph nodes were moderately hypertrophic and hyperplastic, with large numbers of hypercellular mature secondary germinal centers and cellular expansion of the paracortex.

DISCUSSION

The data indicated that axis deer were readily infected when exposed to *B. abortus*. Serologic reactions observed in the deer at 30 days PI were similar to those seen in susceptible bovine hosts. If the current bovine criteria for classification were applied, all of the axis deer would be declared as *Brucella* reactors by any of the serologic tests.

The frequency of *B. abortus* isolations from the tissues equals or surpasses what one would expect in infected cattle. *Bru-*

TABLE 2. Isolations of *B. abortus* biotype 1 from axis deer samples collected at necropsy 30 days post-inoculation.

Tissue/sample	Deer number			
	1	2	3	4
Liver	+	+	+	+
Spleen	+	+	+	+
Suprapharyngeal L.N.[a]	+	+	+	+
Prescapular L.N.	+	+	+	+
Parotid L.N.	+	+	+	+
Supramammary L.N.	−	+	+	+[b]
Internal iliac L.N.	+	+	+	−
Uterus	−	−	−	NA
Testes	NA[c]	NA	NA	−
Urine	NA	−	−	−
Feces	−	−	−	−
Milk	NA	+	−	NA

[a] L.N. = lymph node.
[b] Inguinal lymph node.
[c] Not available.

cella abortus was isolated from 81% (26 of 32) of the deer samples collected and cultured. Isolations of *B. abortus* from milk and uterus from deer #2 indicated that vertical transmission was possible in axis deer. The histologic lesions observed in axis deer tissues were compatible with broad spectrum polyclonal local and systemic antigenic stimulation by a bacterium such as *B. abortus*.

The prevalence of *Brucella* infections in free-ranging populations of axis deer is unknown; however, the species may represent a suitable non-bovine, exotic wildlife reservoir for *B. abortus* if this organism is introduced into populations of this widespread, non-native game animal.

LITERATURE CITED

ADRIAN, W. J., AND R. KEISS. 1977. Survey of Colorado's wild ruminants for serologic titers to brucellosis and leptospirosis. J. Wildl. Dis. 13: 429–431.

BAKER, M. F., G. J. DILL, AND F. A. HAYES. 1962. Further experimental studies on brucellosis in white-tailed deer. J. Wildl. Manage. 26: 27–36.

COREY, R. R., L. J. PAULISSEN, AND D. SWARTZ. 1964. Prevalence of brucellae in the wildlife of Arkansas. Wildl. Dis. 36: 1–9.

CORNER, A. H., AND R. CONNELL. 1953. Brucellosis in bison, elk and moose in Elk Island National Park. Can. J. Comp. Med. 22: 9–21.

FARRELL, I. D. 1974. The development of a new selective medium for the isolation of *Brucella abortus* from contaminated sources. Res. Vet. Sci. 16: 280–286.

HARMEL, D. E. 1980. Statewide census of exotic big game animals. Performance Report, Federal Aid Project No. W-109-R-3, Texas Parks and Wildlife Department, 33 pp.

HAYES, F. A., W. T. GERARD, E. B. SHOTTS, AND G. J. DILL. 1960. Brucellosis in white-tailed deer. J. Am. Vet. Med. Assoc. 137: 190–191.

JONES, L. M., J. B. HENDRICKS, AND D. T. BERMAN. 1963. The standardization and use of the complement fixation test for the diagnosis of bovine brucellosis with a review of the literature. Am. J. Vet. Res. 24: 1143–1151.

MCDIARMID, A. 1951. The occurrence of agglutinins for *Brucella abortus* in the blood of wild deer in the south of England. Vet. Rec. 63: 469–470.

NATIONAL ANIMAL DISEASE LABORATORY. Diagnostic Reagents Manual 650 E and F. USDA, ARS, Animal Health Division, Diagnostic Services, Ames, Iowa, 16 pp.

SHOTTS, E. B., W. E. GREER, AND F. A. HAYES. 1958. A preliminary survey of the incidence of brucellosis and leptospirosis among white-tailed deer (*Odocoileus virginianus*) of the Southeast. J. Am. Vet. Med. Assoc. 133: 359–361.

STEEN, M. O., H. BROH, AND D. ROBB. 1955. A survey of brucellosis in white-tailed deer in Missouri. J. Wildl. Manage. 19: 320–321.

THORNE, E. T., J. K. MORTON, AND G. M. THOMAS. 1978. Brucellosis in elk. I. Serologic and bacteriologic survey in Wyoming. J. Wildl. Dis. 14: 74–81.

THORPE, B. D., R. W. SIDWELL, J. B. BUSHMAN, K. L. SMART, AND R. MOYES. 1965. Brucellosis in wildlife and livestock of west central Utah. J. Am. Vet. Med. Assoc. 146: 225–232.

———, ———, AND D. L. LUNGREN. 1967. Experimental studies with four species of *Brucella* in selected wildlife, laboratory, and domestic animals. Am. J. Trop. Med. Hyg. 16: 665–673.

TRAINER, D. O., AND R. P. HANSON. 1960. Leptospirosis and brucellosis serologic reactors in Wisconsin deer. J. Wildl. Manage. 24: 44–52.

TUNNICLIFF, E. A., AND H. MARSH. 1935. Bang's disease in bison and elk in Yellowstone National Park and on the National Bison Range. J. Am. Vet. Med. Assoc. 86: 745–752.

YOUATT, W. G., AND L. D. FAY. 1959. Experimental brucellosis in white-tailed deer. Am. J. Vet. Res. 20: 925–926.