TICK TRANSMISSION OF ANAPLASMA CENTRALE

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INTRODUCTION

Anaplasmosis is an economically important, tick-borne, rickettsial disease of cattle in the Republic of South Africa. It has been shown in the laboratory that 5 different important cattle ticks can transmit Anaplasma marginale infections in this country (Potgieter, 1979; 1981). Stomoxys calcitrans can transmit A. marginale mechanically (Potgieter, Sutherland & Biggs, 1981), and recent laboratory investigations have indicated that transplacental infections of both A. marginale and A. centrale probably occur more frequently than was previously thought (Potgieter & Van Rensburg, unpublished observations 1986).

Anaplasma marginale was first described by Theiler (1910) as the causative organism of anaplasmosis in cattle in South Africa. In an attempt to isolate pure infections of Anaplasma marginale, Theiler (1911) found an organism in a heifer from Aliwal North in the Cape province that was smaller and more centrally placed in the erythrocyte than A. marginale. This organism caused less severe reactions in cattle than A. marginale and he called it Anaplasma marginale var. centrale. It was also demonstrated that animals infected with A. centrale had sufficient immunity and were protected against A. marginale challenge. Having demonstrated this cross-immunity, Theiler (1912) produced a live blood vaccine containing A. centrale organisms. The isolate has been exported to other countries, where it is used as a live blood vaccine.

Apparently this was the only isolate of A. centrale to have been made in this country until recently, when an A. centrale infection was transmitted to a splenectomized ox in the laboratory with a field collection of unfed adult Rhipicephalus simus.

Theiler (1911) reported the transovarial transmission of anaplasmosis by Boophilus decoloratus and R. simus, the former apparently transmitting both A. marginale and A. centrale. R. simus was reported to have transmitted anaplasmosis, but the specific parasite involved was not mentioned.

The purpose of this study was to determine whether the A. centrale vaccine strain, originally isolated by Theiler more than 75 years ago and still being used in the current live blood vaccine, is still tick transmissible after having been maintained in splenectomized vaccine donor cattle through needle passage in the laboratory all these years.

MATERIALS AND METHODS

Cattle

All the cattle used in these transmission experiments were born and reared under strict, tick-free conditions at this laboratory. They were mainly mixed Bos taurus breeds, splenectomized at approximately 6 months of age and fully susceptible to anaplasmosis.

Certain precautions were taken to prevent possible mechanical transmission of the Anaplasma infections in a particular stable complex, as described by Potgieter et al. (1981).

All the cattle were monitored on a regular basis. Rectal temperatures were taken daily and thin blood smears, prepared from the tip of the tail, were stained with Giemsa's stain and examined daily for Anaplasma bodies. Haematocrits were determined 3 times a week during active infections. Animals showing severe reactions were treated daily intravenously with oxytetracyclines at a dosage rate of 10 mg/kg live body mass for 3 consecutive days.

Cattle that remained negative on blood smear examination were tested serologically after 90 days with a card agglutination test (Potgieter & Van Rensburg, 1983) to confirm unsuccessful transmission.

Anaplasma isolates

The original A. centrale isolate made by Theiler (1911) is still used to produce a live blood vaccine, as described by Potgieter (1979). Almost 60 years later, a second A. centrale isolate from a tick-transmitted infection was made by Potgieter (1979). Adult R. simus ticks, amongst other species, were collected from the field during a Corridor disease outbreak in the Louis Trichardt district of the Northern Transvaal in an attempt to isolate Theileria p. lawrencei in the laboratory. These ticks were identified and fed on susceptible splenectomized cattle under controlled conditions. An ox infested with 80 adult R. simus contracted a pure A. centrale infection, showing a prepatent period of 55 days after tick infestation. Further transmission experiments indicated that the A. centrale infection was not carried transovarily and it was decided to maintain these ticks, designated the LT-strain (Potgieter & Van Rensburg, 1982), as a non-infected laboratory strain.

Infected blood stabiles of both these isolates, stored in liquid nitrogen, were used to infect the experimental animals intravenously.

Ticks

Non-infected, laboratory-maintained batches of 3 tick species, the LT-strain of R. simus (see above) and 2 laboratory strains of B. decoloratus and Boophilus microplus, were used in these transmission trials. All 3 tick strains have previously been shown to transmit Anaplasma marginale infections transstadially (Potgieter, 1979; 1981).

Non-feeding stages were kept in the acaridarium at 26 °C and 85% RH.

Attempts to infect ticks with A. centrale

R. simus: In 2 separate experiments non-infected nymphs were used to infest the ears of 2 oxen undergoing primary A. centrale reactions, according to the method of Neitz, Boughton & Walters (1971), as indicated in...
Table 1. The engorged nymphae were collected and allowed to moult in the acaridarium and the ensuing adults were used to infest the ears of 2 oxen in an attempt to demonstrate transstadial transmission from nymph to adult.

A 3rd batch of nymphae was fed on splenectomized Calf 9630-6, which initially contracted an intra-uterine A. centrale infection and consequently suffered a severe relapse after splenectomy. The dam was an ex-A. centrale vaccine donor used in the tick-free breeding herd.

B. decoloratus: Two attempts with different batches of the same tick strain were used to demonstrate transstadial transmission, larva to nymph-adult and larva-nymph to adult.

Ox 9386-7 was infested with larvae twice, at a 7-day interval. On Days 7 and 8 after the larval infestations, the life cycle of this one-host tick was interrupted when engorged larvae and nymphae were removed by hand and transferred to 2 calves respectively, over a period of 3-5 days, as indicated in Table 2. During this time some of the engorged nymphae moulted in the acaridarium before they were used to infest Calf 9472-2. The ticks were placed into cloth containers (back pockets), glued to the calves' backs.

When this experiment was repeated, only engorged nymphae (no larvae) were removed from the infested ears of Ox 9436-0 and transferred to Ox 9533-8 (Table 2).

B. microplus: Two experiments were executed to demonstrate transstadial, larva-nymph to adult transmission. Engorged nymphae were manually removed from the reacting cattle and transferred over a period of 5 days (Table 3) to the susceptible animals, mainly as newly moulted adults.

Tick suspension

Unfed R. simus adult ticks, which had become infected as nymphae (Table 1), were triturated in a tissue
homogenizer as described by Potgieter & Van Rensburg (1980). Freshly prepared tick suspensions were used to inoculate cattle to demonstrate infectivity.

RESULTS

The A. centrale Onderstepoort live blood vaccine strain was successfully transmitted transstadially by R. simus adult ticks in 4 separate experiments (Table 1).

All attempts to transmit the infection transstadially with the 2 one-host blue tick species failed (Tables 2 & 3).

DISCUSSION

The fact that the original isolate of A. centrale (Theiler, 1911) retained its infectivity to R. simus, after being artificially maintained by needle passage in splanchnecotomized cattle in this laboratory for more than 75 years, is quite remarkable. At this stage it is not known how many tick species are involved in the transmission of this parasite, and limited attempts have been made to compare the pathogenicity of the original isolate made by Theiler with the recent R. simus-transmitted field isolate mentioned above. No significant differences were observed in the clinical response between 2 groups of 4 animals each, infected with these 2 isolates respectively. On challenge with A. marginale the reactions in all 8 animals were comparable (Potgieter, unpublished data, 1980).

The natural host of A. centrale and the prevalence of natural infections in cattle are now obscured by the fact that the vaccine-strain is transmitted by ticks. During the past 10 years an average of 454 446 doses of vaccine per annum have been issued from this Institute. Mechanical as well as in utero transmission of the infection probably also make a significant contribution to spreading the infection.

It is known that vaccination with A. centrale can cause severe clinical reactions and even mortality in older cattle (Bigalke, 1980; Pipano, Mayer & Frank, 1985). However, no evidence is forthcoming that incriminates A. centrale as the causative organism of natural anaplasmosis outbreaks in this country except for a few isolated cases in which older lactating Friesian dairy cows were involved and some unconfirmed field reports (Potgieter, unpublished observations, 1981). It is believed that this mild A. centrale vaccine organism could have been spread in enzootic anaplasmosis areas were the vaccine is used regularly.

Differences between these parasites and the host’s response to the specific infections have been described by Theiler, 1911; Kuttler, 1966; Schindler, Ristic & Wokatsch, 1966; Wokatsch, 1968; Kuttler, 1972. It may also be true that they do not share the same tick vectors, because the same strains of the 2 Boophilus spp. used in the present negative transmission experiments readily transmitted A. marginale infections transstadially under the same laboratory conditions (Potgieter, 1979; 1981).

We conclude that natural infection of calves with A. centrale probably enhances the development of enzootic stability of anaplasmosis in many areas in this country.

REFERENCES


