

Susceptibility of West African dwarf (WAD) goats to experimental *Ehrlichia* (*Cowdria*) *ruminantium* infection

Okaiyeto, S.O.^{1*}, Akerejola, O.O.², Umoh, J.U.³ and Abdullahi, S.U.²

¹Veterinary Teaching Hospital, A.B.U., ²Veterinary Surgery and Medicine, A.B.U., ³Veterinary Public Health and Preventive Medicine, A.B.U., Zaria, Nigeria

*Corresponding author: Okaiyeto, S. O. E-mail: sokaiyeto@yahoo.com.

ABSTRACT

The susceptibility of the West African dwarf goats to experimental *Cowdria ruminantium* infection was studied over a period of 9 weeks using 10 infected and 4 control animals. All the 10 goats reacted to intravenous inoculation of *C. ruminantium* infected blood. Two died hyperacutely 12 days post infection (pi) with rectal temperature of $41.0 \pm 5^{\circ}\text{C}$ as the main clinical sign presented, 3 died 15 days pi exhibiting various clinical signs, the remaining 5 recovered from the infection after maintaining high rectal temperature ($41^{\circ}\text{C} \pm 0.5$) for 8 - 9 days.

The study shows that West African Dwarf goats are highly susceptible to experimental *Cowdria ruminantium* infection.

Key words: Heartwater; susceptibility; *Ehrlichia ruminantium*; West African dwarf goat

INTRODUCTION

Heartwater (Cowdriosis), the most important rickettsial disease of ruminants in Africa, is caused by *Ehrlichia* (previously *Cowdria*) *ruminantium* (Dumler *et al.*, 2001) and is transmitted by a number of species of ixodid ticks of the genus *Amblyomma* (Bezuidehout, 1987). In endemic areas of Africa where East Coast fever is absent, it is the most serious cause of morbidity and mortality of all tick-borne diseases (Walker and Olwage 1987). In Nigeria, heartwater was reported to be responsible for major losses in both exotic breeds of cattle and indigenous sheep and goats. The economic impact is determined by the loss of production (diminished growth rate or weight loss, diminished milk or wool production, loss of use of draft animals and loss of value of hides (Ilemobade, 1976).

The study was therefore undertaken with a view of investigating the Susceptibility of the second major breed of goats (West African dwarf goats) in southern Nigeria to the experimental infection of *Ehrlichia* (*Cowdria*) *ruminantium*.

MATERIALS AND METHODS

Fourteen West African Dwarf goats (6 males and 8 females), aged between 9 and 18 months were used. The animals were kept in a tick-proof pen and pre-conditioned for a period of 6 weeks, during which they were ear-tagged and dewormed using “wormCare” a brand of Levamisole (Sam Pharmaceutical Products Nig. Ltd.) at a therapeutic dose of 7.5 mg/kg body weight, orally. They were also sprayed with 20% w/v supona (Pfizer Products Ltd, Ikeja, Nigeria) at 10 ml in 5 litters of water against ectoparasite and were vaccinated against pest des peptits ruminantium (PPR) using Tissue Culture Rinderpest Vaccine (TCRV) at 1.0 ml, subcutaneously. Blood samples were also taken and screened for haemoparasitosis.

After preconditioning, the animals were divided randomly into two groups, made up of 10 animals (Infected group) and 4 animals (control group). The stabilate used was a stock of *Cowdria* (Cr151)

originally isolated from the supernatant crushed adult *A. variegatum* tick collected from cattle in Basawa, Zaria Nigeria (Lawal, 1990, unpublished data) and cryopreserved in liquid nitrogen at -196°C.

Two milliliters of the cryopreserved stablilate was injected into a donor goat. At reacting temperature of 41°C, 50 ml of the blood were taken by jugular venipuncture into sample bottles containing ethylenediamine tetraacetic acid (EDTA) as anticoagulant. The experimental animal in group 1 were each inoculated with 2.0 ml of the infected blood, rectal temperature of the animals were taken daily and those that showed febrile reaction an indication of infection were allowed to go through the full course of the infection without treatment.

RESULTS

All infected goats reacted by showing pyrexia as from day 9 post-infection (pi) except for goat No. 290 that reacted on day 11, the intensity and duration of the reaction varied greatly. Hyper acute reactions were noticed in goats Nos. 277 and 284 both of which died 3 days after the onset of pyrexia. Those that reacted acutely (goats Nos. 271, 280 and 296) also died after maintaining pyrexia for 5 days, but the temperature dropped to 37°C before death. The recovered animals (Nos. 8, 276, 279, 290 and 283) maintained high temperature profile for 8 to 9 days. The maximum temperature reach before death and recovery are shown in Table 1. The clinical signs exhibited by the reacting animals are shown in table 2. There was a marked fall ($P<0.05$) in the following indices, packed cell volume (PCV), hemoglobin concentration (Hb) and red blood cell (RBC) when compared with the pre-infection values. Significant increase ($P<0.05$) was also observed in the value of serum glucose in the infected group when compare to the control.

The post mortem examination of animals that died acutely revealed congested liver and kidney, the gall bladder was distended and the spleen enlarged. Ten and 15 ml of straw-colored fluid, which clotted on standing, was found in the pericardial sac of animal that died hyperacutely and acutely respectively. However, microscopic examination of the giemsa stained brain squash smears revealed small colonies of *E. (Cowdria) ruminantium* (Fig. 1).

Table 1. Incubation periods and temperature profile of West African Dwarf goats experimentally infected with *Erhlichia ruminantium*

Goats No.	Forms of the disease	Incubation period (days)	Maximum temperature (°C)	Duration of fever (days)	Remarks
277	A	9	41.8	3	Died hyper acutely
284	A	9	40.9	3	Died hyper acutely
274	B	9	42.0	5	Died acutely
280	B	9	41.3	5	Died acutely
296	B	9	41.3	5	Died acutely
276	C	9	41.7	8	Recovered
290	C	11	41.6	8	Recovered

A: PERACUTE, B: ACUTE, C: MILD

Table 2. Onset and duration of clinical signs, in WAD goats experimentally infected With *Ehrlichia ruminantium*

Clinical Signs	Onset of Signs	Duration (Days)
High fever, excitation, raised hair coat	Day 9 pi	2
Dullness, reluctance to move, tucked in appearance rapid eye movement, anorexia, cessation of rumination, head shaking and in-coordinated gait.	Day 14 pi	4
Circling	Day 16 pi	1
Standing and collapsing, lateral recumbency, intermittent convulsions, padding movements, subnormal temperatures and death.	Day 17 pi	2

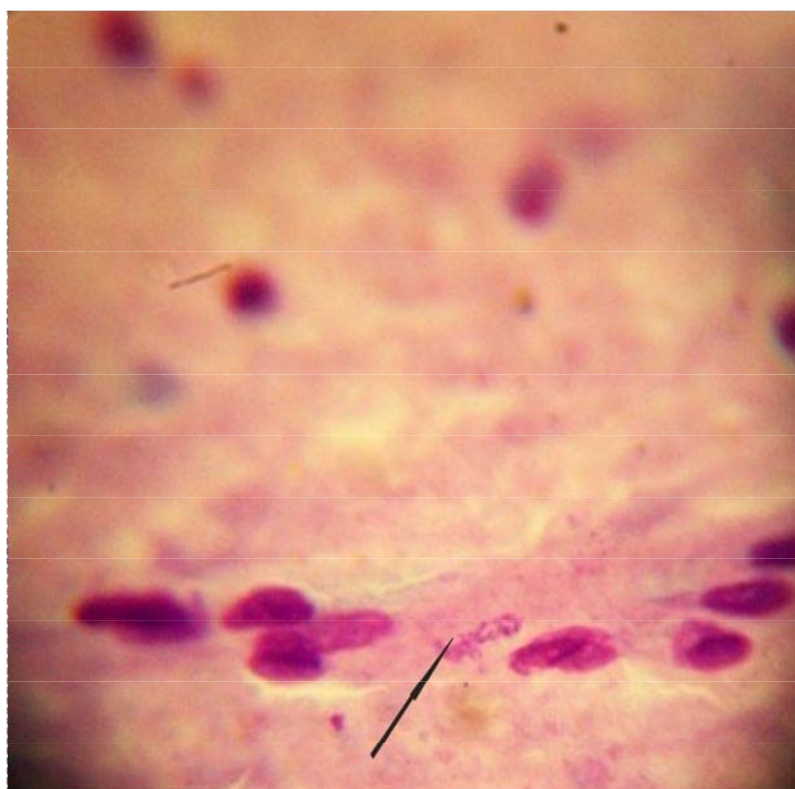


Fig. 1. *Ehrlichia ruminantium* granules (Arrow) in the brain squash smear (Hematoxylin and eosin x1,000)

DISCUSSION

All the ten experimentally infected West African dwarf (WAD) goats reacted within 9 - 11 days of infection, as indicated by increase in rectal temperature. This shows the susceptibility of the breed, WAD goats to *Ehrlichia ruminantium* infection. The varying degree of susceptibility and their classification into hyper acute and acute as observed in this study was also reported by some workers in other breed of goats (Ilemobade, 1976; Uilenberg, 1983 and Losos, 1986). The high susceptibility of the breed was probably due to the system of management practiced, this is because in the Southern Guinea zone where WAD goats predominate, semi-intensive management system is practiced whereby the goats are not allowed to go on

free range grazing but are usually localized by tying them to trees or other objects in and around the homes. This method of husbandry therefore exposes the animals to less ticks population despite the presence of the vector in these zones. The observation in this study is similar to the findings made by Ilemobade (1977) that the method of husbandry in northern Nigeria whereby goats are confined within the villages reduces their chance of being exposed to ticks. In addition, he also suggested that goats are not preferential host of adult *Amblyomma* ticks which feed more on cattle. This may further reduce their chances of developing immunity.

The marked dropped in the PCV, Hb and RBC counts during the course of the infection could be attributed to the febrile reaction, as marked decrease in PCV coincided with the peak of pyrexia. In a similar investigation, Clark (1962, unpublished data) observed a drop in PCV and Hb in heartwater infected animals, the elevation of body temperature might have led to the destruction of RBC and subsequent reduction in the PCV values.

The noticeable increase in blood glucose level in the infected animals may be due to severe stress as Lording *et al.* (1991) reported that severe stress could cause the release of endogenous corticosteroid into the circulatory system leading to mobilization of body glucose.

The level of mortality observed in this study was low (50%) compared to 100% mortality recorded in experimentally infected savannah brown goats (Ilemobade and Leeftang 1977) indicating that WAD goats could possess some level of resistance to cowdriosis, it is however yet to be established whether there is genetic involvement in this trait, or that the recovered goats might have been exposed to milder strain of the parasite previously.

CONCLUSION

The susceptibility of WAD goats to *E. ruminantium* infection has been established in this study. There is therefore the need for proper control measures, probably through the development of an effective vaccine to immunize these animals against the disease, since antemortem diagnosis of the disease is difficult (Uileberg, 1983)

ACKNOWLEDGEMENTS

The support of the Ahmadu Bello University Board of Research is greatly acknowledged for the funding of the project.

REFERENCES

- Bezuidendhout, J.D. 1987. Natural transmission of heartwater. Onderstepoort journal of Veterinary Research. 54: 349-351
- Dumler, J.S., Barbet, A.F., Bekker, C.P.J., Dasch, G.A., Palmer, G.H., Ray, S.C., Rikihisa, Y., Rurangirwa, F.R. 2001. Reorganization of genera in the families *Rickettsiaceae* and *Anaplasmataceae* in the order *Rickettsiales*: Unification of some species of *Erhlichia* with *Anaplasma*, *Cowdria* with *Erhlichia* and *Erhlichia* with *Neorickettia*, description of six new species combination and designation of *Erhlichia equi* and HGE agent as subjective synonyms of *Erhlichia phagocytophila*. International Journal Systemic Evolution Microbiology 51: 2145-2165.
- Ilemobade, A.A. 1976. Study of heartwater and causative agent. (*Cowdria ruminantium*) in Nigeria. Ph.D. thesis, Ahmadu Bello University: 214-227.
- Ilemobade, A.A. and Leeftang, P. 1977. Epidemiology of Heartwater in Nigeria. Revue d'Elevage et de Medecine Veterinaire des pays tropicaux. 30: 149-150.

- Lording, P.M and Susan, C.E.F. 1991. Interpretation of Laboratory Results. Australian Veterinary Practitioner. 4: 21
- Losos, J.G. 1986. Heartwater. In: Infectious Tropical Diseases of domestic Animals, Churchill Livingstone. New York: 817-831.
- Uileberg, G. 1983. Heartwater (*Cowdria ruminantium*) infection: current status. Advances in Veterinary Science and Comparative Medicine 27: 430-928. Journal of Veterinary Research: 355-379.
- Walker, J.B. and Olwage, A. 1987. The tick vectors of *Cowdria ruminantium* (Ixodoidea, Ixodiadae, genus *Amblyomma*) and the distribution. Onderstepoort Journal of Veterinary Research. 54: 355-379.