MORPHOLOGY OF TRYPANOSOMES FROM WHITE-TAILED DEER AND WAPITI IN MICHIGAN

Author: STUHT, JOHN N.

Source: Journal of Wildlife Diseases, 11(2) : 256-262

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-11.2.256

MORPHOLOGY OF TRYPANOSOMES FROM WHITE-TAILED DEER AND WAPITI IN MICHIGAN

JOHN N. STUHT, Michigan Department of Natural Resources, Wildlife Pathology Laboratory, Rose Lake Wildlife Research Center, East Lansing, Michigan 48823, U.S.A.

Abstract: Trypanosomes were isolated from a wapiti (*Cervus canadensis*) and 72 white-tailed deer (*Odocoileus virginianus*) from several locations in Michigan. Although significantly fewer fawns were infected, there were no significant differences in rate of infection between sexes or among geographic areas. From appearance of the trypomastigote, the trypanosome from white-tailed deer belongs in the genus *Trypanosoma* and the subgenus *Megatrypanum*. It was morphometrically similar to the common trypanosome of cattle, *Trypanosoma theileri*.

INTRODUCTION

There are at least three species of trypanosomes which infect cervids, *T. vivax*, *T. evansi* and *T. mazamarum* (Table 1). Of the three, *T. evansi* is known to be pathogenic to cervids.[1,7,10,14] There is apparently nothing known of the effect of these parasites on wild populations.[10]

In 1969, unidentified trypanosomes were reported from white-tailed deer in Alabama, North and South Carolina, Virginia, Georgia, and Louisiana.[13] Recently, they have been isolated from mule deer[2] and wapiti.[6] The purpose of this study was to determine if white-tailed deer in Michigan were infected.

METHODS

Blood samples from 106 white-tailed deer from several locations in Michigan were cultured for trypanosomes: Rose Lake Wildlife Research Center[1] (RLWRC) (42° 48'N, 84° 25'W), Houghton Lake Wildlife Research Station[1] (HLWRS) (44° 19'N, 84° 52' W), Cusino Wildlife Research Station[1] (CWRS) (46° 21'N, 86° 29' W), Edwin S. George Reserve[2] (ESGR) (42° 27'N, 84° OO'W). In addition, blood from a wapiti from the lower peninsula (45° 12'N, 84° 36'W) was also cultured.

January through March 1973, captive deer at the HLWRS, RLWRC, and CWRS were immobilized with CI-744,[3] Sucostrin[4] or leg shackles and bled from the jugular. The deer at the ESGR were shot in December 1973, and bled immediately from the jugular or from the ascending aorta at the dressing station. The wapiti was immobilized with Sucostrin in the field 12 June 1973, and bled from the jugular.

Following the method of Kistner and Hanson,[13] 5 ml of blood from each animal was inoculated into screw-cap culture tubes containing 10 ml of veal infusion medium.[5] The blood was cultured as soon after collection as possible (usually immediately). Each ml of medium contained 500 U potassium penicillin G and 500 U dihydrostreptomycin sulfate. Cultures were held at room temperature (22-25C) and examined for trypanosomes at 7, 14, and 21 days postinoculation.

[1] Michigan Department of Natural Resources facility.
[2] University of Michigan, Ann Arbor facility.
[3] Experimental drug, Parke Davis and Co., Detroit, Michigan.
[4] Succinylcholine chloride, E. R. Squibb and Sons Inc., New York, New York.
[5] Difco Laboratories, Detroit, Michigan.

TABLE 1. Trypanosomes from the family Cervidae.

Trypanosome*	Common Name	Scientific Name*	Location	Reference
Trypanosoma vivax	White-tailed deer	*Odocoileus gymnotis*	Venezuela	9
*Trypanosoma hippicum***	White-tailed deer	*Odocoileus chiriquensis*	Panama	3
	Brocket deer	*Mazama sartarii reperticia*		
Trypanosoma evansi	Sambar deer	*Cervus unicolor*	Mauritius	1
	Barking deer	*Muntiacus muntjak*	Indonesia	14
	Axis deer	*Axis axis*		
	Rusa deer	*Cervus timorensis*		
	Roe deer	*Capreolus capreolus*	Kazakstan	10
Trypanosoma mazamarum	Brocket deer	*Mazama simplicornus*	Brazil	7
		Mazama rufa toba	Argentina	16
		Mazama nemorivaga		
Trypanosome spp.	White-tailed deer	*Odocoileus virginianus*	United States	13
	Mule deer	*Odocoileus hemionus*		2
	Elk (Wapiti)	*Cervus canadensis*		6
	White-tailed deer	*Odocoileus virginianus gymnotis*	Colombia	5
	Brocket deer	*Mazama guasubira medemi*		

* Scientific names as cited in references.

**Synonymous with *T. evansi*.

A small drop of medium (approx. 0.01 ml) was removed from near the surface of each culture with an inoculating loop, placed on a microscope slide, covered with a coverglass (22 mm^2) and examined at 125X until trypanosomes were seen or until the entire slide had been examined.

Using a method similar to that used by Woo *et al*,[39] allantoic cavities of 10-day-old chicken embryos were inoculated with 0.2 ml of veal infusion medium containing active epimastigote trypanosomes. Inoculum was from cultures 7 to 10 days old that were free from contamination with filamentous fungi, yeasts, or bacteria. The embryos were incubated at 37C and a drop of allantoic fluid from each examined for trypanosomes as described above, at 3 and 5 days post-inoculation.

Thin films of culture medium and allantoic fluid containing trypanosomes were air dried, fixed in methanol, stained with Giemsa, and examined under oil immersion (1250X). Trypanosomes were measured with the aid of a camera lucida.

Infection data was tested for statistical significance using the Chi-square test for two independent samples.[35]

RESULTS

The wapiti and 72 of 91 deer were infected with trypanosomes.[6] There were significantly fewer fawns infected (39/58) than older deer (33/33) ($P<0.001$) and about as many male fawns infected (11/16) as females (28/42). There was no significant difference in rate of infection between fawns from different geographic areas (CWRS 11/14, HLWRS 27/43, ESGR 1/1).

Trypanosomes seen in veal infusion medium were usually typical epimastigotes (Fig. 1). Those of both the deer and wapiti trypanosomes were similar in size and morphology. They were slender and tapered to a point at the posterior end. The kinetoplast was usually marginal and located in the anterior end near the nucleus. The nucleus was acentric and usually in the anterior end. A free flagellum was present. A random sample of 10 epimastigotes of the deer trypanosome were measured. Excluding the free flagellum, the body was 18.51 to 23.70 (20.92) μm long and 2.22 to 3.33 (2.62) μm wide. The flagellum was 5.92 to 12.59 (9.22) μm long.

Allantoic fluid from six of eight embryos inoculated with epimastigotes of the trypanosome from deer contained trypomastigotes on days 3 and 5 post-inoculation (Fig. 1). They were slender and tapered to a point at the posterior end. The kinetoplast was large and oval, usually marginal, and located in the posterior end near the nucleus. A random sample of 50 trypomastigotes were measured (Table 2). The kinetoplast was near the nucleus and far from the posterior end (KI=4.31). The nucleus was near the center of the body and in the anterior end (NI=1.23). Excluding the free flagellum, the body was 29.98 to 53.13 (41.53) μm long and 2.58 to 6.27 (4.32) μm wide. The flagellum was 5.53 to 20.66 (13.04) μm long. Trypomastigotes were not seen in either of two embryos inoculated with epimastigotes of the wapiti trypanosome.

DISCUSSION

Trypanosomes are very common parasites of white-tailed deer in Michigan, literally every animal examined over 1 year old was infected. Some fawns were either not infected or they had such low parasitemia that their infections were not detected.

The high infection rate in older animals suggests deer do not develop an immunity capable of ridding them of infection or protecting them from acquiring new ones. However, they must develop some form of protective immunity or have innate resistance which prevents lethal infections. There is evidence that

[6] Cultures from 15 deer not included became contaminated with yeasts and/or filamentous fungi.

the immune system may be important in preventing severe *T. theileri* infection in cattle.[12]

The epimastigotes of the trypanosomes from both deer and wapiti were similar in size and morphology to those previously described from white-tailed deer,[13] but were somewhat larger than those previously described from mule deer[2] and wapiti.[6]

The trypomastigote seen in this study was morphometrically similar to *T. theileri* (Table 2) and morphologically similar to *T. mazamarum*. *Trypanosoma theileri* is thought to infect only bovids. However, trypanosomes that looked like *T. theileri* have been reported from white-tailed deer and brocket deer in South America.[5] *Trypanosoma mazamarum* has been reported from brocket deer

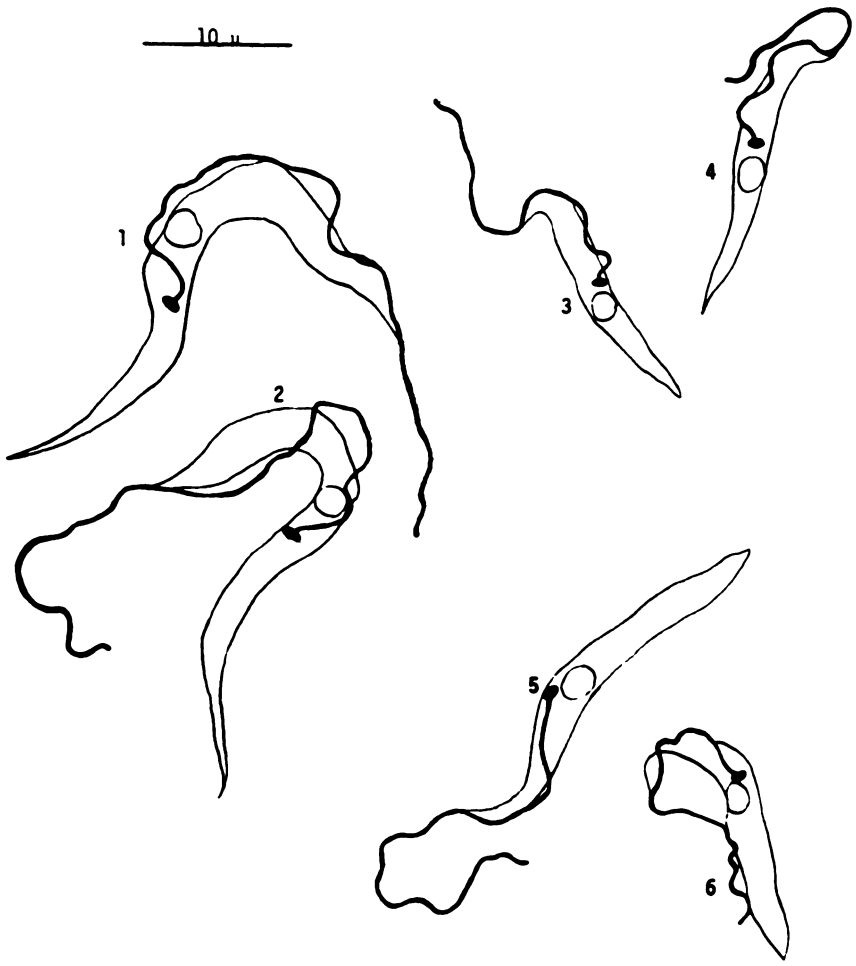

FIGURE 1. Trypanosomes from white-tailed deer and wapiti in Michigan.

Camera lucida drawings: Trypomastigotes of deer trypanosome (Strain CWRS 48806-07) (1-2), epimastigotes of deer trypanosome (Strain HLWRS 730) (3-4), epimastigotes of wapiti trypanosome (Strain WPL 73-334) (5-6).

TABLE 2. Measurements of Trypanosomes from white-tailed deer in Michigan and cattle in Ontario.

Trypanosome	PK	KN	PN	NA	F	AP	NI	KI	PK/AP	NA/AP
Trypanosoma sp. (Deer—Michigan)	16.68	5.32	21.94	19.39	13.04	41.53	1.23	4.31	.40	.45
Trypanosoma theileri (Cattle—Ontario)	12.80	5.53	18.33	15.37	13.87	33.70	1.19	3.31	.38	.46

Measurements are means in microns.

Abbreviations: PK, the distance from the posterior end to the kinetoplast; KN, the distance from the kinetoplast to the center of the nucleus; PN, the distance from the posterior end to the center of the nucleus; NA, the distance from the center of the nucleus to the anterior end; AP, the length of the body excluding the free flagellum; F, the length of the free flagellum; NI, (PN/NA), nucleus index; KI (PN/KN), kinetoplast index.

Data on *T. theileri* from Woo *et al.*[20]

in Argentina[16] and Brazil.[7] It has not been reported as infecting other cervids.

Undoubtedly, the trypanosome from white-tailed deer in Michigan belongs in the group Stercoraria.[11] Members of this group are characterized by trypanosomes with a free flagellum, a large kinetoplast that is not terminal and a pointed posterior end. There is little doubt that it also belongs in the genus *Trypanosoma* and the subgenus *Megatrypanum*.[11] Members of this subgenus are rather large trypanosomes of mammals whose kinetoplast is typically located near the nucleus and far from the posterior end. The type species is *T. theileri*.

Even though *T. theileri* has been known for about 70 years, there is still controversy regarding its effect upon cattle. The prevailing view is that the trypanosome is harmless. However, many still feel that it is potentially pathogenic, its dormant virulence being activated in the presence of some intercurrent infection, such as piroplasmosis or rinderpest.[12] In cattle, *T. theileri* has been associated with abortion,[8,15] decreased milk production[17] and signs of illness such as lymphocytosis, lymphadenopathy and eosinophilia.[4,17]

Unfortunately, no conclusions can be made concerning the pathogenicity of trypanosomes from deer or wapiti until they are properly identified or until animals are infected experimentally under controlled conditions.

Acknowledgements

I appreciated the help and cooperation of my colleagues, Lawrence Fay, John Ozoga, Louis Verme, and William Youatt in collecting the blood samples and technical assistance of Myra Fraidenburg and Hazel Harte.

LITERATURE CITED

1. ADAMS, A. R. D. and F. E. LIONNET. 1933. An outbreak of surra among the wild deer (*Cervius unicolor* var) of Mauritius. J. comp. Path. Therap. 46: 165-167.
2. CLARK, G. G. 1972. Trypanosomes from mule deer in New Mexico and Colorado. J. Wildl. Dis. 8: 325-326.
3. CLARK, H. C. and L. H. DUNN. 1933. Animal susceptibility to *Trypanosoma hippicum*, the equine trypanosome of Panama with special reference to cattle as an unharmed host and probable reservoir of importance. Am. J. trop. Med. 13: 273-281.
4. CROSS, R. F., D. R. REDMAN and E. H. BOHL. 1968. Trypanosomes associated with bovine lymphocytosis. J. Am. vet. med. Ass. 53: 571-575.
5. D'ALLESSANDRO, A. and E. A. WELLS. 1971. Trypanosome infections in the family cervidae. Trans. R. Soc. trop. Med. Hyg. 65: 845.
6. DAVIES, R. B. and G. G. CLARK. 1974. Trypanosomes from elk and horse flies in New Mexico. J. Wildl. Dis. 10: 63-65.
7. DEANE, L. M. 1961. Tripanosomideos de mamiferos da Regiao Amazonica. I. Alguns flagelados encontrados no sangue de mamiferos silvestres do Estado do Para. Rev. Inst. Med. Trop. S. Paulo. 3: 15.
8. DIKMAN, G., E. A. MANTHEI and A. H. FRANK. 1957. Demonstration of *Trypanosoma theileri* in the stomach of an aborted bovine fetus. Cornell Vet. 47: 344-353.
9. FIASSON, R., M. MAYER and F. PIFANO. 1948. Lecariacou (*Odocoileus gymnotis*) porteur de Trypanosome vivax. and Venezuela. Bull. Soc. Path. Exot. 41: 206-208.

10. GALUZO, I. G. and V. F. NOVINSKAJA. 1960. (Trypanosomes of animals in Kazakstan.) Trudy Inst. Zool. Akad. Nauk. Kazakh. SSR. 14, 3.

11. HOARE, C. A. 1964. Morphological and taxonomic studies on mammalian trypanosomes X. Revision of the systematics. J. Protozool. 11: 200-207.

12. HOARE, C. A. 1972. *The Trypanosomes of Mammals.* Blackwell scientific publication, Oxford and Edinburgh. Pages 137-141.

13. KISTNER, T. P. and W. L. HANSON. 1969. Trypanosomiasis in white-tailed deer. Bull. Wildl. Dis. Ass. 5: 398-399.

14. KRANEVELD, F. C. and M. MANSJOER. 1952. Onderzaekinquen over de qevoeligheid voar surra. II Het verloop der xiekte bij enkeli in het wild levendr dieren in Indonesis'. Hemera. Zoa. 59: 117.

15. LEVINE, N. D., A. M. WATRACH, S. K. HARDENBROOK and H. J. HARDENBROOK. 1956. A case of bovine trypanosomiasis due to *Trypanosoma theileri* in Illinois. J. Parasit. 42: 553.

16. MAZZA, S. 1932. Algunos hemoparasitos de mamiferos del Norte, VII Reun. Soc. Argent. Patol. Reg. Norte (Buenos Aires), part 2: 990-997.

17. RISTIC, M. and W. TRAGER. 1958. Cultivation at 37C of a trypanosome (*Trypanosoma theileri*) from cows with depressed milk production. J. Protozool. 5: 146-148.

18. SIEGEL, S. 1956. *Nonparametric Statistics for the Behavioral Sciences.* McGraw-Hill Book Company Inc., New York, Toronto, and London. Pages 107-111.

19. WELLS, E. A. and W. H. R. LUMSDEN. 1971. Trypanosomiasis. Pages 309-325. in J. W. Davis and R. C. Anderson, eds. *Parasitic Diseases of Wild Mammals.* Iowa State Press, Ames.

20. WOO, P., M. A. SOLTYS and A. C. GILLICK. 1970. Trypanosomes in cattle in Southern Ontario. Can. J. comp. Med. 34: 142-147.

Received for publication 30 September 1974