

Virus Name: Epizootic Hemorrhagic Disease of Deer

Abbreviation: EHDV

Status: Probable Arbovirus

Select Agent:

SALS Level: 2

SALS Basis: S

HEPA Filtration:

Antigenic Group: Epizootic Hemorrhagic Disease

Taxonomic status:

Other Information: USDA restricted.

Section I - Full Virus Name and Prototype Number

Full Virus Name: Epizootic Hemorrhagic Disease of Deer

Prototype Number: New Jersey strain

Information from: R.E. Shope

Date:

*

3/5/1985

Address: Animal Diseases Research Inst., P.O. Box 1400, Hull, Quebec

*

Reviewed by editor

Section II - Original Source

Isolated by: R.E. Shope (1,2) **at:** Rockport, New Jersey

Genus and species: *Odocoileus virginianus* **Sentinel** X

Age/Stage: **Sex:**

Isolated From	Isolation detail
---------------	------------------

Signs and symptoms of illness: prostration and death

Arthropod engorged depleted gravid

Time held alive before inoculation:

Collection date: 9/6/1955 **Method:** from dead deer

Place collected: Morris County, New Jersey

Latitude: 40° ' ' N

Longitude: 75° ' ' W

Macrohabitat: rural

Microhabitat: woodland

Method of storage until inoculated: refrigerated

Footnotes:

Section III - Method of Isolation and Validity

Inoculation Date: 9/1/1955

Animal: yg deer

Embryonated egg:

Tissue Culture:

(Details in Section VI - Biologic Char.)

Route inoculated: subcutaneous

Reisolation: Yes

Other reasons:

Homologous antibody formation by source animal (See Section II):

Test used: HI

CF

NT

Other:

Footnotes:

Section IV - Virus Properties

Physicochemical:

RNA: X DNA: Single Strand: Double Strand: X
Pieces: 10 Infectivity: Sedimentation coefficient(s): /strong>
Percentage wt. of virion protein , lipid carbohydrate
Virion polypeptides:
Number: Details: RNA; total MW = 12.1 - 15.1 x 10⁶ (14)
Non-virion polypeptides:
Number: Details:
Virion density: Sedimentation coefficient:
Nucleocapsid density Sedimentation coefficient:

Stability of infectivity (effects) pH labile at pH 3.0; partial or complete resistance to lipid solvents (3-5)

Lipid solvent:

(ether) 1:5 After treatment titer about 0.2 dex loss Control titer
(chloroform) After treatment titer Control titer
Detergent:
(deoxycholate) After treatment titer 4.0 dex Control titer 4.0 dex (5)
Other (formalin, radiation): chloroform treatment caused a 100-fold reduction in mouse ED50 (5)

Virion morphology:

Shape icosahedral shape Dimensions 75 nm (4)
Mean (nm) range (nm) how measured negative contrast electron microscopy
Surface projections, envelope no envelope
Nucleocapsid dimensions, symmetry capsid = 5.3 nm (3); contains 32 capsomeres

Morphogenesis:

Site of constituent formation in cell
Site of virion assembly
Inclusion bodies
Other

Hemagglutination:

Hemagglutination Yes and No Antigen source concentrated infective Vero culture fluid (23)
Erythrocytes various* pH range 5.5 - 8.0 pH optimum 7.0 - 8.0
Temperature optimum range 4dC, RT, 37dC
Remarks HA optimal in presence of 0.6M NaCl
Serologic methods recommended HI, CF, NT (nb mice), PRNT, agar-gel precipitation
Footnotes: HA optimal in presence of 0.6M NaCl

Section V - Antigenic Relationship And Lack of Relationship To Other Viruses

Related to but perhaps not identical with the South Dakota strain (serotype 2) of EHD isolated in 1956 [2] ; not related to Korean hemorrhagic fever, or to the Bucyrus strain of equine arteritis virus [2] .

Originally, this agent was compared by CF with at least 150 arboviruses and no overlap was noted. Among those compared are the following: By CF, using immune sera (two-fold dilutions from 4 to 128) for a large number of arboviruses and New Jersey EHD antigen (4, 8 and 16 units) no overlap was found with any of the following sera: 15 Group A (homologous titers from 32 to 512); 33 Group B (32 to 512); 7 Group C (32 to 128); 10 from Bunyamwera group (32 to 512); 4 from California group (64 to 128); 4 from Guama group (64 to 128). Nor was there an overlap with any of the following grouped or ungrouped viruses' sera: Capim (128), Guajara (256), Bushbush (128), Bwamba (512), Simbu (64), Oropouche (16), Sathuperi (128), Turlock (64), Umbre (32), Anopheles A (64), Lukuni (64), Bakau (128), Ketapang (128), Koongol (64), Wongal (64), Vesicular Stomatitis, New Jersey (128), Vesicular Stomatitis, Indiana (128), Quaranfil (512), Chenuda (256), Nyamanini (256), Trinita (64), Ieri (32), Aruac (32), Rift Valley fever (256), Colorado tick fever (128), Wad Medani (256), SF Sicilian (128), Hart Park (32), Anopheles B (128), Tacaiuma (64), Manzanilla (256), Piry (128), Witwatersrand (256), Akabane (512), Tacaribe (256), Junin (32), Mossuril (64), SF Naples (64), and a few additional as yet undecribed viruses. (N.E. Mettler and J. Casals, personal communication.)

Antigenically distinguishable from bluetongue virus (BTB) by complement-fixation, plaque-reduction neutralization, immunofluorescence, and agar-gel precipitation, although cross reactivity has been shown to some degree in some circumstances ([5] , [6] , [7]).

Two-way cross relationships between Ibaraki virus and EHD virus, serotypes 1 and 2, demonstrated by agar-gel precipitin and indirect fluorescent antibody tests [12] . By neutralization tests, Ibaraki virus was more closely related to EHD virus, serotype 2 (Alberta strain). Antigenic relationship not observed between Ibaraki virus and four serotypes of bluetongue found in USA.

Related by complement-fixation tests to other members of the orbivirus group, namely bluetongue, Ibaraki and Eubenberg viruses [5] , [8] .

Antigenic relationships demonstrated between BLU, EHD, and Abadina viruses by CF and agar-gel precipitin tests [19] .

High-titered antibody to an Australian isolate of BLU cross-reacted at low titer, by CF, with EHD and Eubenberg virus antigens [20] .

Immunological cross-reaction documented between virus-specified tubules of BLU and EHD viruses [21] .

Presently the EHD serogroup consists of EHD and Ibaraki viruses.

Section VI - Biologic Characteristics

Virus source (all VERTEBRATE isolates): blood (LV), CNS, heart, lung, liver, and skeletal muscles (from experimentally infected deer (8)), spleen, liver, kidney and blood pool (2).

Lab Methods of Virus Recovery (ALL ISOLATIONS): newborn mice, L-929 and BHK-21 cell cultures

Susceptibility of Cell Culture Systems:

Cell system (a)	Virus passage history (b)	Evidence of Infection						
		CPE			PLAQUES			Growth Without CPE +/- (g)
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)	
HeLa (CL)			CPE (9)					
BHK-21 (CL)	field blood or cell culture	1-14	CPE	up to 8.0**				
L-929 (CL)		1-14	CPE	up to 8.0				

** expressed in dex

Section VII - Natural Host Range

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
Odocoileus virginianus (white-tailed Virginia deer)	X		Morris County, New Jersey; epizootic 1955
Deer	X		South Dakota; epizootic in 1956
Deer	X		Alberta, Canada; epizootic 1962
Deer	X		North Dakota; epizootic 1970
Deer	X		Southeastern USA; epizootic 1971
White-tailed deer (blood, spleen)	1		Montana (22)
White-tailed deer		2/42	
Mule deer		36/49	
Cattle		249/314	
Culicoides spp.	2		Nigeria (24)
Culicoides schultzei	1		

Section VIII - Susceptibility To Experimental Infection (Record Viremia)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log10/ml
mice (nb)	deer spleen susp.	ic 0.02	death	8-11	
mice (nb)	MB 3	ip 0.015	death	4-5	4.0
mice (nb)		sc			
mice (wn)		ic			
mice (wn)		ip			
deer (8-10 mo)			death (2)	6-21	

elk	iv	viremia (15)
cattle	iv	low level viremia without clin. dis. (17)
embryonated eggs		failed to propagate in embryonated hens' eggs inoculated by various routes (2)

NOTE: specific for deer. Not infectious for (I.e. does not cause disease in) cattle, horses, sheep, dogs, adult mice, swine, guinea pigs, hamsters or rabbits (2).

Section IX - Experimental Arthropod Infection And Transmission

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c)		Transmission by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected	Days	°C	Host	Ratio	Whole	Organ	System
Aedes aegypti	Mosquitoes inoculated with infected mouse brain have supported virus multiplication with sufficient concentration in the salivary gland to initiate 13 serial mosquito passages. Ae triseriatus, Culex quinquefasciatus partially refractory and Anopheles quadrimaculatus resistant. Ae aegypti unable to infect SM or deer by bite (11).								
Culicoides variipennis	Transmitted EHD to susc. deer 14-20 days after feeding on infected deer (16).								

Section X - Histopathology

Character of lesions: deer; generalized hemorrhages in all tissues and organs (2). Derangement of blood clotting mechanism, plus degenerative changes in walls of blood vessels, resulting in multiple microscopic to massive hemorrhages (12).

Inclusion bodies:

Cytoplasmic:(M) (LV) **Intranuclear:** (M) (LV)

Organs-tissues affected: spleen (LV), kidney (LV), heart (LV), blood vessels (LV), and skeletal muscles (LV) (13)

Category of tropism: pantropic with generalized hemorrhages

Section XI - Human Disease

Human disease: **In nature:** (S) (R)
Death: (S) (R)
Residua: (S) (R)
Laboratory infections: Subclinical: (S) (R)
Overt Disease: (S) (R)

Clinical manifestations:

Category: **No. of cases:**

Section XII - Geographic Distribution

Known (virus):

New Jersey; outbreaks in southeastern USA, Michigan, Washington not typed, S. Dakota; N. Dakota; Montana, USA (22); Alberta, Canada; Nigeria (24)

Section XIII - References

1. Shope, R.E., et al. 1955. New Jersey Outdoors 6:17.
2. Shope, R.E., et al. 1960. J. Exper. Med. 111:155-170.
3. Thomas, F.C., et al. 1971. Can. J. Comp. Med. 35:22-27.
4. Murphy, F.A., et al. 1971. J. Gen. Virol. 13:273-288.
5. Borden, E.C., et al. 1971. J. Gen. Virol. 13:261-272.
6. Thomas, F.C., et al. 1971. Can. J. Comp. Med. 35:187-191.
7. Girard, A., et al. Unpublished data.
8. Moore, D.L., et al. 1972. Arch. Ges. Virusforsch 37:282-284.
9. Mettler, N.E., et al. 1962. J. Exp. Med. 116:665-678.
10. Fay, J.D., et al. 1958. Trans. N. Am. Wildlife Conf. 21:173-190.
11. Whitman, L. Personal communication. 1964.
12. Shope, R.E., et al. 1963. J. Exp. Med. 118:421-424.
13. Karstad, L., et al. 1961. Am. J. Vet. Res. 22:227-235.
14. Tsai, K.S. and Karstad, L. 1973. Infect. Ummun. 8:463-474.
15. Hoff, G.L. and Trainer, D.L. 1973. J. Wildl. Dis. 9:129-132.
16. Foster, N.M., et al. 1977. J. Wildl. Dis. 13:9-16.
17. Gibbs, E.P.J. and Lawman, M.J.P. 1977. J. Comp. Pathol. 87:335-4.
18. Campbell, C.H., et al. 1978. Vet. Microbiol. 3:15-22.
19. Moore, D.L. 1974. Am. J. Vet. Res. 35:1109-1113.
20. St. George, T.D., et al. 1978. Aust. Vet. J. 54:153-154.
21. Huismans, H. and Els, H.J. 1979. Virology 92:397-406.
22. Feldner, T.J. and Smith M.H. 1981. Am. J. Vet. Res. 42:1198-1202.
23. Tocuhsa, S., et al. 1981. Arch. Virol. 69:291-294.
24. Lee, V.H. 1979. J. Med. Ent. 16:76-79.

Section XIV - Remarks