

Virus Name: Epizootic Hemorrhagic Disease of Deer		Abbreviation: EHDV
Status Probable Arbovirus	Select Agent No	SALS Level 2
SALS Basis Results of SALS surveys and information from the Catalogue.		
Other Information USDA Restricted		
Antigenic Group Epizootic Hemorrhagic Disease		

SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation New Jersey strain	Accession Number	Original Date Submitted 3/5/1985
Family Orbivirus	Genus	
Information From R.E. Shope	Address Animal Diseases Research Inst., P.O. Box 1400, Hull, Quebec	
Information Footnote Reviewed by editor		

Section II - Original Source

Isolated By (name) R.E. Shope (1,2)	Isolated at Institute Rockport, New Jersey	
Host Genus Odocoileus virginianus	Species	Host Age/Stage
Sex Not Answered		
<u>Isolated From</u>	<u>Isolation Details</u>	
Organs/Tissues	spleen, liver, kidney and blood pool	
Signs and Symptoms of Illness prostration and death	Arthropod	
Time Held Alive before Inoculation		
Collection Method from dead deer	Collection Date 9/6/1955	
Place Collected (Minimum of City, State, Country) 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

Inoculation Date
9/1/1955

Animal (Details will be in Section 6)
yg deer

Route Inoculated subcutaneous	Reisolation Yes
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Other Reasons

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

Section IV - Virus Properties

Physicochemical
RNA, Double Strand

Pieces (number of genome segments) 10	Infectivity	Sedimentation Coefficients(s) (S)
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 Coefficients(s) (S)	
Nucleocapsid Density	Sedimentation Coefficients(s) (S)	

Stability of Infectivity (effects)

pH (infective range)
labile at pH 3.0; partial or complete resistance to lipid solvents (3-5)

Lipid Solvent (ether - % used to test) 1:5	After Treatment Titer about 0.2 dex loss	Control Titer
Lipid Solvent (chloroform)	After Treatment Titer	Control Titer
Lipid Solvent (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	
Measurement Method negative contrast electron microscopy	Surface Projections/Envelope no envelope	Nucleocapsid Dimensions, Symmetry capsid = 5.3 nm (3); contains 32

Morphogenesis

Site of Constituent Formation in Cell	Site of Virion Assembly	Site of Virion Accumulation
Inclusion Bodies	Other	

Hemagglutination

Hemagglutination Yes and No	Antigen Source concentrated infective Vero culture fluid (23)	Erythrocytes (species used) various*
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pH Range 5.5 - 8.0	pH Optimum 7.0 - 8.0
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Temperature Range 4dC, RT, 37dC	Temperature Optimum
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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), Quarantil (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

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

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 (include viremia)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log ₁₀ /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).

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 (specify host)
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 Intranuclear

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

In Nature	Residual	Death
Subclinical	Overt Disease	
Clinical Manifestations		
Number of Cases	Category (i.e. febrile illness, etc.)	

Section XII - Geographic Distribution

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

Suspected (Antibody only detected)

Section XIII - References

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Remarks