

**A STUDENT COMPENDIUM ON
ARTHROPOD-BORNE VIRAL DISEASES OF
ECONOMIC AND ZOOONOTIC IMPORTANCE
AFFECTING DOMESTIC ANIMALS**

By

Dr. Subha Ganguly



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AFFECTING DOMESTIC ANIMALS**

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PREFACE

The book has been constructed to highlight on the various important issues related to arthropod-borne viral diseases in domestic animals having immense economic importance in animal products and by-products processing industries. These diseases may also affect human beings and possess zoonotic potential too. The book provides an overview on the relevant area of focus. The author also duly acknowledges the various researches as carried out by the investigators worldwide on the related issues as discussed in this text.

Dr. Subha Ganguly

DEDICATION

This book is dedicated to the Students of Veterinary and Animal Sciences and has been composed exclusively for providing firsthand knowledge on the related issues for the development of science, education and technology. I also want to express my indebtedness towards my Parents and family members for their constant encouragement in preparing this Book.

Dr. Subha Ganguly

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Chapter 1: Family Togaviridae

Introduction

The family includes a large group of viruses transmitted by arthropod vectors. Originally these viruses were called group A and group B arboviruses. Later, group A arboviruses were classified in the genus *Alphavirus* under this family. Group B arboviruses were classified in genus *Flavivirus* under the family *Flaviviridae*.

Genus *Alphavirus*

Eastern Equine Encephalomyelitis (EEE), Western Equine Encephalomyelitis (WEE) and Venezuelan Equine Encephalomyelitis (VEE)

These viruses infect equines, human beings, mice, rabbits and guinea pigs and have wide host range. Primarily, these viruses cause neurological symptoms in equines and they are responsible for causing encephalitis in human beings. These viruses are not very resistant and are easily inactivated by disinfectants. The EEE and WEE viruses occur in USA. The three viruses are antigenically distinct. VEE virus has four serotypes which vary in pathogenicity for the equines. The incubation period for all the three diseases ranges from 2-6 days. The virus enters the host through bite of arthropod vectors and multiplies in the nearby cells in close vicinity to the site of bite and in regional lymph nodes. There may be the occurrence of viraemia.

Clinical symptoms:

The symptoms of the disease include fever, anorexia, depression and neurological signs. Clinically, the three diseases can be easily distinguished.

Diagnosis:

Serologically, the VN and HI tests help in differentiation. EEE is also known as sleeping sickness and is characterized by fever, leucopenia and paralysis of lips and legs. Mortality rate may be up to 90% in EEE, 20-25% in WEE and 40-80% in VEE. Death may occur within a week from onset of symptoms.

Transmission:

The infection is transmitted in a cyclic manner from wild animals or birds (chief reservoirs) to the mosquitoes. The virus propagates in the gut of mosquitoes and persists throughout their lifetime. The horses act as dead end hosts.

Virus cultivation:

The virus grows on embryonated chicken eggs and in a wide range of cell cultures including Vero and BHK₂₁ cells and in primary chicken embryo fibroblasts.

These viruses produce clear cytopathic effect in cell cultures. Antibodies appear within a week and can be detected by VN, HI, CF and ID tests. The antibodies in the recovered horses maintain its titre for many months.

Control:

Formalin inactivated vaccines are available for the disease prophylaxis.

Chapter 2: Family Flaviviridae

The group B arboviruses have been categorized in the genus *Flavivirus* under the family *Flaviviridae*.

Genus *Flavivirus*

Japanese B encephalitis:

The disease is widely spread in South East Asian countries including India. The infection is prevalent in mosquitoes which act as maintenance hosts. Mosquitoes when feed on animals hosts i.e. swine, human beings and birds help in the spread of infection among the swines. Swine suffers from infection and help in the spread of the infection. Mosquito-swine-mosquito transmission cycle maintains the mode of virus multiplication. Humans and equines act as dead end hosts. Swine suffer from high rate of abortion and neonatal mortality. Adult cattle, horses and swine generally do not exhibit the clinical features of the disease, but act as maintenance hosts. It causes mild fever in less acute cases. In acute form, there is jaundice, haemorrhages and incoordination among the infected host animals. Encephalitic lesions occur in brain. Incubation period of the disease in swine is about 8-10 days. Inactivated mouse brain vaccine is used for controlling the disease in swines. The JE virus also causes infection in human beings.

Clinical symptoms: The symptoms include high fever, headache and vomiting. After few days, neurological symptoms develop like encephalitis with convulsions and coma. There is high and persistent fever. Mortality rate may increase up to 50%. Recovery may take place in several weeks. Large number of cases may remain inapparent. In India, the infection has been reported from South Eastern States and from South India.

Diagnosis: The disease can be diagnosed by clinical symptoms and by testing sera samples from infected animals by using SN, CF and HI tests. Serum antibodies develop in infected animals within 1-2 weeks after the onset of clinical symptoms and may last for several years. The virus can be cultivated intracerebrally in mice, in embryonated eggs chicken fibroblasts and pig kidney cell cultures.

Louping ill

Louping ill virus is a serocomplex of 14 related tick-borne viruses of Russian Spring Summer encephalitis (RSSE). The disease is prevalent in Scotland and in some parts of Europe. The virus causes encephalitis in sheep and cattle. Horses may also be infected. The disease occurs in spring and summer months. Transmission of the disease takes place through ticks. In nature, the wild animals, rodents and birds act as maintenance hosts. Prolonged viraemia, biphasic fever leading to encephalitis and incoordination and paralysis is caused in sheep. Some animals may survive showing neurological symptoms of the disease. Louping ill is of zoonotic importance. Incubation period is 6-15 days. Infected sheep develops CF, HI and VN antibodies. The virus can be propagated in mammalian and avian cell cultures. It also grows intracerebrally in young mice and in embryonated eggs. Control of the disease can be done by the use of inactivated adjuvant vaccines in lambs. The animals are advised to be dipped in water mixed with anti-tick disinfectants.

Yellow fever

The disease is confined to the African continent and in Central and South Americas. *Aedes aegypti* mosquitoes transmit the virus. The incubation period of the disease ranges from 3-6 days. Outside mosquito-man-mosquito cycle, the virus is maintained in the forest in sylvatic cycle. In sylvatic cycle, the cycle is maintained from monkey to mosquito to monkey. The urban cycle is maintained as man to mosquito to man. Man gets infected from forest mosquitoes.

The disease shows high fever, chills, headache, nausea, vomiting, diarrhoea and albuminuria. The patient generally dies of hepatic and renal failure. Most cases are less severe. Strain 17D (chicken embryo modified virus) vaccine developed by Theiler in 1937 is used to control the disease.

Kyasanur Forest disease

The virus causes tick-borne haemorrhagic fever in man. In India, the disease was reported from Karnataka in 1957 when several dead monkeys were noticed in the forest areas. During that same period, prostrating illness was also noticed among farmers. In humans, there is sudden onset of fever, headache, conjunctivitis, prostration and sometimes haemorrhages on the skin. Mortality may range up to 5%.

The virus is maintained by the ticks and forest birds and small wild mammals including the monkeys act as reservoir hosts.

Russian Spring-Summer Encephalitis (RSSE)

A number of viruses are involved in causing the RSSE complex. The disease is prevalent in several countries of Northern Europe and Russia. The disease is known by different names in different countries depending on the variations in clinical symptoms. In Scotland the disease is called louping ill in sheep. In Russia the disease is called RSSE which causes high mortality and paralysis in survivors. The ticks act as vectors for transmitting the infection by transovarian mode. Ticks, rodents and birds act as reservoir hosts.

A formalin killed inactivated vaccine is available for controlling the disease.

Chapter 3: Family Reoviridae

Genus Orbivirus

Blue tongue disease

The disease is caused by the virus belonging to the Genus *Orbivirus* having 24 serotypes. The etiology is quite resistant to temperature and haemagglutinates and haemadsorbs sheep RBCs. The disease is caused by arthropod vectors and sheep is the primary host. Cattle and goats may also be infected and act as virus carriers. The virus is reported to cause disease in Africa, Europe, USA, Australia and India. The incubation period of the disease is about a week. The *Culicoides spp.* of mosquitoes act as vectors for the spread of the disease. The virus replicates in the haemopoietic and endothelial cells of blood vessels. The adult sheep may remain viraemic for weeks. Depending on the virulence, the disease infects the sheep in mild to severe forms. The fever lasts for several days. In addition to fever, there is depression, anorexia, salivation, discharges from eyes and nose and diarrhoea. There may be ulcers on the tongue, dental pads and lips. Tongue becomes swollen, cyanotic and purple blue in colour. The discharge from nose may turn to mucopurulent and stained with blood. The sheep may die showing marked loss of body condition. The morbidity rate remains high and mortality may go up to 50%. Transplacental infection may take place by vertical transmission. Affected lambs and calves become blind and may develop congenital defects and may die.

A live attenuated chicken embryo vaccine is available for controlling the disease which induces high VN and CF antibody titres.

Citrated blood, saliva, ocular and nasal swabs faecal swabs, spleen and pulmonary tissues and paired sera samples may be considered for isolating the virus for precise disease diagnosis. Bovine and ovine kidneys and testes cell cultures, chicken embryos, BHK₂₁ and HeLa cell lines are suitable host systems for the virus propagation. At the height of temperature, the virus can be isolated from the buffy coat of the blood.

In cattle, the disease should be differentially diagnosed from BVD, Rinderpest, malignant catarrhal fever, vesicular diseases and IBR.

African horse sickness

Horses suffer from this viral disease. Donkeys are resistant to this infection and mules and zebras are refractory to this infection. The disease was first recognized in

South Africa. The disease also spread in South-East Asia countries. The virus gives positive HA test with RBCs of horses at 37°C. The virus has 9 serotypes. All serotypes have group specific CF antibodies. Some serotypes show cross reaction with blue tongue disease. Different strains differ antigenically. Mosquitoes and other blood sucking insects help in the transmission of the disease.

The disease occur in four clinical forms:

- (a) *Peracute or pulmonary form*: Incubation form ranges from 3-5 days. Symptoms are high fever, severe respiratory complications with increased rate of respiration. Animals stand with forelegs apart with extended head and nostrils and nasal discharge. Death occurs within few hours.
- (b) *Cardiac and subacute form*: Incubation form ranges from 7-14 days. There is fever and edematous subcutaneous swellings of the eyes, lips, cheek, tongue and chest. Death occurs in 3-5 days after the appearance of clinical symptoms.
- (c) *Mixed form*: Above tow forms of the disease persists simultaneously in the animal host.
- (d) *Horse sickness form*: This is a mild form of the disease. Incubation form ranges is 5-14 days. Intermittent fever and several other symptoms are seen. SF, CN, ID and HI antibodies develop in recovered hosts. These animals exhibit durable immunity to homologous strains of the virus.

Polyvalent formalin inactivated spleen tissue vaccine provides durable immunity for one year. Mouse brain live attenuated vaccine is also available.

The virus can be isolated from specimens like citrated blood collected from the infected animal at the height of temperature, lymph nodes, lungs, spleen and brain. Intracerebral propagation can be performed in embryonated hen's eggs and in cell cultures. There is plaque formation in monkey kidney cells and Vero cells.

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B.V.Sc. & A.H. (Gold Medalist), M.V.Sc. (First Rank), NET Qualified, Ph.D. (Microbiology), Executive-MBA (HRM), D.Sc. (Honoris Causa) is currently working as Associate Professor and HEAD of the Department of Veterinary Microbiology at Arawali Veterinary College (affiliated with Rajasthan University of Veterinary and Animal Sciences, Bikaner and managed by Aastha Society, Sikar), V.P.O. Bajor, Dist. Sikar, Rajasthan, India. Dr. Ganguly earlier served as Scientist (Food Microbiology) and Scientist In-charge, Sub-Projects, in the All India Coordinated Research Project on Post Harvest Technology (ICAR) at Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, WB, India. Dr. Ganguly has handled many projects as Team leader funded by Indian Council of Agricultural Research (ICAR), New Delhi.

Dr. Subha Ganguly has been conferred with the “Young Scientist of the Year Award 2014” in recognition of his Doctoral research in MICROBIOLOGY and scientific expertise in FOOD SCIENCE by the Foundation for Science and Environment, Kolkata, India (Hon’ble President: Prof. Dr. Samir Banerjee, Retd. Dean & Head, Department of Zoology, University of Calcutta, India) in association with Confederation of Indian Universities, New Delhi (Hon’ble President: Chancellor Dr. P.R. Trivedi) and Scientific and Environmental Research Institute, Kolkata, India and “Young Performer Award” by the Association of Pharmacy Professionals, Bhopal, India.



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