DISCONTOOLS

Nipah Virus
Summary

Introduction

1. This note provides a brief summary of an analysis undertaken by a DISCONTOOLS group of experts on Nipah Virus infection. They reviewed the current knowledge on the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details can be downloaded from the web site at http://www.discontools.eu/ by selecting Disease Database, then the specific disease and highlighting the variables of interest. This is completed by selecting "create a report" which can then be downloaded as either a PDF or Excel spread sheet.

Disease profile

2. Two members of the genus *Henipavirus* in the family Paramyxoviridae, Nipah virus (NiV) and Hendra virus (HeV) can infect and cause disease in number of mammalian species including humans, monkeys, pigs, horses, cats, dogs, ferrets, hamsters and guinea pigs.
3. In 1998 and 1999, NiV transmitted from infected pigs, appeared in humans in Malaysia causing encephalitis with associated pulmonary disease and a case fatality rate of 40%. NiV infections of human and domestic animals have now been documented in Malaysia, Bangladesh and northern India with case fatality rates reaching almost 90% in some outbreaks. To date (2017) close to 600 human cases of NiV disease in humans have been reported. Person-to-person transmission has been documented in several outbreaks especially in Bangladesh. In 2014, an outbreak in Philippines of henipavirus closely related to NiV in horses resulted in transmission to humans with subsequent human to human transmission.
4. Fruit bats (flying foxes) in the genus *Pteropus* are the natural hosts for NiV and HeV. Fruit bats live in large colonies where more than half the population may be sero-positive. Currently it is unclear how the virus is transmitted from bats to pigs. It is suspected, however, that fruit trees close to pig confinement areas are foraged by the bats and the virus is spread via urine or saliva on partially eaten fruit.
5. NiV infection of pigs is characterised by fever with respiratory involvement and nervous signs have been frequently reported. Low mortality rates are generally reported and asymptomatic infections appear to be common. Pigs are known to shed virus in respiratory secretions and saliva.
6. Natural infection of dogs with NiV causes a distemper-like syndrome with high mortality rates. Field infections have also been reported in cats and horses, with fatalities observed in both species.

Risk

7. This is re-emerging zoonosis with a high case fatality rate in humans. The zoonosis appears to be limited to certain countries in Asia with fruit bat populations. In Malaysia, being in close contact with infected swine, especially with diseased swine body fluids but also via husbandry practices such as feeding and handling of pigs, was identified as a significant risk factor. In Bangladesh and India, a primary risk factor is ingestion of the virus by drinking raw palm sap that has been contaminated with virus excreted by fruit bats. NiV outbreaks are seasonal and are assumed to be linked to the life cycle and biology of the bat vector.
8. The direct impact on farms and the pig industry will be significant as the first intervention will very likely be culling. In Malaysia, over one million pigs were culled to stop spread of the disease in the original outbreak. Mass culling and carcase disposal can represent a major logistical problem due to the dangerous zoonotic nature of the agent.

There is a high disruption to pig meat production and trade in affected areas. Movement of infected pigs was considered the main mean of dispersal of NiV infection in Malaysia.

9. One of the main concerns related to NiV is the ease with which it can be grown, its highly pathogenic nature and its broad host range making it a potential agent for bioterrorism.

Diagnostics

10. Diagnosis of NiV infection is by virus isolation, detection of viral RNA or demonstration of viral antigen in tissue collected at necropsy. The complete genome of NiV has been sequenced and PCR-based methods have been used to detect virus and are being validated in a number of laboratories.
11. Serological tests include virus neutralisation and ELISA. Detection of antibody can be useful particularly in pigs where infection may go unnoticed. Retrospective serology has been used in the diagnosis of human infections.
12. The availability of safe laboratory diagnostic tests is limited and is non–existent in low biosafety conditions. Laboratories in Australia and Canada have diagnostic capability, and active research. The Australian Animal Health Laboratory has an active diagnostic program and provides diagnostic services for Asia upon request. There is a need for development of diagnostic tests suitable for low containment laboratories.

Vaccines

13. There are no vaccines currently available for NiV although promising results were reported from experiments in swine, cats, and hamsters. Currently there is a lack of financial motivation for the industry to develop vaccines. Vaccines for pigs in areas with a high density of fruit bats may be advantageous, but would have the disadvantage of masking infection and complicating surveillance. If vaccination were to be contemplated, marker vaccines would be useful to enable the differentiation of infected from vaccinated pigs.

Pharmaceuticals

14. No specific treatment is available for veterinary purposes and, if available, the use of therapeutics would be problematic given biosecurity concerns regarding exposed animals. A human monoclonal antibody therapy for human use is presently under pre-clinical development.

Knowledge

15. Little is known about the immunology, ecology, maintenance and transmission of NiV in bat populations. There are significant gaps in knowledge about routes of infection, susceptibility, infectious doses and intra- and inter-species transmission of NiV in all known susceptible species (pigs, dogs, cats, goats, cattle, horses).
16. A limited amount is known about human NiV disease, with most data coming from the Malaysian outbreak. Serologic studies suggest that some human infections are asymptomatic. More needs to be known about the risk factors for infection. The routes of transmission in and between all known susceptible species, including humans, need further study. The potential of wild boar and feral swine to act as NiV reservoirs is not known.

Conclusions

17. NiV is re-emerging virus responsible for previously unrecognized fatal diseases in animals and humans in Asia. Fruit bats are the natural hosts of the virus. The emergence of NiV appears to have been the result of exposure of new hosts precipitated by certain environmental and behavioural changes. NiV transmission from infected pig herds has led to serious outbreaks of disease in human populations. Control is dependent largely on measures taken to reduce the risk of infection of pigs and the culling and disposal of infected animals.
18. In-depth knowledge concerning many aspects of the distribution, epidemiology, pathogenesis and control of NiV is lacking.