Working Safely with Rift Valley fever virus

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Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.
Research was conducted in compliance with the Animal Welfare Act and other federal statutes and regulations relating to animals and experiments involving animals and adheres to principles stated in the *Guide for the Care and Use of Laboratory Animals*, National Research Council, 1996. The facility where this research was conducted is fully accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care International.
Rift Valley fever:

Human or animal disease?
Disease - Humans

Usually a “mild” febrile illness

Incubation period: 2-6 days

More serious disease

Encephalitis (<1%)

Hemorrhagic fever (<1%)

Ocular disease

Case fatality rate (usually ~1%)
Disease
Livestock (cattle, goats, sheep)

Pregnant animals: abort/die
Adult animals: mild disease
Young animals: >90 fatality
Prior outbreaks

- First described in 1931
- Various outbreaks in sub-Saharan Africa
  - Kenya, South Africa, Rhodesia (Zimbabwe)
- Egyptian Outbreak - 1977
  - Estimated 200,000 human cases
  - 598 reported deaths (estimated at 20,000)
  - First report of RVFV outside of sub-Saharan Africa
Recent outbreaks

- Saudi Arabia/Yemen – 2000-2001
- Sudan – 2007-2008
- South Africa – 2010
- Mauritania – 2010
Overview of Rift Valley fever virus
WHAT DO WE KNOW ABOUT POTENTIAL VECTORS IN NORTH AMERICA?
Criteria for Vector Incrimination

- Repeated isolation of virus from field-collected individual of species

- Association in nature between the arthropod and naturally infected vertebrate hosts

- A temporal association between the arthropods’ activity and viral transmission
Criteria for Vector Incrimination

- Susceptibility of the arthropod to infection in the laboratory
- Ability of the arthropod to transmit the virus in the laboratory
Vector Competence
Virus in the blood meal, but mosquito not infected
Mosquito infected, but limited to midgut
Virus disseminated to hemocoel, but salivary glands not infected
Salivary glands infected, ready to transmit by bite
STUDY PROCEDURE

ALLOW MOSQUITOES TO FEED ON INFECTED ANIMAL

ENGORGED (HOLD 7+ days)

REFEED

TRITURATE (Legs + Bodies)

TRITURATE (Legs + Bodies)

UNENGORGED (DISCARD)

TRITURATE (Legs + Bodies)

ASSAY FOR VIRUS
Known Potential Vectors

Relatively efficient

Aedes canadensis
Ae. sollicitans
Ae. taeniorhynchus

Culex tarsalis
Known Potential Vectors

**Modestly efficient**

<table>
<thead>
<tr>
<th>Aedes cantator</th>
<th>Culex territans</th>
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<tbody>
<tr>
<td>Ae. excrucians</td>
<td>Cx. salinarius</td>
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<tr>
<td>Ae. triseriatus</td>
<td>Cx. (Mel.) erraticus</td>
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<tr>
<td>Ae. vexans (LA/FL)</td>
<td>Cx. pipiens</td>
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<td>Cx. erythrothorax</td>
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</table>
Known Potential Vectors

Anopheles bradleyi/crucians
An. quadrimaculatus

Culex nigripalpus
Cx. quinquefasciatus

Aedes dorsalis
Ae. vexans (CO/CA)
POTENTIAL FOR BECOMING ESTABLISHED IN NORTH AMERICA

Many North American mosquito species are potential vectors of RVF virus

Ample supply of susceptible domestic vertebrate hosts (cattle, goat, sheep)

Role of deer, horses, rodents, etc. is not known
Working safely with Rift Valley fever virus
HAZARDS

1. Stable virus
2. History of laboratory infections
3. Humans produce a viremia
4. Aerosol infection possible
5. Select agent
BIOSECURITY

How does one get into an area where research with live RVFV is being conducted?

“limited access”
BIOSURITY

CDC registration/inspections
Agent inventory
Rules for agent transfer/transport
Personal reliability profile
How do we protect the outside world

1. Training
2. Animal biosafety level-3 laboratory with 100% clothes change and shower out
3. Multiple doors/screens
4. Mosquito traps
SAFETY

How do we protect the outside world

5. Emergency mosquito control
EMERGENCY MOSQUITO CONTROL

Remove plastic piece on side.
Depress button (ensure that it is pointing away from face).
Place on a table and leave the room for 4 hours.
SAFETY

How do we protect the outside world

5. Emergency mosquito control
6. Walls painted white
SAFETY

How do we protect the outside world

5. Emergency mosquito control
6. Walls painted white
7. Drains screened
SAFETY

How do we protect the outside world

5. Emergency mosquito control
6. Walls painted white
7. Drains screened
8. Autoclave all waste out
SAFETY

How do we protect the researcher

1. Training
2. Vaccination
3. Primary engineering controls
   a. Biological safety cabinets
SAFETY

How do we protect the researcher

1. Vaccination
2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging
SAFETY

How do we protect the researcher

1. Vaccination
2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging
   c. Filter bonnet cages in animal room
SAFETY

How do we protect the researcher

1. Vaccination

2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging
   c. Filter bonnet cages in animal room

3. Personal protective equipment (PPE)
RVFV poses a real threat should it be introduced into North America.
SUMMARY

- RVFV poses a real threat should it be introduced into North America.

- We need to have a better understanding of its epidemiology, vectors, diagnostics, vaccines.
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- RVFV poses a real threat should it be introduced into North America.

- We need to have a better understanding of its epidemiology: vectors, diagnostics, vaccines.

- These studies need to be conducted in a safe manner that will not endanger either the researcher or the public.