In today’s presentation we will cover information on what causes Rift Valley Fever. We will also talk about the history of the disease, where it is distributed, species that it affects (including humans), and signs of illness observed. Finally, we will address prevention and control measures for Rift Valley Fever virus. This will include control of mosquitoes and their breeding sites. (Pictures from USDA).

Rift Valley Fever (RVF) is caused by a virus. It requires a mosquito to transmit the disease from animal to animal. Rift Valley fever is a fever-causing viral disease that severely affects sheep, cattle and goats, especially young animals. There is a very high rate of abortion and death in newborn animals. RVF can also affect humans. Typically cases have mild, flu-like signs that are self-limiting, but severe disease can occur.

The photo is an electron micrograph of the Rift Valley Fever virus (RVFV) from the CDC website. Rift Valley fever is associated with heavy rainfalls and is transmitted by an insect, usually mosquitoes. However, contact with contaminated tissue from infected animal, especially aborted fetuses, can transmit the virus to humans. This is a picture of the RVF virus taken using an electron microscope.
Rift Valley Fever was first recognized as a disease in sheep in Rift Valley, Kenya, Africa around 1900. The virus was not actually isolated until 1930. Since then there have been sporadic outbreaks throughout Kenya. A major outbreak occurred in 1950-51 which resulted in 500,000 sheep abortions and 100,000 sheep deaths. This map depicts the area in Africa where this disease was first recognized- Kenya.

In 1977-78, a outbreak of RVF occurred along the Nile in Egypt. This was the first outbreak out of sub-Saharan Africa. This outbreak resulted in an estimated 18,000 human cases. There were 598 human deaths which was due to inflammation of the brain (encephalitis) and a bleeding disorder (hemorrhagic fever). Many abortions and deaths were reported in sheep, goats, cattle, water buffalo and camels. This map depicts the location of the 1977-1978 outbreak in Africa- Egypt.

In 1987, an outbreak of RVF occurred in the Senegal river basin (West Africa). This outbreak in animals differed from prior outbreaks in that it was not associated with the typical heavy rainfall. Mosquito breeding occurred in large rivers and dams. The largest outbreak of RVF reported occurred in Kenya, Africa in 1997-1998. An estimated 89,000 humans were infected with 478 deaths. An outbreak of RVF occurred in Saudi Arabia from August 2000 to September 2001. This epidemic was the first confirmed outbreak of RVF outside of Africa. This outbreak illustrated the potential for the spread of this disease to other regions of the world.

This map is from the CDC web site (Rift Valley Fever). The blue areas indicate African countries that have RVF disease and substantial outbreaks of RVF. The green areas are countries known to have some cases, periodic isolation or evidence from blood samples tested for RVF.
The of RVF in Saudi Arabia and Yemen in 2000-2001 was the first time this disease was discovered outside of Africa. 683 humans were hospitalized with severe disease. Of those cases, 95 died (13.9% death rate). Males were attributed to 82.7 percent of cases. The average duration from disease onset to hospitalization was 3.3 days. The average time from disease onset to death was 6.3 days. Seventy-six percent of the patients reported having close contact with sheep and goats. This is a map of Saudi Arabia and Yemen. These countries are separated from Africa by the Red Sea.

RVF is common throughout most of tropical Africa. Outbreaks tend to occur in a cyclic pattern every 5-20 years and is usually associated with abnormally heavy rainfalls. The long intervals between outbreaks allows for development of a vulnerable animal population that is severely affected by the following outbreak. Photo of Egyptian delta farm from http://www.4egypt.info/images/delta_farm.gif

The vector for RVF is mosquitoes, particularly *Aedes* species. A vector is an insect that is able to transmit the disease from animal to animal. This mosquito will lay eggs in flood-prone areas and containers that may hold water including old tires and birdbaths. Then the eggs become infected with RVF inside the female mosquito after she ingests blood from an infected animal. These eggs lay dormant for many years in the dry soil of grassland areas. Following heavy rainfalls, the pooling water gives the eggs a proper environment to hatch. These newly hatched infected mosquitoes then seek a feeding source (human or animal). This photo depicts an *Aedes* mosquito feeding on a human.

Infected cattle, sheep and goats may have high levels of virus in their blood which is enough to infect mosquitoes. These animals may serve as a source of infection by boosting the amount of virus (amplify) for many other mosquitoes that may then rapidly spread the disease. These animals may help the disease become established in the environment and may lead to large outbreaks. Humans also develop a high level of virus and may be a source of infection for mosquitoes.
In animals, transmission of RVF is through a vector (mosquito). RVF virus has been found in several species of mosquitoes. Several of these species of mosquitoes are found in the United States and could potentially contribute to the spread of RVF in this country.

Rift Valley Fever may be transmitted to people from animals through several ways. A person may be bitten by a mosquito infected with RVF. The RVF virus may be transmitted by direct contact of infected animal tissues, meat, or body fluids with a person’s skin. The RVF virus may be breathed in during slaughter of infected animals or during the birthing process.

Finally, RVF may be transmitted by drinking unpasteurized milk from an infected animal. This method of transmission is not thought to be as common as the others. To date, no person-to-person transmission has been documented.

The period of time from exposure to the virus until signs of the disease in humans has been reported to be anywhere from 2 to 12 days. The average is 2-6 days. The majority of humans who have RVF are asymptomatic (do not have signs) or have self-limiting flu-like signs. These signs include fever, headache, muscle and joint pain, and possible nausea and vomiting. Recovery is usually in 4-7 days. In less than 1% of humans infected, severe disease can occur. This can include inflammation of the retina of the eye (retinitis), high fever with a bleeding disorder (hemorrhagic fever) or inflammation of the brain (encephalitis). The death rate in humans may reach 1% of the people who are infected.
Animales enfermos de Fiebre del Valle de Rift

This table is revised from the Foreign Animal Disease, The Gray Book. The death rate may reach 100% in lambs, calves, kids, puppies and kittens. Sheep, goats and cattle have a high death rate of newborn animals and high rate of abortion in pregnant animals. There is a great economic impact from this disease due to the large losses of young animals. Humans can develop severe, life-threatening complications from RVF. Horses, cats, and dogs may have the virus in their blood but they may not become sick. Finally, rodents, rabbits, and birds do not appear to get RVF.

### Bovinos

- **Adultos**
  - Fiebre, debilidad, anorexia, bálsamo, diarrea, piel amarillenta
  - Tasa de mortalidad del 10%
  - Los abortos pueden alcanzar el 100%

- **Becerros**
  - Fiebre, depresión, muerte súbita
  - Tasa de mortalidad entre 10 y 70%

Cattle are affected by RVF. Adults usually appear normal. Signs of illness that may be seen include fever, weakness, anorexia, drooling and diarrhea. Yellow skin or mucus membranes (jaundice) is also commonly seen. The death rate in adult cattle may be 10%. Abortions also occur in cattle and can be as high as 100%. Calves develop fever, depression and may suddenly die. The death rate in calves can be from 10-70%.

### Borregos y cabras

- **Lapso de tiempo desde la exposición hasta la aparición de signos de la enfermedad:** menos de 3 días
  - Tasa elevada de abortos
    - En cualquier fase de gestación
    - Los adultos pueden parecer normales
    - Diarrea fética, piel amarillenta, moqueo nasal
    - Tasa de mortalidad (20-30%)

Abortion in adult sheep and goats is the most common sign of RVF. It may occur at any state of pregnancy. The fetus will have a decomposed appearance. Abortion rates are very high – in some cases as high as 100%. **Remember birthing tissues and fluid may contain RVF virus which may infect humans.** Adult sheep and goats may appear normal. Clinical signs most commonly seen include fever, snotty nose, yellow skin and mucus membranes (jaundice) and possibly vomiting. Death rate in adults, especially those that have aborted, can be 20-30%; however, abortion may be the only sign seen. This photo of aborted fetuses is from the U.S.D.A.

### Corderos y cabritos

- **Lapso de tiempo desde la exposición hasta la aparición de signos de la enfermedad:** de 12 a 36 horas
  - Muerte de recién nacidos
    - Fiebre elevada, desgano, sin apetito
    - Muere de 12 horas a 2 días
    - Menos de 1 semana de edad
      - Tasa de mortalidad >90%
  - Corderos y cabritos de más de 2 semanas de edad
    - Tasa de mortalidad superior al 20%

The period of time from exposure to RVF virus to signs of the disease in lambs and kids is 12-36 hours. As previously mentioned, aborted fetuses are the most common sign. Newborns most easily get sick. Signs of the disease include high fever (105.8°F), listlessness, and lack of appetite (anorexia). Most lambs die within 2 days, but death can occur within 12 hours. The death rate can be over 90% for young less than 1 week old. Lambs and kids over 2 weeks old have a death rate over 20%.

This table is revised from the Foreign Animal Disease, The Gray Book.
Other species can be infected by RVF, but such cases are less common. Dogs can have abortion rates as high as 100%. Puppies become very sick and typically die. Kittens have also been reported to become easily sick from RVF virus. Horses have been experimentally shown to have a low grade virus in their bloodstream; however, to date there have been no cases of RVF in horses. Pigs have been reported to either be very resistant to the virus or develop an infection without signs of the disease. Birds do not get RVF.

If RVF is suspected, contact your local veterinarian immediately. If human illnesses are noted, contact your primary care physician. These skilled medical professionals can determine if further action is needed.

Now we will discuss the prevention and control of Rift Valley Fever. Since mosquitoes (the vector) are necessary to spread the virus among animals, we will focus on vector control which will include; control of mosquito breeding sites, control of mosquito eggs and larvae, and a discussion about adult mosquito control. This picture shows how ordinary trash can become a mosquito breeding site. The jar full of rainwater has several mosquito eggs and larvae in it. (Picture from CDC Public Health Image Library).

RVF requires a mosquito to spread from animal to animal. One of the most important aspects of prevention and control of this disease is the control of the mosquitoes’ habitat. This is because mosquitoes lay their eggs in predictable areas and therefore control efforts can be concentrated. The *Aedes* mosquito typically carries the RVF virus. This mosquito prefers to lay eggs in areas that are prone to flooding, such as a low lying area in a pasture or a ditch. They may also lay eggs in containers that will fill with water. Examples include: stock tanks, buckets, birdbaths, tires, roof gutters and trash. The top photo depicts a flood-prone area after heavy rains in Africa (source: CDC). The bottom photo is a silage pile covered with full tires; half tires or punching holes in them for drainage is ideal to minimize mosquito habitats (source: Danelle Bickett-Weddle, ISU).
Preveción

- Eliminar lugares que faciliten la reproducción
  - Drenar o llenar tierras bajas
  - Nivelar tierras recién urbanizadas
  - Agujerear recipientes para que drenen
  - Disponer correctamente de la basura
  - Cambiar semanalmente el agua de mascotas/ganado

Alterando el hábitat del mosquito es una solución a largo plazo para el control de mosquitos. Hay varios pasos que pueden ser identificados y reducidos o eliminados, como áreas de reproducción. Debe drenarse el agua de los lugares que pueden contener mosquitos. Las medidas como la limpieza y el drenaje deben hacerse de forma regular para prevenir la reproducción de los mosquitos. Las medidas químicas pueden ser necesarias, pero es importante tener en cuenta las medidas no químicas como la limpieza y la eliminación de las zonas donde se produzca la reproducción de los mosquitos. Es necesario conocer el tipo adecuado y el momento correcto de aplicación de los productos químicos. Se deben recurrir a las oficinas locales de extensión para asistencia en la aplicación de los productos químicos.

Preveción

- Identificar como objetivo a las larvas del mosquito
  - Conocer las zonas de problemas potenciales
  - Existen productos inocuos, sin substancias químicas
    - BTI en granulos
      - zonas de pastizales propensas a inundarse
      - BTI en pastillas sumergibles
      - tanques para el ganado

Hay no-químicos que pueden ser utilizados para controlar el mosquito. Estos productos no químicos pueden ser utilizados en áreas que no sean prácticas para drenar o llenar. Estas medidas no químicas pueden ser utilizadas en áreas que no sean prácticas para drenar o llenar. Estas medidas no químicas no son eficientes, pero pueden ser útiles cuando otras medidas no químicas son fracasadas. Es importante tener en cuenta que el uso de los no-químicos puede ser difícil y no es eficaz en todas las áreas.

Preveción

- El control del mosquito adulto es más problemático
  - Puede ser necesario cuando otras medidas de control no tuvieron éxito
  - Es el menos eficiente
    - Es necesario conocer el tipo adecuado y el momento correcto de aplicar el producto
    - Requiere de personal adecuadamente capacitado
    - Para mayores informes, acudir a la oficina local de servicios de extensión

El control del mosquito adulto puede ser difícil y requiere conocimiento especializado. Se debe tener en cuenta que el uso de los productos químicos puede ser difícil y no es eficaz en todas las áreas.

Control

- Mosquitos
  - Centrarse en la eliminación de los sitios de oviposición de la hembra del mosquito
  - Vacunación de bovinos, borregos y cabras
  - Puede ocausar malformaciones congenitas y abortos
  - No está aprobado para utilizarse en EE.UU
  - Restringir la movilización de animales
  - Restringir la permanencia de personal no esencial en la explotación agropecuaria

El control del mosquito puede ser difícil y requiere conocimiento especializado. Se debe tener en cuenta que el uso de los productos químicos puede ser difícil y no es eficaz en todas las áreas.

La misma información se aplica en la lucha contra el brote de RVF. La lucha debe ser a largo plazo y requiere de un enfoque cuidadoso. Se debe drenar el agua de los lugares que pueden contener mosquitos. Las medidas como la limpieza y el drenaje deben hacerse de forma regular para prevenir la reproducción de los mosquitos. Las medidas químicas pueden ser necesarias, pero es importante tener en cuenta las medidas no químicas como la limpieza y la eliminación de las zonas donde se produzca la reproducción de los mosquitos. Es necesario conocer el tipo adecuado y el momento correcto de aplicación de los productos químicos. Se deben recurrir a las oficinas locales de extensión para asistencia en la aplicación de los productos químicos.

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Mosquitoes can transmit RVF to people. People should avoid mosquitoes vectors. Stay inside during the evening when mosquitoes are most active. When outside wear long pants and sleeves and use a repellent on exposed skin. Repellant with N,N-diethyl-meta-toluamide (DEET) is the most effective. DEET is an insect repellent that is safe to use on people. Make sure to follow the label directions when using. Do not use on pets. This picture depicts a child being sprayed with a mosquito repellent.

Although humans may contract RVF through the bite of an infected mosquito, they may also inhale the virus when handling infected animal tissues. This is why sick animals should not be slaughtered during a RVF outbreak. Bury or burn carcasses. Wear personal protective equipment such as gloves, coveralls, boots, protective eyewear and a respirator when handling aborted fetuses or performing necropsies. If possible, avoid contact with infected tissues and blood. Currently the greatest risk for RVF is for travelers to endemic African countries.

The RVF virus is easily destroyed by disinfectants. However, some disinfectants are easily inactivated by organic material (manure, feed, animal tissues, etc.). Therefore, cleaning is the first important step when treating an area that has become contaminated with RVF virus. When cleaning and disinfecting, it is important to wear personal protective equipment (gloves, coveralls, boots, protective eyewear and a respirator) since the virus may become airborne. Cleaning begins by removing all organic material from the surface. Next, use soap or a detergent with warm water and let the surface dry. Then apply the disinfectant. One part bleach diluted with 10 parts water or using the product Virkon-S® by DuPont will destroy the RVF virus.
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