

Risk of a Rift Valley fever epidemic at the haj in Mecca, Saudi Arabia

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Summary

Rift Valley fever (RVF) is a zoonotic disease that affects both humans and domestic animals. In humans, it can cause a fatal haemorrhagic fever disease. When domestic animals such as sheep, goats, camels and cattle are infected, the infection may or may not be accompanied by clinical signs of disease. Both sub-clinical and clinically affected animals present a hazard as a source of infection for humans. The risk of infection is greatest at the time of killing, when aerosols of infected blood may be generated, particularly by traditional sacrificial slaughtering practices. Every year some 10 million to 15 million small ruminants may be slaughtered during the religious festivals at Mecca. Some of these animals come from the Arabian Peninsula itself, but most are imported across the Red Sea, from countries in East Africa and the Horn of Africa, where RVF is known to be enzootic and can be greatly amplified during periods of epizootic virus activity. These animals may be transported to and arrive in Mecca within the incubation period for the disease. Rift Valley fever is also known to occur in the tihama zones of both Saudi Arabia and Yemen.

Keywords

Mecca – Ramadan – Religious festival – Rift Valley fever – Ritual sacrifice – Saudi Arabia – Small ruminant – Trade from Africa – Zoonosis.

Introduction

The problem

Two major religious festivals are held at Mecca during Ramadan: id al Fitr and id al Adha/Arafa. Pilgrims visit Mecca during Ramadan and to make the haj, and many millions are present for the two principal festivals, particularly id al Adha. The number of people present at these festivals varies from year to year, but estimates suggest that it may be of the order of 12 million to 15 million. People travel from all over the world to the festivals, which usually take place between late November and April, although the actual dates vary from year to year.

One of the principal practices of the haj, particularly at id al Adha, which each pilgrim or family wishes to perform, is the ritual sacrifice of a ram by 'halal'. The exact number of pilgrims and families who actually carry out such a sacrifice is not known, but a figure of 1 million to 2 million

animals a day during the short period of a few days at each festival has been suggested. Much of the halal takes place among the huge crowds that are present on such occasions. Slaughter by proxy also takes place at well-appointed slaughtering facilities, where pilgrims arrange for an animal to be slaughtered on their behalf. Halal has been shown to be a means for infection of humans with Rift Valley fever (RVF) virus, if the animal is viraemic at the time of killing.

To supply this annual demand for small ruminants, particularly sheep, for the haj festivals, there is a huge trade from all the pastoralist areas in east and north-east Africa and the Horn of Africa to Saudi Arabia. The animals have traditionally originated largely from the semi-arid pastoral zones of north-east Kenya, Somalia, south-east Ethiopia, western Sudan and Yemen. These zones generally have low moisture indices of -30 to -50 and consist of bushed and wooded grasslands with *Acacia* or *Commiphora* trees. They do however include riverine systems with floodplains that

emerge from the plateau and mountain regions of Africa and Arabia, which seasonally have a higher water table and may provide excellent grazing at certain times of the year. Traditionally, animals are moved to these areas prior to the period of sale as they fatten more readily on the better pastures.

The Somali black-head or fat-tailed sheep, which originates in these ecosystems, is the animal most desired for sacrifice and has the highest value at the haj. Only entire male animals are involved in the trade, and these must be without any blemish or defect, otherwise their value is diminished.

A traditional marketing and trading system has developed over many years to supply this commodity. A well-structured transport system takes animals directly from the grazing areas in Africa to the ports on the Red Sea, and from these to Jeddah by sea. The value of the animals varies according to their condition; large, well-grown animals in excellent condition fetch the highest price in the market place. For this reason, there is premium on transporting the animals directly from the point of origin to Mecca in the shortest possible time. An animal in transit may lose up to a kilo a day from stress and lack of adequate fodder and water, so it is clearly in the interests of the traders to ensure that the animals arrive in Mecca as swiftly as possible. All these factors create a situation in which animals infected at the point of origin or in transit at watering points may arrive at Mecca within the incubation period for RVF infections.

An additional component of this trade to Mecca is the importation of animals from Africa to Yemen, mostly via the port of Mokkah, to be fed and fattened in the plateau and tihama zones. These animals then enter a northward traditional trade route within Yemen to be marketed in Saudi Arabia and in Mecca during the haj period. Since many human and animal cases of RVF were recognised in the tihama zones of Yemen and Saudi Arabia in 2000/2001, it is now becoming clear that these areas are also enzootic for RVF virus.

The risk presented by halal

The very close proximity of such high densities of people and the large numbers of animals being slaughtered by halal present a hazard. Should the blood be infected with zoonotic pathogens, these may be disseminated to the population during the halal ceremonies by droplets or aerosols, or via the skin by wound contamination. Some hazards are more easily detectable than other hazards. Anthrax is a potential hazard which is usually associated with some clinical signs, and can thus be identified. Screening has been routinely carried out for brucellosis for many years at the ports of exit. There are other disease

agents, which may be asymptomatic in sheep and other domestic animals, and these have greater potential to cause serious problems because they are zoonotic pathogens; examples include RVF and Crimean-Congo haemorrhagic fever (CCHF). These present a serious public health problem to the Saudi Arabian health and livestock ministries involved.

Rift Valley fever

Route of infection

Experience in many parts of Africa has shown that a proportion of human cases of RVF result from the killing of RVF-infected animals or post mortem examination of carcasses. Many recorded instances have shown the association of halal with human RVF infections in Egypt. On occasion, several people present at a single halal slaughtering have subsequently become infected with RVF. The infection is thought to result from the contamination of skin cuts or abrasions and/or from inhalation of the blood aerosol/droplet formation following the cutting of the arteries during the halal. This is likely to be the major route, for many people have been infected while holding the animals although they did not actually come into contact with infected tissue or blood.

The situation at Mecca, where hundreds of thousands of people are concentrated at the haj and millions of animals are killed over a period of a few days, greatly amplifies the likelihood of RVF infection of humans should a proportion of those sheep be viraemic or infected with the virus.

Rift Valley fever infection in humans

Rift Valley fever in humans is one of the highly fatal haemorrhagic fevers, and this syndrome frequently signals the onset of an epizootic/epidemic of RVF. Investigations of such cases have resulted in the identification of RVF epidemics in Egypt, Somalia, Yemen and Saudi Arabia (6, 7, 8, 9, 10, 20). However, the great majority of human RVF virus infections do not manifest in this dramatic manner.

In humans RVF occurs most frequently among those working with or looking after animals, such as shepherds, farmers, milkers, slaughterhouse staff and veterinarians.

The human disease syndromes (1, 21, 29) present as: fever, myalgia, hepatitis and gastro-enteric signs. These clinical signs, either separately or together, comprise by far the greatest proportion of human infections with RVF virus. Many may be so mild as to be unremarkable. The fever is diphasic with a one-day to two-day interval, and is usually accompanied by one or more of the other clinical signs.

However, these signs are highly non-specific and of limited value in identifying index cases of RVF by clinical means. Clearly, it is not justifiable to consider RVF a possible diagnosis on routine presentation of such signs. The course of the disease is usually three to nine days, with jaundice and possibly some haemorrhagic diarrhoea.

Haemorrhagic fever

This occurs only in 1% to 2% of cases and is the most dramatic form of the disease. It is very often fatal. There may be syndromes with different levels of severity, from mild bloody diarrhoea to profuse haemorrhagic vomiting and diarrhoea. There may be more generalised signs of haemorrhagic fever, such as nasal and subcutaneous bleeding, which are also associated with a high fatality rate. The occurrence of such a syndrome should invariably trigger investigations at a higher laboratory level to test for the haemorrhagic fevers such as Ebola, Marburg and CCHF. Such a clinical syndrome can generate a level of panic among inadequately supported medical staff, who often lack the special facilities and equipment that are required for barrier nursing and are critical for the safe nursing of such cases. However, nosocomial infection does not occur with RVF as it does with many of the other haemorrhagic fevers.

Encephalitis

This syndrome develops after an apparent recovery from the fever/myalgia syndrome described above and is thought to affect only about 1% of cases, although this may be too low an estimate.

Ocular disease

This syndrome also develops some days after an apparent recovery from the febrile disease and presents as a retinal vasculitis. It may not be recognised at all, or, if severe, only several weeks later. The condition may resolve itself as the inflammation subsides without severe residual retinal damage. In some cases, infarctions may develop which result in a scarring of the retina and permanent loss in visual acuity. The lesions appear to develop more commonly in the peripheral areas of the retina away from the central macular zone, which is visually more important. The occurrence of this syndrome is thus less readily identified and may have a much greater incidence in RVF epizootics than has hitherto been thought.

Mortality

The mortality rates experienced in most RVF epizootics have been less than 1% to 2%. This has been found in situations where most of the mild clinical cases would not have been included in the case study. On occasion, a much higher fatality rate has been found; an example was Arabia during the 2000/2001 epizootics in the tihama of Yemen and the Kingdom of Saudi Arabia where a fatality rate of

17% was recorded. The outcome in these situations may have been due to intercurrent infections with chronic parasitic disease such as malaria, which may have made the patients more susceptible. Certainly, more severe clinical RVF is seen in areas where malaria is hyper-endemic.

Rift Valley fever infected countries

The whole of sub-Saharan Africa, across the wide range of ecological zones found in the continent, may be considered to be enzootic for RVF, as demonstrated by many animal and human disease data with serological findings, such as those contained in reports produced by the OIE and the FAO. Most RVF viral activity is cryptic, at a low level, and not associated with any disease syndromes in humans and animals. Some cryptic low-level RVF virus activity may be occurring each year in many of the sub-Saharan countries. Most countries do not detect such RVF virus activity. This reflects a lack of systematic surveillance activities for RVF and of the capacity or justification for doing any such testing.

Information is available on the natural history of the virus in many African countries, which share common ecological characteristics across the whole of the African continent. The results show a consistent pattern of virus activity related to particular ecosystems and climatic conditions. While Egypt has experienced epizootic RVF, there is no evidence that any of the Mahgreb countries in north Africa have been infected with RVF virus. Arabia recognised clinical RVF in humans and animals for the first time in 2000/2001. The tihama regions of Saudi Arabia and Yemen were principally involved, and their ecological characteristics are identical with those across the Red Sea in Africa. The Red Sea constitutes the floor of the Great Rift Valley before its separation from the African continent. Today, in Arabia, the eastern floor and the mountain range to the east, represent the edge of the Rift Valley. It is thus not surprising to find evidence of RVF virus activity in such a habitat.

Rift Valley fever in Africa

As with some of the other African virus diseases of livestock, RVF is remarkable in that most of the indigenous livestock breeds of cattle, hair sheep and goats, show relatively high levels of resistance to the disease compared to those breeds/strains imported to the continent (2; Davies, unpublished observations). This resistance is considered to be genetic. Rift Valley fever is only evident clinically in exotic livestock or in animals in the more arid and semi-arid zones in the Sahelian and semi-desert zones to the north and south. Camels are also susceptible in these areas. Throughout much of Africa, RVF produces no clinical signs in livestock other than some abortions, which

may be and often are overlooked. Many African countries have found 15% to 35% of sheep, goats and cattle seropositive for RVF virus throughout most agro-climatic zones in their country, yet no clinical disease has ever been reported in humans or in animals. This is critical information, for it shows that there could be considerable RVF virus activity in a country with no clinical signs of disease. Such a situation has now been confirmed by unpublished epidemiological studies in many African countries. They are infected, but there are no visible signs of the disease.

Historical evidence suggests that epizootics of RVF are extremely rare in the semi-arid zones within the Horn of Africa. Most of the trade sheep that are exported to Saudi Arabia for the haj originate in these zones. There was a period of greatly increased RVF virus activity in north-east Kenya between 1961 and 1963, which was associated with extensive flooding of the major river basins (22, 23, 24). The next obvious outbreak of RVF there was in 1997/1998, after an interval of 34 years. The disease was also confirmed as present at the same period in neighbouring ecotopes, following the identification of disease in humans in the contiguous riverine flood plain systems of the Genale, Wabi Shabelle, and Juba rivers in Somalia and Ethiopia (6, 7, 8, 9, 10, 11). Some evidence of cryptic low-level RVF virus activity had been detected by serology in Kenya, Ethiopia and Somalia during the inter-epizootic periods of the 1980s and 1990s, but no clinical disease had been reported in animals in the latter two countries. More baseline data is required on cryptic virus activity in these areas. There is a lack of transparency in publishing RVF results due to their negative impact upon a trade that is said to be worth at least US\$ 0.6 billion per year.

Risk assessment

Risk during inter-epizootic periods

Many tens of millions of sheep and goats have been exported during inter-epizootic periods from Somalia (and from the Ogaden region of Ethiopia and north-east Kenya) to Saudi Arabia and other countries in the Arabian Peninsula. This large-scale movement of animals has not been associated with any disease outbreaks that might be attributed to RVF. The available evidence suggests that such inter-epizootic periods prevail for at least 95% of the time in the semi-arid lands of the Horn of Africa.

The current changes associated with global warming and the periodic increased amplitude of the southern ocean oscillation temperature indices may alter this historic climatic pattern. One consequence is likely to follow the greater amplitude in the oscillation of the southern ocean temperatures: the frequency, magnitude and extent of

flooding in the region may become much greater and more severe. The historical pattern of RVF virus activity in the region may change radically as a result.

Rift Valley fever risk in epizootic periods

A ban on imports of sheep and goats to the haj at Mecca from the semi-arid zones of the Horn of Africa is justified when there is good evidence for the onset of greatly increased RVF virus activity in the regions from which the animals are being transported. This information can be derived (probably with more than 95% accuracy in parts of East Africa) by climatic predictions, which can be made from satellite-derived information systems. The ground truth data is not currently available to extend this principle to the whole of the region, but efforts are being made to validate a model to do this. It must be emphasised that by the time the virus has been detected at the point of origin of the animals, it is too late and infected animals may already have been exported.

The journey by road and sea to Jeddah from such zones may be completed within the incubation period for the disease. Thus the importing of sheep entails a risk of transporting RVF virus. The possibility that large numbers of viraemic sheep (or goats) may arrive in Mecca and be slaughtered is real. A 1.5% to 3% infection rate, which might prevail if the animals were shipped from an area with high RVF virus activity at or near peak virus activity, could result in some 15,000 to 30,000 infected sheep being slaughtered on the peak day of id al Adha. The risk of RVF infection to pilgrims would thus be significant. It is possible that 5% to 10% or more of sheep from any one epizootic area might be infected.

Awareness of this problem increased in Saudi Arabia, after the identification of epizootic RVF in the country in 2000/2001. This has highlighted the need to establish some guidelines for the control of animal movements at national and international levels. It is especially important to Saudi Arabia due to the very large numbers of sheep and goats which travel through or arrive in the country for the great religious feasts at Mecca every year. This trade has two components.

The first component is the movement of animals from the Horn of Africa and Sudan directly to the ports of Jizan or Jeddah, which is near Mecca. This involves transport by road from regional markets in Somalia, Region 5 of Ethiopia or north Kenya, mainly to the ports of Berbera, Bossasso and Port Sudan, and from these by boat to Saudi Arabia. The speed of the system allows them to arrive in Jeddah within five to ten days of leaving the regional markets. This issue is discussed in some detail in Food and Agriculture Organization (FAO) reports (5, 15).

The second component of animal imports encompasses the 'trickle trade', which involves the movement of animals in a northerly direction in the tihama of Arabia from Yemen into Saudi Arabia. Many of the sheep and goats traded in this way originate in the Horn of Africa and have been transported to the Arabian Peninsula by way of the Yemeni ports of Aden, Al Mukha and Al Hodeidah. However, a significant number are from within Yemen itself; they are grazed and traded in a northerly direction to the big markets on the border with Saudi Arabia. This trade has probably continued unaltered for centuries. These animals could be exposed to RVF during passage through the tihama of Yemen and Saudi Arabia if the climatic conditions are favourable for RVF virus activity.

The incubation period for Rift Valley fever

Observations of laboratory infections indicate that the incubation period for RVF is 18 h to 7 days, and the viraemia may persist for one to seven days (16, 17). The actual period of viraemia varies with the genotype of the animal and its relative susceptibility to the virus. Distinct differences occur (2; Davies, unpublished data). Wool sheep exotic to Africa are in general, highly susceptible, with viraemias persisting for four to seven days. The indigenous hair sheep breeds in East Africa are relatively insusceptible, with generally brief periods of viraemia lasting from a few hours to one to two days, with neither malaise nor clinical signs of disease.

The incubation period and duration of viraemia are critical in attempting to assess the levels of risk posed by RVF virus in sheep to the pilgrims at Mecca. There have not been adequate experiments to determine these characteristics in the strains or breeds of sheep principally involved in the trade.

Strategies for control in the exporting countries

Some institutional involvement in regulating the trade is necessary. A good basic knowledge of animal health matters and clinical signs is a starting point. Such information can be systematically gathered and reported in a network with good information flow. Specific disease information, based upon laboratory investigations, is a valuable aid. A systematic strategy should be established to gather real time evidence by monitoring the weather patterns using satellite predictive tools, and to monitor the presence or absence of RVF virus activity by sentinel herd studies or IgM searches in high-risk zones. The latter can be driven by climatic data, which can identify pre-epizootic conditions.

Evidence for the presence or absence of RVF virus activity in one biotope in Kenya, East Africa, was monitored and

has provided invaluable baseline ground truth data (3, 14, 26). The evidence was collected over more than 25 years and the results were correlated with rainfall data and later with remote sensing satellite data (RSSD). The correlation of periods of virus activity with rainfall, cold cloud density (CCD) and normalised differential vegetation indices (NDVI) allowed predictions to be made of the periods when RVF virus activity was likely to occur. The predictive capacity was improved by the inclusion of the southern ocean temperature oscillation index. The system has also been shown to correlate with periods of RVF virus activity in Zambia (12). These information systems require more ground truth data to validate their extension and application to both similar and other, drier ecotopes in Africa and elsewhere. The system may be used to drive monitoring activities on RVF in these countries, where some baseline data of RVF virus activity is available or where identical ecosystems exist.

Retrospective studies (14) made following the 1997/1998 RVF epidemic show that these predictive tools might have been helpful in Region V of Ethiopia and north-east Kenya and Somalia. There is one caveat however: the rainfall measurements must be made in the catchment areas for the river systems and not in the floodplains, where the virus activity occurs. The catchment areas may be far distant from the actual disease sites in the floodplains. However, it is possible to measure rainfall in the mountain catchment areas for the rivers using a satellite data model of basin excess rainfall monitoring systems (BERMS), which can predict the amplitude of the expected river flow (26). In the wetter ecozones of the highlands and coastal plains in Africa the measurements are relevant at the disease sites. This is the case in ecological zones II, III and IV (14). The danger is that the tools may be applied elsewhere in the absence of any ground truth information, which is hazardous.

The major concern is to avoid the importation of animals from Africa to Mecca for slaughter at a time when there is known to be RVF virus activity at the point of origin of the animals involved. This can only be achieved by establishing collaborative monitoring and networking systems for RVF throughout the sub-region. Efforts are being made to establish a forum where all the modelling and predictive data can be discussed by the interested parties (exporters and importers). The involvement of international organisations such as the FAO and World Organisation for Animal Health (OIE) is important to assist in decision-making at this level.

Such networking activity could be facilitated by the establishment of regional forums on exporting and on laboratory information such as the Regional Animal Disease Surveillance and Control Network (RADISCON) and the Pan African Information System (PANINFO),

coordinated and validated by international organisations such as the FAO, World Health Organization and OIE. Saudi Arabia, as the end user in the livestock marketing chain, has the greatest interest in the establishment and operation of such information networks for RVF and other diseases.

The validity and practicalities of acquiring the above information are discussed briefly below. To generate the information relevant to the problem the following methods can be used:

a) surveillance by:

- clinical inspection of the animals
- serological surveys
- sentinel herd monitoring
- reporting networks for abortion

b) laboratory studies by:

- virus isolation
- enzyme-linked immunosorbent assay testing for IgM or IgG
- other serological methods

c) predictive epidemiology by:

- rainfall monitoring
- met-sat climate monitoring
- RSSD monitoring of CCD and NDVI, southern oscillation index (SOI) and BERMS, fed into a predictive model (when available)
- establishing geographic information systems databases on densities and movement patterns of livestock population
- establishing a database on RVF vector distribution, density and breeding biology
- developing a regional approach to RVF epidemiology.

Determination of the actual risks involved

Clinical inspections of flocks of sheep and goats of breeds indigenous to the region are unlikely to detect RVF virus activity, for the disease is mostly cryptic in these genotypes. Abortion is the principal sign of infection, but the trade is exclusively in male animals and these are unlikely to show any clinical signs of the disease.

To achieve hard data would require the sampling and serological testing of the livestock populations in transit in an attempt to obtain information on the existence of ongoing RVF activity. However, a meaningful sample to give confidence at the 1% level would require sample sizes

of 10,000 or more animals. The logistics and practicalities of doing this make it an impossible task. No laboratory in the region has the capacity to cope in a very short period with the number of tests which would be required to give meaningful results.

The trade depends upon rapid movement of animals from source to avoid the loss of weight which occurs in transit (around 1 kg per day). Delays resulting from sampling and testing are not acceptable to the traders, nor is any weight loss from the stress of sampling. Any permanent marking or ear tagging of animals would also have a negative effect upon the trade. The alternative is to make some assessment of the 'relative risk' presented by RVF in the area from which the animals originate. It has been mentioned that animals may originate from areas that have no institutional capacity in animal health. The pastoralists in these semi-arid zones of Africa are totally dependent upon this trade for their survival. They constitute a highly vulnerable population group. A trade ban would have a dramatic negative impact upon their economy.

Assessment of relative risk

The climatic determinants of the onset of RVF virus activity are those which allow the emergence of large numbers of the primary *Aedes* mosquito vectors. The necessary climatic conditions must persist for long enough to allow the generation of large populations of the secondary mosquito vectors – *Culex*, *Anopheles*, *Mansonia* and other genera. These preconditions are: the occurrence of prolonged and persistent rainfall over several months, leading to a rise in the water table in the higher potential agro-ecological zones, which leads ultimately to some local or extensive flooding. This has been seen in East Africa and parts of South Africa in geomorphic formations called 'dambos', which are depressions found in grasslands prone to flooding. Coincident with the rainfall, the inter-tropical convergence zone (ITCZ) in Africa needs to be much broader and deeper, for longer periods of time than is usual. Rainfall of two to ten times the mean annual values has been associated with periods of epizootic RVF. Flooding in the semi-arid and arid zones is likely to occur in floodplains downstream from the actual rainfall zones, often long distances from the rainfall which occurs in plateaus or mountain forest zones. Examples are the watersheds of the Wabi Shabelle and Genale rivers in the Ethiopian plateau, the Tana River flowing from Mount Kenya, the Nile, and the Senegal and Niger rivers in West Africa. Regional epizootic/epidemic periods may be associated with 10 times to 50 times the mean rainfall in the semi-arid zones, and are clearly driven by the El Niño phenomenon.

The analysis of these climatic factors is the most valuable and cost effective means presently available to make a

relative risk assessment for RVF. To utilise these, recommendations are proposed below as a template for monitoring RVF in the region.

The World Trade Agreement

The trade in small ruminants, mainly sheep, to Saudi Arabia for the religious festivals at Mecca has been estimated to be worth US\$ 0.6 billion to US\$ 0.9 billion dollars each year. Traditionally this had been an unregulated trade, until the awareness of the danger presented by RVF infection was perceived by the Saudi Arabian Health Ministry. The World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures has stressed the need for internationally accepted monitoring and surveillance systems for diseases such as RVF.

Historically, there has often been a considerable trade advantage to be gained by (sometimes deliberate) ignorance of a particular disease problem. This is no longer the case, and importing countries such as Saudi Arabia are in a position to demand verifiable internationally accredited data regarding the status of any disease problem in a country of origin. This is highly relevant to the huge trade in sheep to Mecca for Ramadan and the haj. The situation in one traditional major source of the animals, Somalia, is complicated by the lack of any institutional capacity to generate the critical data. A similar observation may apply to the Ogaden region of Ethiopia, for the animals from this region are traded largely through Bossaso and Berbera in Somalia/Somaliland.

Current and potential monitoring activities for Rift Valley fever

Ethiopia

There is little or no information available to show the distribution of RVF virus in the country. No disease problem which might be RVF has ever been recorded other than in the south-east of the country in 1997/1998. Given the ecological characteristics of RVF enzootic areas common to East Africa and the Horn of Africa, other areas of the country have the potentiality to harbour RVF.

Activities should focus on the riverine floodplains of the wabi Shabelle river and its many tributaries in the Ogaden in the south-east of the country. Baseline data for a 10-year to 20-year period should be obtained, and the differences detected in CCD and NDVI levels for the region in the year 1997 compared with the average values. Clear differences may become evident and serve as the basis for early warning in this region.

Sudan

Rift Valley fever virus activity has been shown to occur upstream of the Gezira irrigation scheme on the Nile, in the large area of the Nile basin with its many tributaries in the south-west of the country, in the riverine irrigated areas near Khartoum, and in Equatoria Province (4, 18, 19).

There are no longitudinal data on the virus activity in the country on which to base any assessment of the level of risk of RVF epizootic virus activity.

An analysis of the conditions which prevailed in 1997 compared with the 20-year means for CCD and NDVI may give some indication of the predisposing conditions. The regional determinants such as SOI indices and the characteristics of the ITCZ and BERMS data for the Nile would be highly relevant.

North-east Kenya

North-east Kenya contributes to the trade in sheep and goats in this region.

Rift Valley fever occurred in epizootic form in the north-east of the country in the years 1961/1962 and 1997/1998. The rainfall and RSSD during these years gave a clear indication of the pre-epizootic conditions (14).

Reasonably accurate predictions can be made for the likelihood of epizootic RVF occurring. The flooding which occurred in those years covered hundreds of square miles in the floodplains of the Uasa Nyiro and Tana River basins. Such a level of flooding is extremely rare.

Between these epizootics, RVF virus activity is extremely difficult to detect in these semi-arid zones, but occasional sero-conversions in camels or cattle (13) show that it does occur.

Somalia

Serological studies carried out many years ago showed the presence of RVF antibody in sheep, goats, cattle and camels in the country. However, no clinical disease syndrome had ever been observed in humans or animals until the epizootic year of 1997/1998.

In 1997/1998 deaths among humans and abortions in camels, sheep, and goats were reported and confirmed to have been caused by RVF in the floodplain areas of the Wabi Shabelle and Juba river systems in the south of the country. No RVF was confirmed in the drier northern parts of the north-east of Somalia (6). Remote sensing satellite data are analysed on a monthly basis by FAO monitoring

systems (MetArt, the Africa Real Time Environmental Monitoring Information System [ARTEMIS]/the Famine Early Warning Systems) to assess the potential for food production. These data can also be used to monitor potential RVF virus activity.

Arabian Peninsula

An analysis of the pre-epizootic conditions in Jizan may reveal the nature of the predisposing factors for RVF in the country in the year 2000. Current observation shows that rainfall was at least two or three times higher than normal from May through to October 2000.

Sentinel herd systems have been established in the high-risk areas in the tihama of both Saudi Arabia and Yemen.

Risk management

Predictive inputs

Any indication that major pre-epizootic/epidemic conditions have been identified in exporting countries should be followed by a total ban on livestock trade to Mecca from the affected countries/regions. Clearly the importing country, i.e. Saudi Arabia, should be the decision-maker in implementing this ban. Transparent monitoring and reporting of the climatic conditions related to the risk of RVF virus activity should be the responsibility of the exporting countries, in collaboration with the importing countries. A regional trade commission would be an excellent forum within which such decision-making can be made and coordinated. Efforts are being made to establish a Red Sea Livestock Trade Commission to facilitate this.

It is strongly recommended that any regional predictive modelling system for RVF should be operated by an agency such as the FAO, which is already active in projections of the relative risks presented by army worm, locusts and quelea in this region. Close collaboration with the disease regulatory body, the OIE, is essential. This would generate the necessary confidence among the countries involved and ensure validation of any and all predictions.

Vaccination

Vaccinated animals would present no risk from RVF at Mecca.

Killed vaccines are expensive and do not always protect against abortion or death, even after repeated vaccinations. In many parts of Africa and in Egypt, the Smithburn vaccine strain (SNS) of a modified live virus has been

extensively used. It is valuable as a means of protecting livestock in high-input/high-output systems in the known epizootic areas where valuable, highly susceptible stock are kept. The Smithburn vaccine strain is a cheap and effective vaccine. It is immunogenic, conferring a lifelong immunity, but suffers the disadvantage that it can produce foetal abnormalities early in pregnancy and abortions later in at least 5% to 15% of pregnant animals in the susceptible breeds of sheep and goats. A good protective immunity can also be induced in cattle by this vaccine. Management standards in such situations are high, and owners follow the strict instructions to vaccinate only when the animals are not pregnant. However, in the face of an epidemic many farmers will take a risk and vaccinate regardless of the problems, which are significantly less than those of the disease itself.

The breeds of sheep and goats involved in the trade outlined above are not highly susceptible to RVF. The trade is in male animals and these can be successfully immunised against RVF by using the SNS vaccine. The mortality induced by the disease has not been greater than 1% to 3% in outbreaks in the Horn of Africa and the Arabian Peninsula, and while abortion rates can reach 10% to 30% in the most severely affected areas, they are less than 10% overall. Vaccination is not a cost-effective, economically justifiable intervention in these low-input/low-production systems against a disease, which may appear at 5-year to 35-year intervals (although the periodicity may change with global warming). The herd structure is predominantly female as males are sold off early and owners do not follow a strict breeding pattern. Many females are liable to be pregnant at any time and problems may follow the use of live vaccine in such herds. In practice, however, few or no abortions have followed its use in these relatively RVF-resistant breeds.

The vaccination of animal populations in semi-arid zones to minimise the amplification of RVF virus and reduce the risk of human infections is another issue. Such an intervention may be justified by the need to limit the impact of a zoonotic disease, and the recognition of pre-epizootic conditions may be the signal for this. However, vaccination on an annual basis cannot be justified, other than in highly focused programmes during periods when RVF virus activity is anticipated in areas that are recognised as being at high risk.

Certification

Problems are likely to arise with any attempts to certify vaccination, for most animals originate in areas where there is no institutional capacity to either administer or validate the status of the trade animals with regard to their origin, vaccination history or immunity to RVF virus. Previous attempts at validation have not proved encouraging. It is hoped that this situation will change.

Conclusions

The evidence, which has accrued over the past 50 years, suggests that whatever risk exists from RVF is normally at a low level. No major RVF disease incident has been reported at Mecca during this time despite the importation of millions of sheep and goats from RVF enzootic and epizootic areas in the Horn of Africa. The last major epizootics of RVF in the semi-arid zones of the Horn of Africa occurred in 1961/1962 and 1997/1998. The export trade was uninterrupted in 1961/1962 and illegal trade was thought to have occurred during 1997/1998. No disease episodes which may have been attributable to RVF were recorded in Saudi Arabia in 1997/1998. They may well have occurred, however. The potential certainly exists.

The author strongly recommends that the movement of sheep and goats to Mecca for the religious festivals should be strictly prohibited from any area in which epizootic RVF virus has occurred in the previous three to six months. This principle should be applied both to the animals originating in the Horn of Africa and in Arabia itself.

Predictive epidemiological inputs can drive prophylactic vaccination campaigns in the high-risk areas, wherever this can be justified economically and where the necessary

institutional capacity exists. The predictive models which are available give at least three months lead time (25, 26, 27, 28). The areas where prophylactic vaccination might be used are, for example, where there are high-input/high-production livestock systems, as in the highland areas of East Africa, or where a relatively limited area is involved, such as the tihama of Arabia. This measure is much less feasible in the semi-arid zones where the pastoralists are moving all the time.

High-risk areas can be defined on the basis of the virus activity detected or disease problems experienced in previous RVF epizootics or by post-epizootic serological surveys. There can be little justification for routine annual RVF vaccination in the semi-arid zones, where the livestock are relatively insusceptible and the losses caused by the disease are low or negligible. Rift Valley fever is not a disease problem for the livestock producers; however, it is perhaps the most important factor which affects trade in the region. Vaccination may be driven by the realities of the market place but vaccinated animals present no hazards per se at the haj. Importing countries may decide that they wish all animals to be vaccinated against the disease. ■

Risque d'épidémie de fièvre de la Vallée du Rift lors du hadj, le pèlerinage à La Mecque, Arabie saoudite

F.G. Davies

Résumé

La fièvre de la Vallée du Rift est une zoonose qui touche à la fois l'homme et les animaux domestiques. Chez l'homme, la maladie peut se traduire par une fièvre hémorragique mortelle. L'infection des animaux domestiques tels que ovins, caprins, camélidés et bovins peut entraîner ou non l'apparition des signes cliniques de la maladie. Les animaux atteints d'infection clinique comme infraclinique représentent un danger pour l'homme en tant que source d'infection. Le risque d'infection est maximal au moment de l'abattage, où peuvent être produits des aérosols de sang infecté, en particulier dans le cadre des pratiques d'abattage rituel. Chaque année, quelque 10 à 15 millions d'animaux peuvent être sacrifiés à l'occasion des fêtes religieuses de La Mecque. Certains de ces animaux proviennent de la péninsule arabique elle-même, mais la plupart sont importés, en passant par la Mer Rouge, de pays d'Afrique orientale et de la Corne de l'Afrique, où la fièvre de la Vallée du Rift est

enzootique et peut être considérablement amplifiée en période d'activité épizootique du virus. Ces animaux sont susceptibles d'être transportés vers La Mecque et d'atteindre ce lieu alors qu'ils sont en période d'incubation de la maladie. On sait que la fièvre de la Vallée du Rift se déclare également dans les zones de la Tihama de l'Arabie saoudite et du Yémen.

Mots-clés

Arabie saoudite – Exportation de l'Afrique – Fête religieuse – Fièvre de la Vallée du Rift – La Mecque – Petit ruminant – Ramadan – Sacrifice rituel – Zoonose.



Riesgo de epidemia de fiebre del Valle del Rift durante el 'haj' de La Meca (Arabia Saudí)

F.G. Davies

Resumen

La fiebre del Valle del Rift (FVR) es una enfermedad zoonótica que ataca a los animales domésticos y al hombre, en el que puede causar una fiebre hemorrágica mortal. Cuando afecta a animales domésticos como la oveja, la cabra, el camello o la vaca, la infección puede acompañarse o no de signos clínicos. Los animales enfermos, ya sea en forma subclínica o clínica, suponen un peligro para el ser humano como fuente de infección. El riesgo de infección es máximo en el momento de la matanza, pues pueden generarse aerosoles de sangre infectada, sobre todo cuando se emplean métodos tradicionales de sacrificio. Cada año, en el curso de distintas celebraciones religiosas, se sacrifican hasta 10 a 15 millones de animales en La Meca. Aunque algunos de ellos provienen de la propia Península Arábiga, la mayoría llegan a través del Mar Rojo de países esteafricanos o del Cuerno de África, donde se sabe que la FVR es enzoótica y puede verse muy amplificada en los periodos de actividad del virus epizootico. Esos animales pueden ser transportados a La Meca y llegar a su destino durante la fase de incubación de la enfermedad. Se sabe que la FVR también está presente en las zonas de "tihama" (llanura desértica) de Arabia Saudí y el Yemen.

Palabras clave

Arabia Saudí – Celebración religiosa – Comercio desde África – Fiebre del Valle del Rift – La Meca – Pequeño rumiante – Ramadán – Sacrificio ritual – Zoonosis.



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