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The Historical and Recent Impact of Rift Valley Fever in Africa

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Rift Valley fever (RVF) was first characterized by Daubney and his co-workers, Hudson and Garnham in 1934, while working at the Veterinary Research Laboratory at Kabete in Kenya. An earlier report by Stordy, working in the same department in 1913, had described a similar disease syndrome, which may well have been RVF; it presented as an acute and highly fatal disease in the Rift Valley in exotic wool sheep, which had been imported into East Africa. An association of the disease with heavy and prolonged rainy seasons was noted.

Epizootics occurred periodically in Kenya until the disease was recognized in South Africa in 1951, when humans became ill after handling dead and infected animals. Sheep and to a lesser extent cattle were the principle disease hosts in both east and southern Africa. Further epizootics were subsequently confirmed in Zimbabwe, Zambia, the Sudan, and other east African countries. In 1977 there was a major epidemic in Egypt, with 20–40,000 clinical illnesses and 600 deaths. Cattle and sheep suffered from abortions and neonatal mortality; goats, camels, and water buffalo were also affected. Subsequently, RVF was identified in West Africa in Senegal and Mauritania, where human mortality was again high. In 2000, an outbreak occurred in Saudi Arabia, the first occurrence of RVF virus (RVFV) outside Africa. The ecology there is identical with that in enzootic zones in Africa and the RVF, which circulated were the same biotopes as were seen in Africa. Today, it is generally acknowledged that RVFV is enzootic throughout the African continent and Saudi Arabia, and in many African countries, although disease has not been recognized in man nor in animals in a substantial proportion of enzootic countries.

Historically, during the major epizootics, the human RVF infections have been predominantly sub-clinical; many present as a mild influenza-like syndrome, commonly attributed to malaria. More serious clinical manifestations are acute febrile syndromes accompanied by findings like severe jaundice, retinitis and other ocular lesions, and encephalitis. These have been variously described to develop in from 5% to 20% of RVFV cases in man. Highly fatal hemorrhagic syndrome (HFS) is the most serious clinical manifestation of RVF infections, and has historically been found in only 1–2% of cases.

The first Egyptian (1977) and the more recent RVF epizootics in West Africa and in the East and Horn of Africa in 1997 and 2006, have been characterized by the occurrence of many (several hundred) hemorrhagic fever cases with a significantly high mortality. While occasional cases had been recognized during the many RVF epizootics in the East and South of Africa, these had constituted only 1–2% of the total number of human RVF infections identified. The more recent epizootics in these areas have suggested that HFS was the predominant presenting sign in the affected population groups, and constituted approximately 10% of the human RVF cases.

The ecology of RVFV may be relevant to this observation. The RVFV activity occurs in forest and forest edge situations and the moist plains and bushed and wooded grasslands, which are found over much of Africa. Rainfall in these zones is relatively high and RVF enzootic/epizootic activity is most frequently found in these zones. The RVFV transmission in such areas has involved principally the animal disease hosts. However, retrospective studies show that often 20–30% of those humans living and working with the animals during the epizootic period, have seroconverted to RVFV, usually with no manifestation of clinical signs. Human RVF cases with HFS were extremely rarely seen.

Hemorrhagic cases of RVF have occurred among human populations of the alluvial flood plain zones, which are found principally in semi-arid regions. It has been tentatively suggested that these cases constituted 10% of all the RVFV cases in the recent 2000 epizootic in the Baringo and NE districts of Kenya. In Egypt in 1977, there were also many such cases. It may be relevant to note that malaria and probably schistosomiasis, were endemic in human populations in these regions. In the semi-arid zones of Senegal and Mauretania, and of Kenya and the lowlands of Somalia, where there are flood plains, malaria and probably schistosomiasis commonly occur, with the possibility also today of widespread human immunodeficiency virus (HIV) infections. It is suggested that the outcome of RVFV infection in such population groups, affected by chronic immunosuppressive diseases, may render them much more susceptible to RVF infections and result in a greater proportion of HFS cases.

The epidemics of RVF in Arabia have occurred principally in the tihama zones, which are the floor of the Rift valley in the west of both the Yemen and Saudi Arabia, and are close to the Red Sea. The greatest Rift Valley Fever virus activity was associated with the alluvial fans of soil brought down from the highland zones by the river systems close to the eastern wall of the Rift Valley. The date of onset of cases in both Yemen and Saudi Arabia was simultaneous, indicating that the emergence of RVFV-infected mosquitoes was multi-focal, driven by common climatic changes. Retrospective studies in both countries have confirmed the suspicion that virus had been present in these areas before these clinical RVF outbreaks occurred.

Vaccination against RVF has been practiced for many years in Africa, as a control measure against the economic losses sustained in highly susceptible breeds of sheep and cattle. A modified live virus strain, the Smithburn, is inexpensive to produce and despite potential for vaccine associated abortions, has been extensively used for many years in high production livestock systems as a prophylactic measure. Livestock owners have vaccinated routinely, when animals were not pregnant, and have maintained a high level of immunity in their herds or flocks. This has been a cost-effective commercial practice.

The epizootic periods in semi arid zones last for only 12–16 weeks. Vaccination of livestock is a dangerous practice if carried out when RVF epizootics have already started. In the recent epizootic in NE Africa in 2000, some 2 million or more doses of this vaccine were administered to livestock, at times when the virulent RVF virus was actively being transmitted in the animal populations being vaccinated. Needles are not changed often enough and needle propagation of the virus occurs. This has facilitated further unnecessary spread among the animals and increased the risk to human populations. Clearly, such vaccination practice is contraindicated unless special safe vaccine

administration methods are used. The latest technologies now available for animal vaccination make this possible.

In the 1970's, using rainfall data, it was possible to give early warning of an epizootic period for RVF. The 6 weeks available before the first cases appeared allowed commercial livestock owners to vaccinate their livestock. The latest geographic information system (GIS) technology, using SST (Sea Surface Temperature) and the SOI (Southern Ocean Oscillation Index) and other data, allows much more accurate prediction of the conditions predisposing to a greater likelihood of epizootic RVF virus activity. Onset and timing, and extent of potentially affected areas can be forecasted. The satellite data now allows a highly focal definition of those areas at greatest risk from RVFV during epizootic periods. Historical data and the identification of soil types liable to flooding, where *Aedes* floodwater mosquitoes are likely to be found, allow emergency preparedness activities to be instituted in well-defined target areas. Interventions can be implemented in the 2–3 months before emergence of infected mosquitoes occurs. During this period, extensive vaccination can be carried out in the livestock populations held in high-risk ecotopes. These are in watershed areas, which have soil types known to support breeding sites of floodwater breeding RVFV mosquito vectors. Mosquito control measures may be instituted, larvicides may be applied in the breeding sites, public awareness can be extended by radio and other means, and medical institutions can be sensitized and supplied with appropriate consumables. Mosquito control activities may be instituted at district and village level. Public awareness can be created about the dangers presented by RVF-infected animals, particularly from fetal discharges and by traditional slaughtering practises.

Climatic changes are predicted to follow the trend to global warming. The sea surface temperatures will rise higher, which may increase the range and severity of epizootics of RVF throughout its existing geographic distribution in Africa. The potential for extension into the Middle and Near East must be realistically examined. Thus far, cryptic existence and persistence of the virus often without any manifestation of disease in man or animals has prevailed in many countries in the African continent, Arabia, and Egypt. The potential for more serious epizootics and extension must now be seriously considered.

Most governments in African countries have not had the resources or the institutional capacity to meet and to manage the emergencies, which have been presented by epizootics of RVF. This has been the case whether man or livestock have been the principal or significant target hosts. The countries are usually unable to generate the resources, which are necessary to effectively address emergencies presented by RVF epizootics. It is suggested that a Regional or sub-Regional Institutional capacity be created, within the framework of WHO or other International structure. I hope that this meeting will drive the formation of a body to routinely carry out the following functions:

- Monitor and predict the relative risk of RVF activity on the continent,
- coordinate Early Warning information derived from satellite data,
- assess available resources and institutional capacity in each country,
- create Emergency Preparedness protocols for all target countries,
- coordinate and drive all regional/national activities in pre-epizootic situations.

One reason that RVF disease has not been described in many countries at risk for disease in Africa is that surveillance for epidemic diseases and timely disease reporting are not necessarily optimal in many of those countries. Ethiopia, one of the largest countries in Africa, has the largest population of domestic ruminants, sheep, goats, and camels in Africa. It has a wide range of ecological zones from high altitude mountain and forest zones to plateau highlands, all the range of bushed and wooded wet and dry savannah, through to semi-desert and desert habitat. It has alluvial river valleys and probably has all of the wide range of habitat in which RVFV has been encountered in the African continent. Despite substantial human and animal populations in this country, and the existence of excellent institutional capacity to provide good services in both animal and human health, RVF has not been reported as a problem in man or in animals. With adoption of the new International Health Regulations in 2005, it is hoped that resources will be identified and applied, resulting in substantial improvements in surveillance and diagnostic capacity, and in compliance with international timely disease reporting, so that when outbreaks occur, measures can be taken to limit public health and economic impact.