I will discuss arboviruses in Africa in three categories, namely, those which are of international significance, those which are associated with fevers of undetermined origin and those which might participate in the etiology of Burkitt's lymphoma.

Africa is the home of a large number of arboviruses which pose a great danger to the world in general and to Africa in particular. These viruses include yellow fever, Lassa, Marburg, Ebola, Rift Valley fever and to a lesser extent Congo-Crimean haemorrhagic fever. These diseases have occurred mainly in tropical African countries with a large number of mammalian fauna and arthropods.

Yellow fever

Outbreaks of yellow fever virus infections have occurred in West Africa since 1977 and in Ghana alone since 1969.18,19 A large epidemic occurred also in Senegal in 1965 with several thousand cases and several hundred deaths.11 In Eastern Africa the recent epidemics of yellow fever occurred in the Sudan and western Ethiopia in 19591 and again in south-west Ethiopia in 1960-1962 producing enormous numbers of cases and between 15 000 and 30 000 deaths.10,11 These epidemics show that yellow fever still exists in most tropical African countries and therefore demand a continued surveillance.

The Table below indicates the official notifications of this disease in Africa since 1977. It shows an increase in both the number of cases and deaths, as well as the spread to three other countries between 1977 and 1979. However, these official notifications seem to underestimate the true figures. For instance 30 cases, all of them fatal, were notified in the Gambia in 1978, but retrospective clinical survey revealed 271 suspected cases and 63 deaths. The retrospective serological survey increased these figures to 5000-8000 cases and 1000-1700 deaths.18,19 The difference in these figures is accounted for by difficulties in identifying atypical forms of yellow fever by clinical examination without laboratory tests. Also, some people, especially those living in rural areas, do not always seek medical treatment or report all illnesses and deaths. Hence, the effect of yellow fever, like that of other diseases discussed in this report, is by far greater than that determined from official notifications.

Lassa, Marburg and Ebola

These three diseases are some of the most important viral diseases in Africa because of the severe epidemics they have produced and the potential threat of similar epidemics appearing outside Africa.

Lassa virus, an arenavirus, caused an epidemic in Nigeria in 1969.4 Since then, seroepidemiological surveys have established that this virus is active in all West African countries between Senegal and Zaire. In Sierra Leone alone this disease accounts for 10% of all febrile illnesses and for 1.7% of the general death rate.5 Recent serological surveys
have established Lassa virus antibodies in 4.8% of 433 human samples from Liberia. More recently, 27.3% of 44 specimens from Sudanese military personnel were found to have IFA antibodies to polyvalent LAS-MBG-EBO antigens. In Sierra Leone and Guinea, Lassa fever was found as a disease of forest and savanna areas. However, no evidence of this disease was found in man in the Central African Republic or northern Zaire. Mastomys natalensis has been identified as the rodent reservoir host of Lassa virus. It suffers no ill effect and develops no immune response. 

Marburg virus was first reported in 1967 in West Germany from an outbreak of a fatal haemorrhagic disease among laboratory workers who had contact with tissues of the African green monkey (Cercopithecus aethiops) from Uganda. Retrospective field and laboratory studies conducted in Uganda failed to show any clinical evidence of a similar disease in monkeys or humans. However, HI antibodies were demonstrated in monkeys, indicating that Marburg or a closely related virus was active in Ugandan monkeys, some of which were sent to West Germany. Subsequently, Marburg virus reappeared in South Africa in 1975 and in Kenya in 1980. Serological surveys in the human population have demonstrated specific antibodies in 1.4% of 499 samples from the Central African Republic and in 2% of 433 samples from Liberia. More recently, 4.6% of 237 human serum samples from Kenya had antibodies to this virus.

Ebola virus caused two epidemics of haemorrhagic disease in Zaire and the Sudan in 1976 with a total of 537 notified cases and 362 deaths. The disease reappeared in the Sudan in 1979 producing 36 confirmed cases and 22 deaths. Serological surveys have established the presence of Ebola virus in 11% of 433 persons in Liberia and in 6% of Sudanese. More recently, 8.4% of 237 persons in Kenya were found to be infected. However, evidence of this virus was not found in Zairean monkeys, squirrels, African porcupines, bats or rodents.

In summary, serological surveys found Ebola virus in rain forests in West and Central Africa and Marburg virus in Central, East and Southern Africa. The presence of antibodies to these three viruses in many persons who gave no history of illness or contact with known cases suggests that these viruses usually cause mild or even asymptomatic infection in man. Once these viruses have been transmitted to man through contact with their reservoir hosts, they become capable of adapting to man-to-man transmission, hence the great danger of episodes of these diseases in non-endemic countries.

Rift Valley fever

Until recently, River Valley fever has not been an important human disease because most outbreaks affected domestic animals and a small number of people working closely with these animals. Human death had never been directly ascribed to Rift Valley fever. However, the first severe human epidemic of Rift Valley fever occurred in South Africa in the epizootic of 1950-1951, where Rift Valley fever virus was isolated from five persons. A subsequent epidemiological survey estimated 20 000 human cases. Again, in 1975, another epidemic of Rift Valley fever appeared in South Africa in which at least four persons died.

The epidemic in Egypt in 1977 was the largest and the most fatal human epidemic of Rift Valley fever. The official notification gave 18 000 human cases and 598 deaths. However, estimates of clinical cases range between 20 000 and 200 000. The high number of human cases and deaths were attributed to the increased virulence of the virus and perhaps the high susceptibility of the human population in Egypt due to endemic liver diseases, such as schistosomiasis.

Although the source of this epidemic was not established, the occurrence of a Rift Valley fever epizootic in the Sudan in 1976 strongly suggests that the virus was introduced into Egypt from the Sudan by infected camels. Egypt imports 50 000-100 000 Sudanese camels every year. The appearance of Rift Valley fever in Egypt in 1977 and its reappearance in 1978 and 1979, as well as the potential continued spread in Egypt and other Mediterranean countries, raises concern for public health in this region and the world at large.
Arboviruses associated with fevers of undetermined origin

The role of arboviruses in fevers of undetermined origin is not well established in Africa because some of the effects of these viruses are attributed to malaria. Most febrile patients are therefore treated for malaria before the diagnosis is confirmed by laboratory tests, which are not always conducted due to lack of facilities or manpower. Viral infections are therefore suspected only after the fevers fail to respond to antibiotics and antimalarial drugs. Specimens taken for virus isolation at this late stage usually yield negative results. Hence, viral infections, particularly those causing sporadic cases, are not normally catered for in public health.

The importance of arboviruses in public health can be shown by studies conducted in my Institute. Attempted virus isolation is conducted on acute blood samples from febrile patients with suspected viral infections by suckling mice inoculation. In the past three years, 1046 specimens were examined and these yielded 20 (1.97%) viral isolates. These isolates have been identified as follows: 7 CHIK, 3 Congo, 2 Zika, 1 Dugbe and 1 WSL. Six remaining isolates are interrelated and are also distantly related to Yogue virus from Senegal. The importance of arboviruses in public health can also be emphasized by the finding given above that Lassa fever accounts for 10% of all febrile illnesses in Sierra Leone.

The role of arboviruses in the production of Burkitt's lymphoma

Burkitt's lymphoma is suspected to be caused by an interaction between Epstein-Barr virus and other agents. This suggestion was made after finding that, although Epstein-Barr virus is cosmopolitan, Burkitt's lymphoma cases are confined to tropical Africa where malaria is prevalent. This observation prompted researchers to conduct an experiment in Tanzania to find out whether chemotherapeutic suppression of malaria results in a reduction of Burkitt's lymphoma cases. The results are not yet known. Since climatic conditions favourable to vectors of malaria are also favourable to vectors of arboviruses, the etiology of Burkitt's lymphoma can best be established by conducting studies on the Burkitt's lymphoma triad: Epstein-Barr virus, malaria and arboviruses.

RECOMMENDATIONS

Yellow fever

1. Virus and seroepidemiological studies should be started or continued in monkeys and rodents to determine the activities of jungle yellow fever in endemic countries so that appropriate preventive measures can be taken to avert epidemics.

2. The role of various species of mosquitoes, particularly Ae. aegypti, Ae. africanus and Ae. simpsoni, found in various endemic regions should be defined in relationship to eruptions of epidemics by conducting studies such as population densities, feeding habits and susceptibility to yellow fever virus.

3. There is a need to determine factors which have prevented the occurrence of yellow fever epidemics in most Eastern and Central African countries for many years despite the fact that yellow fever is endemic in these countries and vaccination has been limited to infants and overseas travellers.

4. Precautionary measures against episodes of yellow fever should include vaccination campaigns every 10 years in all countries where yellow fever is endemic. Further, persons who are at high risk, namely, those working in forests as well as medical and laboratory personnel involved in yellow fever studies, should receive booster doses of yellow fever vaccine whenever necessary.

5. Visitors from non-endemic countries to be vaccinated against yellow fever regardless of the period of their stay in yellow fever endemic countries.
Rift Valley fever

1. Seroepidemiological surveys to be conducted in all African States to determine the distribution of Rift Valley fever in man and lower animals.

2. Surveillance of Rift Valley fever virus conducted in endemic countries to include the tracing of the source of infection and the surveillance of imported animals and animal products of all types.

3. The role played by imported and smuggled animals and animal products is to be defined in relationship to the dissemination of Rift Valley fever.

4. Large quantities of Rift Valley fever vaccine of recognized quality, safety and efficacy to be prepared and made available for emergency use in man and domestic animals.

Other arboviruses

1. The importance of arboviruses, particularly those causing viral haemorrhagic fever (VHF), to be emphasized by encouraging specimen collection from acute cases of suspected viral infections.

2. WHO to collaborate with national governments to circulate guidelines to medical practitioners and veterinarians on the clinical and epidemiological manifestations of viral diseases, specimens to be taken and a set of actions to be followed in future episodes, similar to what was given for Ebola-like diseases.16

3. WHO to recommend certain laboratory techniques to be used in collaborating centres for efficient virus isolation and rapid identification. New serological tests such as indirect immunofluorescence, radioimmunoassay and enzyme-linked immunosorbent assay to be appraised for use in collaborating centres. Where necessary, an adequate supply of diagnostic substances to be provided for implementation of these recommendations.

4. To train researchers who are directly engaged in arbovirus studies in the use of the recommended procedures to ensure rapid diagnosis of viral infections and proper evaluation of epidemiological data from various laboratories. Similarly, workshops to be organized for this purpose.

5. WHO to increase the number of collaborating centres in Africa and sponsor more research projects on arbovirus diseases.

6. WHO to initiate and promote joint research projects on viral diseases by all countries in each region for economic reasons and scarcity of manpower and also because the activities of viruses and their vectors are not restricted by geographical boundaries. Similarly, WHO should encourage individual countries to disseminate their findings to other countries in the same or different regions for information and action.

Lassa, Marburg and Ebola

1. A technical team of experts to be formed for working out a multidisciplinary approach in planning research projects and advising on control measures, including vaccine production against this group of diseases.

2. A thorough seroepidemiological survey to be conducted in all African States to determine the geographical distribution, reservoir and amplifying hosts as well as possible vectors involved.

3. Safety materials and equipment, such as gowns, gloves, masks and caps and also immune globulins against these viruses to be supplied to collaborating centres as precautionary measures against another epidemic.
4. Special containment hospitals and laboratories to be set up in each endemic region to minimize risks involved in sending overseas suspected or confirmed cases for treatment.

5. To prevent an alarm and the expenses involved in instituting public health measures against suspected VHF cases, all overseas persons visiting any sub-Saharan African country should take adequate malaria prophylaxis.3

6. Until adequate information is available on the role of various species of mammals, birds and reptiles in the transmission of VHF, WHO should order that any of these animals be exported from Africa only after being tested by specified procedures and found free from VHF viruses and antibodies.

YELLOW FEVER IN AFRICA: 1977-1979

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