Foot and mouth disease in the Sudan

E.M.E. ABU ELZEIN*

Summary: Epidemiology of foot and mouth disease (FMD) in the Sudan is discussed. Four of the 7 FMD virus serotypes have been recorded in the country; these are O, A, SAT 1 and SAT 2.

The free animal movement together with the lack of vaccination have played a great role in the spread of the disease in the Sudan. The economical importance of the disease in the country has been outlined, and future plans for its control are discussed.

INTRODUCTION

Foot and mouth disease (FMD), caused by aphthoviruses (Cooper et al., 1978) is a highly infectious disease of ungulates and other animals. It has damaging effects on animal economy not only by its direct effect on the infected animal, but also by the reduction in trade in livestock and animal products brought about by the restrictive measures which have to be applied for its prevention and control (Brooksby, 1962).

The disease is widely distributed and is endemic in many parts of the world. Reviews and accounts on the disease and its control have been reported by various authors (Sellers, 1969; Hyslop, 1970).

Strategy for FMD control in different parts of the world is planned according to the epidemiological nature of the disease in each area. Thus geographical regions have been classified according to the distribution of FMD (Brooksby, 1967; Pereira, 1979) into:

1. Virus-free areas.
2. Endemic areas, where the disease is constantly present.
3. Fringe areas, where the disease is introduced at relatively long intervals and eliminated by slaughter of infected animals without recourse to vaccination.

In disease-free areas, the policy of preventing the introduction of infection by restricting the import of livestock or animal products, likely to contain virus, has proved effective. Where outbreaks do occur, slaughter and disinfection of infected premises are carried out.

* Department of FMD, The Central Veterinary Research Institute, Soba, Khartoum, P.O. Box 293, Sudan.
In endemic areas aphthisation has been largely replaced by the use of inactivated vaccines, accompanied by the application of effective sanitary regulations and restriction of animal movement, which has reduced the incidence of the disease in many countries. Once the disease incidence is reduced, a combination of vaccination and slaughter constitutes a step forward towards complete eradication of the disease. This policy has proved successful in Scandinavian countries, where it has now proved possible to discontinue vaccination (Pereira, 1979).

FMD is highly endemic in the Sudan. Four of the 7 virus serotypes (O, A, SAT 1 and SAT 2) have been isolated but only from cattle in the country. The first record of the disease was in 1903 (Anon.) but virus serotyping information has been available consistently since 1952. No information regarding the introduction of the disease into the Sudan is available.

DISEASE SURVEILLANCE

The WRL at Pirbright, U.K., has been receiving FMD virus-suspected samples from the Sudan regularly since 1952. Only virus serotypes A, O, SAT 1, were isolated, until 1977 when SAT 2 was first recorded in the country (Abu Elzein and Crowther, 1979). Other FMD serotypes are not known to exist. However, various distinct FMD virus strains of the same serotypes existing in the Sudan are known to prevail in neighbouring countries (Abu Elzein and Crowther, 1979; Abu Elzein et al., 1980; Abu Elzein and Newman, 1980). Such strains could constitute the same danger to Sudanese livestock as do other serotypes.

Type O:

Type O was the first FMD virus serotype to be recovered in the Sudan (Anon., 1938). It is the most frequent and most widespread. It caused 55% of the total positively-typed samples (1952-1981). During the years under review the longest period the country remained free from type O was 1964-1969. The highest incidence of type O was in 1963 when outbreaks spread from the southern region and extended northwards reaching Khartoum in the same year (Figure 3). Subtype study on the Sudanese type O isolates during the last decade, showed that they belong to the O1 subtype of viruses (Abu Elzein and Newman, 1980).

Type A:

The first record of type A in the Sudan was made in 1957. Its incidence was sporadic. It constituted 20% of the total positively-typed samples during 1952-1982. Serological differentiation of type A virus isolates in Sudan (1967-1981) showed that early isolates were similar to those of the A22 subgroup in the Middle East. However, isolates from later years (1973, 1975, 1977, 1981) were dissimilar to the early isolates, and to vaccine strains from Africa, Europe and South America (Abu Elzein et al., 1980).
Type SAT 1:

WRL records show that SAT 1 in the Sudan was recorded before 1952. Two strains, designated as « Wad Medani » and « Khartoum North », were typed as SAT 1 before 1952 and were sent back to WRL, at Pirbright, in 1952 for retyping by Dr. Leach.

Infection with type SAT 1 in the Sudan appears to take place in cycles with a frequency range from one to five years. Type SAT 1 constituted 20% of the total positively-typed FMD samples from Sudan, during the period reviewed (1952-1981).

SAT 1 isolates in Sudan were antigenically very similar but were dissimilar to vaccine strains in Southern Africa (Abu Elzein et al., 1980).

Type SAT 2:

This type has been only recently recorded for the first time in the Sudan (Abu Elzein and Crowther, 1979). The outbreak involved cattle in the Kadaro quarantine, Khartoum province. That outbreak died out and SAT 2 was not reported from elsewhere in the country. Strain differentiation study on the Sudan SAT 2 isolate indicated that it was different from current isolates from Botswana and Southern Africa but most similar to isolates from Niger (1973) and Tanzania (1975) which are equally interrelated (Crowther, personal communication). The Niger strain is antigenically characteristic of a West African group of isolates from Niger, Ghana, and Nigeria from 1973 to 1975 (Crowther, personal communication).

DISEASE SPREAD

In general, the mode of spread of FMD from endemic areas may occur in one or more of the following forms:

1. Air-borne (Sellers and Parker, 1969).
2. Indirect mechanical transmission e.g. people, domestic and wild animals, birds, vehicles, etc.
3. Direct transmission, attributed mainly to the transmission of ill and in-contact animals.
4. Through « carrier animals »: although animals may appear to recover completely from FMD, a number become virus carriers (Sutmoller and Gaggero, 1965). When these are exposed to stress they succumb to the disease and thus « carrier breakdowns » occur.

Before discussing the mode of spread of the disease in the Sudan, a brief account on the pattern of animal movement in the country is worthwhile, because animal movement seems to play a vital role in spread of the disease in the country.
With the exception of few intensive farms, livestock in the Sudan is reared under nomadic conditions, experiencing extensive movement for pastures and water (Figure 2). Cross-border movement has also been reported (Villon, 1973).

The pattern of FMD outbreaks in the Sudan suggests that the disease is endemic in the southern, south-western and south-eastern parts of the country, where most of the outbreaks originate. From these areas spread of infection seems to take place to the central and northern regions. This is illustrated by the mode of spread of type O in 1963, causing the largest epidemic of the disease ever reported in the country so far. The primary outbreak was in Wau, Bahr El Gazal province (southern region) and spread northwards to Malakal district and to Kordofan province and further north following the trade cattle routes reaching Omdurman (Khartoum province) in the same year (Figure 3). Another example was the wave of type O in 1973 that originated in the Upper Nile province (southern Sudan) and spread to the north-east reaching Rouseiris District (Blue Nile province) and then to cattle markets in both the Blue Nile and the neighbouring Kassala province. The disease circulated in that region of the country until 1979 when it eventually reached Khartoum in 1980 (Figures 1 and 4).

Contact between domesticated and wild animals in the Sudan cannot be avoided in many parts of the country. The role of wild animals in the epidemiology of the disease requires further investigation.

The involvement of carrier cattle in the spread of FMD in the Sudan is not known. Some animals succumb to FMD after being exposed to stress. This usually happens in cattle travelling from western Sudan to Khartoum on the hoof. Whether these cases are actually « carrier breakdowns » needs elucidation.

No information is so far available regarding the air-borne transmission of FMD in the Sudan. However, we have heard nomads incriminating winds, coming from FMD-infected areas, in bringing disease to their herds, especially during winter when there are several FMD outbreaks in the country every year.

To study the role of winds in the spread of FMD in the Sudan, meteorological considerations should be taken into account.

ECONOMY OF THE DISEASE

So far no economical evaluation of the losses due to FMD in the Sudan has been done. Losses due to FMD in the Sudan could be due to direct and/or indirect effects. The direct ones are those reflected by the ill effects brought about by the disease on the animal or by death. Eisa and Rwemamu (1977) have reported that mortality rate due to FMD in calves may reach 50%. Direct effects on adult cattle seem to be drastic, causing severe
FIG. 1
Provinces of the Sudan at the time of the outbreaks
FIG. 2

Animal movement in the Sudan
FIG. 3
Type O FMD outbreak in 1963 in the Sudan
FIG. 4

Type O FMD outbreak in 1973-1974 in the Sudan
reduction in milk and meat production (up to 80% reduction in milk production, Anon., 1943). The lesions on the mouth cause direct deprivation of the animal from food consumption, and the hoof lesions can restrict the movement of the animal to pastures and water especially under nomadic conditions. Plough animals will not be able to work and this has indirect effects on the economy of the peasant.

The indirect effects of FMD on animal economy in the Sudan could be seen in the losses that the animal traders face when there is an outbreak. These losses entail the quarantine expenses, feeding the animals during that period and the loss in body weight of animals as a result of disease.

On the other hand, the existence of FMD in the Sudan has, and still does deprive the country from new markets it should have gained being rich in animal resources.

FMD can cause delays in the birth-conception time of female animals. This can deprive the country of more animals that could have been born.

CONTROL OF FMD IN THE SUDAN

Quarantine and restriction of animal movement are the main measures applied for the control of FMD in the Sudan. Aphthisation was practised on cattle with good results (Anon., 1943). No general vaccination has been practised in the country. However, in 1978 a commercial vaccine has been introduced in the country to cover trade cattle only.

DISCUSSION

An in-depth study of the epidemiology of FMD in the Sudan is very essential before practical attempts are made to control the disease in the country. Vaccination and other control measures are unlikely to meet with success, unless full understanding of the peculiarities of the disease is achieved.

In a vast country like the Sudan, with an area approaching one million square miles, and eight neighbouring countries where five of the seven FMD virus serotypes are known to prevail (WRL records), besides free animal movement along most of the borders, the task of FMD control is challenging.

In order to achieve success in animal production schemes so as to satisfy internal consumption and external markets, FMD should be controlled and eradicated. Control programmes in the Sudan should take into account the following:

1. Education at all levels so that the whole nation should be aware of the situation. This is particularly important in the case of FMD because of its drastically swift mode of spread and its direct effect on animal trade.
2. The establishment of a well equipped laboratory with sufficiently trained staff to deal with all aspects of FMD virus research e.g. virus diagnosis, subtyping, serum assay, study of the carrier state in animals, follow-up of the situation in the field, vaccine production and testing with special reference to production of vaccine from local strains of epidemiological significance.

3. Restriction of animal movement.

4. Vaccination: A step by step vaccination programme will prove useful e.g. the creation of FMD-free areas starting with Khartoum province in the centre of the country and extending outwards to cover the rest of the country. At the same time vaccination of cattle in dairy farms, feedlots, breeding centres and of trade animals, as well as ring vaccination in case of FMD outbreaks, should be applied.

From a recent study (Abu Elzein et al., 1982), antibodies against the virus infection associated (VIA) antigen were detected in sheep and goat sera collected from the Sudan. This suggests that those animals have been infected with FMD virus. However, no overt FMD has ever been reported in those species of animals in the country, suggesting that they may undergo an inapparent form of infection with FMD. Further studies are needed to reveal their role in the epidemiology of FMD in the Sudan.

Although camels are known to be refractory to FMD virus infection, they may harbour the virus for some time (Ahmed, 1973, personal communication). Their role in the epidemiology of FMD in the Sudan remains to be examined.

The role of wild game in the epidemiology of the disease in the Sudan also needs to be investigated.

Our previous studies (Abu Elzein et al., 1982) have shown that there is a good correlation between FMD virus serotyping results of samples from the Sudan with the serum antibody level against each virus serotype in Sudanese cattle. Table I shows that type O is the most endemic in the country followed by type A and SAT 1 whereas SAT 2 is the least endemic and seems to have been recently introduced in the country as no appreciable serum antibody level against it was detected in animals in the Sudan. On the other hand, only one SAT 2 outbreak has been reported so far in the history of the disease in the Sudan. No antibodies against FMD type C were detected in animals from the Sudan nor has any isolation of such a virus ever been reported in the country.

CONCLUSION

Foot and mouth disease is highly endemic in the Sudan. Four of the seven serotypes were reported (O, A, SAT 1 and SAT 2). These were only isolated from cattle. Type O is the most widespread and most endemic. Types A and SAT 1 are sporadic, whereas type SAT 2 was only reported once. The first
TABLE I

Correlation between FMD virus isolation and serum antibody level in cattle exposed to FMD natural infection in the Sudan

<table>
<thead>
<tr>
<th>FMD virus serotype</th>
<th>% cattle sera positive for FMD virus type</th>
<th>% cattle epithelial samples positive for FMD virus type</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>75.6</td>
<td>55</td>
</tr>
<tr>
<td>A</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>SAT 1</td>
<td>6.4</td>
<td>20</td>
</tr>
<tr>
<td>SAT 2</td>
<td>0.2</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

O = Negative results.

record of the disease was made in 1903 but no information is available regarding its introduction in the Sudan. Animal movement seems to play a major role in the spread of the disease in the country.

Quarantine and restriction of animal movement are the two methods of FMD control practised in the Sudan.

* * *

LA FIÈVRE APHTEUSE AU SOUDAN. — E.M.E. Abu Elzein.

Résumé : L'auteur expose l'épidémiologie de la fièvre aphteuse au Soudan. Quatre des sept types du virus aphteux ont été identifiés dans le pays : il s'agit des types O, A, SAT 1 et SAT 2.

Les déplacements du bétail et l'absence de vaccination ont joué un grand rôle dans la dissémination de la maladie au Soudan. L'auteur évoque l'importance économique de la maladie dans le pays et présente les plans à mettre en œuvre pour la contrôler.

* * *

LA FIEBRE AFTOSA EN SUDÁN. — E.M.E. Abu Elzein.

Resumen : Expone el autor la epidemiología de la fiebre aftosa en Sudán. Se identificaron en el país cuatro de los siete tipos del virus aftoso : se trata de los tipos O, A, SAT 1 y SAT 2.

Los movimientos del ganado y falta de vacunación tuvieron gran importancia en la propagación de la enfermedad en el Sudán. Relata el autor la importancia económica de la enfermedad en el país, presentando los programas que se han de aplicar para controlarla.

* * *
REFERENCES


