Observations on the recent epizootic of bovine ephemeral fever in Saudi Arabia

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Summary
Observations of the epizootic of bovine ephemeral fever which occurred in Saudi Arabia during 1996 are presented. The investigations included the collection of epidemiological data from affected farms and the testing of sera for antibodies to the virus. The authors report a mean morbidity rate of 50% and a mean case fatality rate of 0.3%. Of the infected cattle, 4% were affected by recumbency, the majority of these recovered (89%). The clinical signs observed in affected cattle were uniform throughout the region concerned. The features of the outbreak, obtained through field investigations, were considered in relation to the ecological and meteorological conditions which were prevalent at the time. The outbreak occurred during the summer months (May to October) in the central and eastern regions of Saudi Arabia, with the initial infection reported at the Al-Ahsa oasis. Farms which were subsequently affected were all reported to possess areas of stagnant water suitable for the reproduction of the vectors of the disease (Culicoides spp. and mosquitoes). To conclude, the authors discuss precautions to prevent future outbreaks of bovine ephemeral fever in Saudi Arabia.

Keywords

Introduction

Bovine ephemeral fever or 'three-day stiff sickness' is a non-contagious disease of cattle and buffalo which is caused by an unclassified arbovirus of the family Rhabdoviridae (10). Culicoides spp. midges and mosquitoes may be involved in transmitting the virus (11, 15, 17).

The disease was first described in South Africa in the mid-nineteenth century (7) and was later reported in other states of Africa (2), Australia (13), Japan (16) and Kenya (5).

In the Near East, the disease has been reported in Jordan, Israel, Syria, Iran and Iraq (4). Two suspected outbreaks of bovine ephemeral fever have occurred in the Kingdom of Saudi Arabia. The first took place during the 1980s (9), the second in the summer of 1991 (S. Hazem, unpublished data, 1991). On neither occasion was virus isolation reported. The latest epidemic of bovine ephemeral fever in Saudi Arabia was recorded between May and October 1996; this time the virus was isolated and identified and the disease was experimentally reproduced (1).

However, since little information is available regarding the epidemiology of the disease in Saudi Arabia and the Arabian peninsula (6), an epidemiological investigation of the disease, with special emphasis on the last epizootic, was considered of great significance.

Materials and methods

Field investigations
Detailed information was collected from the affected farms. This included the following:
- date of the outbreak
- breed of cattle
- type of husbandry
- morbidity rate
- case fatality rate
- recumbency
- clinical signs
- meteorological conditions
- the micro-ecosystems on the farm in relation to the breeding sites of Culicoides spp. and mosquitoes
- previous history of bovine ephemeral fever on the farm
- vaccination against bovine ephemeral fever
- type of vaccine used
- the treatment administered and the response obtained.

**Antibody detection**

The sera tested were collected from naturally infected cattle at both the acute and convalescent stages. The virus used was the Webster 919 vaccine strain. The sera were inactivated at 56°C for 30 min before testing.

The micro virus neutralisation test (VNT) was employed as described by Nagaro et al. (14). The virus used was the Webster 919 strain of bovine ephemeral fever virus which was passaged twice in Vero (African green monkey kidney) cells, and the tissue culture infective dose 50 (TCID\textsubscript{50}) was calculated according to the method described by Reed and Muench (15).

The serum neutralisation test (SNT) was performed by using serial two-fold serum dilutions in F-12 media without serum. Each serum dilution was mixed with an equal volume of the virus containing 200 TCID\textsubscript{50} per 0.1 ml. The virus/serum mixture was incubated for 1 h at 37°C and then overnight at 4°C. The Vero cells were added to each well at a concentration of 106 cells/ml. The plates were then incubated at 37°C for 7 days and examined for inhibition of cytopathogenic effect (CPE). The serum titre was calculated according to the method described by Reed and Muench (15).

**Meteorological data**

Data on temperature and rainfall was obtained from the King Faisal University Weather Station at Al-Ahsa.

**Results**

**Epidemiological investigations**

Epidemiological information was collected from the affected dairy farms and also from villages where a small number of cattle are kept in small agricultural activity areas or in backyards (usually three to five animals).

Between May and October (summer months) 1996, a severe outbreak of disease occurred in cattle in the eastern and central regions of Saudi Arabia. Only cattle over the age of five months were affected. Foreign and local breeds were equally affected. Virus isolation, identification and reproduction of the disease were reported earlier (1).

On affected farms, substantial water spillage was observed, for example, overflows of cattle drinking troughs, forming small stagnant boggy areas and water saturated soil. On these farms, no cases of bovine ephemeral fever had been recorded for six years, and no bovine ephemeral fever vaccine had been used during that period. The initial outbreaks commenced at Al-Ahsa oasis in May 1996; Al-Ahsa is the largest oasis in Saudi Arabia. Sufficient water is present all the year round to create ecosystems suitable for the reproduction of Culicoides spp. and mosquitoes (M. Hilali, personal communication, 1994). From Al-Ahsa, the disease spread throughout the eastern region infecting almost every farm. The disease reached the central region by June 1996 and subsided by the end of October 1996 (Fig. 1). Most cases were reported in June, July and August, with a peak in July.

Figure 2 displays the ambient temperature at Al-Ahsa in 1996. Summer commenced in April with peak temperatures in July/August followed by a reduction in temperature in November. The lowest temperatures were recorded in December and January. Winter usually extends from November/December to February/March.

Figure 3 shows rainfall at Al-Ahsa during 1996. Rains are usually experienced during winter months. Winter can be cold (in some places the temperature drops below 0°C). During winter, biting flies are rarely detected (M. Hilali, personal communication, 1994).

Figure 4 illustrates the temperature profile between 1991 and 1996 at Al-Ahsa. The highest temperatures were recorded in the months of April, May, June, July, August, September and October.

![Number of cases of bovine ephemeral fever during the outbreak in the eastern region of Saudi Arabia, 1996](Fig. 1)
Fig. 2
Minimum, maximum and mean temperatures at Al-Ahsa (January to December 1996)

Fig. 3
Monthly rainfall at Al-Ahsa, 1996

Fig. 4
Minimum, maximum and mean temperatures at Al-Ahsa between 1991 and 1996
Rainfall at Al-Ahsa between 1991 and 1996

Figure 5 depicts the total rainfall from 1991 to 1996 at Al-Ahsa. Rains were recorded during the months of December, January, February, March, April and, at a very low level, in May. The dry summer months were from June to November.

Clinical signs

The clinical signs of bovine ephemeral fever were identical in all the examined cases. The duration of the disease extended from 3 to 6 days after which the animal either returned to a normal state of health or, in very few cases, died.

Affected animals displayed transient anorexia, hyperpnoea, a sudden reduction in milk yield with pink discoloration of milk in some cases, fever (40°C-41°C) lasting for 3 days, seromucoid nasal discharge and occasionally lacrimation. Laboured respiration was observed and the nostrils were hyperemic and opened widely during respiration.

Lameness was common, mainly affecting the hind limbs; when standing, the animal supports itself on three legs with the toe of the affected limb just touching the ground (Fig. 6). Many animals became recumbent for 3 to 10 days and some for several weeks. A few older, heavy animals (over seven years of age) remained prostrate but retained a good appetite.

Table I shows the morbidity and case fatality rates for cattle affected by bovine ephemeral fever at various locations in Saudi Arabia. The highest morbidity rates were recorded at both Al-Ahsa villages and Al-Ahsa Qatar Road (59%). This was followed by Al-Ahsa dairy farm 2 (58%), Dammam dairy farm (51%), Al-Qatif villages (50%) and Al-Ahsa dairy farm 1 (41%). The mean morbidity rate was 52%. The mortality rate (MR) ranged from 0% to 2.6% with a mean of 0.18%. The highest MR was seen at Al-Ahsa villages (2.6%), followed by the Al-Ahsa dairy farm 1 (0.96%), Al-Ahsa dairy farm 2 (0.67%), Al-Ahsa Qatar Road (0.6%), Dammam dairy farm (0.08%) and Al-Qatif villages (0%).

Table II illustrates the problem of recumbency in cattle due to bovine ephemeral fever. Of the total number of cattle affected by the disease, 4% became recumbent. The highest recumbency rate was seen at Al-Ahsa dairy farm 1 (36%), the lowest recumbency rate recorded was 2%. The majority of cattle recovered from recumbency (89%).

Table III lists the results of SNT on sera collected during the acute phase and from convalescent cattle involved in the outbreak. In all districts, the sera collected during the acute phase gave an SNT titre of less than 0.3 (based on log10) while titres of the convalescent sera examined ranged from 1.8 to 2.1, indicating a rise in titre of up to 64-fold compared to that of the acute phase.

No diarrhoea was observed. The tongue and feet were normal. Pregnant cows did not abort.

Treatment

The affected cattle received a combination of antipyretic, analgesic, and anti-inflammatory drugs and infusions with isotonic fluids. The animals were also rested. The treatment continued for 3 to 5 days, after which animals returned to a normal state of health. Treatment of recumbent animals was discontinued and the animals culled when maintenance was judged to be uneconomical.

Discussion

Information on outbreaks of bovine ephemeral fever in Saudi Arabia is scarce. The first mention of the disease in the literature was made by Butiker in 1983, as cited by Lane (9). Eight years later, suspected outbreaks of the disease were encountered in the summer of 1991 (May to October) (8). No virus isolation was reported on either occasion. In 1996, the disease was confirmed by virus isolation and identification (1). The present study investigates the epidemiological features of the 1996 epizootic.
The rapid spread of bovine ephemeral fever and the relatively high morbidity rate in the 1996 epizootic, demonstrate that a high proportion of the cattle in the affected regions were susceptible to the virus. Interestingly, all the cattle affected were over the age of five months. This indicates that the calves aged five months and below were protected from virus infection. This could have been due to maternal antibodies acquired from previously vaccinated or naturally-infected dams.

The schedule of treatment adopted for the affected cattle during the epidemic proved successful. However, recumbency and/or death, were encountered at a very low frequency at the beginning of the epidemic, when cases were sporadic. This was due to confusion among field veterinarians regarding symptoms of the disease, as the disease was new to the area. As a result, delays occurred in the administration of suitable and timely treatment. In addition, farmers in villages did not report the disease immediately. This also resulted in the aggravation of clinical signs due to delays in providing supportive treatment.

The source of the introduction of bovine ephemeral fever into Saudi Arabia is difficult to determine. However, several concomitant factors could have been involved. For instance, Saudi Arabia imports large numbers of live animals from countries in which the disease is known to be present. It is therefore not unexpected that animals should arrive in Saudi Arabia during the incubation period of the disease. This could have coincided with the presence of the right local vector(s), which were abundant at the time of the epidemic and seemed to assist circulation of the virus.

The virus appeared to have found an ideal situation for circulation where cattle were vulnerable to infection and thus the disease was exacerbated.

### Table I

Morbidity and mortality rates of cattle affected by bovine ephemeral fever in Saudi Arabia, May-October 1996

<table>
<thead>
<tr>
<th>Location</th>
<th>Total No.</th>
<th>No. affected</th>
<th>Morbidity rate (%)</th>
<th>Deaths</th>
<th>Mortality rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Ahsa dairy farm 1</td>
<td>104</td>
<td>42</td>
<td>41</td>
<td>1</td>
<td>0.96</td>
</tr>
<tr>
<td>Al-Ahsa dairy farm 2</td>
<td>448</td>
<td>260</td>
<td>58</td>
<td>3</td>
<td>0.67</td>
</tr>
<tr>
<td>Dammam dairy farm</td>
<td>8,000</td>
<td>4,100</td>
<td>51</td>
<td>6</td>
<td>0.08</td>
</tr>
<tr>
<td>Al-Qatif villages</td>
<td>60</td>
<td>30</td>
<td>50</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Al-Ahsa villages</td>
<td>156</td>
<td>92</td>
<td>59</td>
<td>4</td>
<td>2.00</td>
</tr>
<tr>
<td>Al-Ahsa Qatar Road</td>
<td>331</td>
<td>195</td>
<td>59</td>
<td>2</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,099</strong></td>
<td><strong>4,719</strong></td>
<td><strong>52</strong></td>
<td><strong>16</strong></td>
<td><strong>0.18</strong></td>
</tr>
</tbody>
</table>
Table II
Recumbent animals due to bovine ephemeral fever infection, Saudi Arabia, May-October 1996

<table>
<thead>
<tr>
<th>Location</th>
<th>No. affected</th>
<th>No. recumbent</th>
<th>No. recovered from recumbency</th>
<th>No. remaining recumbent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Ahsa dairy farm 1</td>
<td>42</td>
<td>15 (36%)</td>
<td>12 (80%)</td>
<td>3 (20%)</td>
</tr>
<tr>
<td>Al-Ahsa dairy farm 2</td>
<td>260</td>
<td>19 (7%)</td>
<td>16 (84%)</td>
<td>3 (16%)</td>
</tr>
<tr>
<td>Dammam dairy farm</td>
<td>4,100</td>
<td>95 (2%)</td>
<td>90 (94%)</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Al-Qatif villages</td>
<td>30</td>
<td>6 (20%)</td>
<td>6 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Al-Ahsa villages</td>
<td>92</td>
<td>29 (32%)</td>
<td>25 (85%)</td>
<td>4 (14%)</td>
</tr>
<tr>
<td>Al-Ahsa Qatar Road</td>
<td>195</td>
<td>19 (10%)</td>
<td>17 (89%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,719</strong></td>
<td><strong>184 (4%)</strong></td>
<td><strong>166 (90%)</strong></td>
<td><strong>18 (10%)</strong></td>
</tr>
</tbody>
</table>

A second possible method of introduction of the disease during the recent epidemic could have been through virally-infected insect vectors driven from Africa by the then prevailing south-westerly winds.

The epidemic occurred during the summer (May to October), when the ambient temperature exceeded 40°C (Fig. 2). Rains usually fall in the winter, which can be cold (Fig. 3); in some locations temperatures may drop to below 0°C. The conditions for breeding of mosquitoes and *Culicoides* midges were therefore optimum during the summer months (May to October). Despite the lack of rains in summer, the high temperatures, together with the presence of stagnant water, boggy land and other ecosystems in the oasis, created a favourable habitat for the reproduction of these vectors, and thus assisted virogenesis of the bovine ephemeral fever virus (12).

Long-term studies on candidate arthropod vectors of animal arboviral diseases of animals, have been identified in various locations within Saudi Arabia, including the regions affected by the recent epizootic (eastern and central regions) (3, 9; M. Hilali, 1994, personal communication). Thus, the presence of the appropriate vector(s), together with introduction of the virus to a bovine ephemeral fever naïve locality (as seemed to have occurred in the recent bovine ephemeral fever epizootic in Saudi Arabia), could have led to the rapid spread of the disease over a wide area (T.D. St George, 1997, personal communication).

Bovine ephemeral fever is not endemic in Saudi Arabia. However, the occurrence of the disease in episodes with a long interval between epidemics necessitates the adoption of preventive measures, as discussed below.

Firstly, since previous studies (E.M.E. Abu Elzein, 1996, unpublished data) indicated that cattle in Saudi Arabia gave negative results to serological tests for bovine ephemeral fever virus during the inter-epidemic period (1992-1994), the authors recommend that annual serological surveys for antibodies to bovine ephemeral fever be conducted. This will enable detection of the decline in herd immunity of cattle in the country. Given that the inter-epidemic period of the disease in Saudi Arabia extends from 5 to 8 years, then the date of the next outbreak could be predicted and vaccination may be adopted, using the appropriate vaccine.

Secondly, the establishment of sentinel cattle herds for studies is recommended at locations within Saudi Arabia where bovine ephemeral fever has been reported in the three epidemics (e.g. Al-Ahsa and the central region).

Thirdly, studies on the vector should be performed. This may entail seasonality and abundance of *Culicoides* spp. and mosquitoes of different species in the various regions, especially localities facing the prevailing south-westerly winds during the summer.

Fourthly, virus isolation should be attempted from the suspected potential vectors.
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The authors thank Dr I.A. Ali for advice regarding computer analysis, Mr I. Al-Muhana, engineer at the King Faisal University Weather Research Station for the meteorological data, Mr A. Al-Khars for technical assistance, Mr H.A. Saud for cattle sera and Dr M.R. Abdin-Bey for the design of Figure 1.

Observations sur l’épizootie récente de fièvre éphémère bovine en Arabie saoudite


Résumé
Les auteurs présentent leurs observations sur la fièvre éphémère bovine, apparue en Arabie saoudite en 1996. Les enquêtes comportaient notamment la collecte de données épidémiologiques dans les élevages concernés et des prélèvements de sérum pour la recherche d’anticorps spécifiques. Les auteurs font état d’un taux moyen de morbidité de 50 % et d’un taux de létalité moyen de 0,3 %. Parmi les bovins infectés, 4 % restaient couchés, mais la plupart d’entre eux (89 %) se relevaient par la suite. Les signes cliniques observés chez les bovins atteints étaient les mêmes dans toute la région de l’enquête. Lors de l’enquête sur le terrain, la corrélation entre les caractéristiques de l’épidémie et les conditions écologiques et météorologiques qui prévalaient alors a été étudiée. L’épidémie est survenue pendant les mois d’été (mai à octobre) dans le centre et l’est de l’Arabie saoudite, le premier cas ayant été signalé dans l’oasis d’Al-Ahsa. Les élevages atteints ensuite étaient tous situés près de mares d’eau stagnante, propices à la reproduction des vecteurs de la maladie (Culicoides spp. et moustiques). Dans leur conclusion, les auteurs évoquent les précautions à prendre pour empêcher l’apparition de nouveaux foyers de fièvre éphémère bovine en Arabie saoudite.

Mots-clés
Observaciones sobre la reciente epizootia de fiebre efímera bovina en Arabia Saudí


Resumen
Los autores hacen una serie de observaciones sobre el brote epizoótico de fiebre efímera bovina que se declaró en Arabia Saudí en 1996. Para investigar dicho brote se obtuvieron datos epidemiológicos de las granjas afectadas y se realizaron pruebas serológicas de detección de anticuerpos específicos. De dichos análisis se infiere una tasa media de morbilidad del 50% y una tasa media de letalidad del 0,3%. Un 4% de los bovinos infectados se vieron aquejados de postración, aunque la mayoría de ellos (un 89%) se recuperó. Los bovinos afectados presentaban signos clínicos invariables en todo el territorio afectado.

El estudio de campo permitió determinar una serie de características del brote epizoótico que después se analizaron en relación con las condiciones ecológicas y meteorológicas imperantes en aquel momento. El brote se produjo durante los meses de verano (de mayo a octubre) en las regiones central y oriental de Arabia Saudí, tras notificarse la infección inicial en el oasis de Al-Ahsa. En todas las granjas que resultaron posteriormente afectadas había, según se informó, áreas de agua estancada, un medio propicio a la reproducción de los vectores de la enfermedad (Culicoides spp. y mosquitos). A modo de conclusión, los autores explican las precauciones que deben adoptarse para prevenir ulteriores brotes de fiebre efímera bovina en Arabia Saudí.

Palabras clave

References


