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Recent outbreaks of foot and mouth disease in countries of east Asia

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Summary

Japan regained the status of freedom from foot and mouth disease (FMD) without vaccination in September 2000 and the Republic of Korea likewise obtained this status in September 2001. However, new outbreaks of FMD caused by the pan-Asian topotype have occurred in pigs in the Republic of Korea since May 2002. Taipei China has not experienced an outbreak of FMD since February 2001 and the country is currently implementing an eradication programme. These countries had been free from FMD for many decades when in 1997, the FMD virus (FMDV) once again invaded the region, particularly in 2000; this resulted in widespread occurrence of the disease. The types of FMDV were investigated by genome analysis, and in each case the virus concerned was found to be a member of the pan-Asian O lineage.

The authors present the recent situations and the characteristics of FMD in countries of east Asia.

Keywords

Asia – Foot and mouth disease – Pan-Asian topotype – Pathogenicity – Vaccination.

Introduction

Until the late 1990s, countries in east Asia, such as Taipei China, Japan and the Republic of Korea had been free from foot and mouth disease (FMD) for decades (Taipei China for 68 years, the Republic of Korea for 66 years and Japan for 92 years). However, from 1997 to 2000, FMD invaded these and other countries of east Asia. All these outbreaks were caused by FMD virus (FMDV) type O.

In March 2000, an outbreak of FMD occurred in Japan and in March and April, simultaneous outbreaks occurred in the Republic of Korea, far eastern Russia and Mongolia (Fig. 1). Molecular epidemiological studies on the viral protein 1 (VP1) gene sequences of the causative viruses showed that these strains belonged to a new lineage of type O that originated in India in 1990 (3). The pan-Asian topotype first spread westwards to Saudi Arabia during 1994, then throughout the Middle East and into European countries such as Turkey, Greece and Bulgaria in 1996. Towards the east, the virus spread into Nepal (1993), Bangladesh (1996), Bhutan (1998), the People's Republic of China (1999), Taipei China (1999) and finally invaded countries of the Far East. Further afield, the topotype invaded South Africa in September 2000 and an outbreak caused by the same viral lineage occurred in the United Kingdom (UK) in February 2001 (4) and subsequently spread into France, the Netherlands and Ireland. Most recently, in May 2002, outbreaks of FMD in pigs, caused by the same topotype, re-occurred in the Republic of Korea.

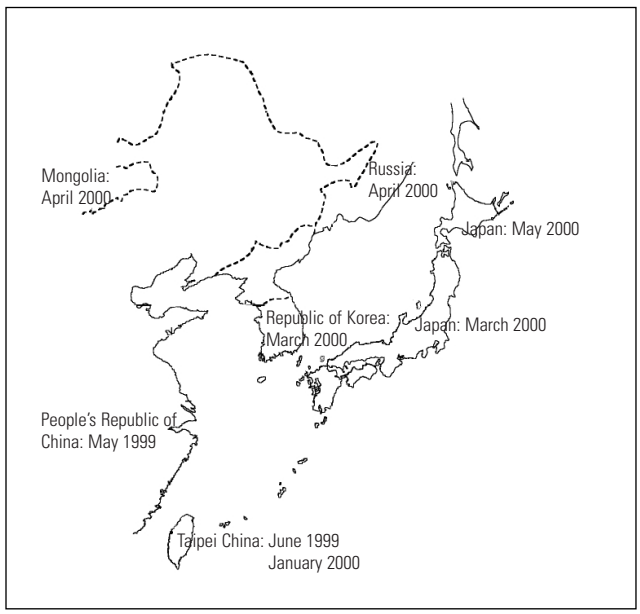

Fig. 1
Recent outbreaks of foot and mouth disease by pan-Asian strain in east Asia
(Dates: initial outbreak)

Features of recent outbreaks in east Asia

In 1997, a catastrophic outbreak of FMD occurred in Taipei China. Pigs showed typical lesions of FMD and the disease spread rapidly among the animals over a period of several months. Experimentally, the virus was found to be pig-adapted and a member of the Cathay topotype (1). In 1999, another strain of FMDV (O/Taiwan/99) was isolated from Taiwanese Yellow cattle that did not develop clinical signs of the disease on Kinmen Island, Taipei China. In spite of the absence of clinical signs, the cattle transmitted the infection to in-contact animals. These included goats, Chinese Yellow cattle and dairy cattle. Dairy cattle, young goats and pigs infected experimentally developed clinical signs typical of FMD. The O/Taiwan/99 strain is a member of the pan-Asian O topotype (2).

In 2000, infection occurred in dairy and native cattle in the Republic of Korea. Both the dairy and native cattle showed clinical signs. In Mongolia, the virus (O/MNG/2000) infected cattle, sheep, goats and camels and caused typical disease. Pigs and dairy cattle infected experimentally with the Russian strain (O/Rus/2000) showed clinical signs typical of FMD (5).

These observations demonstrate the range and variety in pathogenicity observed in pan-Asian strains.

The diagnosis of atypical FMD is difficult as antigen detection enzyme-linked immunosorbent assays (ELISAs), complement fixation tests and virus isolation applied to epithelial tissue samples may yield negative results due to the difficulty in obtaining good quality lesion material, or because the virus in the lesion material is masked by antibody (8). In the worst cases, FMD is difficult to detect in cattle, sheep and goats because these animals may develop mild and atypical signs. In some cases, there may be no indication of infection and the disease is only detected later when it affects pigs. Although the polymerase chain reaction (PCR) method is the most reliable method for diagnosis, rare cases of contamination reactions can occur when using ribonucleic acid (RNA) in the laboratory environment because of its high sensitivity.

Holstein cattle, sheep and goats do not develop clinical signs when infected with FMD strain O/JPN/2000 (6). To diagnose disease caused by this virus, serological tests such as ELISA and virus neutralisation need to be performed retrospectively to identify infected animals. The virus was isolated from naturally infected Japanese Black cattle with high levels of antibody against this particular strain. However, the animals did not develop typical clinical signs of FMD.

The prevalence of FMDVs such as O/JPN/2000 creates new obstacles for world-wide trade in animals and animal products. Importing countries do not have efficient measures to screen imports and thereby ensure that these are free from infection and furthermore, if introduced, the disease may not be immediately apparent. In Japan, a local private veterinarian suspected FMD when called to the first outbreak because of the rapidity of infection. Had the veterinarian not recognised the disease as FMD, although the animals showed no typical signs or vesicles on the feet or in mouth and nose, the presence of FMDV in Japan may have taken much longer to detect (Table I).

Table I
Comparison of clinical signs induced in livestock by recently isolated foot and mouth disease virus from east Asia (5)

Country	Date	Virus strain	Affected animals	Signs
Taipei China	March 1997	O/TAW/97	Pigs	++
	June 1999	O/TAW/99	Chinese Yellow cattle	–
	January 2000	O/TAW/2000	Chinese Yellow cattle	+
			Dairy cattle	++
			Goats (adult/young)	–/++
Republic of Korea	March 2000	O/SKR/2000	Dairy cattle	++
			Korean native cattle	+
Japan	March 2000	O/JPN/2000	Japanese Black cattle	+
			Dairy cattle	–
Mongolia	April 2000	O/MNG/2000	Cattle, sheep, goats	++
			Camels	++
Russia	April 2000	O/RUS/2000	Pigs	++

++ : clear and typical clinical signs
+ : mild and sometimes atypical clinical signs
- : no clinical signs with antibody positive

Use of vaccination in the control and eradication of outbreaks

No vaccination was used to eradicate FMD from Japan. The strategy adopted by Japan in 2000 was based on immediate eradication by stamping-out.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) imported 3.8 million doses of type O vaccine between 3 and 27 April, in addition to the 300,000 doses imported annually for emergency use. All the vaccines were stored at the Animal Quarantine Services and other national institutions under the supervision of the MAFF.

During the FMD outbreak in the Republic of Korea, emergency vaccination of all susceptible animals within the protection zones (10-km radius from outbreak farms) was performed by the National Veterinary Research and Quarantine Services (NVRQS) and provincial veterinary officers. In total, 860,700 animals were vaccinated in the first round of vaccinations and 661,900 in the second round. There have been no further vaccinations against FMD since August 2000.

In 2000, vaccine strains O_1 Manisa, O_1 Campos and O Taiwan were used in Taipei China and a total of 14,173,825 doses of vaccine were used. Since no further outbreaks of FMD have occurred in Taipei China since February 2001, an FMD eradication programme has been instituted. The FMD eradication strategy adopted comprises two phases. The first phase consists of compulsory vaccination. The target for 2002 is to raise vaccination coverage from 85% to 100%. In the second phase, vaccination will cease and be replaced by surveillance.

Emergency vaccination was also implemented in Mongolia and Russia in 2000 (Table II).

Table II
Details of foot and mouth disease outbreaks in east Asia in 2000

Country	No. of cases	Species	No. of susceptible animals	No. of slaughtered animals	No. of vaccinated animals
Japan	4	Bovine	740	740	No vaccination applied
Republic of Korea	15	Bovine	2,216 (within 500-m radius)	2,216	1,522,600
Taipei China	1	Suidae	5	5	14,173,825
	3	Bovine	265	265	
	2	Goat	61	61	
Mongolia	26	Sheep	8,275	152	917,000
		Goat	6,397	158	
		Cattle	1,918	545	
		Camel	572	51	
Russia	1	Pig	965	965	235,000

Sources of outbreaks

The World Reference Laboratory (WRL) for FMD in the UK (Institute for Animal Health, Pirbright Laboratory), which provides a service that enables classification of FMDVs into related groups based on the results of nucleotide sequencing, confirmed that the type O viruses isolated in Japan (O/JPN/2000), the Republic of Korea (O/SKR/2000) and Mongolia (O/MNG/2000) were members of the pan-Asian O lineage.

Wheat straw imported into Japan from China was used as feedstuff on the first farm where FMD was detected, although livestock on 23 other farms using wheat straw derived from the same imported lot failed to become infected. On Mainland China, three outbreaks of FMD caused by type O virus were reported in May 1999 (7). The Chinese straw is considered to be the likely source of the FMD outbreak in Japan, although this has not been proven. If the origin had been contaminated animal products or garbage, pigs would probably have been the first animals to become infected. There was no evidence suggesting other possible routes of infection, such as imported animals, people, vehicles or airborne spread.

Authorities in Taipei China demonstrated that illegal animal movement or imports of animal products from mainland China were the most likely sources of both outbreaks of FMD in 1997 and 1999.

The Epidemiological Investigation Committee of the Republic of Korea identified three possible sources of infection. One of the sources could have been international travellers who may have introduced contaminated meat products, clothing or shoes. Alternatively, imported hay or the wind-borne spread of contaminated particles (yellow sand) (6) may have been the origin of infection.

The source of infection for the recent outbreak of FMD in the Republic of Korea in 2002 is under investigation.

Conclusion

In 2000, FMD caused by the pan-Asian O topotype affected several countries of east Asia and was prevalent for periods lasting from several months to more than a year. The first outbreak of FMD for 92 years in Japan was successfully eradicated within 80 days from the time of confirmation of the first case. There are several reasons for this successful eradication in such a short period. The first is the low virulence of the FMDV strain in cattle. Secondly, the first case was detected before the disease had spread widely in the area. The clinical signs observed were not characteristic of FMD and so the presence of infection may have escaped notice but for the careful examination conducted by the veterinarian concerned. The veterinarian who reported the first case was officially commended for his service. This stresses the important role that field veterinarians play in emergency preparedness against foreign animal diseases. Thirdly, the rate of transmission of FMDV between cattle farms was not high. This may be related to the mild clinical signs in cattle as observed in the field. These signs suggest that replication of FMDV type O/JPN/2000 in cattle is limited and that infected cattle therefore may excrete less infectious virus. Laboratory experiments supported the theory of low virus transmission (6). Farm size is also considered important. Most cattle farms are small in the area of Kyusyu in the southern part of Japan, where the outbreaks of FMD occurred in 2000. The outbreak may therefore have been restricted to sporadic occurrences because virus excretion and the average contact rate between animals were both low.

On the other hand, in the Republic of Korea, FMD was successfully eradicated by vaccination and active serological surveillance in a short period of time. The country regained the

FMD-free status without vaccination in September 2001. However, a new outbreak of FMD subsequently occurred in pigs.

Taipei China continues to implement an eradication programme.

The countries of east Asia are in agreement to co-operate with one another regardless of differences in politics and religion to combat the threat posed by FMD.

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Récents foyers de fièvre aphteuse dans les pays de l'Est asiatique

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Résumé
Le Japon a recouvré le statut de pays indemne de fièvre aphteuse où n'est pas pratiquée la vaccination en septembre 2000 ; pour sa part, la République de Corée se voyait octroyer ce statut en septembre 2001. Toutefois, de nouveaux foyers de fièvre aphteuse, causés par le topotype panasiatique, sont apparus en République de Corée depuis mai 2002 chez les porcins. Aucun foyer de fièvre aphteuse n'a été observé à Taipei China depuis février 2001 ; un programme d'éradication y est actuellement en vigueur. Ces pays étaient indemnes de fièvre aphteuse depuis plusieurs décennies lorsque le virus de la fièvre aphteuse fut introduit à nouveau dans la région, en 1997 et surtout en 2000, entraînant la propagation de la maladie. Les sérotypes du virus de la fièvre aphteuse ont été étudiés par analyse du génome et, dans chaque cas, le virus incriminé appartenait à la lignée O panasiatique.
Les auteurs font le dernier bilan de la situation et précisent les caractéristiques de la fièvre aphteuse dans les pays de l'Est asiatique.

Mots-clés
Asie – Fièvre aphteuse – Pathogénie – Topotype panasiatique – Vaccination.

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Brotes recientes de fiebre aftosa en países del Asia Oriental

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Resumen
Japón recobró el estatus de país libre de fiebre aftosa sin vacunación en septiembre de 2000, y la República de Corea también obtuvo ese estatus en septiembre de 2001. Sin embargo, desde mayo de 2002 se declararon en República de Corea nuevos brotes de fiebre aftosa en porcinos causados por el topotipo panasiático del virus. Taipei China no ha sufrido ningún brote desde febrero de 2001 y está aplicando actualmente un programa de erradicación. Esos países llevaban varios decenios sin sufrir la enfermedad cuando en 1997 el virus invadió una vez más la región, sobre todo en 2000, e indujo una extensión generalizada de fiebre aftosa. El estudio por análisis genómico de los tipos de virus reveló que pertenecían en todos los casos al linaje panasiático O.
Los autores refieren los últimos acontecimientos y describen las características de la fiebre aftosa en los países del Asia Oriental.

Palabras clave
Asia – Fiebre aftosa – Patogenicidad – Topotipo panasiático – Vacunación.

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