

A review of the status of foot and mouth disease in South-East Asia and approaches to control and eradication

L.J. Gleeson

South-East Asia Foot and Mouth Disease Campaign Regional Co-ordination Unit, Office International des Epizooties (OIE) Sub-Commission for Foot and Mouth Disease in South-East Asia (SEAFMD) Project, c/o Faculty of Veterinary Medicine, Kasetsart University, Bangkok 10 903, Thailand
Present address: Commonwealth Scientific and Industrial Research Organisation, Australian Animal Health Laboratory, Private Bag 24, Geelong 3220, Australia

Summary

The author presents reports of foot and mouth disease (FMD) submitted between 1996 and 2001 to the Office International des Epizooties (OIE: World organisation for animal health) Sub-Commission for FMD in South-East Asia. Of the ten countries in South-East Asia, FMD is endemic in seven (Cambodia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam) and three are free of the disease (Brunei, Indonesia and Singapore). Part of the Philippines is also recognised internationally as being free of FMD. From 1996 to 2001, serotype O viruses caused outbreaks in all seven of the endemically infected countries. On the mainland, three different type O lineages have been recorded, namely: the South-East Asian (SEA) topotype, the pig-adapted or Cathay topotype and the pan-Asian topotype. Prior to 1999, one group of SEA topotype viruses occurred in the eastern part of the region and another group in the western part. However, in 1999, the pan-Asian lineage was introduced to the region and has become widespread. The Cathay topotype was reported from Vietnam in 1997 and is the only FMD virus currently endemic in the Philippines. Type Asia 1 has never been reported from the Philippines but was reported from all countries on the mainland except Vietnam between 1996 and 2001. Type A virus has not been reported from east of the Mekong River in the past six years and seems to be mainly confined to Thailand with occasional spillover into Malaysia. The distribution and movement of FMD viruses in the region is a reflection of the trade-driven movement of livestock.

There is great disparity across the region in the strength and resources of the animal health services and this has a direct impact on FMD control. Regulatory environments are not well developed and enforcement of regulations can be ineffectual. The management of animal movement is quite variable across the region and much market-driven transboundary movement of livestock is unregulated. Formal quarantine approaches are generally not supported by traders or are not available. Vaccination is not used widely as a control tool because of the expense. However, it is applied by the Veterinary Services in Malaysia to control incursions of the disease and there is a mass vaccination programme for large ruminants in Thailand where the Government produces and distributes vaccine. Vaccination is also used by the commercial pig sector, particularly in the Philippines and Thailand.

Keywords

Asia – Control – Eradication – Foot and mouth disease – Office International des Epizooties – Regional control strategies – Serotypes – South-East Asia.

Introduction

For the purpose of this review, South-East Asia comprises the countries that constitute the regional political grouping known as ASEAN (Association of South-East Asian Nations). Foot and mouth disease (FMD) is endemic in seven ASEAN countries, namely: Cambodia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Brunei, Indonesia and Singapore are free from FMD. There is an extensive FMD-free zone in the Philippines, recognised by the Office International des Epizooties (OIE: World organisation for animal health), and east Malaysia, contiguous with the Indonesian territory of Kalimantan, has been traditionally regarded as free from the disease.

In 1990, a regional meeting co-ordinated by the OIE examined the impact of important livestock diseases and recommended that a regionally co-ordinated effort was required to control FMD, the highest priority disease identified by the meeting (1). A working group was established and met from 1991 to 1994, when the OIE officially endorsed the creation of the OIE Sub-Commission for Foot and Mouth Disease in South-East Asia (SEAFMD). The Sub-Commission endorsed a plan for FMD control and the OIE sought international support for an initial period of three to five years. In the plan, the activities to control FMD in South-East Asia (SEAFMD campaign) were to be co-ordinated by a regional co-ordination unit (RCU). The Governments of Switzerland, Australia and Japan provided external support that extended from 1997 to 2001 for the activities of the Sub-Commission and the RCU, and the RCU commenced operation in September 1997. The Government of Australia has funded a further three-year phase of the SEAFMD programme, from 2001 to 2004, with limited support from the Government of Japan, while the Government of Thailand continues to host the operations of the RCU. Initially, the seven member countries of SEAFMD were those listed above with endemic FMD. Indonesia, which is free from FMD, requested membership of the Sub-Commission and joined in 2000.

Other international organisations and funding agencies have also conducted projects that have had direct or indirect impacts on the SEAFMD programme. The Food and Agriculture Organization (FAO) managed an Australian Government-funded FMD control project in the Philippines that aimed at preventing the severe epidemic of 1995 from spreading from Luzon to the islands in the south. The project was able to achieve this objective as well as develop better control programmes for FMD on Luzon. The FAO has also supported technical co-operation projects related to FMD in a number of SEAFMD countries, and will soon commence another regional FMD project involving the People's Republic of China, Laos, Myanmar, Vietnam and Thailand. The joint division of the FAO and the International Atomic Energy Agency (IAEA) has provided technical support for national FMD laboratories to establish enzyme-linked immunosorbent assay (ELISA)-based

diagnostic tests, and continues to provide support to a number of laboratories in the region through projects on FMD non-structural protein ELISAs and laboratory quality control. The European Union supports projects aimed at strengthening the animal health services of Laos and Vietnam, and these projects have an indirect impact on SEAFMD through project components concerned with disease control regulation, disease information management, training and animal health extension. The Australian Centre for International Agricultural Research has supported research and technology transfer in the areas of FMD diagnosis, epidemiology and disease surveillance and information management methodologies in both Thailand and Laos. All these activities have contributed or continue to contribute to the overall regional effort to control FMD.

The major thrust of the SEAFMD programme between 2002 and 2004 will be to establish an FMD control zone on the Malaysia-Thailand-Myanmar peninsula. Establishment of this zone will provide a blueprint for FMD control in the region and a platform to extend the disease-free area to other parts of the region. The plan is that by the end of this three-year phase, the programme will be assumed under the jurisdiction of ASEAN. This will be vital for the long-term sustainability of SEAFMD. Other main areas of activity will be concerned with strengthening animal movement management, communications and public awareness about the programme.

Overview of the status of foot and mouth disease in South-East Asia

The sources of information about FMD in the region are the annual reports of the member countries to the FMD Sub-Commission meetings and of the national animal health services to the OIE. Since 1997, the SEAFMD programme has undertaken a monthly FMD reporting system among the members and this is also a source of data. The World Reference Laboratory (WRL) for FMD in Pirbright in the United Kingdom (UK) provides information on the genetic relationships between field isolates submitted from member countries. There are a limited number of scientific publications on FMD epidemiology in South-East Asia, with most of the work arising from studies conducted in Thailand (2, 3, 4, 5).

The quality of the surveillance data available from the region varies and this is a reflection of the differing strengths of the animal health services and the respective surveillance networks. In the first phase of the SEAFMD campaign, emphasis was placed on strengthening national FMD surveillance activities, but at this point, the reports of FMD outbreaks are not truly indicative of disease incidence. However, the epidemiological

information gathered about the viruses in circulation provides a useful picture of the field situation.

In general terms, O, A and Asia 1 are the only three serotypes endemic in the region. Type C was endemic in the Philippines but has not been detected in the country since September 1995. At present, there are at least two distinct topotypes of serotype O present in mainland countries, these being the pan-Asian topotype and the pig-adapted strain (or Cathay topotype). The Cathay topotype is present in the Philippines but no type O strains have been detected in large ruminants for more than ten years. However, among the mainland SEAFMD countries, the Cathay topotype has so far only been identified in Vietnam. The pan-Asian topotype is now the dominant type O virus circulating on the mainland and it may have completely displaced the South-East Asian topotype in the ruminant population. There is a distinct South-East Asian topotype of serotype A, which might have some historical relationship with the A₂₂ strains from the Middle East. Type A viruses have not been reported east of the Mekong River for some years and it is probably reasonable to suggest that they may have disappeared from the countries of Indochina (Laos, Cambodia and Vietnam). However, lack of serotyping data from Cambodia in recent years is the weakest point of this assertion. Type A virus has not been detected in the Philippines for more than ten years. Asia 1 viruses circulate across the entire mainland, although recently Asia 1 has not been reported from Indochina. Type Asia 1 viruses have never been reported from the Philippines. Some specific details of the FMD situation in SEAFMD member countries are outlined below. Numbers of outbreaks and the serotypes involved in these countries are summarised in Table I.

Foot and mouth disease status of member countries of the Sub-Commission for foot and mouth disease in South-East Asia

Cambodia

The principal FMD-susceptible species in Cambodia are cattle, buffalo and pigs. Most pigs are located in village production systems and may be housed in simple pens or run free in the village. Depending on the time of year and other market factors, pigs may enter Cambodia from Vietnam or Thailand. Sometimes pigs move from Cambodia to southern Vietnam. Swill-feeding is not commonly practised in Cambodia. Cattle and buffalo form an integral part of the rice production system in Cambodia and cattle are an important source of draught power when carts are used to transport commodities. Cattle production is significant in the north-east of Cambodia and animals must move on the hoof from this part to markets either in Phnom Penh or towards Thailand. During the wet season in Cambodia, large parts of the country are inundated, resulting in a significant increase in stocking density in higher areas of the flood plain, and probably exacerbated stress levels in livestock.

Over the last ten years, outbreaks due to serotypes O and Asia 1 have been reported, but none has been caused by serotype A. Data from the WRL indicates that in the last four years, two distinct strains of serotype O have been present. The earlier strain that belonged to the South-East Asian topotype was

Table I
Official foot and mouth disease status of member countries of the Sub-Commission for Foot and Mouth Disease in South-East Asia (SEAFMD), 1996-2001^(a)

Country	Outbreaks	1996	1997	1998	1999	2000	2001
Cambodia	Serotypes	Unknown	O, Asia 1	Unknown	0	0	Unknown
	Total	17	9	2 ^(b)	28	32	3 ^(c)
Laos	Serotypes	Unknown	Asia 1	O, Asia 1	O, Asia 1	0	O, Asia 1
	Total	7	4	8	37	140	64
Malaysia	Serotypes	O, A, Asia 1	O, A, Asia 1	A	O, Asia 1	0	0
	Total	10	39	10	10	3	14
Myanmar	Serotypes	O, Asia 1	O, Asia 1	O, Asia 1	O, A, Asia 1	O, Asia 1	O, Asia 1
	Total	15	10	10	24	11	28
Philippines	Serotypes	0	0	0	0	0	0
	Total	388	421	269	340	328	221
Thailand	Serotypes	O, Asia 1	O, A, Asia 1	O, A, Asia 1	O, A	O, A	O, A, Asia 1
	Total	21	15	32	48	103	160
Vietnam	Serotypes	0	0	0	0	0	0
	Total	28	17	23	47	23	13

(a) Based on reports to the Office International des Epizooties Sub-Commission for Foot and Mouth Disease in South-East Asia

(b) Reports received for two months only

(c) Reports received for one month only

replaced in 2000 by the pan-Asian topotype that was probably introduced from Vietnam. Overall reporting, laboratory diagnosis and use of reference laboratories have been variable from Cambodia.

The principal risk factors for outbreaks in Cambodia have not been formally established, but limited experience and anecdotal evidence suggest that movement or sale of infected animals is very important. Cattle and buffalo tend to aggregate, mix and disperse in certain locations at different times of the year, but there is no systematic study to date of the role this plays in generating and disseminating outbreaks of FMD. Vaccination rates in cattle, buffalo and pigs are very low at present.

Laos

Laos is very mountainous with a relatively small ruminant population and no intensive pig industry. Large ruminants are scattered throughout the three main agri-ecological systems in Laos. In the lowland areas, animals are raised in association with the dominant, wetland, rice production system, where they provide essential draught power, manure and a means of recycling rice stubble. These animals are generally kept within the village surrounds, although in some places, they may leave the village to roam in the nearby jungle for part of the year. In the uplands, large ruminants are relatively uncontrolled, although in some areas where there are highland pastures, cattle are raised and kept in small herds. There are no commercial pig farms in Laos, and sheep and goat populations are small.

Only types Asia 1 and O have been detected in field outbreaks in the last ten years, although recent serological data suggested that there is some localised circulation of serotype A in a remote area (S.D. Blacksell, unpublished findings). There has been no formal study of the risk factors for FMD outbreaks in Laos, although animal health authorities consider trading practices important in the spread of disease. Apparently, traders commonly purchase sick animals for lower prices in outbreak areas and then transport them to other areas for slaughter, thus spreading the disease. Laos is also the pathway for the movement of suckling pigs and large ruminants from Vietnam to Thailand, of large ruminants from Cambodia to Thailand (through the south of Laos), and from the People's Republic of China to Thailand (through north-west Laos). These movements were important to the recent regional epidemiology of FMD, as the pan-Asian strain has been introduced to Thailand along all three routes.

Malaysia

There are two principal production systems for large ruminants in Malaysia. Cattle and buffalo are kept by smallholder farmers in association with rice paddy production and large herds of cattle are kept in association with rubber and oil palm plantations. Export-focused commercial pig production was an important impetus for FMD control before the occurrence of Nipah virus in this sector. In some parts of Malaysia, there are

significant numbers of goats. Malaysia is dependent on imports of live cattle and frozen beef to meet domestic demand for red meat.

Risk factors for outbreaks have not been formally studied, but most of the problems with FMD outbreaks in Malaysia are associated with both legal and illegal introductions of livestock from regional sources. Serological surveys of animals imported from Myanmar showed that up to 70% demonstrated evidence of previous infection with FMD (7). Movement of infected animals is the principal risk factor for spread of the disease from the introduction site. Goats have been involved in a recent outbreak caused by type O. All three serotypes of FMD have been introduced into Malaysia in the last five years. The type A and type Asia 1 outbreaks of recent years have been controlled, and more recent incursions of type O are being restricted. The pan-Asian strain caused an outbreak in Malaysia in 1994, but the virus was eliminated. The source of this outbreak was never confirmed, but may have been imported meat.

Myanmar

Myanmar has a very large cattle population, a small dairy industry and significant numbers of small ruminants. Cattle raising is carried out as a distinct enterprise, as well as in association with other agricultural pursuits, particularly rice production. Cattle and buffalo provide most of the draught power required for rice production. There are large livestock auction markets in Myanmar, but laws have been promulgated to restrict the flow of cattle into the meat market. As a result, most exports of live animals must take place illegally. Within the country, animals move from north to south, and large numbers of cattle cross the border to Thailand for this market or travel on to Malaysia.

In recent years, FMD type O has been the most commonly reported serotype from Myanmar, although type Asia 1 outbreaks have also been present every year. There have been no reports of type A viruses from Myanmar for many years except for one localised outbreak on the border with Thailand in 1999. However, there is serological evidence of infection in animals that enter Thailand from Myanmar (W. Kalpravidh, personal communication). This serological profile suggests that either type A is circulating undetected in Myanmar (vaccine containing type A virus is not used), or that the animals originate from further west (i.e. the Indian sub-continent), where type A is more prevalent. Myanmar is a key country in terms of regional epidemiology because of the very large ruminant population that is a potential source of disease from the Indian sub-continent.

Philippines

In the past seven years, the only strain of FMD detected in the Philippines has been the pig-adapted strain of serotype O. This virus is restricted to the island of Luzon and mostly to the central part of the island where most pig production occurs. It is plausible that the ruminant strains of serotypes A and O have

died out, as there is now a fully susceptible population and no vaccination of ruminants is carried out. There are a number of important features of the pig production system that have impacts on the prevalence of FMD. About 85% of pig production takes place in 'backyard systems', and most backyard producers feed swill, much of which is untreated. There are many small traders (*viajeros*) operating in this system. During 1995 and 1996, in the early stages of the epidemic following the introduction of the pig-adapted strain, *viajeros* traded in sick animals because they were able to reduce the purchase price. More recently, the Bureau of Animal Industry has reported that the most important risk factors for outbreaks are activities of *viajeros* and swill-feeding. The commercial sector is taking greater interest in the FMD control programme because of the benefits that have accrued from the FMD-free zones and a partnership is emerging between this sector and the national FMD task force that could have considerable impact on the national FMD control programme.

Thailand

Most of the production of large ruminants in Thailand originates from the smallholder sector. Cattle and buffalo are used less for draught purposes in rice and other crop production and, as a result, the population of buffalo is declining and the emphasis on cattle production is for the sale for meat. However, domestic supplies do not meet market demand and consequently, large numbers of cattle and buffalo enter the country each year from Myanmar, Laos and Cambodia to meet this demand. This trade movement of cattle probably restricts the growth of the small commercial cattle production industry. There is an overall movement of cattle in the country towards the main market in Bangkok and also towards the south to supply the market in Malaysia. This market was not strong in the years immediately following the recent regional economic crisis, but strengthening demand has seen a renewed increase in movements to the south. Thailand has a well-developed commercial pig production sector with potential to export, but opportunities are currently limited by the status of key diseases.

All three serotypes of FMD are endemic in Thailand and have been reported during the last five years. Both the South-East Asian and pan-Asian topotypes of serotype O were reported, the latter being introduced through livestock trading from the north and the east. Risk factors for FMD outbreaks in Thailand include cross-border movements of livestock and the purchase of livestock from local markets. There is also endemic spread from village to village due to sharing of grazing areas (5).

Vietnam

Cattle and buffalo are produced principally in association with rice paddy production, where they supply essential draught power. However, in the central highlands, there are areas where large herds of cattle are kept primarily for meat production. Cattle and buffalo are traded through Laos to the markets in Thailand and also in smaller numbers to the People's Republic

of China. However, in recent years uncharacteristic movements of livestock have taken place from the People's Republic of China to Vietnam and these have been implicated as the source of the introduction of the pan-Asian strain of serotype O in 1999. The pig-adapted (Cathay) strain of FMD was also reported to have been introduced from the People's Republic of China in 1997 due to movement of pigs across the border into the northern provinces. There are large movements of cattle, buffalo and pigs from the northern provinces to the southern markets, especially Ho Chi Minh City. In addition, cattle and buffalo enter this market from Cambodia. There are also significant exports of pigs from Vietnam to Cambodia but, to date, the Cathay strain has not been detected in Cambodia.

Serotypes A and Asia 1 have not been reported from Vietnam in the last six years, although vaccination against all three was practised in the early 1990s. The South-East Asian topotype of serotype O was the predominant strain prior to the introduction of the pan-Asian lineage. Vietnam provides an important link in the regional epidemiology of FMD because of the significant trade in livestock that takes place with the People's Republic of China, the rapid movement of animals from north to south and because of the export of pigs to Cambodia and Thailand.

Approaches to the control of foot and mouth disease in South-East Asia

Regulatory environments

The frameworks for animal health regulations in the SEAFMD member countries are developed to varying degrees. A number of key points of difference arise because of the variety of legislative environments that exists. In some countries, there has been significant devolution of responsibility and authority away from central departments to local or regional levels so no line responsibility exists for animal health within the jurisdiction as a whole. In such circumstances, central offices may develop animal health regulations, but have little power to enforce them at the local level. Co-operation and involvement in animal health measures that must be co-ordinated nationally is then dependent on the communication and goodwill that exists between the various levels of government. In the Philippines, for example, the Bureau of Animal Health has no line responsibility for the execution of the national FMD programme at the local level. However, the relative success of the FMD control programme in the country is in large part due to the ability of the national FMD task force to engage the local administrative units as part of the national FMD control team. In some countries, animal health authorities have little leverage over officials in other administrative departments such as Customs or Trade. This is in part due to the lack of economic and political power of relatively poor smallholder farmers and

because animal production is not a part of the formal economy. Exceptions occur if an outbreak of disease threatens draught power resources that might have an impact on other government programmes, especially rice production targets, and the disease then assumes immediate importance.

In some circumstances, regulations theoretically allow the imposition of the disease control measures required to reduce the spread of the disease, but there is ineffectual enforcement, especially in regard to managing the movement of animals. There are a number of reasons why enforcement is weak. One is that the blanket movement controls that are recommended in textbooks and manuals are impractical to impose. Another is lack of resources and understanding of disease control principles on the part of both the animal health services and livestock owners. It would be most unusual for a livestock owner in the region to be prosecuted for failing to declare the presence of a 'reportable disease'. In some instances, there may be local political interference in the process if individuals with power and influence are inconvenienced by regulations. As animal health staff can be poorly paid, there may be other incentives not to enforce regulations. In Malaysia, the Department of Veterinary Services (DVS) has devised an approach that is effective in assisting the control of FMD outbreaks but at the same time fits the culture and the animal production environment. The DVS acts co-operatively by allowing animals from infected areas to go to slaughter as well as providing vaccination in the area of the outbreak. The DVS insists that owners obtain permits to move animals and that the destination of the stock is agreed and monitored. These measures appear to be an effective part of the approach to eliminating FMD outbreaks. Malaysia, however, does not have as large a population of cattle and buffalo as some of the other member countries, and has a relatively skilled and well-resourced animal health service.

In conclusion, the regulatory environment is not uniform across member countries and the restrictions required to reduce the spread of FMD from outbreak foci are sometimes impossible to apply.

Quarantine measures

Traditional quarantine measures at international borders are often impractical in the approach to the transboundary spread of FMD in South-East Asia. Very few countries of the region have the resources and manpower to operate the facilities and the cost of the operation means that traders will not use them. The marketplaces that have the demand for red meat are affluent in relative terms, but red meat is probably affordable to consumers because there are not significant overheads in the supply chain. The impact of a reduction in the supply and a concomitant increase in price would be difficult to predict. However, a reduction in supply would probably have political implications for the animal health services and would make smuggling even more profitable and difficult to control.

Some countries have adopted a modified quarantine approach that is dependent on FMD vaccination as a key tool in the programme. Animals are held for periods varying from one week to 21 days after vaccination before they are moved. The impact of this approach is related to the environment into which the animals are transported. In the case of Malaysia where FMD is not considered endemic, the practice has resulted in two outbreaks of FMD because the vaccination programme has presumably masked the disease in the animals assembled for export. The occurrence of an outbreak in Malaysia is a cause of considerable concern. On the other hand, FMD is still considered endemic in Thailand, and large numbers of cattle and buffalo move into the country every year. If 'quarantine' vaccination of these animals reduces the overall risk of outbreaks then it can be argued that the practice is of benefit to the overall situation. However, excessive dependence on vaccination for both control and 'quarantine' should be discouraged in the longer term.

Animal movement management

In terms of the global disease situation in the region, the greatest impact will probably arise from a more integrated approach to the management of animal movements. This requires a degree of openness and co-operation between the animal health services where blame for the presence of the disease is replaced by mutual concern over the impact of the epizootic on the co-operative programme. Both the importer and the exporter benefit if there is a reduction in the risk of FMD spreading as a result of necessary trade. This requires that the FMD control be initiated in the villages that supply the cattle. An importing country can, in a co-operative sense, extend the disease control programme across borders to embrace the livestock of neighbouring countries. Such a programme would have to be trialled on a reduced scale but, if successful, would provide economic benefit to the smallholder producers supplying the stock and reduce the impact of disease outbreaks at the destination. To encourage participation, there would have to be a market benefit to both the suppliers and the traders. It is noteworthy that the SEAFMD programme is predicated on the position that a country cannot control FMD in isolation, and so regional co-operation is required. However, a possible impediment to the overall concept is that the international border is a point where disease control measures and resources can fundamentally change.

One of the ideas developed by Perry *et al.* in a study of a large FMD outbreak in Laos was that there are distinct trading corridors and source areas for livestock supplying a particular market (8). In the case of Laos, the movement of some infected stock across the territory appears to have introduced the disease. Foot and mouth disease then spread from the foci of introduction. If the level of threat from trade cannot be reduced, then another means of reducing the threat of foci developing is to protect the trading corridor by routine and consistent vaccination. This strategy could be replaced by one that reduces the threat at the source, but this is not always possible.

One of the additional issues to be faced is that animals can and possibly do move from outside SEAFMD countries to markets in Thailand and Malaysia. There is anecdotal evidence of cattle arriving in Thailand from India and the People's Republic of China. Certainly, movement across such distances has the potential to introduce new strains of FMD into South-East Asia, as was demonstrated in 1999 when buffalo purportedly originating from the People's Republic of China were associated with the first appearance of the pan-Asian O strain of FMD in Thailand.

Over the next three years, the SEAFMD programme will develop a project to control FMD on the Malaysia-Thailand-Myanmar peninsula. This project will use some of the approaches suggested above and others will no doubt evolve during the course of the exercise. Winning the trust and co-operation of livestock owners and traders in South-East Asia is clearly a major challenge to be faced by any animal health authority. However, these approaches are compatible with the resources and cultures of the region and could hopefully give rise to incremental improvements in the FMD situation.

Vaccination programmes

Widespread vaccination is an option that is beyond the financial resources of many of the SEAFMD member countries. In general, in the predominantly subsistence agricultural systems, FMD control is not a measure that smallholder farmers will invest meagre cash resources in, and animal health services cannot depend on widespread owner participation even when the vaccine is offered free of charge. In addition, the use of vaccines in outbreak control is not effective when movements of livestock from the infected area cannot be effectively controlled.

Two countries in the region (Thailand and Myanmar) produce FMD vaccine and any vaccine used in other countries is imported. Malaysia uses imported vaccines in targeted districts that are considered high-risk for introduction of infected livestock from Thailand. In addition, the imported vaccines are used to conduct ring vaccination around any outbreak foci. Vaccine strain selection by the authorities of Malaysia is usually based on antigenic studies of recent field viruses submitted to the WRL in Pirbright. This approach has prevented FMD from becoming firmly endemic in the northern states of peninsular Malaysia. There is extensive vaccination of pigs in the commercial sector of the Philippines that is aimed at control of the Cathay topotype of serotype O only. Vietnam performs some tactical vaccination in high-risk areas along international borders using trivalent vaccine (O, A and Asia 1), but may start to use monovalent type O vaccines only for endemic disease control. Vaccines used in the Philippines and Vietnam are imported from European manufacturers. Depending on the capacity of the local plant to supply FMD vaccines formulated for pigs, some of the vaccine used in the commercial pig sector in Thailand is also supplied from European manufacturers. Virtually no FMD vaccine is used in Cambodia and Laos.

Thailand has invested considerable resources in production and application of FMD vaccines and the control strategy is a twice-annual mass vaccination of large ruminants. The vaccine plant has a capacity to produce sufficient trivalent vaccine to cover the target group twice yearly. However, recently the plant has experienced difficulties in reaching production targets and movement of livestock into and within the country continues to interfere with attempts to develop a firm and systematic hold on reducing disease prevalence. Thailand selects new vaccine strains from the field when there is evidence that vaccines are not effective in controlling outbreaks. Myanmar has a small FMD vaccine facility with a maximum production potential of about 1 million doses per year. However, a lack of resources for production substrates means that the plant produces about 10% of this maximum, and with such a large cattle population, the vaccine can have only a limited impact on the overall prevalence of the disease.

Quality assurance for FMD vaccines used in the region is the responsibility of the manufacturers. International manufacturers supply quality control data to their customers, but there is no independent assessment conducted in the region. The SEAFMD member countries have a policy to develop an independent system of quality assurance for commercial FMD vaccines, but this goal is presently beyond the financial resources of the region. In Thailand, the FMD production unit performs FMD quality control that requires animal challenge tests to be used for each batch of vaccine. However, there is no external evaluation of the process. In Myanmar, quality control is restricted to safety, as determined by tissue culture inoculation and sterility tests. Vaccine strain selection in Thailand and Myanmar is performed by the FMD laboratories in each country, whereas the strains requested from international suppliers are usually on the recommendation of the WRL. These recommendations are in turn derived from studies of recently submitted field samples from the country or the region.

The future of foot and mouth disease control in South-East Asia

There is limited understanding of the epidemiology of FMD in the region. However, some of the broad risk factors for outbreaks have been determined in the general sense. Recent studies have shown the genetic relationship between outbreak viruses from different countries (6, 9), and the outbreaks can be linked through information about animal trade movements in the region. Limited formal studies have also determined that livestock purchases are the most important risk factor for FMD outbreaks in villages in Thailand (5).

Livestock trade in the region has increased with general improvements in political stability, liberalisation of economic policies and the development of the ASEAN Free Trade Area (AFTA). The demand for trade has increased far more rapidly than the capacity and capability of the animal health services to manage the risks that accompany trade or to respond to reports of disease outbreaks. The situation may be additionally complicated because animal health services are unable to apply restrictions to commercial trade in livestock and livestock products from or across areas where FMD outbreaks are occurring. In the view of the author, national animal health services have become somewhat marginalised in the trade process because either they are unable to effectively deliver the desired outcome to government (prevention of disease), or the approaches to disease management are regarded as impractical by influential commercial operators. As a result, the animal health services in some constituencies have limited control over the transboundary trading process and are 'well down the pecking order' when decisions are made in the regulatory process.

The future of FMD control in South-East Asia lies in understanding the epidemiology of the disease and developing strategies to respond to disease outbreaks, especially outbreaks that are due to introduced or variant viruses. Proper co-ordination of Veterinary Services is required to prevent transboundary expansion of such outbreaks. To achieve this co-ordination, inherent delays in the surveillance and reporting systems will have to be overcome and timely diagnosis and transparent exchange of information are required. There may also be reluctance on the part of some administrations to provide information about FMD, as the occurrence of outbreaks has negative repercussions on the animal health services or operators in the livestock production system.

The threat that the FMD situation in South-East Asia poses to the rest of the world is difficult to estimate, as official trade in animals or animal products from SEAFMD countries is very limited. Indonesia is in a key position to prevent the spread of FMD to Australasia and Oceania; protection of the FMD-free status of this nation is therefore very important. Some qualitative assessment of areas of high risk has been carried out, but more information and analysis are required to effectively target the limited resources of the animal health services to FMD prevention and emergency preparedness. Both Indonesia and FMD-free countries should consider contingencies to provide rapid support in the event of an FMD incursion into Indonesia.

Tourism is a major industry in the region and therefore there is potential for export of the disease agent in smuggled meat delicacies. The risk of transmission is greatest where there are established swill-feeding practices. Many people resident in the region have close family connections with persons living in FMD-free countries and there are frequent visits in both directions. A major communications issue is to convince people

that it is not in the public interest to carry gifts of food across international borders. While the portal of entry of FMD virus into the UK in 2001 is unknown, the source of the virus was probably a food product that was smuggled either personally or as part of a 'commercial' operation. The primary outbreak in the UK was also associated with pigs fed on swill.

There is increased pressure on governments in the region to allow importation of meat from other countries where FMD is endemic. Decisions to import have to be accompanied by a sound risk assessment incorporating stringent quality control of the product, as well as implementation of enforceable measures to prevent meat waste being fed to pigs. The strain of FMD prevalent on the Indian sub-continent in the middle of the 1990s caused an outbreak of FMD in Malaysia in 1994. One potential source of this virus was imported beef.

The most effective tool to reduce both the local impact of FMD and the threat of spread of FMD on a global scale would seem to be the development of better methodologies to study and quantify risk. Resources can then be targeted to reduce the identified risk. Meaningful risk assessment has to be founded on good quality surveillance information. In South-East Asia, trade will take place regardless of disease status issues and so greater understanding of the trading process is required in order for animal health services to effectively interact with the commercial sector. Equally, the commercial sector has to take more responsibility for the outcomes of the trading process. Developing the attitudes to enable this synergy is a considerable challenge.

Conclusion

The OIE is co-ordinating a regional programme to control and eventually eliminate FMD, which continues to have a significant impact on countries in South-East Asia. The key to success for this programme will be to make incremental advances in various crucial components of the overall strategy, and to build on advances and success. The disease control initiative on the Malaysia-Thailand-Myanmar peninsula will be a critical testing ground for the principles underlying the strategy. The distribution of viruses suggests that strategies could be developed to control specific serotypes in some locations. The risk of introduction of new strains from outside South-East Asia will continue to pose a threat to the SEAFMD programme.

Acknowledgement

The author would like to thank his colleagues from SEAFMD member countries who offered their time and wisdom and so willingly shared their experiences and views on FMD control between 1997 and 2001.

Statut de la fièvre aphteuse et inventaire des mesures de prophylaxie et d'éradication en Asie du Sud-Est

L.J. Gleeson

Résumé

L'auteur présente les rapports consacrés à la fièvre aphteuse qui ont été soumis, entre 1996 et 2001, à la sous-commission pour la fièvre aphteuse en Asie du Sud-Est de l'Office international des épizooties. La fièvre aphteuse est enzootique dans sept des dix pays de l'Asie du Sud-Est (Cambodge, Laos, Malaysia, Philippines, Thaïlande et Vietnam) ; trois pays sont indemnes de la maladie (Brunei, Indonésie et Singapour). Par ailleurs, une partie des Philippines est reconnue indemne de fièvre aphteuse par la communauté internationale. Le sérotype O a été à l'origine de foyers signalés entre 1996 et 2001 dans les sept pays où la situation est enzootique. Trois lignées différentes du sérotype O ont été isolées sur le continent, à savoir : le topotype d'Asie du Sud-Est ou SEA, le topotype adapté aux porcs, également connu sous le nom de topotype Cathay et le topotype panasiatique. Avant 1999, la partie orientale de la région abritait un groupe de virus du topotype SEA, tandis que l'autre groupe se rencontrait dans la partie occidentale. Cependant, la lignée panasiatique introduite en 1999 s'est rapidement propagée dans toute la région. Le topotype Cathay a été signalé au Vietnam en 1997 et reste le seul virus de fièvre aphteuse actuellement enzootique aux Philippines. Le sérotype Asia 1 n'a jamais été signalé aux Philippines, alors que sa présence a été rapportée entre 1996 et 2001 dans tous les pays du continent, à l'exception du Vietnam. Le virus de sérotype A n'a plus été signalé à l'est du fleuve Mékong depuis six ans. Il semblerait se confiner principalement à la Thaïlande, avec quelques incursions occasionnelles en Malaysia. La distribution et l'évolution des virus de la fièvre aphteuse dans la région sont liées aux déplacements d'animaux lors des échanges commerciaux.

L'efficacité et les ressources des services de santé animale de la région sont très inégales, ce qui se ressent directement au niveau de la prophylaxie de la fièvre aphteuse. Les textes réglementaires sont insuffisants et, par ailleurs, l'application de la réglementation n'est pas systématiquement respectée. L'organisation des déplacements d'animaux dans la région souffre d'un manque de cohérence, la plupart des déplacements transfrontaliers d'animaux liés aux impératifs des marchés n'étant soumis à aucune réglementation. D'une façon générale, les mesures officielles de mise en quarantaine ne sont pas volontiers acceptées par les marchands de bestiaux, ou sont inexistantes. Compte tenu de son coût, la vaccination est peu répandue comme moyen prophylactique. En revanche, elle est utilisée par les Services vétérinaires de Malaysia pour lutter contre les incursions du virus. En outre, un programme de vaccination généralisée des grands ruminants est en vigueur en Thaïlande, où le gouvernement assure la production et la distribution du vaccin. La vaccination est également utilisée par la filière porcine industrielle, notamment aux Philippines et en Thaïlande.

Mots-clés

Asie – Asie du Sud-Est – Éradication – Fièvre aphteuse – Office international des épizooties – Prophylaxie – Sérotypes – Stratégies régionales de prophylaxie.



Repaso de la situación de la fiebre aftosa en Asia Sudoriental y métodos utilizados para su control y erradicación

L.J. Gleeson

Resumen

El autor sintetiza los informes sobre la fiebre aftosa recibidos entre 1996 y 2001 por la Subcomisión para la fiebre aftosa en Asia Sudoriental de la Oficina Internacional de Epizootias. La fiebre aftosa es endémica en siete de los diez países de Asia Sudoriental (Camboya, Filipinas, Laos, Malasia, Myanmar, Tailandia y Vietnam), mientras que tres de ellos están libres de la enfermedad (Brunei, Indonesia y Singapur). Una parte de Filipinas goza también del estatus internacional de zona libre de fiebre aftosa. Entre 1996 y 2001 se declararon brotes debidos al serotipo O en los siete países donde la infección es endémica. En la zona continental se describieron tres linajes del serotipo O (topotipo de Asia Sudoriental: SEA, topotipo adaptado a los porcinos o Cathay, y topotipo panasiático). Antes de 1999 un grupo de virus del topotipo SEA afectaba la parte oriental de la región y otro grupo la parte occidental. En 1999 el linaje panasiático penetró en la región, y hoy en día está presente en todo el territorio. El topotipo Cathay ha sido detectado en Vietnam en 1997 y es el único virus de fiebre aftosa endémico en Filipinas. Nunca se ha comunicado la presencia del tipo Asia 1 en Filipinas, pero entre 1996 y 2001 se detectó ese tipo en todos los países continentales excepto Vietnam. En los últimos seis años no se detectaron virus de tipo A al Este del río Mekong, lo que parece indicar que está circunscrito sobre todo a Tailandia, con ocasionales episodios de extensión secundaria a Malasia. La distribución y desplazamiento de los virus de fiebre aftosa en la región reflejan los movimientos de ganado ligados al comercio.

Los servicios zoonosarios de la región presentan niveles muy dispares de efectividad y recursos, y ello repercute directamente en la lucha contra la fiebre aftosa. Las disposiciones normativas son insuficientes, y su aplicación puede resultar ineficaz. Los movimientos de animales se gestionan de manera notablemente distinta según la zona, y hay un gran número de desplazamientos transfronterizos de ganado, ligados a las demandas del mercado, que no están sujetos a normativa alguna. Los intermediarios suelen hacer caso omiso de las medidas oficiales de cuarentena, cuando éstas existen. La aplicación generalizada de vacunas como instrumento de control es poco frecuente porque resulta demasiado cara. Sin embargo, los Servicios Veterinarios de Malasia recurren a la vacunación para controlar las incursiones de la enfermedad, y en Tailandia, donde el Gobierno elabora y distribuye vacunas, existe un programa de vacunación masiva de grandes rumiantes. El sector de la producción porcina industrial suele aplicar la vacunación, en particular en Filipinas y Tailandia.

Palabras clave

Asia – Asia Sudoriental – Control – Erradicación – Estrategias regionales de control – Fiebre aftosa – Oficina Internacional de Epizootias – Serotipos.



References

1. Anon. (1991). – Control of major livestock diseases in Asia. Proc. Office International des Epizooties (OIE)/Federation of Asian Veterinary Association (FAVA) Symposium, 8-9 November 1990, Pattaya, Thailand. OIE, Paris, 191 pp.
2. Chamnanpood P. & Gleeson L.J. (1992). – Investigation of the role of goats and sheep in the epidemiology of foot-and-mouth disease in Northern Thailand. *Thai J. vet. Med.*, **22**, 217-230.
3. Chamnanpood P., Cleland P.C., Baldock F.C. & Gleeson L.J. (1995). – The minor role of pigs in outbreaks of foot-and-mouth disease of northern Thailand. *Aust. vet. J.*, **72**, 142-144.
4. Cleland P.C., Chamnanpood P., Baldock F.C. & Gleeson L.J. (1995). – An investigation of 11 outbreaks of foot-and-mouth disease in villages in northern Thailand. *Prev. vet. Med.*, **22**, 293-302.
5. Cleland P.C., Baldock F.C., Chamnanpood P. & Gleeson L.J. (1996). – Village level risk factors for foot-and-mouth disease in northern Thailand. *Prev. vet. Med.*, **26**, 253-261.
6. Gleeson L.J., Samuel A.R. & Knowles N.J. (2002). – Epidemiology of foot and mouth disease in South-East Asia. In *Foot and mouth disease: control strategies*. Proc. International Symposium, 2-5 June, Lyons. Elsevier, Paris (in press).
7. Office International des Epizooties (2001). – Report of the Seventh meeting of the OIE Sub-Commission for foot and mouth disease in South-East Asia, 26 February-3 March, Yangon, Myanmar. Office International des Epizooties, Paris, 186 pp.
8. Perry B.D., Gleeson L.J., Khounsey S., Bounma P. & Blacksell S.D. (2002). – The dynamics and impact of foot and mouth disease in smallholder farming systems in South-East Asia: a case study in Laos. In *Foot and mouth disease: facing the new dilemmas* (G.R. Thomson, ed.). *Rev. sci. tech. Off. int. Epiz.*, **21** (3), 663-673.
9. Samuel A.R. & Knowles N.J. (2001). – Foot-and-mouth disease type O viruses exhibit genetically and geographically distinct evolutionary lineages (topotypes). *J. gen. Virol.*, **82**, 609-621.