Foot-and-Mouth Disease in Small Ruminants – An Issue of Concern

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Abstract
Introduction: Food and Agricultural Organisation has its long-standing interest in the global eradication of the foot and mouth disease. FAO recognized Pirbright Laboratory as the World Reference Laboratory (1958) for epidemiology and researches on FMD which paved the way for the eradication of FMD from most of the developing countries, but still the virus is circulating in about two third of the OIE member countries. If FMD control campaign is considered as an international public good, one of the issues that needs to be addressed is strategies and control of FMD in small ruminants.

Materials and Methods: The role of small ruminants in the epidemiology of FMD in India was elucidated as early as in 1972 (Uppal et al; 1972). The clinical sign of the disease in sheep and goat were hardly visible. The disease can easily be overlooked until and unless individual animals are carefully examined for disease lesion. With these peculiarities, sheep and goat may function as repository of the virus. Subsequently in India many workers came to the same observation. Besides India, Iraq, Iran there are reports where small ruminants have been responsible for the epidemic of FMD in cattle in Greece in 1994, South East Asia in 1999 and Turkey in 2001. Recently, in UK and Ireland (2001) the role of sheep for transmission of FMD cannot be ignored.

Discussion: Even with the growing evidence of small ruminants in the transmission of diseases very little attention has been paid either on the researches or control policy of FMD in this species. It is proposed that FAO takes visionary approach of regional and global nature for the control of FMD in small ruminants which function as a repository of viruses and play an important role as silent repository helping inter epidemic survival of FMD virus, the spill over of which in large or other susceptible animal population may cause severe outbreaks of FMD.

Introduction
Food and Agricultural Organisation has its long-standing interest in the global eradication of the foot and mouth disease (FMD). Therefore to meet this challenge FAO supported and recognized Pirbright Laboratory as the World Reference Laboratory (1958) for epidemiology and researches on FMD which paved the way for the eradication of FMD from most of the developing countries, but still the virus is circulating in about two third of the OIE member countries. The disease in small ruminants is generally silent and has not received much attention in European countries except when outbreaks numbering 4 in U.K. alarmed that it was the movement of sheep, which resulted into unprecedented outbreaks of FMD in United Kingdom. However the role of small ruminants in the epidemiology of FMD in Asian African and Arabian countries is well documented where the small ruminants contaminates river water, ponds, pastures, the shrubs and other environment. The source of infection to the other livestock occurs because the movement of ruminants in these countries is unrestricted and is of free-range nature. If FMD control campaign is considered as an international public good, one of the issues that needs to be addressed is to have strategies for the control of FMD in small ruminants.

Materials and Methods
The role of small ruminants in the epidemiology of FMD in India was elucidated as early as in 1972 (Uppal et al; 1972). Prior to this publication no attention was paid in India to the occurrence of this disease in small ruminants. FMD outbreak was investigated by the author in one of the organized cattle farm in northern India (Hisar) where FMD vaccination was followed regularly except in sheep, goats & pigs. All cross bred cattle were stall fed and were not allowed out of the premises and the movement of attendants was regulated except that Sheep & goats were allowed outside for grazing and returned back to the farm as a usual practice. Moreover these animals were unvaccinated. The disease at the farm was reported when 19 crossbred cattle out of 193 showed clinical evidence of FMD disease in spite of the fact that prior to this several
goats and sheep considered sick were housed separately. Extensive investigation by the author revealed that the sheep and goat had very tiny vesicles either on tongue, gums, hard palate and feet in the decreasing order. The clinical sign of the disease in sheep and goat were hardly visible. Therefore disease remained unnoticed in these animals. Most of the sheep look healthy except on careful examination of the tongue when rubbed gently with the muslin cloth the small vesicles ruptured. In all 100 adult Sheep were examined only 8 showed mouth lesions but no foot lesions. The disease can easily be overlooked until and unless individual animals are carefully examined for disease lesion. Interestingly no pig was involved with the disease. However, 27 lambs 2-8 days of age died at the farm without showing any clinical symptoms. Virus was isolated from the heart muscle of lambs. However compared to sheep the clinical syndrome in goats were more visible. The virus identified was type ‘O’.

Experimental trials done in susceptible sheep, only small vesicles measuring 0.5 to 2 mm. in diameter appeared within 24 hours. None of the sheep in any experiment showed any secondary lesions in the feet. Thus, with these peculiarities it was considered that sheep and goat may function as repository of the virus. Subsequently, in India many workers came to the same observations that small ruminants shows subdued symptoms and lesions and the disease occurring in occult form without being noticed (Singh and Sharma 1980, Mishra and Ghei 1983, Datta et al; 1984). However, Shankar et al; 1998 in India reported severe form of disease in the goats with high fatality rate. Many FMD outbreaks in cattle in India are linked with the transmission of FMD virus from small ruminants. Besides India (P.K.Uppal, 1980 & 2003 unpublished observations), observed several severe outbreaks in cattle in Iraq of which many were traced to the silent nature of FMD in Sheep. Number of diseased sheep involved in the flock did not exceed more than 2%. Disease in sheep remained unnoticed till the time cattle were affected & productivity losses were noticed. The disease was mainly observed during the disease investigation work done in the region of Northern Iraq Mosul, which is bordering Turkey. Similarly the disease in sheep in Arbil, Kirkuk and Sulamanyia in the northern region of Iraq was noticed. In 2003, during my technical mission on food security through animal health care to Veterinary College Baghdad as well as to Veterinary College Mosul, the unapparent form of FMD in sheep at Namrud area as well as in sheep grazing along the coast of Tigris river were noticed. However, no isolation work was conducted. Besides Iraq, the author during his visit to Iran in 1996 was apprised that FMD in sheep is quite prevalent in mild nature in the different parts of Iran. During the OIE meeting at Paris in July 2003 the author questioned the epidemiological role of small ruminants in FMD control outside South America. During the meeting the Iranian delegate stated that FMD in sheep in Iran is prevalent and with their movement the disease spreads silently, therefore vaccination strategies for the control of disease in sheep has to be considered.

In Libya in 1986 mild nature of FMD in sheep & goat in the region of Jamahiriya due to type ‘O’ virus was considered responsible for the wide spread prevalence of the disease (Elmanjni & Hassan 1986). In 1989, Tunisia in Africa which was previously free from FMD got the disease in cattle with the importation of sheep and goat imported from the Middle East. Subsequently the disease spread into Algeria and Morocco (Kitching 1998).

The outbreak in Bulgaria in 1991 amongst cattle due to type ‘O’ was attributed to the alleged introduction of goat from the Turkish village, which was taken by the Bulgarian villagers due to rivalry, (Kitching 1998).

In the end of July 1994, Greece experienced an outbreak of type O in cattle and sheep population of Lesbos Island. The disease remained unnoticed until the time a consignment of infected sheep was transported to the mainland thereby contaminating the cattle. In all Greece noticed 95 outbreaks.

It was inferred that the illegal sheep trade from Turkey into Lesbos possibly in April was the most likely explanation for the origin of the disease. In 2000 Greece again experienced FMD in sheep and goats with Asia I (Leforban & Gerbier 2003). In Turkish Thrace 1996, there has been outbreak of serotype O FMD amongst cattle as well as in Evros prefecture of Greece. This perhaps happened because of illegal importation of live sheep by a farmer with close family connection in Turkey (Kitching 1998). Again in 2001 in Turkish Thrace in the District of Malakara of Tekirdag Province FMD type O in Goat flock was detected which seems to have occurred because of infected goat brought in from Asiatic Turkey by the dealers (Leforban & Gerbier
In February 2001 FMD outbreak in United Kingdom lasted for about 32 weeks, where the role of sheep in the spread of FMD was realized. The spread of disease in Northumberland was attributed due to the movement of the infected sheep through a series of a market which finally resulted in extensive spread in the northwest and south west of England.

Additional movement of sheep resulted in the dissemination of the virus to Scotland, Wales, Northern Ireland, the Republic of Ireland and France. Calves that had been in contact with sheep imported into France from the UK spread the virus to the Netherlands. The clinical signs were very mild in the vast majority of outbreaks involving sheep. The average number of sheep displaying lesions within a single flock was less than 5%. The lesions occurred mainly in the mouths of sheep. A small minority of sheep exhibited foot lesions or lameness. The virus caused severe clinical disease in cattle and pigs, (Donaldson and Alexandersen 2003).

Discussion
In 1969, Bachrach in the First International Pilot Conference on Foot-and-Mouth Disease held in New York stated that lesions on feet in sheep and goats alone are symptomatic because mouth lesions usually go unnoticed. However, experimental and field investigation conducted in sheep showed that adult sheep under natural and experimental conditions did not show feet lesions (Uppal, 1972). Author happened to attend some outbreaks of concurrent infection of FMD with blue tongue or Sheep pox or mainly with Pasturelllosis. It was observed that lameness in sheep appeared when other viral and bacterial ailments are involved especially when there was bacteremia. Therefore, critical examination of small ruminants suffering from FMD is important. There are now publications that silent nature of FMD in small ruminants transmit virus and has caused outbreaks in Asia (India), Middle east (Iran, Iraq, Turkey), Africa (Libya, Algeria, Morocco, Tunisia), South east Asia (Cambodia, Laos and Thailand) and European Countries (Bulgaria, United Kingdom, Ireland and France). The author foresee that presently the bovine and porcine wealth of Europe is far more threatened to FMD than ever before, if the issue of FMD in small ruminants is not adequately addressed. This is suggested because of two major reasons: -

Firstly, the author believes from his experience in Iraq that the entry of FMD through the movement of small ruminants as salient carrier from Iran, Iraq, and turkey to the European countries could occur. It is stated on the assumption that the origin of disease in Bulgaria (1991), Greece (1994,1996), Turkish Thrace (1996,2001) was traced with the introduction of small ruminants from the Turkey. The country, which is in a close proximity to Mosul (Iraq) where FMD in sheep occurs quite often (P. K. Uppal 1980, 2003 unpublished observations). It was also noticed under field conditions that the disease in sheep was not self limiting at least for a period of one month. Since severe outbreaks was even noticed in vaccinated cattle in Iraq when recovered sheep came into contact with cattle after 4-6 weeks. Secondly, with no vaccination being carried out in most of the European countries against FMD the new livestock crop coming in these countries will be highly susceptible to the infection. Therefore the implications of subclinically infected sheep in the transmission of FMD disease has to be considered as one of the risk factors.

No doubt the disease in most of the small ruminants is not discernable and could be responsible for perpetuating the epidemic in other livestock especially in those countries where there is a mixed farming and those countries where the movement of sheep is unrestricted. Moreover, small ruminants which function as a repository of viruses and play an important role as silent repository helping inter epidemic survival of FMD virus, the spill over of which in other susceptible animal population may cause severe outbreaks of FMD.

If one considers the threat of FMD in European countries from Turkey due to the movement of small ruminants from middle east which is in close proximately to turkey in north and to Asia in South east and south west to the African countries, then it would be pertinent that FAO takes visionary approach of regional or of international nature for the global eradication of FMD.If FAO considers regional approach for the safety of livestock of European Union countries against the incursion of FMD, then it would be pertinent that primary epidemic areas of FMD and the movement of animals especially of small ruminants is given due consideration in the control
programme. It is known that FMD virus has escaped through the buffer zone in Turkish Thrace from Asiatic Turkey.

There is sufficient knowledge about the FMD disease, epidemics in cattle and about their diagnostic tools and vaccination strategies. The control of FMD in small ruminants will require more emphasis on scientific work besides speedy reporting of FMD through fast track system and their wide coverage of vaccination. It will be required to study the distribution of Foot and Mouth virus strains in small ruminants in different agro climatic regions and to do the molecular epidemiological studies and as well as analysis on the genetic lineages of FMD isolates both from small ruminants and cattle from the same outbreak.

In Addition, the study on the factors responsible for the exaltation of virulence in cattle with strain showing sub clinical infection in small ruminants would be important to know the mechanism of pathogenicity in bovine. The binding capacity of Foot and Mouth virus in surface susceptible cell of sheep and goat and its comparison with susceptible cell of cattle and buffaloes with the isolates when the same isolates show unnoticed infection in small ruminants and frank disease in cattle and buffaloes need to be elucidated. The World Reference Lab (WRL) could examine these studies, which is the technical arm of OIE and FAO. In addition, regional units under the aeges of WRL could be created for diagnostic and epidemiological work and collate the information for speedily dissemination.

The detection of virus from silent infection in small ruminants requires rapid, reliable and specific sero-surveillance tests. The present solid phase immunochromatographic assay which can differentiate the infected from the vaccinated animals using 2C & 3ABC protein for capturing specific antibodies (anti NSP) can not detect early infection in sheep (Hyun et al; 2003). For early detection of virus in small ruminants and to ascertain that the virus is no longer circulating in the target population, the sero-surveillance diagnostic tests developed if any are evaluated.

In order to be more efficient in pilot testing programme for FMD diagnosis in small ruminants, there is need for the availability of uniform standard sera raised in sheep & goat or obtained in large quantities from the naturally infected small ruminants. There is a possibility that immune reaction in small ruminants is different from that of cattle. Therefore the validity of sero-surveillance tests under various field conditions would be required. Besides it, it would be useful to study the role of IgA (Secretory antibodies), if any, in establishing a carrier status in small ruminants.

For the control programme of FMD in small ruminants one of the options is the usage of large quantities of monovalent type O vaccine based on epidemiological data in target areas could be adopted. Before the implementation of the programme experimental trials on the antigen payloads for vaccines as well as in corporation of suitable adjuvant in small ruminants is worked out. Besides it the study on the genetic endowment character of sheep susceptibility to FMD virus strains for the better control programme of FMD may be helpful.

Conclusions

• FMD in small ruminants is generally silent and is not self-limiting and is responsible for the spread of disease in European, Middle East, Asia, South East Asia and African countries.
• Small ruminants from Iran and Iraq constitute one of the major risk factor for the transmission of virus to the susceptible livestock population of European countries.
• The speedy reporting of disease and wide coverage of vaccination would depend upon researches on the development of sero-surveillance tests for early detection of virus and its validation under field condition along with the development of potent vaccine.

Recommendations

• FAO may consider to develop FMD control programme for small ruminants in certain primary endemic target areas.
• FAO may set up regional diagnostic laboratories for sero-surveillance for small ruminants with the availability of uniform standard reagents.
• World Reference Laboratory may develop validated field based pen-side test for
early detection of virus in small ruminants and basic researches on FMD on these animals.

References


