Haemorrhagic septicaemia, its significance, prevention and control in Asia

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ABSTRACT: Haemorrhagic septicaemia (HS) is an endemic disease in most countries of Asia and sub-Saharan Africa. Within the Asian Region, countries can be classified into three categories, on the basis of incidence and distribution of the disease; these are respectively countries where the disease is endemic or sporadic, clinically suspected but not confirmed, or free. Economic losses due to HS are not only confined to losses to the animal industry, but also rice production on account of its high prevalence among draught animals used in rice fields. Only a few attempts have been made to estimate economic losses, the methodologies used in different countries have varied, and many are not based on active surveillance, and a consideration of all components of direct and indirect losses. Most Asian countries rank HS as the most important contagious disease or the most important bacterial disease in cattle and buffaloes. Resource allocation for prevention and control of HS nationally or internationally will evidently depend on a correct estimate of its economic impact. The key factors in prevention and control would be timely and correct reporting, accurate and rapid diagnosis, strategic use of vaccines with the attainment of a high coverage where necessary with a high quality vaccine. National level activities geared towards attainment of these objectives may be with advantage supported and strengthened by international organisations involved in animal health. The present paper attempts to review aspects related to the epidemiology, control and containment of HS in Asia and, proposes some key issues on which a regional programme for HS control in this continent should be centred.

Keywords: haemorrhagic septicaemia; prevention; control; vaccine; Asia

CONTENTS

1. INTRODUCTION

Haemorrhagic septicaemia (HS) has a wide distribution particularly in tropical countries in Africa and Asia. In Asia, HS epidemics may occur as an alarming and devastating disease problems in cattle and buffaloes and jeopardise, not only the economic return of animal production but also, often more dramatically, animal traction and the harvest of vital crops such as rice. Livestock owners generally fear this disease while they view foot-and-mouth disease and other major infectious disease in the continent merely as a "nuisance".

2. ISSUES IN HS EPIDEMIOLOGY, DIAGNOSIS AND CONTROL

2.1. Geographical distribution

On the basis of distribution of the disease, three distinct categories of countries can be identified in the Asian continent (FAO-WHO-OIE, 1994):

Category A: The disease is reported to be endemic and is of utmost economic importance in Bhutan, China, India, Indonesia, Mongolia, Myanmar, Philippines, Sri Lanka and Malaysia (except in Sabah region where only a low sporadic or exceptional occurrence is presently recorded). Most of these countries have large cattle/buffalo populations, in respect to the existing infrastructures and the limited operational capabilities of their veterinary services. Furthermore, livestock rearing is largely extensive and management is rather poor in view of the significance of ruminants in the respective national economies.

Category B: In this category of countries, although sporadic outbreaks of the disease have been suspected clinically, its presence has not been confirmed by isolation of the agent and serotyping. Example: Kuwait, Qatar. These countries are net livestock importers and therefore, may see the disease introduced occasionally through cattle imports.

Category C: In this group of countries which are spread throughout all the continent, clinical reports of the disease in the past are on record, but presently, these countries are free of the disease (Singapore, Chinese Province of Hong Kong, Israel) or the disease has never been reported (Japan, Jordan).

2.2. Epidemiological patterns

The major susceptible animal species consist of buffaloes and cattle. There is ample evidence that buffaloes are more susceptible than cattle and that, in both species, young and young adult animals are more susceptible than older animals (De Alwis, 1990b).

The two common serotypes of *Pasteurella multocida* (Carter; Heddleston) associated with disease in these species are types B:2 (in Asia) and E:2 (in Africa). The Asian B:2 serotype has also been associated with sporadic septicaemic disease in pigs. Besides type B:2, several other B serotypes have been incriminated in sporadic outbreaks of disease particularly in feral ruminants (Rimler, 1993; Jones and Husseini, 1982; OIE, 2000; Rimler and Wilson, 1994).

The organism causing HS does not survive outside the animal body to any significant degree so as to be a source of infection. Moist conditions prolong its survival. Thus the disease tends to spread more during the wet season. The onset of the monsoon in Asian countries also set into motion other activities such as rice cultivation which bring about movements of animals, work stress in work animals, etc. all of which favour the precipitation of outbreaks (De Alwis, 1990a).

Infection occurs by inhalation or ingestion of *P. multocida* bacteria. Higher incidence of HS is associated with moist, humid conditions, high buffalo population density, and extensive free grazing system of management, where large herds graze freely in common pastures and are paddocked together at night. In situations where occasional sporadic outbreaks occur in some regions within endemic countries, mortality may be very high unlike endemic areas where regular, seasonal outbreaks occur, where losses in each outbreak are low and confined to young animals. The phenomenon of naturally acquired immunity resulting from the so-called non-fatal infection largely controls the mortality and morbidity patterns. It is, on the other hand the mechanism through which animals that have recovered from HS acquire a long lasting carrier status which render the prevention of new outbreaks rather difficult. These losses in endemic areas may be of an insidious nature which may escape the notice of the animal health authorities but may be of considerable economic significance (De Alwis, 1981). Once clinical signs appear, case fatality is nearly 100%. Variable numbers of immune carriers are present in animal populations, particularly in endemic areas. They may be latent carriers, where the organisms are lodged in the tonsils, or active carriers, where organisms are detectable in the nasopharynx (De Alwis, 1990c; De Alwis *et al.*, 1986, 1990).

2.3. Detection and confirmation of disease outbreaks/foci

A clinical, provisional diagnosis of HS is based on a combination of clinical signs, gross pathological lesions and a consideration of relevant epidemiological parameters and other similar diseases prevalent in the locality.

A provisional diagnosis is important since preventive measures to control the spread of the disease are required immediately, without waiting for the necessary laboratory confirmation. At the earliest opportunity, however, appropriate material should be collected and dispatched to the nearest laboratory. The mere isolation of *P. multocida* does not mean that HS was diagnosed. On the one hand it should be put in the epidemiological context and, on the other hand the isolated strain must be serotyped. Anthrax, blackquarter and, more specifically rinderpest (due to its possible implications in international animal health) should always be considered when investigating sudden deaths in cattle and buffaloes.

A variety of diagnostic techniques have been developed over the years for HS. These include:

– Blood smear, culture and biological tests for isolation of the causative agent. Mouse isolation may prove necessary as samples are often heavily contaminated when they reach the diagnostic laboratory. A mouse colony is therefore necessary in such laboratories.
– Biochemical and serological tests (capsular such as rapid slide agglutination and indirect haemagglutination tests or somatic such as agar gel precipitation test) for identification of *P. multocida* and determination of serotypes. An ELISA test has recently been developed in Australia, however it fails to differentiate between the Asian (B:2) and African (E:2) types. This is not a serious limitation in Asia as only B:2 type of *P. multocida* has been encountered so far. Thus ELISA can be a good test for screening a large number of cultures from a collection in a laboratory where the turnover is high.
– Nonserological tests for presumptive identification of serotypes (e.g. acriflavine flocculation test, hyaluronidase test).
– Molecular methods such as PCR, ribotyping or restriction endonuclease analysis which have an epidemiological significance because they enable strain differentiation within serotypes and hence some epidemiological inferences, for investigations extending beyond routine diagnosis.

2.4. Approaches to treatment, prevention and control

2.4.1. Treatment

HS is a primary bacterial disease and, theoretically, could be effectively treated by the wide range of antibiotics currently available. However, treatment is constrained by a host of practical considerations. Animals can be cured only if they have been treated in the very early stages of the disease. The conditions for an early detection of the disease and hence its effective treatment are usually lacking in primitive husbandry systems. In organised farms, however, early detection and effective treatment are achieved through regular checking of rectal temperatures of in-contact animals. Usually chemotherapy resorts to either streptomycin or oxytetracycline administered by intramuscular route at fairly high dosage. Penicillin and Ampicilline are also widely used. Antibiotic resistance of *P. multocida* may occur and it has been reported at least vis-à-vis streptomycin and sulfonamides (Abeynayake *et al.*, 1993; Kedrak and Borkowska-Opacka, 2001).

2.4.2. Prevention and control

2.4.2.1. Measures during an outbreak

– Vaccination is a major control measure in the face of a new epidemic. Various vaccine types have been developed among which the broth bacterin, the oil adjuvant vaccine, the double emulsion vaccine and a live vaccine (Verma and Jaiswal, 1998). The latter is a deer strain aerosol vaccine developed in Myanmar. Although this vaccine is the sole vaccine used (apparently with success) in Myanmar, it does not seem to have gained popular acceptance outside this country. The reasons advanced to explain this are numerous: the fact that the strain concerned (*Pasteurella multocida* serotype B:3.4) has occasionally been associated with sporadic outbreaks of disease due to hitherto unexplained reasons (Jones and Husseini, 1982; Rimler and Wilson, 1994; OIE, 2000) and its occasional virulence to young animals when administered by the subcutaneous route (Myint and Carter, 1989, 1990) are the possible reasons, apart from the general reluctance to use a live vaccine and the fact that antibiotics cannot be administered simultaneously to this live vaccine.

During an outbreak, one should resort to immediate whole herd vaccination, irrespective of previous vaccination history. The use of either broth bacterin or oil adjuvant vaccine is recommended;

– Sanitary measures include early detection and isolation of new cases and their immediate treatment with antibiotics, deep burial of carcasses or incineration, and the prevention of movements of animals to disease free areas.

2.4.2.2. Measures in endemic countries/zones

– Vaccination on a routine prophylactic basis preferably two to three months before the high-risk season (monsoon).
– Awareness of the disease among farmers backed up by a good disease reporting/disease information systém.
– Segregation of animals from endemic and nonendemic areas to avoid contact with carriers.

2.4.2.3. Prevention of spread across borders

It has been said above that HS was an endemic disease unlikely to spread in a way such as it easily crosses borders. However, import of animals from an area of unknown status vis-à-vis HS to a free area should comply with some practical procedures which should take into account the high percentage of carriers that occur in endemic areas than was earlier believed, and the persistence of the carrier status for long periods (De Alwis *et al.*, 1990). Briefly, these are: (a) ensure that the animals originate from a region where no outbreaks of HS have occurred for a minimum period of one year; (b) carry out an indirect haemagglutination (IHA) testing (a test which can reveal recent infection) on the animals to be exported as well as on a random sample of in-contacts in the country of origin whenever possible; (c) hold animals under observation for 2–3 weeks before transport (while carrying out the above testing); (d) quarantine them for the same period of time upon arrival to destination and; (e) vaccinate all animals at the end of the quarantine period. Whenever animals are exported from HS endemic countries, even after observing all the above precautions, it is important to vaccinate all susceptible stock in the importing country that are likely to come into contact with the imported animals.

Whilst these above-mentioned measures may be feasible and meaningful in island situations, the Asian continent has to contend with many land borders, across which considerable unquarantined animals may be moving.

2.5. Economic losses

HS is a disease of utmost economic importance particularly in Asia and to a lesser extent in Africa. In Asia the susceptible animal population consists of 432 million cattle and 146 million buffaloes, which constitute 30% and 95% of the world's cattle and buffalo population, respectively. In India where the production of milk is highest in Asia, around 50% of the milk come from the more susceptible buffaloes. In Asia as a whole, the contribution of the buffalo to the milk production is 37%. Most of the cattle and buffaloes are used as draught animals in the rice fields, and rice is the staple diet in many countries. Thus, the high population of buffalo in Asia, the high susceptibility of buffalo to HS and the high case fatality, all point to the significance of the economic losses due to the disease (FAO, 1994, 1995).

Few countries have attempted to quantify the losses due to HS, and there is no uniformity in the methods adopted. Thus, these studies are not strictly comparable, but will reflect the trends. Most of the available information is derived from passive reporting systems.

In India, during the past four decades it has been found that HS accounted for 46–55% of all bovine deaths. During the twelve years period since 1974 to 1986 it accounted for 58.7% of the aggregate of deaths due to five endemic diseases, viz. foot-and-mouth disease (FMD), rinderpest, blackquarter, anthrax and HS (Dutta *et al.*, 1990). In an active surveillance study in Sri Lanka, it was shown that in the 1970's, around 15% buffaloes and 8% cattle in the HS endemic areas died of HS annually. During the same period, the passive reporting systems recorded only 1 200 to 1 500 deaths a year in a cattle and buffalo population of approximately 2.5 million (De Alwis and Vipulasiri, 1981).

Other countries in South Asia also ranked HS as the most economically important infectious disease or the most economically important bacterial disease. Pakistan reports that 34.4% of all deaths in susceptible stock is due to HS. With a cattle and buffalo population of 17.7 and 18.8 million respectively, the annual economic losses have been estimated at 1.89 billion rupees (350 million USD) (Chandry and Khan, 1978; FAO, 1979; Sheikh *et al.*, 1994).

In the South-East Asian region, countries such as Indonesia, Malaysia, Thailand, Myanmar, Laos, Cambodia and the Philippines rank HS high among the economically important diseases of cattle and buffaloes (Patten *et al.*, 1993). In Myanmar it is reckoned that 50% of the government's effort in animal disease control is directed towards HS (Patten *et al.*, 1993). Malaysia, with a relatively small population of 735 000 cattle and 186 000 buffaloes, estimates the animal losses due to HS to be 2.25 million Malaysian Ringit (0.85 million USD) (FAO, 1979).

Most estimates of losses take into account only direct losses, i.e. value of animals that die of HS. A true estimate of losses should take into account a variety of factors which constitute indirect losses. These are listed below:

(i) Loss of productivity – milk, meat, draught power, and cost of alternate sources of draught power.

(ii) Impairment of the reproductive potential of the animals.

(iii) A reliable differential diagnosis as there is tendency during the Monsoon to attribute any mortality to HS. Thus a possible over-estimation of these losses should be taken into account. However, it must also be borne in mind that reported losses constitute only a fraction of the actual losses. This is bound to be so since HS is a disease that occurs in situations where husbandry practices are poor and therefore disease reporting system will also be poorly developed.

In a study in Bangladesh (Ahmed, 1996), an attempt was made to compute the economic losses resulting from three important endemic diseases, anthrax, blackquarter and HS. It was found that the direct losses which took into account the market value of the animals that died and the cost of treatment was 2.3 million US dollars. Their computation of indirect losses took into account the value of the rice that would have been produced from the land left uncultivated as a result of loss of draught power. These losses amounted to 148 million USD annually due to these three diseases (Ahmed, 1996). It may therefore be concluded that no accurate estimates are available on the actual deaths due to HS, and the available information on direct and indirect economic losses is incomplete. The available information, however, suggests that HS is a disease of considerable economic importance in the Asian Region.

3. SOME KEY ELEMENTS FOR A HS REGIONAL CONTROL PROGRAMME IN ASIA

It must be noted that, unlike FMD and rinderpest, HS eradication does not seem to be feasible presently, with the limited experience in the Lombok Island in Indonesia (Syamsudin, 1993). With the present information on economic losses and a knowledge of its epidemiology in the countries of the region, the key factors in prevention and control appear to be quick reporting, accurate and rapid diagnosis, strategic use of vaccines with attainment of a high prophylactic vaccination coverage with a high quality vaccine, i.e., potent, economical, and easily administrable. All of these would constitute national level activities within the countries of the region.

A regional programme aiming at reducing the economic losses associated with the disease should, therefore, focus on strengthening of these activities within the countries and co-ordinating their efforts.

The proposed elements articulate around the following range of outputs and activities:

- Develop simple, accurate and rapid diagnostic tests that can be carried out even in the modestly equipped laboratories in the region.
  - Identify simple, accurate and rapid diagnostic tests, standardise the techniques and make them available to all countries of the region.
  - Make available, through the regional HS Reference Laboratory (Peradenyia, Sri Lanka) type cultures, reference sera or any other biologicals that may be necessary.
  - Produce a Manual of Diagnostic Procedures, for use in all countries of the Region.
- Acquire sufficient knowledge of the epidemiology of the disease in each country so as to formulate a strategic control programme.
  - Strengthen disease reporting and surveillance systems in general.
  - Develop protocols for collection of relevant epidemiological data and the management and processing of such data so as to obtain a clear epidemiological picture in each country.

– Develop standard protocols for active surveillance studies on HS in particular.
– Develop standard procedures for estimating economic losses.
– Assist in the development of a strategic vaccination programme for each country based on the above information.
• Make available the technology for the production of a vaccine that is potent, economical, that can be easily administered and with a production technology simple and sustainable in countries of the region.
– Identify vaccines such as the new oil adjuvant vaccines, double emulsion vaccines and live vaccines for further development.
– Encourage and support research and development (R & D) activities on these vaccines.
– Enlist a range of tested and proven vaccines of acceptable standard which the countries of the region could select from, depending on their resources and level of technology available within the country.
– Publish a 'Manual of Standard Procedures for Production and Quality Control of HS Vaccines', incorporating the range of vaccines identified above.
• Develop training programmes for veterinarians and other animal health field officers. Also, enhance awareness among the livestock farmers so as to improve their co-operation and stimulate their participation in the control programme. This would require a serious investment geared towards the improvement of the quality of the veterinary extension services.

4. CONCLUSION

The incidence and prevalence of HS in South and South-East Asia is undermining both the livestock industry and the agriculture sector as a whole. A set of activities, as described above, if put in motion, may contribute to reducing the pressure exerted by this disease on the fragile economies of most countries where it occurs. It remains that some critical gaps are still encountered in the knowledge of disease patterns and the true economic impact on livestock.

Periodic meetings organised within the region, will undoubtedly assist in planning HS surveillance and control programmes and monitoring progress towards the attainment of the overall objective.

Since the eradication of HS is not a realistic option for the time being (Syamsudin, 1993), mass prophylactic vaccination, combined with treatment where possible, should theoretically suffice to contain mortality associated with HS. A sound HS control programme may be adopted at national level provided that the tools used for the diagnosis and control of the disease meet international standards (OIE, 2000). Therefore, focus should be placed on supporting the applied research and a well designed programme of work for action to be taken in the continent, as well as standardisation of products and procedures, to the extend possible, with due consideration to the national situation. Training and extension activities should backup these efforts.

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