JEMBRANA DISEASE: A REVIEW

NURUL HILMIATI and ACHMAD MUZANI

Balai Pengkajian Teknologi Pertanian Nusa Tenggara Barat
Jl. Raya Peninjauan Narmada, Lombok Barat, NTB

ABSTRACT

Jembrana disease is a highly fatal acute infectious disease that occurs exclusively in Bali cattle (*Bos javanicus*) caused by Jembrana disease virus (JDV). The disease is characterised by high morbidity and high mortality that has posed a devastating impacts on farmers economically. The mechanism of JD transmission is poorly understood. Based on the history of JD control in Indonesia, it seems that some approaches occupied by the government in the early JD outbreak contribute to the expansion of this disease. More over, cattle rearing system in Indonesia is attributable to the disease spread to some extent. In the field conditions, Jembrana disease is difficult to diagnose based on clinical signs solely because the disease is frequently associated with the occurrence of secondary infections. Though laboratory diagnosis of Jembrana disease has been developed using ELISA technique, more advance research are still required to increase the sensitivity and the specif The inability of Jembrana Disease vaccine to protect animals against Jembrana disease indicates that other feasible approaches like animal movement control and test and slaughter policy should be considered as a measure to deter the disease incidence.

Key Words: Jembrana Disease, Bali Cattle, Transmission, Control

INTRODUCTION

Jembrana disease is a highly fatal acute infectious disease that occurs exclusively in Bali cattle (*Bos javanicus*) caused by Jembrana disease virus (JDV). This virus has been identified recently as lentivirus (HARTANINGSIH *et al.*, 1993, RADOSTITS *et al.*, 2000, BARBONI *et al.*, 2001). The disease is characterised by high morbidity and high mortality (MURPHY *et* al., 1999). As a result, this disease may cause a great economic lost particularly for smallholder farmers.

Since the transmission of JDV is poorly understood (SOEHARSONO *et al.*, 1995, SOEHARSONO *et al.*, 1997), it is worthwhile to scrutinize the biology of such disease. Therefore, this paper aim to provide knowledge regarding Jembrana Disease in a review form based on the Indonesia experiences in copping with this disease. It is expected that this basic knowledge could be useful to fight against this formidable disease.

DISCUSSION

Brief Description

Jembrana disease is a highly fatal acute infectious disease that occurs exclusively in Bali cattle (*Bos javanicus*) caused by Jembrana disease virus (JDV), which has been identified as lentivirus (HARTANINGSIH *et al.*, 1993, RADOSTITS *et al.*, 2000, BARBONI *et al.*, 2001). The disease is characterised by high morbidity and high mortality (MURPHY *et* al., 1999). Since the transmission of JDV is poorly understood, it is suspected that hematophagous arthrophods, secretions of the infected animals during the acute febrile phase of the disease, close contact between animals and multiple use of syringe and needle during vaccination are involved in spreading this disease (SOEHARSONO *et al.*, 1995, SOEHARSONO *et al.*, 1997).

Aetiology and biology

Jembrana disease virus (JDV) as the agent of Jembrana disease is caused by a recently identified as bovine lentivirus (BURKALA *et al.*, 1998). This virus belongs to Retroviridae family (BARBONI *et al.*, 2001). BURKALA *et al.* (1998) describe JDV as an atypical lentivirus. Lentiviruses generally have a long incubation period followed by a slowly progressive and usually fatal disease. Conversely, Jembrana disease occurs after a short incubation period (5-12 days) where the animal starts developing an acute fatal disease. The size of the virus particle is 50 to 100 nm and is not cell-associated virus (KERTAYADNYA *et al.*, 1997).

JDV is a single-stranded RNA virus, which has a unique and complex replication process within the host cell. The replication starts with reverse transcription of the virion RNA into double-stranded DNA by the reverse transcriptase. The viral DNA then are integrated into the host chromosomal DNA and then used for transcription including the transcription of mRNA. The mRNA is in charge of viral protein synthesis, which in turn are utilised for viral assembly (MURPHY *et al.*, 1999).

Epidemiology

The original epizootic of Jembrana disease was recognised in 1964 in the Jembrana district, Bali. It is estimated that 60% of the Bali cattle and buffalo populations was attacked with the mortality of 98.9% (RAMACHANDRAN, 1997). This is followed by other outbreaks in 1972 and 1973, which expand the disease throughout the island (SOEHARSONO and TEMADJA, 1997). By 1992, a disease similar to JD was reported in other provinces and islands of Indonesia (Lampung, Bengkulu, South Sumatra, East Java, West Sumatra, and South Kalimantan). Thirty years after the first epidemic, JD is regarded as endemic throughout the island of Bali with sporadic outbreaks at intervals of 4-5 years (PUTRA and SULISTYANA, 1997).

Based on the history of JD control in Indonesia, it seems that some approaches occupied by the government in the early JD outbreak contribute to the expansion of this disease. RAMACHANDRAN (1997) underline that there was a mistaken diagnosis where JD was diagnosed as rinderpest despite the finding that histopathology changes in JD were distinctly different from those documented for rinderpest. This misleading diagnose was followed by a mass rinderpest vaccination program by the Directorate of Animal Health office (SOEHARSONO and TEMADJA, 1997).

Though the mechanism of JD transmission is poorly understood (SOEHARSONO *et al.*, 1997), the mass vaccination program could be attributable to the JD disease spread since vaccination procedures involving a multiple utilisation of single syringe and needle are frequently practiced in the areas where JD is endemic. SOEHARSONO *et al.* (1995) mention that the high titre of the virus in blood (10^8 ID_{50}/ml) could transmit the virus mechanically. Therefore, it is possibly that the vaccination unintentionally spread the JD incidence.

However, close contact with infected animals during the acute phase of the disease when it is contagious is likely to be the major route of JD transmission. In a trial SOEHARSONO *et al.* (1995) observed the presence of JD virus in saliva, milk and urine during the febrile stage and the ability to transmit the disease by oral, intranasal and conjunctival inoculation. This suggest that infection from excrete of infected animals can be involved in the disease spread. This likelihood was proven by the fact that cattle owned by individual farmers tended to be either all infected (antibody-positive) or all uninfected (antibody-negative) (SOEHARSONO *et al.*, 1995).

In addition, cattle farming system in Indonesia has been potentially accelerate the spread of JD disease. A vast majority of cattle are owned by small farmers with a cut-and-carry system feeding. The animals are commonly tethered in the communal grass field. In some villages cattle are placed in a collective animal house (NITIS, 1994). This practice enables a close contact between animals that potentially transfer the disease agent from infected animals to other animals in the same group.

In order to overcome close contact route of transmission as a consequence of the farming system, the local government and the animal health office should approach the farmers to

report every suspected JD incidence and avoid mixing infected animals with the health ones. Farmers as cattle owner are the first line in detecting the disease. They can either accelerate or scupper the disease spread. Therefore, understandable information about JD should be provided for the farmers. Since many farmers are laypeople and commonly have a low level of education, some visible pathognomonic signs of JD can be utilised as an indication for the farmers.

Meanwhile, geography condition of Indonesia and arthropod as vector seem to play a minor role in JD spread. Clinical observation and serological test by HARTANINGSIH *et al.* (1993) indicate that although the disease has occurred in Bali since 1964 there has been no clinical evidence of JD infection in the closely adjacent islands of Lombok and Nusa Penida. This unlikely prevalence also reveals for the vector transmitted JD. Though biting arthropods such as *Tabanus* and mosquito has been suspected to transmit JD agent, there has been no disease spread from endemic areas in Central Lampung to the adjacent district of North Lampung where there is no physical barriers to spread of free-flying arthropods (HARTANINGSIH *et al.*, 1993).

Regarding the immunity status post infection, there is evidence that recovered Bali cattle become immune carrier animals. In an experimental infection PUTRA and SULISTYANA (1997) found that Bali cattle with ELISA-detected antibodies were resistance JDV challenge. Meanwhile WILCOX *et al*., (1995) report that clinical disease recurrence is unlikely occurs in animals with JDV antibodies. The antibody was still detectable 59 weeks after infection. This indicates that there is possibility to prevent the infection in cattle, which previously have been exposed to the disease agent. The exposure probably can be induced either by vaccination or natural exposure in endemic areas.

Economic and social impact

Jembrana disease has posed several impacts amongst Indonesian farmers since rearing cattle has economic and social aspects in the society. Economically, cattle provide employment for the family and play a role as capital reserve as well as to reduce the risk associated with the crop production failure in a mixed farming system like in Indonesia. Moreover, cattle are utilised as draught power, source of manure as fertiliser, and as an economic activity to earn extra cash from crop residue for fodder (WIRYOSUHANTO, 1997). In the social community, cattle have a high value for ceremonial events such as marriage, religious and considered to be prestigious possession (BUTTERWORTH, 1985).

Apart from direct economic impact of Jembrana disease to the animal keeper, this disease also threatens the economy in a wider scale. Following the disease outbreak in 1964, the Directorate of animal health has banned the cattle export from Bali to other islands within Indonesia archipelago with the exception to Jakarta for slaughter (RAMACHANDRAN, 1997). This consequence of JD has a disadvantageous to the local cattle trade. The market for Balinese cattle becomes confined only in Bali and Jakarta. This condition might lead to an unfair trade as well-funded buyers could dictate the price of the cattle while farmers have a weak bargaining position due to the disease status of the region. In this circumstance, the government should provide subsidy to support smallholder farmers or allocating some fund to purchase the farmer's stock in order to avoid a loop sided trade.

Clinical signs

The principal clinical signs observed in field cases of JD in Bali cattle are inappetence, fever, lethargy and reluctant to move, enlargement of superficial lymph nodes particularly the prescapular and prefemoral and parotid lymph nodes, hypersalivation, nasal discharge, and diarrhoea with blood in the faeces (SOEHARSONO *et al*., 1997, WILCOX *et al*., 1995). In an experimental infection, SOEHARSONO *et al*. (1997) found there were no clinical signs in JD infection.

Clinical-pathologically, animals with JD develops leucopenia coincide with the febrile period principally due to lymphopenia. SOEHARSONO *et al*. (1997) observed there was a reduction of PCV, number of erythrocyte, Hb value and amount of plasma protein that occurred at the start of febrile period.

Meanwhile, blood urea concentrations increased markedly but in the recovered animals the blood urea concentration returned to normal. The high concentration of blood urea suggests that this may have been contributing to the death of the animals. The abnormal blood urea concentration in JD infection is likely to be associated with kidney lesions, which consistently detected in animals with JD (SOEHARSONO *et al*., 1997).

Clinical and Laboratory Diagnosis

In the field conditions, Jembrana disease is difficult to diagnose based on clinical signs solely. This is because the disease is frequently associated with the occurrence of secondary infections such as bacterial pneumonia (SOEHARSONO *et al*., 1997). However, some consistent clinical signs can be used in diagnosing JD clinically. Marked enlargement of superficial lymph nodes particularly prescapular, prefemoral and parotid lymph nodes is one of the consistent clinical signs of JD. Moreover, due to the unique of this disease, which mostly attacks Bali cattle, breed and geographical location can be taken into consideration for disease diagnosis. Yet, diagnosis based on clinical signs and history merely is not convincing since other diseases might show the similar signs.

Laboratory diagnosis of Jembrana disease virus has been developed mainly based on immunological test. ELISA, a quick and simple method has been developed to detect JDV infection using sucrose gradient purified virus as an antigen. However, in a study Burkala *et al*. (1998) found the conventional ELISA that utilises whole virus as antigen is not specific in detecting JDV by revealing a little reactivity with sera from JDV-infected and recovered cattle. This might be due to the cross-reactivity between recombinant of capsid (CA) protein of JD virus with bovine immunodeficiency virus (BIV) antisera indicating these two bovine lentiviruses share common antigenic epitopes contained in the capsid (BURKALA *et al*., 1998). A consistent result was shown in an investigation to detect bovine lentivirus infection in Western Australia (BURKALA *et al*., 1998) where all serum samples antibody-positive with JDV CA protein antigens were also antibody-positive to recombinant BIV CA antigens.

In order to increase the specificity of the ELISA, Burkala *et al*. (1998) proposed the utilisation of transmembrane (TM) recombinant antigens rather than whole virus antigen where the capsid (CA) protein would be the major antigen. This recombinant antigen may be beneficial since they can be produced in large quantities by cloning in *E. coli*, are easily purified and are highly specific.

Other researchers (CHADWICK *et al*., 1997) used paraffin-embedded tissue sections by in situ hybridisation method to detect Jembrana disease virus. Basically, in this method tissue sections obtained from JDV-infected Bali cattle are stained using riboprobes consisted of fragment of cDNA derived from the *pol* gene of JDV. Unfortunately the authors did not explain the positive and negative characteristic result of this method in detail despite stating that staining was consistently strongest in the nucleus. This method might be not specific in diagnosing JDV as some other viruses also multiplicate in the nucleus of infected tissue resulting a similar result in staining.

Given these facts, combination between anamnesa, clinical signs, and laboratory diagnosis is required to identify the Jembrana disease virus infection since a single diagnosis method can be misled to other diseases with similar signs.

Treatment

As Jembrana disease is caused by virus, METHAROM *et al*. (2000) state that there is no treatment yet nor preventive vaccine for JD. However, the evidence that cattle develop a protective immunity after recovery from JD indicates the possibility to induce immunity in Bali cattle by vaccination with the appropriate antigen. HARTANINGSIH *et al.* (1997) in an experiment attempted to develop vaccine against JD using inactivated virus derived from tissues of affected animals. Yet, none of the vaccination procedure provides a complete protection toward JD.

The inability of JD vaccine to protect animals against Jembrana disease was shown in the experiment (HARTANINGSIH *et al*., 1997) that vaccination only suppressed the duration

and severity of the disease to a variable extent. This is probably related to the evidence that the mechanism of recovery is likely to be T-cell driven, like most viral infections, rather than antibody mediated, although an antibody response may be vital to post-vaccination or infection immunity (METHAROM *et al*., 2000)

Control

Controlling the animals' movement in the infected regions is one of the most feasible ways to reduce the incidence of new infection in other areas of Indonesia and to combat the spread of this disease. In this circumstance, the government action through quarantine rule enforcement is crucial. Though the government policy to ban cattle export from Bali (RAMACHANDRAN, 1997) seems to be economically unbeneficial for the farmers, this option prevents a greater lost in a wider areas of Indonesia. However, the government action solely cannot be successful without participation from the society and the farmers. Cattle smuggling cases that potentially spread the disease are still high due to the disability of the government to provide sufficient quarantine monitoring in such a huge archipelago. Community education and approach is essential to solve this problem.

Another approach that can be reasonable to control Jembrana disease is breed selection. Since Jembrana disease mostly attacks Bali cattle (*Bos javanicus*) (HARTANINGSIH *et al.*, 1993), introducing other breed such as Brahman, Ongol, even *Bos Taurus* breeds like Limousin and Simmental could be beneficial in term of disease resistance against JD. Expensive cost of importing *Bos Taurus* should be taken into consideration, yet this obstacle can be countered by cross breeding using artificial insemination method. As far as my concern, there has been no report of JD occurrence in Bali cattle cross breed nor the report stating that this cross breed has a similar susceptibility to JD compared with Bali cattle. Apart from JD resistance, *Bos Taurus* cattle has revealed a faster growth compared to Bali cattle, which can be an additional benefit for genetic improvement in the livestock production to some extent.

In the case of Jembrana disease, the Indonesian government does not apply "test and slaughter" strategy to control the disease due to the lack of fund. Nonetheless, this policy might be wise particularly for JD. The government assume that JD can be confined in Bali as the original place of emerges by the export cattle ban policy. Moreover, several evidences showing that recovered animal from JD develop immunity has led to an assumption that cattle in Bali that survive until recently has developed resistance against Jembrana disease. This assumption is also true for other regions in Indonesia with endemic JD infection.

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