Seroprevalence of Bovine Immunodeficiency Virus in Dairy and Beef Cattle Herds in Korea

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ABSTRACT. Infection of bovine immunodeficiency virus (BIV), a lentivirus, is thought to sporadically occur throughout the world, but seroepidemiological surveys concerning the incidence of BIV are limited and have not been undertaken in Korea. A total of 266 sera from different twenty dairy (Holstein) and twenty-six Korean native beef (Hanwoo) farms of the south-western part of Korea was analyzed for the presence of anti-BIV antibodies by Western blotting. Thirty five percent and 33% of dairy and beef cattle, respectively, were BIV-seropositive. By nested polymerase chain reaction, it was confirmed that these seropositive cows had provirus in the peripheral blood mononuclear cells. To demonstrate the correlation with BIV and bovine leukemia virus (BLV) infection, these sera were also analyzed for anti-BLV antibodies by immunodiffusion test, resulting in high prevalence of BLV infection but relatively a few dual infections. We report herein the first serological detection of antibodies to BIV in Korea.—KEY WORDS: bovine immunodeficiency virus, bovine leukemia virus, seroprevalence.

Bovine immunodeficiency virus (BIV), family Retroviridae, genus Lentivirus, was originally isolated from cattle showing lymphocytosis, lymphadenopathy, neuropathy, progressive weakness, and emaciation [23]. BIV is genetically and structurally similar to human immunodeficiency virus [11, 12]. BIV can cause dysfunction of monocytes and neutrophils in infected cattle [7, 8, 20]. However, the precise features of BIV infection are still unclear, because BIV-infected calves do not develop any severe clinical symptoms [3, 7, 8, 20].

Since serological survey is an important way to determine the distribution of BIV in cattle, serological data of BIV indicate that it may have a worldwide prevalence [1, 5, 6, 9, 13–15, 17–19, 22]. The BIV is more prevalent in dairy cattle than in beef cattle [1, 22]. Nevertheless, a survey of seroprevalence on BIV infection in dairy and beef cattle has not been conducted in Korea.

Although it is not yet known whether BIV causes significant immunosuppression and promotes secondary infection with other pathogenic agents, BIV-infection was associated with decreased milk production shown by a large seroepidemiological study of dairy cows [17]. It was also reported that BIV is frequently coinfected with the other bovine viruses, such as bovine leukemia virus (BLV) [1, 2, 4–6, 17], and bovine syncytial virus [1]. Indeed, the R29 isolate of BIV originates from cattle coinfected with bovine viral diarrhea virus [23].

The aim of this study was to examine the seroprevalence of BIV infection in dairy and beef cattle in Korea, where there have been no previous reports on BIV infection. Since BIV was frequently coinfected with other retroviruses, the second objective of this study was to determine the correlation between BIV and BLV infections.

A total of 266 sera was collected from different twenty Holstein and twenty-six Korean native beef (Hanwoo) farms of the south-western part of Korea during the period 1994–1998 for different study purposes (Table 1). Sera from the Cheju region were collected for the survey of Theileria parasite infestation. Except for 5 calves in Cheju (the ages were under 4 month old), the ages of tested cattle from all regions ranged from 1 to 8 year old. Sera used in the present study have been stored at -20°C until further use.

Seroprevalence for BIV was determined by Western blot analysis as described previously [13, 18, 25]. As shown in Fig. 1, antibodies against BIV-specific p26 protein were detected in sera obtained from cows of different areas in Korea, and the results of sera examined in this study were summarized in Table 1. The seroprevalence for BIV in cattle from each district ranged from 15 to 56% (means: 35%) in dairy cattle and 19 to 67% (means: 33%) in beef cattle. The percentages of seropositive farms for BIV in each district ranged from 50 to 83% (means: 60%) in dairy farms and 56% to 100% (means: 65%) in beef farms, respectively (data not shown). All of the seropositive cows were over 1 year old except one 4-month-old dairy calf in the Cheju area. To further confirm the results of the serological survey, 11 BIV-seropositive dairy cows in the Kwangju area were randomly selected. DNA samples were prepared from their blood, and nested polymerase chain reaction (PCR) was performed to detect BIV provirus DNA in these samples as described by Meas et al. [18]. As shown in Fig. 2, BIV-specific 298-bp fragments corresponding to the part of the pol region were detected in all the samples prepared from seropositive cows.

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In the next experiment, to determine the incidence of mixed infection of BIV with BLV in cows in Korea, antibodies to the BLV antigen were also detected in those sera by immunodiffusion test (Table 1). The BLV antigen was prepared and immunodiffusion test was performed as described by Onuma et al. [21]. The seroprevalence for BLV in cattle from each district ranged from 15 to 67% (means: 40%) in dairy cattle and 0 to 66% (means: 48%) in beef cattle. The incidence of dual-infected cattle in each district ranged from 5 to 13% (means: 9%) in dairy cattle and 0 to 15% (means: 10%) in beef cattle. A 4-month-old dairy calf showing BIV-seropositivity in Cheju also had seropositive reaction for BLV.

This is the first report of serologic evidence for BIV infection in Korea. Nested PCR used in the present study confirmed that BIV-seropositive cows had BIV provirus in their peripheral blood mononuclear cells. The incidence of BIV infection in the world varied in different dairy and beef herds [1, 5, 6, 9, 13–15, 17–19, 22]. Seropositive farms for BIV in Korea was 60% in dairy and 69% in beef ones. This seroepidemiological survey provides evidence that BIV infection is widespread among the farms in Korea. Although there were significant differences in the incidence rate of BIV infection in the world, the rate of BIV infection in Korea was high compared to other countries.
of BIV-positive cattle per herd in Korea (Table 1), the seroprevalence of BIV-infected cattle in Korea was ranked high amongst countries [1, 5, 6, 9, 13–15, 17–19, 22]. Since herd maintenance and breeding methods were different between dairy and beef cattle, seroprevalence of BIV infection is higher in dairy cattle than in beef cattle [1, 22]. However, the difference in seroprevalence for BIV between dairy and beef cattle was not observed in the present study.

Several studies with BIV have explored the possibility that this virus causes immune dysfunctions [7, 8, 16, 20]. As previous studies demonstrated that many farms had dual infection with BIV and BLV, BIV infection in cattle has been suspected to be associated with disease progression of BLV [1, 10]. To clarify the possibility that BIV-mediated impairment of bovine immune system makes cattle more susceptible to BLV infection, seroepidemiological survey of BIV and BLV in 46 different dairy and beef herds were performed. The present seroepidemiological data (Table 1) indicate that BIV and BLV infections were prevalent in both dairy and beef herds in Korea, but that the number of dual-infected cows per herd was relatively fewer. These results indicate that a greater percentage of BIV-seropositive cattle was BLV-seronegative. Therefore, dual infection with BIV and BLV may be incidental because of high prevalence of both virus infections in dual infected farms. These results are consistent with those of the previous papers in which no correlation between two virus infections was reported [6, 17, 24].

Both BIV and BLV are thought to be spread by transfer of blood, artificial insemination, iatrogenic transmission with contaminated instruments, or blood sucking insects [5, 6, 10]. Therefore, it might be speculated that infection with one agent would parallel the other. Taken together, these results can support the conclusion that infection with BIV and BLV can occur independent of one another or at the same time. However, it was not possible to determine routes of exposure because of no detailed epidemiological data about transmission in the present study. A larger serological study with detailed epidemiological observation for long term will be necessary to confirm these preliminary findings.

REFERENCES