Maternally Derived Antibodies to Japanese Encephalitis Virus in Cattle

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Key words: Cattle, Japanese encephalitis virus (JEV), Maternal antibody

Summary

Serum samples were collected from 55 pairs of calves that had not passed the first summer and their dams reared in Kagoshima from 1983 through 1985. They were investigated for the HI antibody to Japanese encephalitis virus (JEV) in calves and for the correlation of antibody levels between calves and their dams. The maternally derived antibody was detected in 35 of 55 calves (63.6%), showing the mean antibody titer of 12.4. A significant negative correlation (p<0.01) was noted between the age of calf and titer of passively acquired antibodies. The regression equation suggested that the maternal antibody disappeared from the calf serum at about 3 months of age. On the other hand, 37 of 55 dams (67.3%) were positive for HI antibody to JEV, and the mean titer of the antibody was 12.7. There was a significant correlation (p<0.01) in serum antibody titers between dams and their calves.

Introduction

Japanese encephalitis is a serious public health problem with significant mortality in children and old people in many countries of Asia. Recently, the epidemiological patterns of Japanese encephalitis have been changed. The incidence of Japanese encephalitis appears to be subsiding in Japan, but at the same time has been increasing and spreading over India, Nepal and Thailand1).

Our previous serological investigations were focused on the dissemination of Japanese encephalitis virus (JEV) in cattle reared a long period of time without vaccination2)-5). The increase in hemagglutination inhibiton (HI) antibody titer due to JEV infection is less remarkable in cattle than in swines or humans, and it is difficult to estimate the time of infection in cattle by the level of 2-mercaptoethanol (ME)-sensitive antibody which is useful in the swine6). In juvenile animals, the maternally derived antibodies and actively produced ones in response to natural infections should be differentiated in epidemiologic studies. In the present study, we investigated the HI antibody in newborn calves that had not passed a summer and the correlation of antibody levels between calves and their dams.

Materials and Methods

Bovine serum: A total of 110 serum samples were collected from 55 pairs of calves and dams in 1983 through 1985. Calves were aged 1 to 138 days, and had not passed the first summer. Dams were being reared in Kagoshima Prefecture, aged 2 to 19 years old. They were the Japanese Black breed. The samples were stored at $-20^\circ$C. At the time of determination of HI antibody titer, they were thawed and treated with acetone. They were adsorbed by goose hematocytes. The euslting supernatant was incubated at 56$^\circ$C for 30

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minutes before the test.

HI test: HI antibody titers were determined by employing goose erythrocytes and JEV commercial antigen of strain JaGAr#01 (Takeda Yakuhin Kogyo Co.). The test was carried out in a microtiter system in accordance with the method of Clarke and Casals. An HI antibody titer of 1:10 or higher was defined as positive for this antibody. JEV-positive serum was used as a positive control.

**Results**

Table 1 shows the distribution of HI antibody to JEV in the 55 pairs of calves and dams grouped into six according to the age of calves.

HI antibody was detected in 35 of 55 calves (63.6%), showing titers of 1:10 to 1:160 (mean; 1:12.4). Antibody positivities of calves aged 0–7 days, 8–14 days and 15–21 days, were 9/9 (100%), 9/12 (75%) and 9/13 (69%), respectively. Positivities in calves aged 22–35 days, 36–49 days and 50–138 days were 2/4 (50%), 5/11 (46%) and 1/6 (17%), respectively. Antibody positivity rate tends to decrease in accordance to the aged of the calves in days. The mean antibody titer was 1:25.2 in calves aged 0–7 days while 1:5.6 in those older than 50 days. Fig. 1 shows the relationship between the age of the calves and HI antibody titers. There was a significant negative correlation (p<0.01) between ages and antibody titers, with a regression equation of y=1.28 – 0.0067x and a correlation coefficient of −0.468.

On the other hand, 37 of 55 (67.3%) maternal sera were positive for antibody showing titers of 1:10 to

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Calf</th>
<th>Antibody titer</th>
<th>Dam</th>
<th>Antibody titer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Positive/ Tested (%)</td>
<td>&lt;10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>I (0–7)</td>
<td>9/ 9(100)</td>
<td>0*</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>II (8–14)</td>
<td>9/12&lt;75&gt;</td>
<td>3</td>
<td>3</td>
<td>2</td>
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<tr>
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<td>9/13&lt;69&gt;</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>IV (22–35)</td>
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<td>0</td>
<td>2</td>
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<tr>
<td>V (36–49)</td>
<td>5/11&lt;46&gt;</td>
<td>6</td>
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<td>2</td>
</tr>
<tr>
<td>VI (50–138)</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>35/55&lt;63.6&gt;</td>
<td>20</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>

*Number of cases showing the titer.

**Fig. 1** Relationship between the age of calves and serum antibody titers
Fig. 2 Correlation of the HI antibody titer between calves and their dams

1:80 (mean; 1:12.7). These values in maternal sera were comparable to those of calves. Of calves more than 36 days old, dams showed antibody titers lower than those of their calves. No significant differences in positivity and titers were seen among dams of calves aged less than 35 days. The distributions of HI antibody in the dams differed from those of the calves.

Fig. 2 shows the relationship of HI antibody between calves and their dams. A significant correlation (p<0.01) in serum antibody titers was observed between calves and their dams with a correlation coefficient of 0.73481.

Discussion

Several workers investigated the maternally derived antibodies to JEV in swine\(^8\)\(^{-10}\). It has been reported that antibodies to JEV of maternal origin disappear in 3~7 months\(^8\) or 4~6 months\(^9\) after birth in swine. There, however, have been no reports on the bovine species except for Shimizu et al.\(^8\).

In the present study, HI antibodies to JEV were detected in the calves that had experienced no first summer. Our previous reports have been revealed the JEV infection among cattle occurred mainly during summer\(^2\)\(^{-5}\). Therefore, the calves in this study were supposed to have no JEV infection after birth and most detectable antibodies were considered to be passively acquired and represented maternal antibodies transferred via the colostrum.

A significant negative correlation was demonstrated between the ages of calves and their antibody titers. The regression equation obtained in this study suggested the disappearance of maternal antibodies from the calf serum about 3 months after birth, being slightly earlier than in the swine. Since the persistence of maternal antibodies in calf serum might depend upon the antibody titer of the dam\(^10\), and there was a close correlation in the antibody titers between calves and their dams in this study, the discrepancy between bovine and swine species may be related to considerable lower antibody titers in adult cattle than in the swine during the endemic season.

References


牛の日本脳炎ウイルスに対する移行抗体の消長

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1983年〜1985年に鹿児島県で飼育されていた黒毛和種の未越夏仔牛及びその母牛より採取した55組の血清について、日本脳炎ウイルスに対するHI抗体の消長と母仔間の相関性について検討した。日本脳炎ウイルスに対する移行抗体が仔牛血清55例中35例（63.6％）に検出され、その平均抗体価は12.4であった。これらの移行抗体の抗体価と仔牛の日齢との間には有意な（p<0.01）負の相関が認められ、移行抗体は約3ヶ月で消失することが推定された。一方、母牛血清の抗体保有率は67.3%（37/55）、平均抗体価は12.7であり、母仔間の抗体価には有意な（p<0.01）相関が認められた。