Preventive Administration of Bovine Colostral Immunoglobulins for Foal Diarrhea with Rotavirus

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ABSTRACT. Foal diarrhea due to serotype 3 rotavirus broke out on a foil-raising farm in the years 1987 and 1989. In 1989, all of the foals, regardless of whether or not they suffered from diarrhea, received bovine colostral immunoglobulin (Ig) powder orally for 3 to 5 days during the epidemic. The morbidity of the diarrhea was lower than that observed in 1987, when the Ig powder was not administered to foals. These data suggested that the administration of Ig powder might partially prevent foal diarrhea with rotavirus infection. — Key words: foal diarrhea, immunoglobulin, rotavirus.


Equine rotavirus (RV) has been recognized as a major cause of acute diarrhea in foals throughout the world [4]. No effective and safe vaccine for RV infection has yet been developed for animals [2]. In our previous paper, the administration of bovine colostral immunoglobulins had a preventive effect on RV diarrhea in beef calves when it was given soon after calving [10]. There have also been many experiments on the oral administration of normal or immune bovine colostral globulins for RV in calves and piglets, egg yolk immunoglobulins for RV in suckling mice, and specific or monoclonal antibodies to RV in piglets and young children [1, 3, 5, 6, 11, 12]. This paper is concerned with the preventive effect of bovine colostral immunoglobulins on RV diarrhea in foals, as a basis for comparison of the morbidity rates for foal diarrhea recognized between 1987 and 1989 on a foil-raising farm.

The foil-raising farm is located at the seaside in the Iburi district of Hokkaido. On this farm epizootics of foal diarrhea due to serotype 3 RV were observed from April to August in 1986 to 1989. Briefly, the SH-31 (1986), SH-52 (1987) and SH-98 (1989) strains of serotype 3 RV were isolated from fecal swabs in MA-104 cell cultures [9] and designated as the representative strain in each epizootic. These strains were examined for reactivity to bovine colostral immunoglobulin (Ig) powder by the 60% plaque reduction neutralization test (PRN) test [9] and Western blot analysis. In the PRN test, strain SH-31 showed cross-reaction in a titer of 1:12,500 to anti-SH-52 serum with a homologous titer of 1:36,000; strain SH-52, a titer of 1:31,500 to anti-SH-31 serum with 1:9,000; and strain SH-98, a titer of 1:14,500 to the anti-SH-52 serum and a titer of 1:38,000 to the anti-SH-31 serum, respectively. These strains also showed a similar migration pattern of viral RNA segment in polyacrylamide gel electrophoresis (data not shown). The Western blot analysis followed the procedure described in a preceding paper [10], with slight modification using the E.C.L.-Western-blotting detection system (Amersham International plc, UK). The Ig powder was supplied by the Chugai Pharmaceutical Co., Ltd., Tokyo, and was prepared by the procedure described in our previous report [10].

The Ig powder used here was negative in the detection of coliform bacteria and the live bacterial count was 155 organisms per gram of the powder. The Ig powder had a titer of 1:6,250 against strain SH-31 in the PRN test. In the Western blot analysis with virus structural proteins (VP) (Fig. 1), the Ig powder showed specific reactions to the VP2, VP6 and VP7 derived from strain SH-31 or SH-98, and to the VP2, VP4, VP6 and VP7, from strain NCDV of bovine RV.

A total of 54 foals were born on this foil-raising farm between February and June, 1987, and 53 foals in the same months in 1989. More than half of the foals were born from the same dams in both years. The foals developed severe diarrhea at days 61 to 65 after birth with an average of 64.7±27.0 days in 1987 and 60.8±24.9 days in 1989. The diarrheal cases were observed only in the month of June in each year. These findings indicated that the foil diarrhea on this farm occurred in foals of the same age, and at the same time of the year. On this farm also, it is well known to the breeder that annual outbreaks of foil diarrhea correspond closely with cloudy weather and thick fog at the seaside in this season.

When the first case of diarrhea was recognized in June, 1989, all the foals, regardless of whether or not they suffered from diarrhea, immediately received Ig powder for 3 to 5 days. The Ig powder was administered orally twice a day (50 g/day) in approximately a 20% aqueous solution. As shown in Table 1, when there was no administration of the Ig powder to diarrheal foals in 1987, 41 (75.9%) of 54 foals were affected with severe diarrhea. The isolation rate of RV was 100% (26/26 feces) by cell culture method. In 1989, however, 22 (41.5%) of 53 foals showed severe diarrhea, and RV was detected from 17 (77.3%) of the 22 fecal samples examined in the latex agglutination test (ROTALEX, Orion Diagnostica, Espoo, Finland). The confidence interval of diarrheal morbidity (P value in Table 1) shifted to a lower level in the year 1989 in comparison with the year 1987, in spite even though RV detection values were high in both years.

These findings, suggested that the oral administration of Ig powder to foals might prevent serious diarrhea due to RV infection, because the Ig powder reacts with viral capsid proteins of RV, especially outer capsid proteins of
VP4 and VP7, which are known to be associated with the neutralization of RV [7, 8]. Since the Ig powder was made from the colostrum of normal cows, which were not vaccinated with any RV, anti-RV antibodies contained in the powder were obtained in natural infections with bovine RV. Cross-reactivity with RVs in inter-species and inter-serotypes has been reported [1, 3, 5, 6]. However, further studies on the dosage and duration of Ig powder in such administration experiments are necessary.

Fig. 1. Reactivity of bovine colostral Ig powder against equine RV in Western-blot analysis. The picture (a) and diagram (b) show the nitrocellulose membrane transblotted RV proteins, which were then stained with AuroDye forte stain [10] (Lanes A to D), or immuno-stained with a solution (Lanes E to H). Lanes A and E: molecular weight markers. Lanes B and F: strain SH-98. Lanes C and G: strain SH-31. Lanes D and H: bovine standard RV strain, NCDV as a positive control of immunoreactions. Numbers on the left indicate M.W. of protein in thousands. Viral proteins reacting with the Ig powder are indicated on the right.

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REFERENCES


Table 1. Comparison of the morbidities of foal diarrhea in the years 1987 and 1989

<table>
<thead>
<tr>
<th>Year</th>
<th>Ig fed (50 g/day)</th>
<th>No. of diarrheal foals /total (P)a</th>
<th>No. of foals RV positive /tested (P)b</th>
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</thead>
<tbody>
<tr>
<td>1987</td>
<td>−</td>
<td>41/54 (0.652≤P≤0.863)</td>
<td>26/26 (0.844≤P≤1.000)</td>
</tr>
<tr>
<td>1989</td>
<td>+</td>
<td>22/53 (0.260≤P≤0.583)</td>
<td>17/22 (0.540≤P≤0.938)</td>
</tr>
</tbody>
</table>

a) Confidence intervals of the diarrheal morbidity (P) and RV positive rate (p) are expressed as 98% confidence limits of parametric expected values.
b) RV in fecal swabs was detected by virus isolation with MA-104 cell-culture in 1987 [10], and latex agglutination test in 1989.