Relationship between serum sialic acid levels and eye lesions in calves with infectious bovine keratoconjunctivitis

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SUMMARY

The aim of this study was to evaluate the clinical and biochemical importance of sialic acid (SA) serum concentrations (total, lipid-bound and protein-bound) in calves suffering from infectious bovine keratoconjunctivitis (IBK). The study included 18 calves with IBK (Group I) and 11 healthy calves (Group II). Blood samples were collected from all calves for the determination of serum SA and glucose concentrations. Eye lesions were scored as mild, moderate and severe based on severity of the clinical symptoms. Mean total sialic acid (TSA), lipid-bound sialic acid (LBSA) and protein-bound sialic acid (PBSA) concentrations of the calves with IBK were 106.9±3.6 mg/dl, 54.8±2.78 mg/dl, 52.1±3.1 mg/dl, respectively. Values of TSA, LBSA and PBSA determined for healthy calves were 76.4±3.1mg/dl, 38.4±2.1 mg/dl and 38±3.7 mg/dl, respectively. Serum TSA and LBSA values measured in animals from group I were significantly higher than those of animals from group II (p<0.001). As the severity of eye lesions increased, the LBSA serum concentration was also increased reaching 47.5±1.8 mg/dl; 50.8±0.9 mg/dl; 66.1±6.1 mg/dl for calves presenting mild, moderate and severe lesions, respectively.

The results of the present study may suggest that TSA, especially LBSA values could be a valuable indicator for the prognosis of eye lesions such as that of IBK.

KEY-WORDS : Serum sialic acid, keratoconjunctivitis, calves, prognosis, Moraxella bovis.

Introduction

Sialic acid (SA), an acetylated derivative of neuroaminic acid, is widely distributed in mammals’ tissues and body fluids. N-acetyl neuroaminic acid is the most common form of SA [3]. Sialic acid significantly bounds to glycoproteins, glycolipids, oligosacharides and polysaccharides, but small amounts are free in the body. Moreover, SA is an important structural component of biological membranes. It is also widely distributed in bacterial membranes [19].

The measurement of SA serum concentrations is important in the diagnosis and prognosis of inflammation and cancer in human and animals (i.e. horse and dog) [11,14,15,18,22]. Serum SA values were determined in many diseases such as nephritic syndrome, rheumatoid arthritis [19], chronic tuberculosis [5], meningitis [20], trypanosoma vivax infection [9], chronic bovine haematurie [21], distemper [8] and bovine leucosis [24]. Therefore, determination of serum SA, especially lipid-bound SA concentrations may be an indicator for cellular damage during the inflammatory process, and postoperative prognosis [17].

Infectious bovine keratoconjunctivitis (IBK) is an infectious disease of ruminants caused by Moraxella bovis [10]. Although IBK is not a lethal disease, it usually leads to serious economic losses. IBK affects more commonly calves rather than adult cattle, and occurs particularly in summer [25]. The disease is spread by contaminated insects and air particles, and is highly contagious [4]. During the course of the infection, only one eye is affected at the onset of the clinical course and lesions are characterised by keratitis, conjunctivitis and corneal ulceration [10]. The agent adheres to the outer surface of the cornea, and establishes a rapid infection that can lead to keratoconjunctivitis and corneal ulceration [25]. The agent may also disseminate to the rest of the body and cause primary systemic infection [25].

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rheumatoid arthritis, chronic tuberculosis, meningitis
to conjunctival and corneal epithelium by its pili. Later, bacterial colonisation develops and dermonecrotic and haemolytic toxins are produced, causing cell destruction [6].

The present study was designed to compare SA serum concentrations of calves suffering of IBK with that of healthy calves and to correlate these concentrations with the degree of eye lesions.

Materials and Methods

Eighteen Swiss Brown calves aged 6 to 12 months suffering from naturally occurring IBK between June and July 2002 in a herd of Kars district (Turkey) were included in the study (Group I). Control group (Group II) consisted of 11 Swiss Brown healthy calves aged from 6 to 9 months old.

Calves were examined for the presence of eye lesions such as lacrimation, photophobia, blepharospasm, conjunctivitis, keratitis, corneal ulcer and opacity. Eye lesions were classified as mild, moderate and severe on the basis of clinical presentation. Eye swaps were taken from all cases for microbiological examination. Blood samples from all calves were collected into plain tubes for SA and glucose analyses. Blood samples were stored for one hour at room temperature and centrifuged at 6000 rpm for 10 min, and then kept at -20°C until analyses.

Serum TSA analyses were carried out according to the method reported by Sydows [23]. LBSA concentrations were measured colorimetrically on a spectrophotometer (UV-1201, Shimadzu, Japan) as described by Katopodis et al. [12]. Protein-bound sialic acid values were calculated by subtracting LBSA serum concentrations to TSA ones.

Unpaired Student-t test was used to compare SA serum levels between groups. ANOVA was also used to compare serum SA concentrations according to the severity of eye lesions.

Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group I (IBK n=18)</th>
<th>Group II (Control n=11)</th>
<th>Significance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSA (mg/dl)</td>
<td>106.9 ± 3.6</td>
<td>76.4 ± 3.1</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>LBSA (mg/dl)</td>
<td>54.8 ± 2.8</td>
<td>38.4 ± 2.1</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>PBSA (mg/dl)</td>
<td>52.1 ± 3.1</td>
<td>38.0 ± 3.7</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>44.6 ± 0.7</td>
<td>65.4 ± 3.3</td>
<td>P&lt;0.01</td>
</tr>
</tbody>
</table>

*Statistically significant difference between groups I and II.

Table I. — Mean ((SE) serum glucose and total, Lipid Bound and Protein Bound Sialic Acid concentrations of calves suffering of IBK (group I) and control ones (group II).
Discussion

The serum SA concentration has been reported to be a potentially useful but non-specific disease marker [11,21,24]. Studies recorded that SA concentrations was increased in various infectious disease and tissue injury in both people and animals (i.e. cattle, dog and horse) [2,14,15,17,18,19,21]. As toxins released by *M. bovis* induce

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild (n=6)</th>
<th>Moderate (n=6)</th>
<th>Severe (n=6)</th>
<th>Control (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSA</td>
<td>98.4 ± 3.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.7 ± 3.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>118.6 ± 8.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>76.4 ± 3.1</td>
</tr>
<tr>
<td>LBSA</td>
<td>47.5 ± 1.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50.8 ± 0.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>66.1 ± 6.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38.4 ± 2.1</td>
</tr>
<tr>
<td>PBSA</td>
<td>50.9 ± 2.9</td>
<td>52.9 ± 3.9</td>
<td>52.6 ± 8.8</td>
<td>38.0 ± 3.7</td>
</tr>
</tbody>
</table>

* Values with different superscripts (a,b,c) are statistically different (P<0.05).

**TABLE II.** — Mean serum (SE) total, lipid bound and protein Bound sialic acid according to the degree of eye lesions of calves affected with IBK.
cell destruction, SA is expected to be released into the circulation. Therefore, serum SA concentration may be a useful but non-specific inflammatory marker of IBK.

Normal ranges of serum SA levels have not extensively been investigated in animals. However, mean SA level of healthy cattle was determined to be 206 ± 33 μmol/100 ml (n=100) [24]. It has also been reported that these levels may vary according to age, sex, pregnancy status and breed [13,24]. Sialic acid levels of the healthy calves determined in this study were in accordance with the previous studies [17,24].

There have been a limited number of studies reporting SA levels in patients with ophthalmological disorders [1,7]. Serum SA level in humans affected with retinopathy (89.8±7.2 mg/dl) was reported to be significantly higher than the values of healthy ones [16]. The present study revealed an increase in serum SA concentrations in calves affected with IBK. It has been well documented that M. bovis colonises on the cornea and causes cell damage through its toxins which results in release of serum SA into blood circulation.

Serum LBSA values obtained in the present study were comparable to those reported by Motoi et al. [17]. The increase in serum LBSA and TSA in calves affected with ocular lesions might be explained by the effect of demanetric toxins produced by M. bovis at the time of inducing eye disorders. Furthermore, in the present study the severity of the eye lesions correlated well with the increase of serum TSA concentrations, particularly, serum LBSA. This may be useful in determining prognosis of cases with IBK and may also indicate that serum LBSA concentrations decrease as healing of the tissue is progressed.

Serum SA biosynthesis is known to originate from glucose, therefore the decrease of serum glucose concentrations could be explained by an increase of serum SA concentrations. Another likely explanation could be that glucose intake was reduced in diseased calves due to anorexia.

To the best of our knowledge, this was the first study determining serum SA concentrations in calves with eye lesions due to IBK. Elevated serum concentrations of TSA, especially serum LBSA, appears useful in the prognosis rather than the diagnosis of IBK. Additionally, a good correlation between the severity of eye lesions and serum concentrations of LBSA may be of prognostic value in evaluating the effectiveness of the treatment.

References