Efficiency of Oral Versus Parenteral Fluid Therapy by Isotonic Saccarose / Dextrose, Sodium Chloride and Sodium Bicarbonate for Treatment of Dehydration in Calf Diarrhoea

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Summary

In the literature, there exist numerous oral or parenteral formulations for rehydration in diarrhoeic and dehydratic calves. Most of them however, require high technology, labour and expense. To overcome these problems, the efficiency of oral fluid therapy (by administration of equal amounts of isotonic sodium chloride, sodium bicarbonate and Saccarose as sugar) compared to parenteral (IV) rehydration solution (containing the equal amounts of isotonic sodium chloride, sodium bicarbonate and dextrose) was investigated in this study. According to the findings, (i) there were no statistical differences between the treatment groups (p>0.05) and (ii) the data from groups approached to the normal levels of the calf. The results showed that used oral rehydration solution in this study was rather cheap and effective choice for all levels of diarrhoeic and dehydratic cases, except the calves in agony.

Key words: Calf diarrhoea, oral, fluid therapy.

Ishalli Buzagılarda Dehidrasyonun Tedavisi İçin İzotonik Sakkaroz / Dekstroz, Sodyum Klorür Ve Sodyum Bikarbonat Oral Sıvı Tedavisinin Parenteral Etkinliği

ÖZET

Hali hâlarda, ishalli ve dehidrasyonlu buzagalılar için çok sayıda oral ve parenteral rehidrasyon formülasyonu vardır. Bununla birlikte onların çoğu ikişteki teknolojiye, işçiliğe ihtiyaç duyarlar ve pahalılarlar. Bu problemlerin üstesinden gelebilmek için, bu çalışmada oral sıvı (esit miktarda izotonik sodyum klorür, sodyum bikarbonat ve sakkaroz olarak şekler çözeltleri uygulandı) tedavisinin etkinliği parenteral (IV) rehidrasyon solüsyonu (esit miktarda izotonik sodyum klorür, sodyom bikar-
Diarrhoea is a common disease of new born calves and characterised clinically by abnormal faecal discharge and progressive dehydration resulting in death in a few days. Diseases has a large and important lose in the large animal practice in the world and Turkey. The therapy for the diseases is very expensive especially fluid-electrolyte applications. Also these applications require to spend technician’s time (5, 7-10).

The effects of the loss of electrolytes and fluids can be evaluated in the laboratory. The packed cell volume (PCV) indicates the degree of dehydration. The blood bicarbonate values are markedly reduced while lowered levels of blood pH represent acidosis. In general, there is also a decrease in sodium, chloride and potassium levels, but potassium concentration may be elevated in severe cases of acidosis (14).

Patients cannot benefit from the food and thus a deficiency of energy exists throughout diarrhoea. Sugar (Saccrose) involves fructose and glucose. Glucose is needed by the body as energy source for life functions. Fructose is also converted to glucose by liver metabolism.

In the course of diarrhoea, metabolic acidosis occurs in two ways; the loss of baseline pH caused by diarrhoea and lactic acid production following anaerobic oxidation procedures. The occurrence of metabolic acidosis requires immediate treatment to recover normal physiologic functions. For this, sodium bicarbonate application is the most appropriate choice (6, 12).

The objective of fluid-electrolyte therapy is to aid the recovery of volume and composition of body fluids to their physiologic levels and removing the effects of metabolic acidosis. Therapy can be applied either in oral or in parenteral ways. The latter way is the most appropriate one, but it requires high technology, expense and labour. By contrast, the former way is cheap and simple, with numerous formulations available (1, 3). These solutions should be isotonic for optimum intestinal absorption. However, most of them are ‘hypertonic’ and thus appear to be dangerous (14). Moreover, they are not always available in the market and are also having expensive ingredients. But, water, salt, sugar and carbonate all can easily be purchased in the small market or grocery.

Therefore, the aim of this study was to investigate the efficiency of oral (as compared to parenteral) fluid therapy by isotonic mixture of sugar (saccarose), salt (Sodium chloride) and carbonate (Sodium bicarbonate) on diarrhoeic and dehydratic (metabolic acidotic) calves.

**MATERIALS AND METHODS**

**Animals:** A number of 47 diarrhoeic and dehydratic calves was used in this study. First, the calves were divided into two groups according to packed cell volume (PCV) in their blood; (i) Group A, dehydratic (PCV < 45%) and (ii) Group B, heavy dehydratic (PCV 45%-6). Secondly, each group was divided randomly into two subgroups; A1 (n=11), A2 (n=12), B1 (n=12) and B2 (n=12) for oral and parenteral fluid applications. The patients were monitored for three days during treatment periods.

**Fluid-Electrolyte Therapy:** The therapy was applied both in oral (PO) and in parenteral (intravenous - IV) ways. In these ways, similar fluid-electrolyte combinations were used for rehydration. For PO way, equal amounts of isotonic NaCl (0.9%), NaHCO3 (1.4%) and Saccarose (as sugar) (5%) solutions were used for the recovery. For IV way, equal amounts of isotonic NaCl, NaHCO3 and Dextrose (5%) solutions were used.

The protocols of fluid-electrolyte combinations (per 10 kg bw/day) were as follows; Group A1: 1000 ml PO, Group A2: 1000 ml IV, Group B1: 100 ml IV + 900 ml PO, and Group B2: 1000 ml IV.

**Antibacterial Therapy:** 7.5 mg/kg b.w. Gentamicine sulphate was used IM for all groups (9).

**Blood sample collection:** Blood samples were collected from the jugular vein with or without EDTA (10mg/10ml blood). The PCV, hemoglobin (Hb), total leukocyte (TL), erythrocyte numbers and other hematological parameters were determined by using the whole blood according to the criteria of Kelly (11). The plasma was separated from the blood with EDTA by centrifuge device at 3000 tour/minute for five minute and used for analyses of the levels of sodium (Na), potassium (K), chlorine (Cl), urea and bicarbonate (HCO3) by SAPOLYTE Na/K/Cl analyzer and COBAS MIRA auto analyzer.

**Evaluation of Clinical Dehydration:** Clinical dehydration findings (sunken eyes, skin turgor) were classified as: (0) zero, 1, 2, 3, 4, 5 according to the severity of dehydration (5 being the most dehydratic cases).

**Statistical analysis:** Two-sample t-test was used for statistical analysis (13).

**RESULTS**

Data from the parameters of diarrhoeic and dehydratic calves in the first and the last days of treatment were illustrated in Table 1.

**DISCUSSION**

During and after the treatment, one calf from group B1 and
two calves from group B2 died. The conditions of these animals were the weakest (at the last stage of dehydration) of their own groups based on the clinical and laboratory findings. Therefore, the percentage of survival rates in Groups A1, A2, B1 and B2 were 100, 100, 91.7, and 83.3%, respectively. These results indicate that the survival rates were quite high. The reason for this might either be that oral fluid therapy were applied in the early stages of diarrhoea or that calves were successfully hydrated following parenteral fluid therapy. It has also been reported that severely dehydrated or agonic calves may not respond favourably to oral fluid therapy (4). Data from group A1 were in parallel with this conclusion, but data from group B1 were not. Since group B1 has received only a small amount of fluid-electrolyte combinations via IV and hydration of calves in this group would not be sufficient for full rehydration. For these calves (group A1 and B1), total amount of fluid-electrolyte application were not more than those of group A2 and B2. However, the results of both therapy protocols were not dissimilar between these groups. Likewise, the survival rate in group B1 was considerably higher than that of group B2. This observation might be disregarded as the calves were assigned randomly in group B1 and B2.

At the first day of therapy, plasma sodium and chloride levels were below the normal. This condition may be related to insufficient absorption caused by diarrhoea and passage with the urine. At the last day, these levels returned to the normal values following the therapy.

It has been reported in diarrhoeic calves that, potassium levels are higher than the normal at the beginning, but they decreased following the therapies. PCV, Hb, plasma urea levels due to inadequate renal perfusion (2). In the present study, while plasma urea levels of all groups were high at the first days of treatments, the levels decreased following the therapies. PCV, Hb, erythrocyte count and dehydration is parallel parameters to each other. This were also confirmed with the present findings. MCH, MCHC and MCV values were at their normal ranges at the first and the last days. These results indicate that the disease did not affect erythrocyte construction (4).

Considering the parameters studied, there were no statistical differences between both groups A1 and A2 and groups B1 and B2 prior to treatments. In addition, clinical and laboratory findings tended to be at their normal levels during the course of treatments. At the end of the study, no marked differences were found between the last days’ results of all groups. These results indicate that PO applications were as efficient as i.v. applications for treatment of dehydration in calves (Table 1). This might be due to; (i) the absorption of PO fluid-electrolyte solution was as much as the patients need from the intestines, (ii) isotonic feature of the solution allowing easier absorption, (iii) the solution’s minimum load on the circulation system including the hearth and (iv) an easier conversion of saccharose to glucose in gut and metabolism.

**Conclusion:** The findings of the present study suggest that the protocols of PO and IV, fluid therapy are equally effective in diarrhoeic and dehydratic calves. Thus, oral solution of the equal amounts of isotonic NaCl (0.9%), NaHCO₃ (1.4%) and Saccharose (as sugar) (5%) are safely recommendable for fluid-electrolyte replacement, as with the equal amounts of isotonic NaCl (0.9%), NaHCO₃ (1.4%) and Dextrose (5%) intravenous solution. But, a small amount of i.v. solution have to be given to severely dehydratic patients with PCV <45%. So vital therapy for rehydration of dehydrated calves with diarrhoea can provide rather cheap by helping of a small market and drinking water.

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**REFERENCES**

Table 1: Biochemical and haematological data of diarrhoeic and dehydratic calves in the first and last days of oral and parenteral fluid therapy (X±Sx).

**Parenteral and oral svi tedavisinin ilk ve sonuncu günlerinde ishalli ve dehidratik buzagilarin biyokimyasal ve hematojik verileri (X±Sx).**

<table>
<thead>
<tr>
<th></th>
<th>First day</th>
<th>Last day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na (mEq/l)</td>
<td>128.65± 2.09</td>
<td>131.05± 1.86</td>
</tr>
<tr>
<td>K (mEq/l)</td>
<td>5.17± 0.19</td>
<td>5.08± 0.15</td>
</tr>
<tr>
<td>Cl (mEq/l)</td>
<td>98.35± 1.17</td>
<td>94.94± 0.72</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>63.73± 5.41</td>
<td>62.67± 3.55</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>13.77± 0.57</td>
<td>13.83± 0.47</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>37.73± 0.94</td>
<td>38.08± 1.08</td>
</tr>
<tr>
<td>Erythrocyte (10³/mm³)</td>
<td>9.58± 0.41</td>
<td>9.43± 0.28</td>
</tr>
<tr>
<td>TL (10³/mm³)</td>
<td>91.58± 4.56</td>
<td>92.75± 4.15</td>
</tr>
<tr>
<td>HCO₃⁻ (mEq/l)</td>
<td>14.28± 1.07</td>
<td>15.06± 0.97</td>
</tr>
<tr>
<td>MCH (µg)</td>
<td>14.77± 1.10</td>
<td>14.83± 0.66</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>36.81± 1.57</td>
<td>36.54± 1.40</td>
</tr>
<tr>
<td>MCV (µ³)</td>
<td>40.14± 2.14</td>
<td>40.70± 1.37</td>
</tr>
<tr>
<td>Dehydratio n degree</td>
<td>3.55± 0.16</td>
<td>3.58± 0.23</td>
</tr>
</tbody>
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Differences between the values having the same letter in the same line are not statistically significant (p>0.05).