Effects of transportation induced stress in electrocardiography data and blood parameters in Kangal Akkaraman sheep breed

Mustafa KOÇKAYA

Sivas Cumhuriyet University, Faculty of Veterinary Medicine, Department of Veterinary Physiology, 58140, Sivas/TURKEY

INTRODUCTION

Sheep husbandry in Turkey is generally maintained in non-agricultural plains and in pastoral countryside. Sheep husbandry is contributing to the national economy and the feeding of the populace by providing meat, milk, and wool products. Kangal Akkaraman sheep breed contributes to 45.8% of all sheep population in Turkey (2, 12, 20).

Transportation of livestock is one of the critical elements conducted in agricultural establishments, and is one of the factors that affects the wellness of animals by inducing stress factors in animals (8, 13, 14, 15, 23). Stress as a term is described as the behavioral, physiological, and mental responses from the animal against anything that perceived as a threat (30). Transportation duration is the crucial factor that determines the stress inducement from the transportation. Especially animals that are not used to transportation would be affected by intensive stress during the first hours of the transportation (4). Such a condition in turn results in certain physiological and biochemical responses displayed by animals. Once the stress is induced, alterations in many physiological and biochemical parameters become apparent due to the activities of sympathetic nervous system and hormonal changes (9, 24). Metabolic alterations caused by the transportation induced stress can be determined by the detection of changes in physiological ranges of certain biochemical molecules in the blood (3, 18, 21).

During the initial hours of the transportation, heart pulse rates of sheep are known to be increased, which was stated to occur due to induced stress in animals (17). Electrocardiography (ECG) is a method that records the action potentials of the heart during its pulsing which enables the evaluation of the action potentials and the electrical activity of the heart along with some degree of its functional state (32). By utilizing the ECG method, many physiological conditions related to the heart can be determined (7, 22, 26, 29). No study was found in literature related to the physiological parameter changes caused by transportation induced stress in Kangal Akkaraman sheep breed. Therefore in this study, it was aimed to investigate the effects of the transportation induced stress in Kangal Akkaraman sheep breed in both blood parameters and ECG data.

MATERIALS and METHODS

The sheep used in the study were obtained from the sheep husband Mehmet Sahin in Sivas province. A total of 36 clinically healthy Kangal Akkaraman sheep aging between 1 to 3 years were selected. Animal experimentations were approved by the Local Ethics Committee for Animal Experimentations of Cumhuriyet University with issue number of 65202830-050.04.04-248 in February 21, 2019.

The ECG data of the sheep were recorded by using holder device (Televet II, KRUUSE, Denmark) in their resting perio-
**Table 1. Differences in the ECG data obtained from the sheep in their resting periods, and during 30 and 120 minutes transportations.**

<table>
<thead>
<tr>
<th>ECG datas</th>
<th>Resting state (Mean ± SEM)</th>
<th>30 min. (Mean ± SEM)</th>
<th>120 min. (Mean ± SEM)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P wave duration (s)</td>
<td>0.042 ± 0.000222</td>
<td>0.038 ± 0.000276</td>
<td>0.040 ± 0.000314</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P wave amplitude (mV)</td>
<td>0.221 ± 0.000561</td>
<td>0.184 ± 0.000384</td>
<td>0.191 ± 0.000494</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>QRS complex duration (s)</td>
<td>0.069 ± 0.000120</td>
<td>0.068 ± 0.000113</td>
<td>0.069 ± 0.000120</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>T wave duration (s)</td>
<td>0.068 ± 0.000113</td>
<td>0.067 ± 0.000132</td>
<td>0.068 ± 0.000113</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PR intervals duration (s)</td>
<td>0.144 ± 0.000898</td>
<td>0.126 ± 0.000897</td>
<td>0.135 ± 0.000813</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>QT intervals duration (s)</td>
<td>0.205 ± 0.000538</td>
<td>0.198 ± 0.000447</td>
<td>0.204 ± 0.000329</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>131.03 ± 0.773</td>
<td>180.00 ± 1.076</td>
<td>143.00 ± 0.556</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

SEM: standard error of mean, N: number of Kangal Akkaraman sheep, mm: millimeter, s: second, mV: millivolt, bpm: beats per minute. Superscripts denotes the statistical significance.

Table 2. Differences in the blood serum levels obtained from the sheep in their resting periods, and after the 30 and 120 minutes transportations.

<table>
<thead>
<tr>
<th>Blood Serum Parameters</th>
<th>Resting state (Mean ± SEM)</th>
<th>30 min. (Mean ± SEM)</th>
<th>120 min. (Mean ± SEM)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mg/dL)</td>
<td>64.47 ± 1.03</td>
<td>107.94 ± 0.75</td>
<td>92.78 ± 1.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total Protein (g/dL)</td>
<td>5.89 ± 0.04</td>
<td>5.90 ± 0.04</td>
<td>6.68 ± 0.09</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Albumine (g/dL)</td>
<td>2.76 ± 0.02</td>
<td>2.76 ± 0.02</td>
<td>3.32 ± 0.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood Urea Nitrogen (mg/dL)</td>
<td>18.56 ± 0.71</td>
<td>18.29 ± 0.80</td>
<td>19.08 ± 0.73</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Creatinin (mg/dL)</td>
<td>1.21 ± 0.01</td>
<td>1.21 ± 0.01</td>
<td>1.23 ± 0.01</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

SEM: standard error of mean, N: number of Kangal Akkaraman sheep, mm: millimeter, s: second, mV: millivolt, bpm: beats per minute. Superscripts denotes the statistical significance.

Blood glucose, total protein, albumine, blood urea nitrogen, and creatinine levels in obtained blood serum samples were determined by using biochemical autoanalyzer (Mindray BS200, PRC).

**Statistical Analyses**

Mean and standard error values of all groups were given and intergroup differences were determined by using Paired Samples t-Test. All the tests were conducted by using the SPSS v.22 package software (27).

**RESULTS**

In Table 1, differences in the ECG data obtained from the sheep in their resting periods, and during 30 minutes and 120 minutes transportation periods were shown. For each group shown, significant differences were observed for the durations of PR, QT intervals and P-wave, T-wave and QRS complex, in P-wave amplitude, and in heart pulse count per minute. When compared to the resting period values, durations of PR, QT intervals and the P-wave were observed as shorter in 30 and 120 minutes transportation groups, and these datas were observed as shorter in 30 minutes transportation group compared to the 120 minutes transportation group. These differences were determined as significant (P<0.001, P<0.01). Amplitudes of the P-wave were observed as shorter in 30 minutes transportation.
values in both 30 and 120 minutes transportations were observed as higher compared to resting periods. The same data in 30 minutes transportation were observed as higher compared to 120 minutes transportation. These differences were determined as significant ($p<0.001$).

In Table 2, differences in the blood serum levels obtained from the sheep in their resting periods, and after the 30 minutes and 120 minutes transportation periods were shown. Significant differences for each group were determined in blood glucose levels. Blood serum glucose levels in resting periods were observed lower compared to both 30 and 120 minutes transportation periods. Blood serum glucose levels after 120 minutes transportations were observed as lower compared to 30 minutes transportation. These differences were determined as significant ($P<0.001$). After 120 minutes transportation serum total protein, albumin, and creatinine levels were observed as higher compared to the values from the resting periods and after 30 minutes transportation. These differences were determined as significant ($P<0.001$, $P<0.05$, $P<0.01$). No significant difference was determined for serum blood urea nitrogen levels in each group ($P>0.05$).

DISCUSSION

Transportation is a process that includes stress inducing physiological stimulants which result in alterations in both metabolism and homeostasis of affected animals (6, 25, 31). It was stated that the plasma cortisol levels of sheep elevate significantly in the first 20 minutes of the transportation and stays elevated for the first 24 hours after the transportation (4, 11). This indicates that the stress inducement significantly elevates certain physiological parameters, these parameters alter in the first 20 minutes of the transportation. Several studies reported that the heart pulse count per minute elevates initially during the transportation, then gradually decreases from the elevated counts in the first 30 to 60 minutes of the transportation, and becomes fixated in 10 to 25% higher than normal rates (5, 8, 16). In our study, the highest heart pulse counts were obtained during the 30 minutes transportation which were higher than the 120 minutes transportation counts. Similarly, heart pulse counts during the 120 minutes transportation were higher than the counts in resting periods. These results are in accordance with the available literature, and it is thought that the significant increase of heart pulse counts in the first 30 minutes of transportation was due to the transport induced stress. Gradual decrease in heart pulse counts in later stages of the transportation was thought to be due to adaptation of animals to the transportation. It was stated that the ECG data could be altered according to factors that would change the heart pulse counts per minutes such as age, gender, stress, drug administration etc. (1, 10, 22, 26, 28). Different studies reported in their respective studies that the durations of P and T-waves, QRS complex, PR, QT, and ST intervals, the amplitudes of P and T-waves decrease when the heart pulse counts per minute increase (10, 22, 28). Similarly in our study, the groups of higher heart pulse counts per minutes were provided with shorter durations for P and T-waves, QRS complex, PR and QT intervals, and with lower amplitude for P-wave.

Noyan (2008) stated that the stress results in various physiological and biochemical changes like increases in blood glucose levels due to the activity of sympathetic nervous system and the hormonal changes. Previous studies indicated that the transportation of animals results in changes in various blood parameters (3-5, 8, 19, 21, 23). Ali-Gholi et al. (2007) reported that the blood glucose levels increase during the initial stages of the transportation, then gradually decrease but stay fixed in higher levels compared to pre-transportation levels. In the present study, the blood glucose levels obtained after the 30 minutes transportation were the highest, while the blood glucose levels obtained after 120 minutes transportation were higher compared to resting period levels. Many studies reported in their respective studies that levels of serum total protein, albumin, and creatinine increase as the duration of the transportation increases (19, 21, 23). Similarly, these values in our study obtained after 120 minutes transportation were higher compared to other groups. Even though Haydardedeoşglu et al. (2017) reported that the blood urea nitrogen levels would increase as the transportation duration increases, in our study no significant difference was determined for blood urea nitrogen levels for each group. This was attributed to the shorter duration transportation in our study compared to others.

In conclusion, it was determined that the ECG data and blood parameters change in Kangal Akkaraman sheep breed by transportation induced stress in relation to the transportation duration. It would be beneficial to take these parameters into consideration for animal transportations.

REFERENCES


