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ELECTRIC STIMULATION OF RUMEN IN CALVES

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Abstract

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The effects of telemetric registration and electric stimulation on rumen motility were studied in calves up to 2 months of age. Electric impulses were found to exercise a positive effect on the frequency of rumen contractions and their total motility. Experiments were carried out on both clinically healthy calves and calves with gastrointestinal disorders.

Key words: electrical stimulation, rumen motility, telemetry

Introduction

Newborn calves often have gastrointestinal disorders due to nutrition malpractice such as excess feeding, uptake of large milk doses and violation of hygienic requirements, etc. Chemical treatment of these disorders, leading to enteritis, etc., is not always successful. Hence, the need for an alternative independent or combined therapy. Physiotherapeutic methods, especially electric impulses, are among them. There is little information about this in the literature we have access to.

Our objective was to study the effect of low frequency impulse currents on calf rumen motility.

Material and Methods

The research was carried out on 8 Black-and-White calves up to the 60th day after birth. Rumen contraction records were made by means of a telemetric system of our own construction (Kostov and Bodurov, 1977).

The electric stimulation of rumen was done by means of a transistor stimulator of our own construction (Kostov, 1983). The shape of electric impulses was orthogonal with frequency 50 Hz and current power 2 – 3 mA. One of the electrodes (+) – a stainless steel cylinder with an area of 1.5 cm² – was placed close to the balloon of the telemetric probe. It was inserted under local anesthesia into the calf's rumen through one of the nostrils and the esophagus. The other electrode (-) with dimensions of 50 cm², was placed in a cotton pouch soaked with physiological solution and positioned in the area of the back line between the scapulae of the front limbs. The point of electrode positioning was wiped and washed. The duration of electrical stimulation was 7 min.

Total rumen motility (units) was evaluated on the basis of the following indexes: contraction frequency for 5 min (f), contraction duration (t) and amplitude (a) and expressed with the following formula with their average values:

$$A = f \times t \times a$$

Data were processed by the methods of variation statistics.

Results

Data on electric stimulation of rumen are given in Table 1. It shows that total motility prior to stimulation was 301.12 ± 31.77 units. It increased at the time of stimulation with a significant difference of this index towards the 30th min - 485.40 ± 64.91 units, $P \leq 0.05$. Higher values of this index were recorded towards the 1st hour after stimulation.

The increase of total motility took place at the expense of rumen contraction frequency, which was

4. $37 \pm 0.14 \text{ min}^{-1}$ prior to electric stimulation. It increased at the time of stimulation and reached the mathematically proven value of $5.80 \pm 0.51 \text{ min}^{-1}$, $P \leq 0.05$ on the 30th min.

The changes of the remaining indexes of total motility, i.e. duration and amplitude of rumen contractions, were insignificant.

Figure 1 shows rumen motility of a healthy calf with electric stimulation. Line 1 of the figure shows spontaneous rumen contractions with amplitude of up to 10 mmHg. Contraction duration was about 10 s. Their shape was sharp-peaked. Breathing and other body

movements were registered on the output line. Line 2 of the figure shows a record of calf's rumen during electrical stimulation. Number of contractions increased while the interval between them decreased. Contraction frequency increased almost twice towards the 40th minute of the stimulation (Line 3). At the end of the record, the output line was shifted because of calf's lying position. The frequency of rumen motility was the same in the 3rd hour after stimulation (Line 4).

Electric stimulation of calf rumen post enteritis is shown on Figure 2. Line 1 on the figure is a record of rumen contractions prior to electric stimulation. They have a sharp-peak shape and normal frequency. Contraction amplitude is comparatively low – 6-7 mmHg. Line 2 has recorded the increase of total rumen tone during electric stimulation, expressed as a rise of the output line in the record, followed by multiple rumen contractions with amplitude of 5 mmHg at first contraction. On the 30th minute of electric stimulation (line 3), the number of contractions and their amplitude increased.

Gastrointestinal diseases cause substantial changes in rumen motility. In such cases, the number of rumen contractions and their amplitude decrease significantly. This is clearly exhibited by the records of Figure 3. The record of Line 1 of the figure was made before

Table 1
Dynamics of rumen contractions in calves after electric stimulation

(\bar{X} ; $S\bar{x}$)

Parameters	Electric stimulation			
	Before electric stimulation	At the time of electric stimulation	30 min after electric stimulation	1 h after electric stimulation
Number of animals (n)	8.00	8.00	8.00	8.00
Total motility (unit)	301.12 ± 31.77	398.75 ± 30.73	485.40* ± 64.91	604.80* ± 97.50
Frequency of rumen contractions (min^{-1})	4.37 ± 0.14	5.56 ± 0.28	5.80* ± 0.51	5.40* ± 0.10
Duration of rumen contractions (s)	10.06 ± 0.65	10.05 ± 0.50	10.80 ± 0.48	10.50 ± 0.56
Amplitude of rumen contractions (mmHg)	7.12 ± 0.58	7.00 ± 0.65	7.80 ± 0.96	9.00 ± 0.95

* $P \leq 0.05$

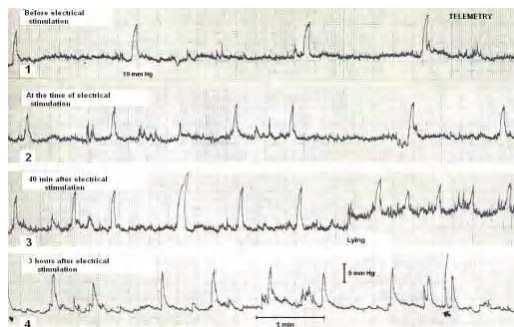


Fig. 1. Electric stimulation of the rumen of a healthy calf:

- 1) Before of the electrical stimulation,
- 2) At the time of electrical stimulation,
- 3) 40 min after electrical stimulation,
- 4) 3 hours after electrical stimulation

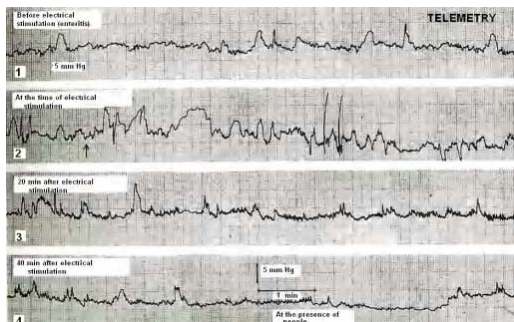


Fig. 3. Rumen contractions of a calf with gastrointestinal disorder (enteritis):

- 1) Before of the electrical stimulation,
- 2) At the time of electrical stimulation,
- 3) 20 min after electrical stimulation,
- 4) 40 min after electrical stimulation

the electric stimulation and shows 4 rumen contractions with amplitude of 5 mmHg and longer duration. Contraction shape is rounded, no sharp peaks. Electric stimulation (Line 2) caused total toning up of the organ as well as the appearance of a series of contraction waves of small amplitude. Line 3 shows the increase of rumen contraction frequency in the 20th minute of electric stimulation without any changes in

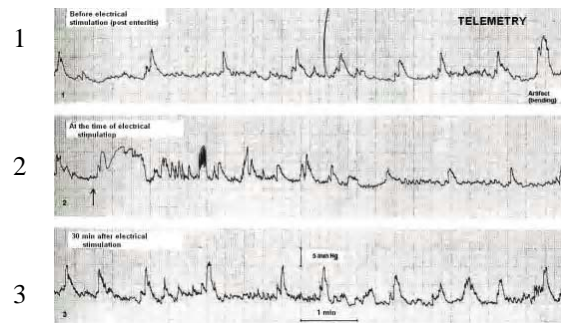


Fig. 2. Rumen contractions of a calf with a history of gastrointestinal disorders (post enteritis):

- 1) Before of the electrical stimulation,
- 2) At the time of electrical stimulation,
- 3) 30 min after electrical stimulation

amplitude. This peculiarity persisted in the 40th minute of electric stimulation (Line 4). Therefore, emerged rumen motility was unstable. The presence of people was enough to interrupt it and it could be restored only after eliminating the reasons that caused it.

Discussion

The positive effect of impulse currents on rumen motility can be explained with the indirect irritative effect on the afferent branches of *n. vagus*, on the one hand, and a possible effect on some tissue hormones and rumen walls vascularity, etc., on the other. The reason for this is the conditional-reflector effect on fragile motility that appeared after electric stimulation of calves with gastro-intestinal disorders.

As seen from the results, this method of rumen electric stimulation lead to a total toning up of the organ prior to the regular increase of the frequency of rumen contractions and this was better expressed in calves with gastrointestinal disorders.

Total motility increased significantly towards the 30th minute of stimulation and remained unaltered for the next several hours.

Low frequency impulse currents can be used for motility stimulation of calf rumen, especially in cases of gastrointestinal disorders.

Conclusion

Low frequency impulse currents cause increase of total rumen motility in calves. It increases several minutes after electric stimulation due to enhanced rumen contraction frequency.

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