PARADOXICAL EFFECT OF PARTIAL VAGAL BLOCKADE ON RUMINAL MOTILITY

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Introduction

Nervous control of recticuloruminal motility is commonly known. Atropinisation or short time blockade of vagal conductivity abolishes electrical and mechanical activity of the reticulorumen (see Ruckebusch, 1983; Leek, 1987). Unfortunately nearly all experiments with vagal blockade were done as acute ones and anaesthesia might interfere with the results. Besides the vagal blockade was complete – so intermediate effects were not observed.

Methods

The experiments were carried out on four sheep. Two bipolar stimulating/recording electrodes and a cooling device between them were placed on right cervical vagus. Then right laryngeal recurrent nerve and right sympathetic trunk were cut. Left thoracic vagi were cut in the next surgery.

About two weeks after the last surgery the recording of evoked potentials of vagus during supra maximal stimulation in different temperatures started (Podgurniak, 1988). After examination of neutral conductivity, intraruminal pressure during spontaneous reticuloruminal contractions was recorded in the second part of experiment. The pressure was monitored via a needle of 1 mm external diameter introduced to the rumen through the abdominal wall at the beginning of each experiment and connected to the recording system with combined liquid and air transmission (figure 1). During the experiments the temperature of vagus was maintained at 37, 20, 12 and 3°C.

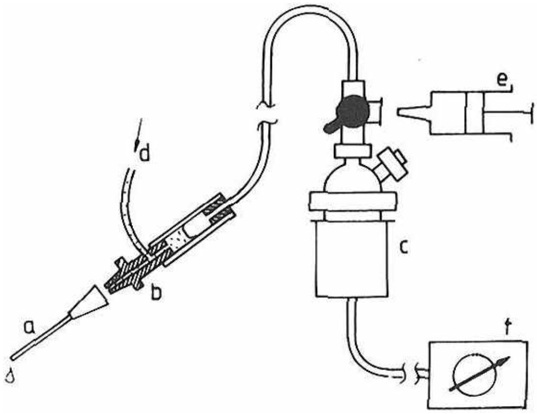

Figure 1. Scheme of the intraruminal pressure registration system.
a – needle, b – connector, c – pressure transducer, d – flushing inflow, e – syringe for air supplementation, f – electromanometer.

Results and Discussion

Averaged responses of vagal B-fibers in different temperatures of cooling device are presented in figure 2. The temperature of 12°C significantly depressed vagal conductivity decreasing the amplitude of evoked nerve trunk potentials about twice and of 3°C completly inhibited it. The inhibition was fully reversible.

Diminution of vagal nerve temperature to 20°C did not influence the ruminal contractions. Further cooling up to 15-10°C lead to an unexpected result: increase of the force of contractions. In the temperatures lower then 5°C no ruminal contractions were present and the resting intraruminal pressure started to rise. Successive rewarming of the vagus to physiological temperature restored the normal motility. The resting pressure came back to normal after first eructations (figure 3).

Several explanations of the mechanism of presented phenomenon are possible. First – cooling of vagus evokes firing of irritated efferent neurons. However the spontaneous spikes of this

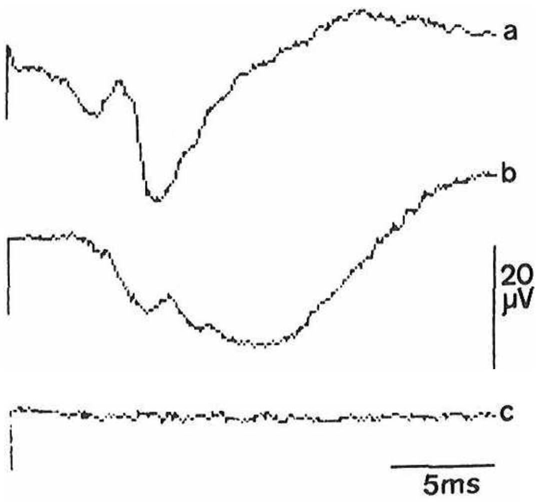

Figure 2. Averaged (n=64) responses of vagal B-fibers to supramaximal stimulation. Temperatures of cooling device: a – 37°C; b – 12°C and c – 3°C.

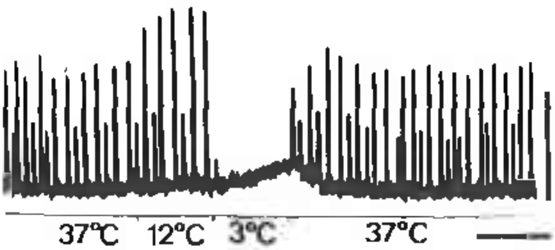

Figure 3. *Intraruminal pressure during vagal cooling.* Calibration: 10 min and 1 kP.

kind do not appear in any cooled neurons (Paintal, 1965) and there was no increase of resting pressure during this period of cooling in experiment presented above. Second – the inhibitory fibers have higher blocking temperatures and are blocked earlier, but no continuously active neurons which could be called inhibitory ones have been demonstrated in the reticuloruminal vagal branches in sheep (Iggo and Leek, 1967). This fact does not exclude the existence of inhibitory fibers active during the contraction only. Third and most probable theory is the existence of feedback mechanism regulating the force of ruminal contractions. Cooling of the vagal nerve supresses both efferent and afferent neurons and in contrast to experiments with atropine or other substances blocking efferent control, diminishes the afferently conducted information of the force of contraction. This in turn can increase the efferent excitatory impulsation.

To confirm this hypothesis a short time selective blockade of afferent pathways is still necessary.

(Key Words: Vagal Blockade, Ruminal Motility, Sheep)

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