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## EFFECT OF ARTERIAL BLOOD LOSS ON MYOELECTRICAL ACTIVITY OF THE PYLORIC SPHINCTER AND DUODENUM

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Blood loss is a stress factor which may lead to gastric and duodenal ulcer formation [3, 9, 13-15]. Arterial blood loss leads to considerable release of catecholamines [8, 9, 15], which predominantly inhibit the motor function of the gastrointestinal tract [1, 2, 5, 7, 12] and take part in ulcer formation [4, 6, 13]. Meanwhile the effect of this stress factor on motor function of the pyloroduodenal zone (which is most vulnerable to ulcer formation) has not been fully explained. The aim of this investigation was to study changes in electrical activity of smooth muscles of the pyloric sphincter and duodenum under the influence of arterial blood loss.

### EXPERIMENTAL METHOD

Chronic experiments were carried out on six male rabbits weighing 2.6-3.2 kg. Two weeks before the experiment silver loop electrodes were implanted into the smooth muscles under the serous membrane of the pyloric sphincter and duodenum, by a method described previously [10, 11]. Electrical activity of the smooth muscles of the pyloroduodenal zone was recorded on an encephalograph at a speed of 7.5 mm/sec, with time constant of 0.3 sec. The rabbits received the normal diet (vegetables, oats, hay) and were used in the experiments without any preliminary limitation of food intake. One week before the experiments the right common carotid artery was exteriorized in the neck into a skin bridge 2-3 cm long. Blood loss was produced by puncture of this vessel in animals immobilized in the supine position by the method in [3]. The blood loss amounted to about 5, 10, and 25% of the total blood volume, and it lasted not more than 2 min. Electrical potentials of the smooth muscles of the sphincter and duodenum were recorded for 1 h before blood loss, during blood loss, and for 1 h thereafter. The frequency of bursts of action potentials of smooth muscles of the pyloric sphincter and duodenum was analyzed before and after blood loss, and the pulse rate (as an indicator of activation of the adrenergic system) was recorded on the electrocardiogram. The statistical significance of differences of the means was estimated by Student's test with a level of significance of 95%.

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TABLE 1. Frequency of Bursts of Action Potentials of Smooth Muscles of Pyloric Sphincter and Duodenum before and after Blood Loss ( $M \pm m$ )

Magnitude of blood loss	Number of experiment	Location of electrodes	Frequency of bursts of action potentials ( $\text{min}^{-1}$ )			
			before blood loss (control)	after blood loss		
				at 10th min.	at 30th min	at 60th min
5	9	Pyloric sphincter	$2.7 \pm 0.4$ (100 %)	$1.3 \pm 0.3^*$ (48 %)	$2.6 \pm 0.5$ (96 %)	$2.2 \pm 0.7$ (81 %)
		Duodenum	$6.6 \pm 0.8$ (100 %)	$3.3 \pm 0.4^*$ (50 %)	$4.7 \pm 0.6^*$ (71 %)	$5.3 \pm 0.8$ (80 %)
10	6	Pyloric sphincter	$2.7 \pm 0.5$ (100 %)	$0.7 \pm 0.2^*$ (26 %)	$1.2 \pm 0.3^*$ (44 %)	$2.1 \pm 0.5^*$ (78 %)
		Duodenum	$6.5 \pm 0.7$ (100 %)	$5.1 \pm 0.6^*$ (78 %)	$4.5 \pm 0.5^*$ (69 %)	$6.6 \pm 0.7$ (101 %)
25	7	Pyloric sphincter	$2.6 \pm 0.5$ (100 %)	$0.5 \pm 0.2^*$ (19 %)	$1.1 \pm 0.3^*$ (42 %)	$1.0 \pm 0.4^*$ (40 %)
		Duodenum	$6.4 \pm 0.6$ (100 %)	$4.5 \pm 0.6^*$ (70 %)	$9.8 \pm 1.4^*$ (153 %)	$10.2 \pm 1.5^*$ (159 %)

Legend.  $*p < 0.05$  compared with control.

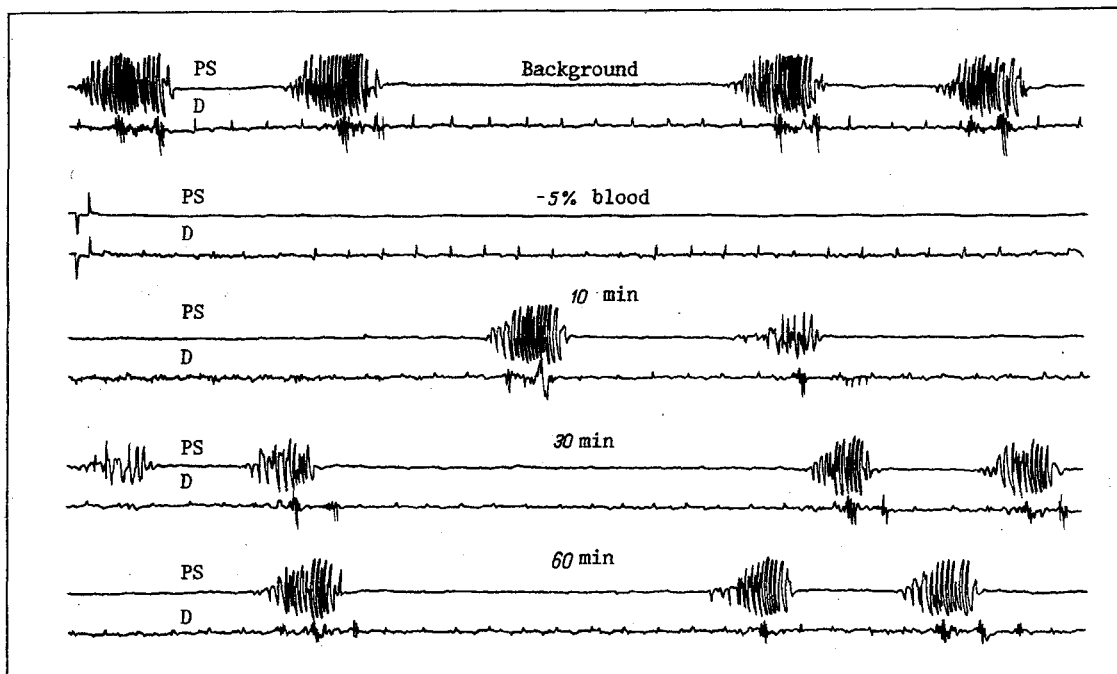


Fig. 1. Myoelectrical activity of pyloric sphincter and duodenum before, during, and 10, 30, and 60 min after 5% arterial blood loss. PS) Pyloric sphincter, D) duodenum. Time marker 1 sec, calibration  $500 \mu\text{V}$  (for all three figures).

## EXPERIMENTAL RESULTS

Arterial blood loss (5, 10, and 25% of the blood volume) caused biphasic changes in electrical activity of the smooth muscles of the pyloric sphincter and duodenum. The first phase of action of arterial blood loss was manifested as inhibition of activity of the pyloroduodenal zone, the second phase as gradual restoration of activity depending on the volume of blood lost.

In the control experiments, immobilization for 2 min without blood loss led to inhibition of activity of the sphincter and duodenum; complete recovery of this activity was observed during the first 5 min after exposure. The pulse rate rose during immobilization on average by 12% and was restored after 10-20 min.

Changes in activity of the sphincter and duodenum depending on the extent of blood loss were observed 10, 30, and 60 min after the procedure.

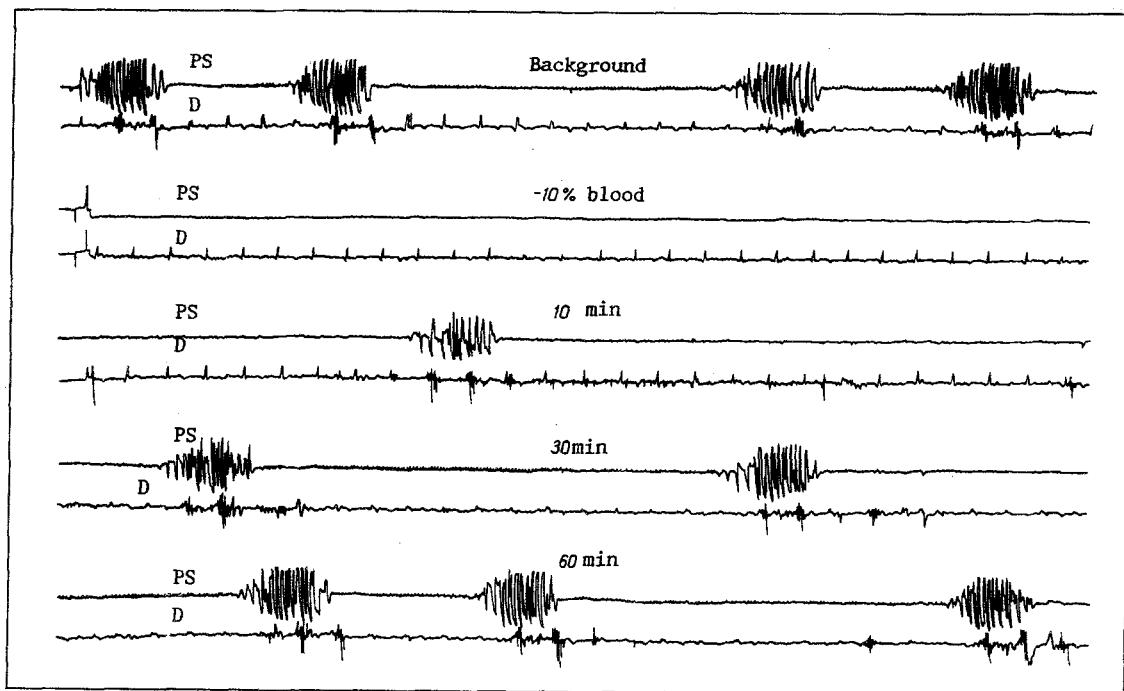


Fig. 2. Myoelectrical activity of pyloric sphincter and duodenum before, during, and 10, 30, and 60 min after 10% blood loss.

During 5% blood loss bursts of action potentials ceased completely both when recorded from the pylorus and from the duodenum (Fig. 1). At the 10th minute after the end of blood loss, about 50% of the bursts of action potentials from the sphincter and duodenum were restored. Recovery of activity of the sphincter was virtually complete at the 30th minute after this blood loss, whereas restoration of duodenal activity was incomplete. Activity of the smooth muscles of the pyloroduodenal zone 1 h after blood loss did not differ significantly from the control (Table 1). The pulse rate with 5% blood loss was increased on average by 19% and restored after 10-20 min.

Consequently, 5% arterial blood loss caused inhibition of activity of the smooth muscles of the pyloroduodenal zone, and this activity was restored 30-60 min after blood loss.

During 10% arterial blood loss complete disappearance of bursts of action potentials of the smooth muscles of the sphincter and duodenum was observed (Fig. 2). Activity of the sphincter was restored 10 min after the end of blood loss only one-third as strongly as duodenal activity. At the 30th minute after this blood loss the degree of recovery of duodenal activity was greater than that of the sphincter. Complete restoration of duodenal activity, accompanied by weakened activity of the sphincter was observed 1 h after blood loss (Table 1). The pulse rate after 10% blood loss was increased on average by 22%, and the normal rate was restored after 20-40 min.

Consequently, 10% arterial blood loss inhibited activity of muscles of the pyloroduodenal zone; recovery of activity of the duodenum after blood loss was more marked than that of the pyloric sphincter.

During 25% arterial blood loss complete inhibition of activity of muscles of the pyloroduodenal zone was observed (Fig. 3). Activity of the sphincter was restored 10 min after the end of blood loss 3.6 times less strongly than duodenal activity. At the 30th minute after this blood loss activity of the sphincter was restored by less than 50%, whereas duodenal activity exceeded the initial level by more than 1.5 times. Predominance of duodenal activity over that of the sphincter also persisted 1 h after this blood loss (Table 1). The pulse rate with 25% blood loss was increased on average by 39% and was not restored in the course of 60 min.

Consequently, 25% arterial blood loss caused inhibition of activity of muscles of the pyloroduodenal zone; duodenal activity, moreover, was restored by a greater degree than activity of the pyloric sphincter.

Thus the stressor action of arterial blood loss inhibits activity of smooth muscles of the pyloroduodenal zone, and judging by the tachycardia, this effect is connected with activation of the adrenergic system. Recovery of myogenic activity in the duodenum takes place more rapidly than in the sphincter, especially in the case of a large blood loss. These results are evidence

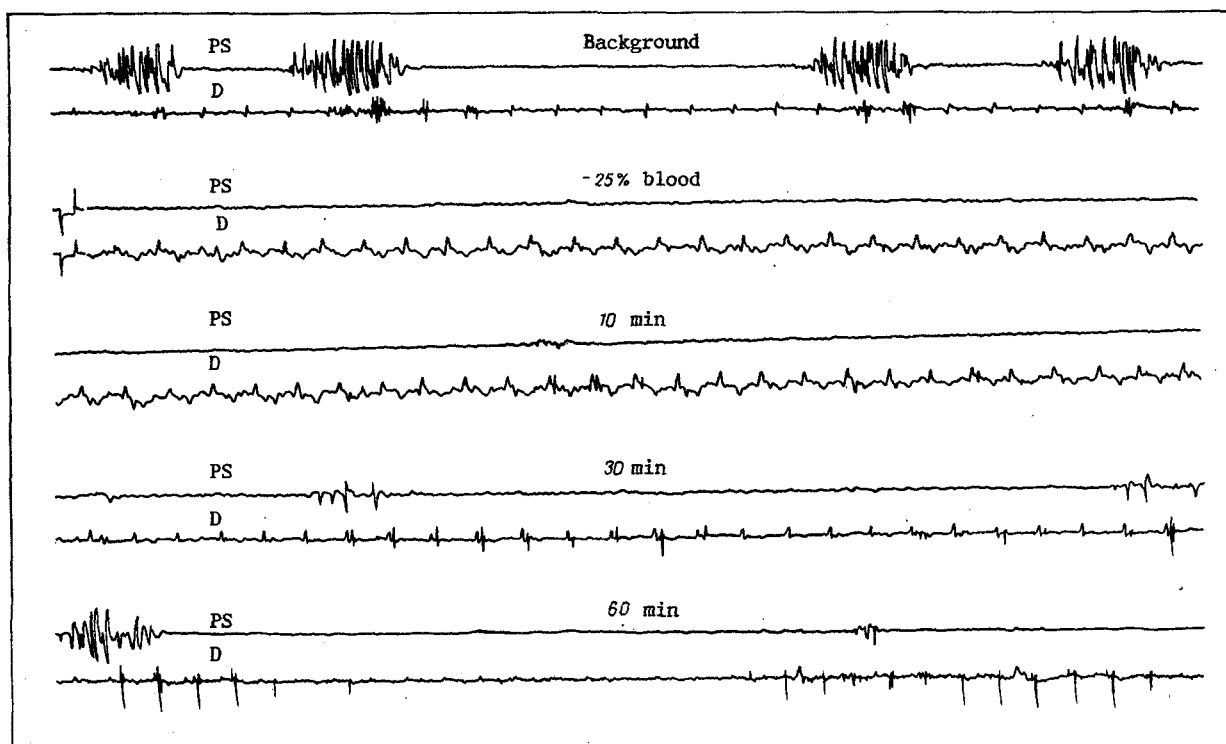


Fig. 3. Myoelectrical activity of pyloric sphincter and duodenum before, during, and 10, 30, and 60 min after 25% blood loss.

that blood loss can lead not only to inhibition of activity of muscles of the sphincter and duodenum, but can also give rise to duodenogastric dyskinesia, in the form of predominance of activity of the duodenum over that of the pyloric sphincter.

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