

THE STATE OF THE EVACUATORY FUNCTION OF THE STOMACH AFTER EXPERIMENTAL INTERFERENCE WITH ITS BLOOD SUPPLY

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With the widening of the field of surgical intervention on the abdominal organs, the study of the changes in the gastric function during disturbances of its blood supply has become of considerable interest. Several workers [7-9] have shown that the secretory function of the stomach is disturbed after experimental occlusion of its blood vessels. The evacuatory activity of this organ after occlusion of the blood vessels supplying it has received little study. It has been reported [3-5] that the evacuatory activity of the stomach is accelerated after partial, and also after subtotal, devascularization of the organ. A close relationship has been observed [1] between the state of the functions of the stomach and the reactions of its blood vessels.

For these reasons, we have studied the changes in the evacuatory function of the stomach after ligation of various groups of arteries supplying it.

EXPERIMENTAL METHOD

Experiments were conducted on 12 dogs with a fistula of the fundal part of the stomach, in which the reaction of the mucous membrane is weakly alkaline or neutral.

The state of the evacuatory activity was judged from the rate of movement of 200 ml of 2% lactic acid from the stomach into the duodenum, measured every 15 min. For this purpose, lactic acid solution, warmed to 37°, was introduced into the stomach through the fistula tube. The residual lactic acid was withdrawn into a measuring glass every 15 min, and after determination of its volume, color, and consistency, it was immediately returned to the stomach. The evacuatory power of the organ was estimated from the difference between the volumes of acid introduced and withdrawn. Evacuation was regarded as complete if the volume of lactic acid withdrawn into the measuring glass was equal to that introduced into the stomach, which amounted in our experiments to 25-30 ml.

After the initial background pattern of the evacuatory power of the stomach had been determined, in the experimental animals the arteries of the lesser (in 4 dogs) and greater (in 4 dogs) curvatures were ligated; in 4 dogs a subtotal devascularization of the stomach was performed. The repeated investigations began on the 5th-6th day after operation.

EXPERIMENTAL RESULTS

After occlusion of the arteries of the lesser curvature, the blood vessels otherwise being anatomically normal, marked changes in the activity of the stomach were observed. On the 5th day after the operation the evacuation of 200 ml of 2% lactic acid from the stomach into the duodenum was accelerated twice or three times by comparison with normal. The largest volume of fluid was evacuated during the first 15 min, and during the second and third 15-min periods evacuation was a little slower. Meanwhile the enzymic activity of the gastric juice fell; bile appeared more frequently in the stomach cavity.

During the next 2-6 weeks after operation, the evacuation of lactic acid was complete on the average after 62 min, compared with the normal 83 min.

Angiographic investigations of the changes in the structural pattern of the vascular system of the stomach after occlusion of the arteries of the lesser curvature showed that the blood supply to the organ was not merely restored — it was actually increased. The number of arterial trunks per unit of surface was increased, the vessels and their ana-

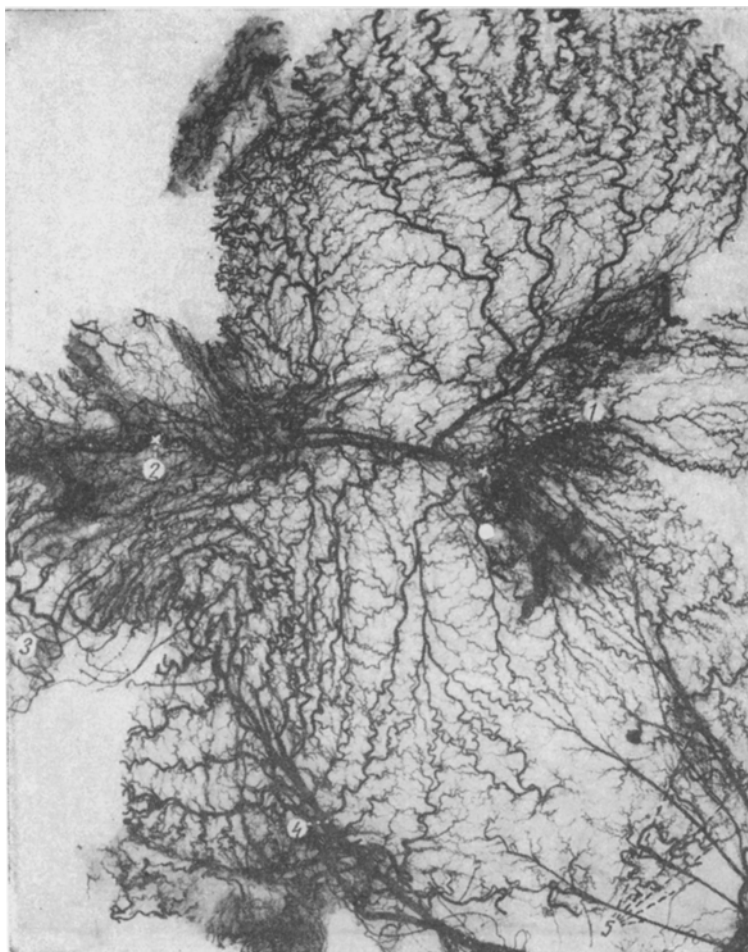


Fig. 1. Arterial system of the stomach of dog No. 1 on the 75th day after ligation of the vessels of the lesser curvature. 1/2 actual size. 1) Collaterals joining the two segments of the left gastric artery; 2) site of ligation of right gastric artery, O – site of ligation of left gastric artery; 3 and 4) right and left gastro-epiploic arteries; 5) short epiploic arteries of the stomach.

stomoses were dilated and tortuous, and the organ was overfilled with blood. Numerous anastomoses and collaterals developed (Fig. 1).

Later, as the neurovascular relationships became stabilized, the ventricular evacuation gradually slowed, and on the 56th-163rd day after occlusion of both gastric arteries it returned to its initial level.

To illustrate our findings we give below a table showing the evacuatory power of the stomach of dog No. 3 in normal conditions and after ligation of the arteries of the lesser curvature.

After occlusion of the arteries of the greater curvature of the stomach, the time taken to evacuate its contents was shortened on the average by 25 min. On the 5th day after the operation, transfer of the lactic acid to the duodenum occupied 30-60 min compared with the normal time of 87 min. From the 10th to the 29th day after operation, at a time of most rapid development of the collateral circulation, and of a sharp rise in the number of vascular trunks per unit of surface, a further acceleration of the evacuation of the stomach contents was observed in all the experimental animals (except in dog No. 7).

At the end of the first and beginning of the second month, evacuation was slowed, and on the 57th-129th day it returned to its original level, which coincided with the time of onset of relative stabilization of the vascular system of the stomach.

Evacuation of 200 ml of 2% Lactic Acid from the Stomach into the Duodenum after
Ligation of the Arteries of the Lesser Curvature (Dog No. 3)

Date of experiment (1957)	Vol. of fluid evacuated (in ml)					Duration of evac- uation (in min)	Days after operation
	in 1st	in 2nd	in 3rd	in 4th	in 2nd		
	15 min	15 min	15 min	15 min	hour		
In normal conditions							
28/VI	60	45	35	20	15	80	
4/VII	55	45	25	25	20	75	
7/VII	50	60	15	25	20	85	
10/VII	55	45	25	20	25	75	
15/VII	After ligation of arteries of the lesser curvature of the stomach						
19/VII	155	15	—	—	—	30	5
24/VII	170	—	—	—	—	15	10
29/VII	25	75	55	15	—	55	15
3/VIII	70	70	25	5	—	45	20
6/VIII	90	40	15	25	—	60	23
13/VIII	155	15	—	—	—	25	30
18/VIII	50	60	50	10	—	50	35
28/VIII	25	75	35	30	5	65	45
7/IX	55	45	25	25	20	75	55
17/IX	60	40	25	25	20	75	65

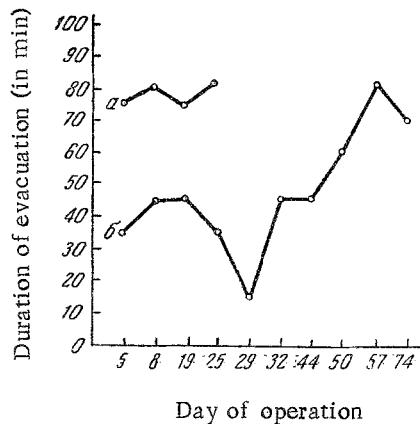


Fig. 2. Evacuatory function of the stomach of dog No. 8 in normal conditions (a) and after ligation of the arteries of the greater curvature (b).

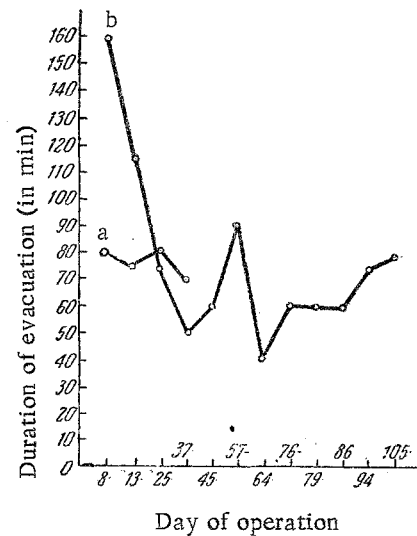


Fig. 3. Evacuatory function of the stomach of dog No. 9 in normal conditions (a) and after ligation of all its coronary and short gastric arteries (b).

In Fig. 2 we show the curves of evacuation of lactic acid from the stomach into the duodenum of dog No. 8 in normal conditions and after ligation of the right and left gastro-epiploic arteries together with the short gastric arteries.

After ligation of all the coronary arteries of the stomach and the short gastric arteries a depression of the evacuatory motor activity was observed, although angio-roentgenographic investigations revealed a well-defined vascular network. During the first 2-3 weeks, the gastric contents were retained for up to 2-2.5 h. With the development of new vascular channels, the blood supply to the organ improved, and this was accompanied by a 3-4-fold acceleration of gastric evacuation. The changes in the evacuatory activity of the stomach were most marked in dogs Nos. 9 and 12. In the first of these animals, on the 8th day after operation, the lactic acid sample was transferred to the duodenum from the stomach in 160 min by comparison with 76 min in normal conditions (Fig. 3).

Whereas in normal conditions almost half the gastric contents passed into the duodenum during the first 30-45 min, after subtotal devascularization of the stomach evacuation during the first 15 min was minimal; during the second and third 15-min periods complete inhibition was observed, and not until the end of the first hour did it reappear, increasing gradually during the second hour. The emptying time of the stomach regained its preoperative level 25 days after operation, and by the 37th day the rate of evacuation was almost doubled, being complete in 50 min. Under these circumstances, the transfer of the gastric contents to the intestine took place very rapidly; almost half the lactic acid introduced into the stomach left the organ during the first 15 min. On the 45th day, evacuation was slightly slowed (complete in 60 min), and on the 57th day it was complete in 90 min.

Hence, the occlusion of the arteries of the greater and lesser curvatures of the stomach, together or separately, led to a prolonged disturbance of its evacuatory power, notwithstanding the rapid restoration of the blood supply.

The changes in the evacuatory function were more marked and longer in duration after ligation of the arteries of the lesser curvature and subtotal devascularization. The left gastric artery is the principal source of the blood supply of the stomach, and its occlusion leads to changes in the nutrition of the wall in the region of the lesser curvature, where, according to some writers [2, 6], the motor "center" of the stomach is situated.

The important changes in the evacuatory function of the stomach after occlusion of all the coronary arteries of the organ and the short gastric arteries may be attributed to the more severe disturbances of the nutrition of the organ than after partial occlusion of the vessels. During the first few days after operation the number of collateral vessels opened up is still too small. The development of anoxia of the stomach walls therefore leads to depression of its evacuatory power. With the development of collaterals and improvement in the blood supply of the organ, the evacuatory power is not only restored, but actually increased, subsequently returning to its initial state.

SUMMARY

The evacuatory function of the stomach was studied on 12 fistular dogs both in separate and in simultaneous occlusion of arteries of the major and minor curvatures. Experiments carried out demonstrated that after occluding the majority of the main sources of stomach supply its circulation was rapidly restored due to the presence of a wide network of anastomoses and collaterals. However, the evacuatory function of the organ is deranged for 2.5-4 months. The passage of the stomach contents into the duodenum is accelerated.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.