Changes in Weight and Composition of Stomachs and Small Intestines of Rats after Vagotomy.* (25138)

J. E. C. DORCHESTER (Introduced by M. H. F. Friedman)
Dept. of Physiology, Jefferson Medical College, Philadelphia, Pa.

Recently we demonstrated that vagotomy resulted in decreased secretin but increased pancreozymin content of small intestine of the rat(1). Routine observations on stomachs revealed a substantial increase in weight of this organ in the vagotomized as compared to control animals. The present study was undertaken to confirm and extend this finding.

Methods. Female rats of Wistar strain were paired according to weight. A subdiaphragmatic bilateral vagectomy was performed on 1 member of each pair, a mock operation on the other. Vagotomized and control animals were maintained in individual cages on a paired feeding regimen for 7-63 days. Animals were fasted 12 hours before sacrifice. The rats were sacrificed in pairs, stomachs and intestines removed, and wet weight, dry weight, and weight of fat free residue of tissues determined. Weight of food residue was also noted. In 12 cases glandular and non-glandular stomachs were separated and weight measurements made for the 2 portions.

Results. Mean values for measurements are given in Table I.

Discussion. The results show that following vagotomy a marked increase in stomach tissue weight and a less dramatic reduction in intestinal tissue weight occurred. Changes in fat and water content, which in stomachs seem to have occurred in the glandular rather than muscular portion, are too small to account for changes in weight.

It is possible that mechanical distension due to retained food in some manner caused hypertrophy of the stomachs. However, in 2 vagotomized animals there was no evidence of food retention, yet the stomachs were enlarged.

It is obvious from the data that the observed weight changes in stomachs of vagotomized rats are not due to edema or fat deposition. Nitrogen determinations made on some of the fat free residues indicate that increase

TABLE I. Effect of Vagotomy on Weight and Composition of Stomachs and Small Intestines of Rats.

No. of pairs of rats		Vagotomized	Control	Mean difference V − C	P
35	*Mean wt of food residue in stomach after 12 hr fast	7.00	1.77	+5.24 ±1.30	<.001
35	Mean wt of rats	130.7	134.76	−4.0 ±3.4	Not sig.
35	" wet wt of stomachs	1.55	.95	+ .60 ± .12	<.001
24	" wt of oven dried stomachs	.34	.24	+ .10 ± .03	<.005
24	" wt of fat free residue	.30	.20	+ .09 ± .03	"
24	" % water in stomach tissue	79.9	77.5	+2.4 ± .6	<.001
24	" % fat *Idem*	11.4	16.2	−4.8 ±1.6	<.01
24	" Ratio, stomach wt:body wt	.02	.01	+ .01 ± .0031	<.005
12	Mean ratio non-glandular : glandular portion of stomach: Wet	.46	.40	+ .06 ± .03	Not sig.
	Dry	.44	.36	+ .07 ± .44	*Idem*
12	Mean % water: Glandular	78.2	75.7	+2.5 ± .4	<.001
	Non-glandular	78.8	77.0	+1.8 ±1.0	Not sig.
12	" % fat: Glandular	9.6	15.1	−5.5 ±1.9	<.02
	Non-glandular	9.1	10.7	−1.7 ±1.7	Not sig.
27	Dry wt of intestine	.92	1.06	− .14 ± .06	<.05
16	% fat in intestinal tissue	15.3	21.5	−6.2 ±3.4	Not sig.
8	% water *Idem*	89.4	86.9	+2.5 ±1.2	*Idem*

* All weights in g.

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in stomach weight is due to protein rather than carbohydrate or minerals. The underlying mechanism is unknown.

Summary. Vagal denervation produced a marked increase in stomach weight and a less dramatic loss of intestinal weight. Changes in fat and water content of these structures could not account for the observed changes in weight.

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Action of Protamine on Production and Activity of Heparin-induced Clearing Factor.* (25139)

FRANK C. MONKHOUSE, FLORENCE MCCLAIN AND DONALD G. BAKER
Depts. of Physiology and Medical Research, University of Toronto, Canada

It is well established that protamine inhibits clearing factor *activity*. This inhibition can be demonstrated *in vivo*(1,2) and *in vitro*(3, 4). The effect of protamine injections on clearing factor *release* is not clearly established. Bragdon and Havel(5) showed that protamine caused hyperlipemia in fasting rats, and this has been confirmed by several other workers. Bragdon(6) subsequently found that protamine inhibits the disappearance of injected phospholipids from blood. He concluded that this was the result of anti-heparin activity of protamine. Similar conclusions could be drawn from the work of French and Morris(7) who injected C^{14}-labelled chylomicrons obtained from lymph of rats. They found that heparin caused an increase in rate of removal of chylomicron while protamine caused a decrease. According to the hypothesis of Robinson and French(8), clearing factor occurs normally on the capillary surface and may be displaced into the blood stream by injection of heparin or by adsorption on circulating chylomicra. Our recent results(9) support such an hypothesis. The question arises whether protamine may inhibit *release* of clearing factor by attaching itself to the capillary surface. Experiments were carried out to distinguish between an inhibitory effect on *release* of clearing factor and inhibition of clearing factor itself. Determinations were made first on the time protamine remained in the circulating blood after injection and, secondly how long after a protamine injection was it before a challenging dose of heparin would elicit full release of clearing factor.

Materials and methods. Protamine. Commercial product (Connaught Medical Labs) prepared as 1% solution, was used. *Clearing factor assay* was carried out by the method of Monkhouse and Mackneson(9). Lipemic substrate was prepared by adding either commercial fat emulsion, "Ediol," or chylomicrons to pooled oxalated dog plasma previously heated to 56°C for 5 minutes and stored at –20°C. Changes in turbidity were measured in Coleman Junior spectrophotometer at 500 mμ after 1 hour incubation at 37° C, and the activity expressed as changes in transmission for 0.1 ml of plasma being assayed. *Clearing factor release.* Each rat was given 50 units of heparin in 1 ml of saline solution intravenously, and the post heparin plasma taken 6 minutes thereafter. *Heparin* was kindly supplied by Connaught Medical Labs. Blood was removed from rats *via* exposed jugular vein. All samples were taken into one-tenth volume of 3.8% trisodium citrate solution. *Fat diet* contained approximately 40% protein (7% casein, 28% alcohol extract of peanut meat, 5% soya protein) 34% lard, 2% cholesterol, 10% sucrose and adequate vitamin supplements.

Results. Fig. 1 illustrates the relationship between protamine concentration and inhibition of clearing activity. Various dilutions of protamine were made with pooled citrated rat plasma. To each of 2 tubes, one containing

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