Effect of Antrectomy on Acid Secretion from Pavlov Pouches in Cat[1] (35585)

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In man, antrectomy greatly reduced histamine-stimulated gastric acid secretion (1). By contrast, in dog antrectomy increased the response of Pavlov pouches to histamine and gastrin (2). In this study, we found that antrectomy in cat increased the response of Pavlov pouches to histamine and pentagastrin. Thus, the effect of antrectomy is similar in dog and cat and both differ from man.

Methods. Surgical procedures. In 4 cats, weighing 4.3 to 5.2 kg, Pavlov pouches drained by plastic cannulas (3) were made. Three weeks were allowed for recovery from surgery before secretory tests were started. On completion of the first series of tests, the cats were antrectomized. The line of resection began 1 cm caudad to the pylorus and extended 46 to 65 mm on the lesser curvature and 68 to 90 mm on the greater curvature. The completeness of antrectomy was verified by histological sections that showed oxyntic glands along the entire proximal border. Continuity was restored by end-to-side gastroduodenostomy. Beginning 3 weeks after antrectomy the secretory tests done in the first series were repeated.

Secretory stimulants. The secretory stimulants used were: (a) histamine dihydrochloride in doses from 10 to 320 μg/kg-hr; (b) pentagastrin (gift of Ayerst Laboratories, New York, N.Y.) in doses of 1 to 32 μg/kg-hr; and (c) regular insulin in doses of 0.3 or 0.6 units/kg by rapid intravenous injection (the 0.6 units/kg dose was also tested during a background stimulation with 0.5 μg/kg-hr pentagastrin).

Test procedure. Cats were fasted 18 hr before each test. The interval between tests was at least 48 hr. Throughout all tests 0.15 *M* NaCl was infused intravenously by peristaltic pump at 20 ml/hr. Secretory stimulants were added to the saline infusion in amounts required to give the doses designated. Secretion from the Pavlov pouches was collected continuously and divided into 15-min samples. Volume was recorded to the nearest 0.1 ml and acid concentration was determined by titration with 0.2 *M* NaOH to pH 7.0 on an automatic titrator.

Basal secretion was collected for two 15-min periods before giving stimulants. Histamine or pentagastrin was given in stepwise manner, that is, the lowest dose was given for 1 hr and the dose was doubled each hour until all 6 doses had been given. Tests with insulin were continued for 3 hr after injection of insulin. The order of administration of stimulants was randomized.

Statistical analysis. Peak acid output was taken as the highest output during any 15-min period for each dose in each cat. Each test with histamine or pentagastrin on each cat gave a dose–response curve that was analyzed by a computer program devised by Dr. William Best of the Veterans Administration Midwest Research Support Center, Hines, Illinois. The program gave values of V (calculated maximal response) and K (dose for half maximal response) on the basis of minimizing the sum of squares of observed minus predicted Y in the equation $Y = VX/(K+X)$ where Y is response [gastric acid secretion (μEq/min)] and X is dose of stimulant (μg/kg-hr). An example of the analysis from a single test is shown in Fig. 1. Significance of differences between means was tested by analysis of variance (4). Differences are called significant if the probability that a difference this large would occur on

[1] Supported by Veterans Administration funds and by grant AM8354 from U.S. Public Health Service.

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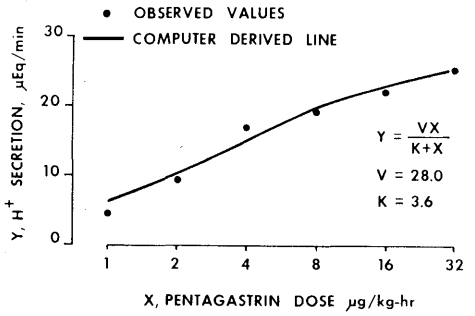

FIG. 1. Observed values and computer derived constants and line for a single test in one cat. V is calculated maximal response and K is dose for half maximal response.

the basis of random sampling error is less than 1 in 100.

Results. Antrectomy significantly increased the observed response of the Pavlov pouches to all doses of histamine and pentagastrin (Figs. 2 and 3) and also significantly increased V, the calculated maximal response to these stimulants (Table I). Antrectomy significantly decreased K, the dose of histamine required for half maximal response, but had no significant effect on K for pentagastrin (Table I).

To determine whether the increased response to histamine persisted, tests were repeated at 24 weeks after antrectomy. The response was not significantly different from those obtained 3 to 8 weeks after antrectomy.

Antrectomy significantly decreased the response to both doses of insulin (Table II).

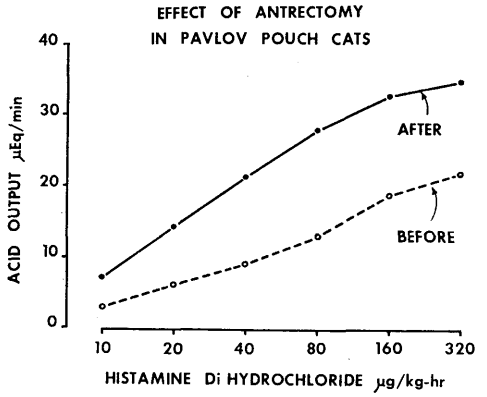

FIG. 2. Effect of antrectomy in Pavlov pouch cats: Peak acid output in response to various doses of histamine before and after antrectomy. Each point is the mean of 2 tests in each of 4 cats.

Before antrectomy, adding the low dose background of pentagastrin (0.5 μg/kg-hr) had no significant effect on the response to 0.6 units/kg insulin. After antrectomy, however, addition of this small dose of pentagastrin caused marked augmentation, giving a response significantly greater than to either dose of insulin alone before or after antrectomy (Table II).

Discussion. The present study shows that antrectomy in cat causes an increase in acid secretion from Pavlov pouches in response to histamine and pentagastrin as had been found earlier in dog (2). The mechanism of the increase is not known. It requires the presence of vagal innervation to the oxyntic glands since antrectomy does not cause an increase in maximal response to histamine or

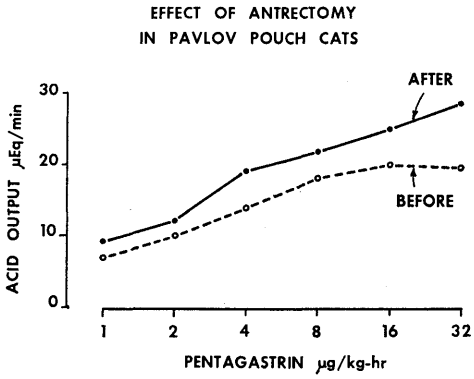

FIG. 3. Effect of antrectomy in Pavlov pouch cats: Peak acid output in response to various doses of pentagastrin before and after antrectomy. Each point is the mean of 2 tests in each of 4 cats.

gastrin in dogs with Heidenhain pouches (2). This suggests that there may be a vagally mediated inhibitory reflex operating from antrum to oxyntic glands but there is no direct evidence for such a reflex. The observation in the present study that the calculated maximal response to histamine and pentagastrin is increased by antrectomy suggests that hyperplasia of the oxyntic glands may be involved. Again there is no direct evidence for or against this possibility.

The decreased response to histamine that follows antrectomy in man (1) is no better understood than the increase seen in cat and dog. Giving pentagastrin along with hista-

TABLE I. Effect of Antrectomy on Calculated Maximal Response (V) and Dose for Half Maximal Response (K) of Pavlov Pouches in Cats Stimulated by Histamine or Pentagastrin.

	Cat no.				
	1	2	3	4	Mean
V, calculated maximal response (μEq/min)					
Histamine					
Before antrectomy	27.0	27.0	29.6	28.8	28.1
After antrectomy	44.7	43.3	34.6	34.8	39.4
Pentagastrin					
Before antrectomy	19.5	22.1	23.5	23.1	22.1
After antrectomy	28.5	33.2	26.1	27.1	28.7
K, dose for half maximal response (μg/kg-hr)					
Histamine					
Before antrectomy	164	74	87	60	96.3
After antrectomy	38	44	37	28	36.8
Pentagastrin					
Before antrectomy	4.0	1.7	1.7	2.1	2.4
After antrectomy	3.7	2.3	1.4	3.0	2.6

mine did not restore the response to histamine (1) indicating that simple withdrawal of background antral gastrin is not an adequate explanation. Just as an excess of gastrin causes hyperplasia of oxyntic glands (5), a decrease in gastrin produced by antrectomy might lead to hypoplasia. Thus antrectomy in rat (5) produced marked atrophy of the oxyntic glands but it is not known whether this was the result solely of withdrawal of gastrin or whether other factors such as regurgitation of duodenal contents into the stomach also participated. Possibly the difference in findings between dog and cat on the one hand and man and rat on the other may be entirely accounted for by the fact that in the former case Pavlov pouches shielded from duodenal regurgitation were studied, whereas in the latter case the residual stomach in continuity with the duodenum was studied.

TABLE II. Effect of Antrectomy on Peak Acid Output in Response to Insulin in Cats with Pavlov Pouches.

Each value is the mean of 2 tests in each of 4 cats.

	Antrectomy; (μEq/min)	
	Before	After
Insulin, 0.3 units/kg	10.9	8.7
0.6 units/kg	15.4	8.2
Insulin, 0.6 units/kg + pentagastrin, 0.5 μg/kg-hr	15.1	20.9

Decrease in acid response to insulin is expected after antrectomy (7). A low background dose of gastrin not only restored the response to insulin but gave higher responses than were seen with insulin alone or insulin plus pentagastrin before antrectomy. This indicates that the increased response of the oxyntic glands after antrectomy occurs with combined vagal and gastrin simulation as well as with gastrin alone.

Summary. In cats with Pavlov pouches antrectomy increased maximal acid secretion in response to histamine (40% increase) and to pentagastrin (30% increase). The mechanism of this effect is not known.

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Received Jan. 18, 1971. P.S.E.B.M., 1971, Vol. 137.