

PAIN IN ACTIVE PATHOLOGIC
PROCESSES IN STOMACH
OR DUODENUM

GASTRIC AND DUODENAL CONTRACTIONS AS THE
DIRECT CAUSE

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That the question of genesis of gastric pain in pathologic conditions of the stomach and duodenum is still an open one can readily be seen from the diversified opinions of authors on the subject. The work of Ginsburg, Tumpowsky and Hamburger¹ emphasizes the gastric tension and contractions of the stomach, together with the hyperirritability of the stomach, as the most important factors in the etiology of pain.

According to the older view of chemical distress in gastric ulcer, there are certain facts which are not explainable on the basis of acid irritation. The only basis for this view at present is the alkali treatment in gastric ulcer, by which the pains are immediately relieved.² Carlson³ concludes that the pains of gastric and duodenal ulcers are contraction pains, either in the stomach or in the pylorus and upper part of the duodenum. In order to confirm the contraction theory, analysis was made of three distinct types of cases:

1. Carcinoma of the pylorus in which there were vigorous peristalsis and a moderate degree of pain.
2. Healed ulcer of the duodenum with cicatricial contractions, high grade obstruction, and a very pronounced hyperperistalsis.
3. Typical peptic ulcer with vigorous peristalsis.

METHOD

The patients employed for this work were carefully examined and diagnosed clinically by Dr. B. W. Sippy and his assistants. After the diagnosis was made, the procedure was similar to that of Ginsburg, Tumpowsky and Hamburger. Kymographic tracings of the stomach contraction were begun immediately after

the patient had a meal, and were continued until vigorous hunger peristalsis was obtained. The patients all cooperated very intelligently. In each case the patient swallowed two tubes, one a Rehffuss and the other an ordinary tube with rubber balloon attached. By means of the Rehffuss tube, acids and alkalis could be administered, or the stomach contents could be aspirated from time to time without disturbing the patient. When the tracings were started, the patient was told to tap the key, to note the occurrence of pain. If the pains were mild, he tapped the key once; if severe he tapped it twice, and when intense he tapped it three times. The line below the tracings records the pain periods.

REPORT OF CASES

CASE 1.—A boy, aged 17, gave a typical history of gastric ulcer which began about eight years previous to admission. The pain had been present at irregular intervals for about

five years after the onset. But during the three years previous to admission, the pains had practically disappeared, and obstructive symptoms developed. When the patient entered the hospital, Feb. 3, 1917, he had the symptoms compatible with a high grade obstruction at the outlet of the stomach. Practically no food could pass beyond the pyloric outlet. The

stomach was found to be very much enlarged, the lower border coming to a level two fingerbreadths below the umbilical line. Peristaltic waves were plainly visible through the abdominal wall. Repeated stomach analysis showed no evidence of blood, a free acidity ranging from 40 to 65, and a total acidity from 50 to 90. There was no blood in the stool.

Medical management seemed out of the question because the boy was rapidly becoming dehydrated in spite of medicinal and dietetic measures. An operation was performed and a cicatrix found at the outlet of the stomach involving a portion of the upper part of the duodenum and lower part of the pylorus. There was no evidence of an active process. Tracings (Fig. 1) were obtained previous to the operation, and vigorous peristalsis was recorded. In no instance were the peristaltic contractions associated with pain. The more vigorous

were obtained when the stomach contained large quantities of food and liquid which could not pass beyond the pylorus. The contractions of the empty stomach were also exaggerated but not painful.

CASE 2.—The case described here is one which is typical of four others of this group. The patient, a man, aged 47, entered the hospital, March 5, 1917, with a typical history of gastric ulcer of about one year's duration. The distress came from two to four hours after eating, and was relieved by the taking of food or alkalis. The pains were usually more severe in the afternoon, but occasionally the patient was awaked in the middle of the night by the distress. On care-

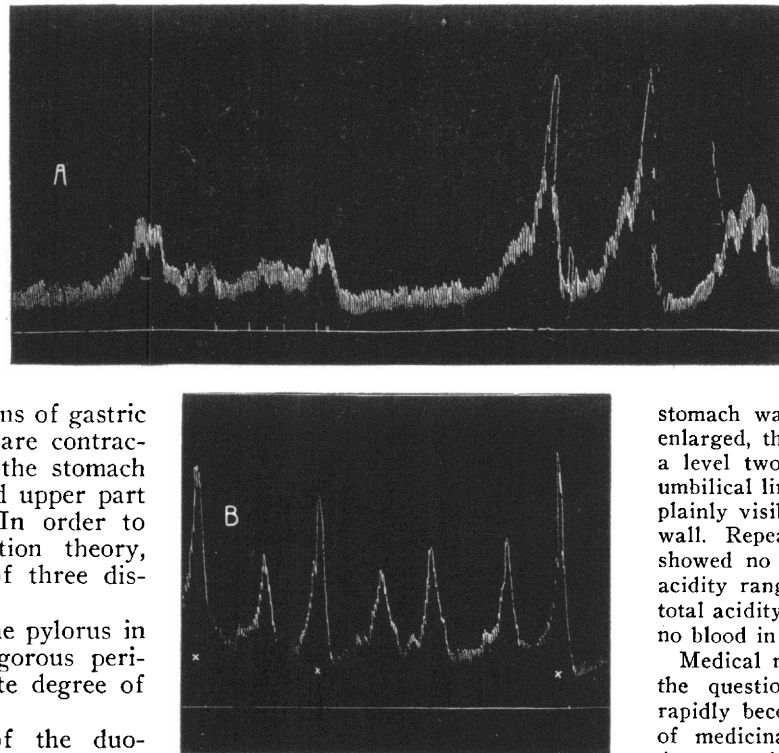


Fig. 1 (Case 1).—Record of the visible peristalsis, Feb. 20, 1917, by means of a recording signal (straight line at bottom of tracings) parallel with the recording of the contractions of the stomach by the balloon method, with the use of a chloroform manometer: A, two hours after the patient had eaten soup, milk, potatoes, beans, bread, tea and ice cream; B, after the aspiration of 700 c.c. of food material with a free acidity of 40 and a total acidity of 65. These tracings show that in healed ulcer of the duodenum or pylorus, with high grade obstruction, the contractions of the stomach are not painful.

1. Ginsburg, Harry; Tumpowsky, Isidor, and Hamburger, W. W.: Contribution to the Physiology of the Stomach: The Newer Interpretation of the Gastric Pain in Chronic Ulcer, THE JOURNAL A. M. A., Sept. 30, 1916, pp. 990-994.

2. Sippy, B. W.: Medical Cure of Gastric and Duodenal Ulcer by an Efficient Removal of Gastric Juice Corrosion, THE JOURNAL A. M. A., May 15, 1915, pp. 1625-1630.

3. Carlson, A. J.: Am. Jour. Physiol., 1917, 45, 81.

ful questioning, we find that the pains were intermittent in character and not continuous.

Two complete series of tracings were obtained which were begun immediately after the eating of a large meal and continued until intense pains were experienced. The results of the two experiments were practically identical. No pains were experienced during the first two or three hours after eating, but fractional distillations of gastric juice at this time revealed a free acidity of from 30 to 40, and a total acidity of from 50 to 60. The digestive peristalsis was plainly visible on the records at this time, but nothing to indicate the painful pylorospasm or hunger peristalsis (Fig. 2 *A*). Three hours after eating, the patient complained of severe pain (Fig. 2 *B*). Sixty c.c. of 0.3 per cent. hydrochloric acid was administered, which gave temporary relief (Fig. 2 *C*).

Five hours after eating, the patient complained of a great deal of epigastric distress, which was of a burning, gnawing character, and as the records show, also intermittent. The pains were more severe toward the end of a hunger contraction. The patient was aspirated, and 25 c.c. of thick mucus were withdrawn. No free acid was present, and only a trace of combined acidity. Immediately after aspiration, the pain disappeared for about ten minutes. The stomach was then washed, and the pains again disappeared. One and a half hours after it had been washed, the pains were quite severe and the stomach was again aspirated. The aspiration yielded 55 c.c. of fluid which had a free acidity of 55 and a total acidity of 70. The pains were severe at this time, but the contractions were also augmented.

During one of the painful periods a powder, containing 30 grains each of bismuth and sodium bicarbonate, was administered through the tube and gave almost instant relief. No pains were experienced for the next hour and a half, and the stomach was practically quiescent (Fig. 2 *D*). At the end of this period, the stomach was aspirated and 55 c.c. of a yellowish green material were obtained which had a free acidity of 65 and a total acidity of 75. Ten minutes after aspiration, the pains returned and were more intense than on any previous occasion. The vigorous peristalsis of the stomach returned, synchronous with the return of the pain (Fig. 2 *E*).

CASE 3.—A man, aged 67, was first admitted to the hospital, April 1, 1916, at which time a diagnosis of peptic ulcer of the duodenum was made. He left the hospital, June 13, 1916,

apparently very much improved. At that time repeated stomach analyses showed a free acidity of 70 and a total acidity of 110, with an occasional weak positive Weber test. The stools also showed a weak positive Weber test. He returned again, Feb. 25, 1917, very much undernourished, and with all of the classical symptoms of high grade pyloric obstruction. Peristaltic waves were visible in the upper abdomen and as low as half way between the umbilicus and symphysis. The patient was rapidly losing weight, and an operation was performed under a local anesthetic. Carcinoma was found at the outlet of the pylorus. Gastro-enterostomy was performed, and the patient recovered. A number of

tracings previous to operation were obtained which revealed the following facts:

There was a hyperperistalsis of the stomach. The digestive peristalsis as seen in the normal individual

was greatly augmented, and found to be painful. The pains, as the records show, were most severe at the end of the peristaltic wave (Fig. 3 *A* and *B*). In other words, when the peristalsis had reached the pyloric end of the stomach, the same type of peristalsis was also present when the stomach had been aspirated of its food contents.

COMMENT ON RESULTS

The results further substantiate the theory that the pain is mainly due to the contraction or spasm of the upper end of the duodenum and pylorus, together with the peristalsis of the fundus, the acid playing only a secondary rôle. That the vigorous peristalsis in Case 1 is not associated with pain is due to the obliteration of the upper portion of the duodenum and lower portion of the pylorus by scar tissue. The ulcer had healed and there was no longer an active hyperirritable process to produce a duodenopylorospasm. The increase in the tension and the hyperperistalsis of the fundus were not sufficient to produce typical gastric pains. This peristalsis is merely intensified digestive peristalsis, which is not subjective in character in the absence of an active hyperesthetic process.

DISCUSSION ON CAUSE OF GASTRIC PAIN

In the normal stomach, as digestion continues and the stomach gradually empties itself, there is an

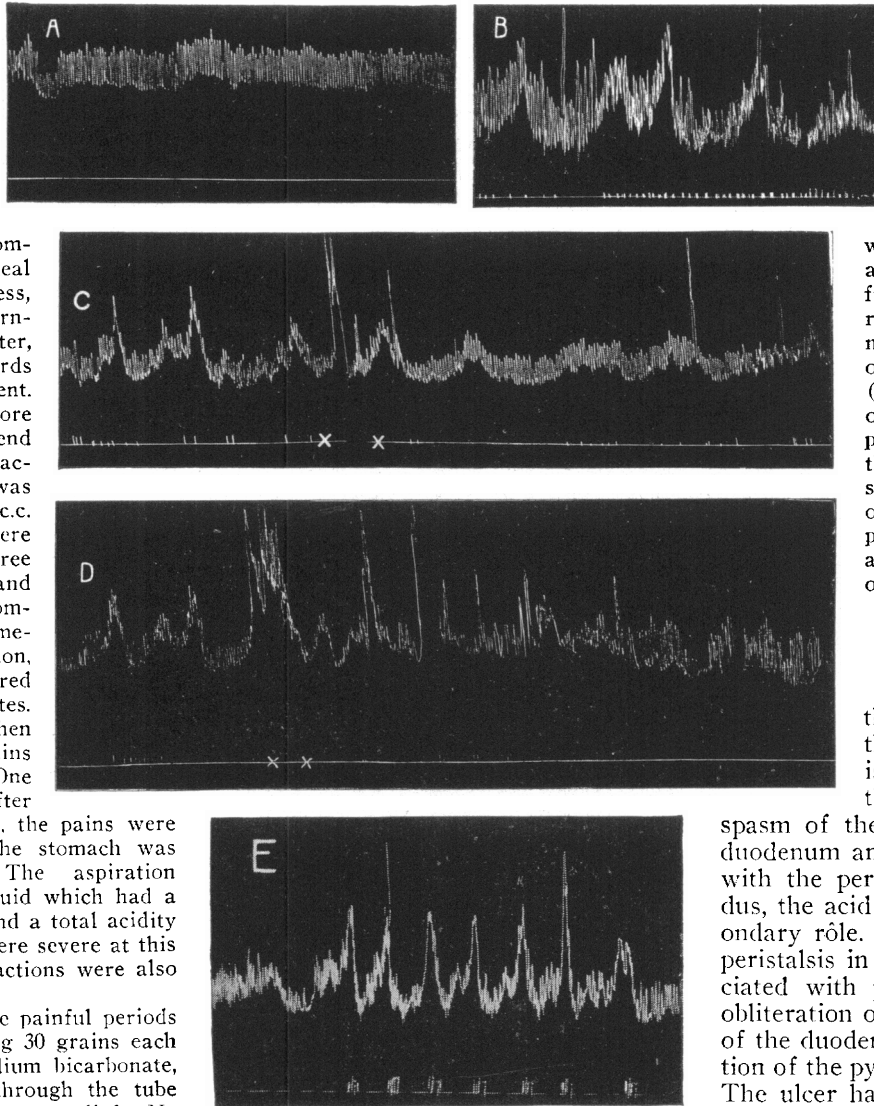


Fig. 2 (Case 2).—Record of the pain in case of gastric ulcer, March 13, 1917: *A*, one hour after the patient had eaten meat, potatoes, vegetables, bread, butter and tea; no pains; stomach contents showed a free acidity of 30 and a total acidity of 50; *B*, three hours after eating (intense pains); stomach contents showed a free acidity of 35 and a total acidity of 60; *C*, 60 c.c. of 0.3 per cent. hydrochloric acid were introduced into the stomach through a tube; *D*, at *x*, sodium bicarbonate and magnesium carbonate, 30 grains each, were introduced into the stomach through the tube; pain ceased five minutes after administration of the alkalis; the stomach was aspirated one and a half hours later, and 55 c.c. of fluid with a free acidity of 65 and a total of 75 were removed; *E*, ten minutes after the aspiration, the contractions became vigorous and the pains returned.

increasing tonus together with a low degree of hyperirritability, which culminates in hunger pains.⁴ When there is an active ulcer, or carcinoma at the outlet, these normal processes are intensified and we have distinct gastric pains. If the pain were due to acid corrosion, we would expect that when the stomach contents were sufficiently acid (free acidity from 30 to 50 and total acidity from 40 to 70) pain would be experienced; but the results in Case 2 do not support this theory. When the stomach was relatively quiescent (Fig. 2 A) and the stomach contents had a free acidity of 30 and a total acidity of 50, the patient did not complain of pain. Two hours later, with only a slight variation in acidity (free, 35, total, 60) and with marked peristalsis, he complained of severe epigastric pains (Fig. 2 B). These pains were temporarily relieved by a 0.3 per cent. hydrochloric acid solution, and the contractions were slightly diminished.

The action of the alkalis in relieving pain is due not merely to the neutralizing of the acid content, but also to their inhibitory action on the contractions of the stomach. The alkalis act partly through a sedative effect on the stomach, in which the vigorous peristalses and painful pylorospasms are inhibited. The neutralization of the acid is probably a minor factor in the relief of pain, as is shown in Figure 2 E. The alkalis relieved the pain for one and a half hours, after which the stomach was aspirated of 55 c.c. of fluid, with a free acidity of 65 and a total acidity of 75. Ten minutes after 55 c.c. of acid had been aspirated, pains became more severe than on any previous occasion, and continued until the stomach was washed. The pains returned one hour after the stomach had been washed. The stomach analysis showed this time 55 c.c. of a watery mucus with a free acidity of 60 and a total acidity of 70. The ulcer pain is apparently independent of the variations in acid concentration. There may be intense intermittent pains synchronous with the contractions with no free acid in the stomach. The stomach contents may be highly acid without causing pain.

Case 3 represents a high grade pyloric obstruction in which an active hyperirritable process is present. By means of the kymographic tracing, it was demonstrated, previous to operation, that an active process was present at the pylorus or upper duodenum. The patient invariably recorded pains (of varying intensity) toward the end of a contraction. The fact that pains were experienced when the stomach contained

from 12 to 1,500 c.c. of food material, and that the pains were felt only when the peristalsis had reached the pylorus, led to the conclusion that an active process was present at the outlet. Operation confirmed the conclusion.

CONCLUSIONS

1. Ulcer pains may be present in the absence of free acid, and may be temporarily relieved by a 0.3 per cent. hydrochloric acid solution.
2. Gastric ulcer pains may be absent in the presence of high acidity.
3. Any active process (ulcer or carcinoma) producing a hyperirritable condition may result in pain; but the pains are intermittent, being synchronous with the contractions of the stomach, pylorus or duodenum, and bearing no relation to the degree of acidity.
4. Hypertension and hyperperistalsis with high grade pyloric obstruction are not sufficient to produce pain in the absence of an active irritable process (ulcer or carcinoma).

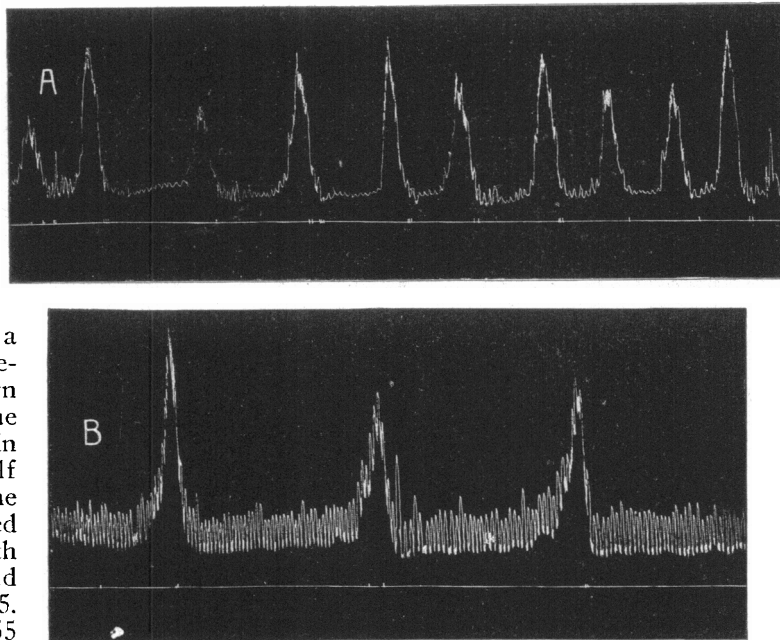


Fig. 3 (Case 3).—Record of the pain in a case of carcinoma of the pylorus, Feb. 22, 1917: A, one and a half hours after the patient had eaten toast, milk, egg, soup and cereal; the pain usually occurred toward the end of the contraction; B, two hours after the aspiration of 1,300 c.c. of food material; the contractions and pains were present, but not so marked as in A.

pronounced change in their living conditions would undoubtedly have a distinct effect on their physical condition; 5,284, or 31 per cent., belonged to the fourth class, which was distinctly undernourished, and in need of immediate supervision and readjustment of life and environment. Of the children 6 years of age, 22.5 per cent. were undernourished. This undernourishment increased in percentage up to 9 years of age, at which 25.2 per cent. were found undernourished. Then followed a gradual decrease up to the age of 16 years, at which only 12.1 per cent. were found undernourished. The general proportion of actual undernourishment for the borough was 21.6 per cent. It was found that nationality played an important part in the consideration of the prevalence of malnutrition. Of the Italian children examined, 28.7 per cent. were found undernourished. The Italian children comprised 23 per cent. of the total number examined. The children from Russia and Poland, who comprised 26 per cent. of all the children examined, were found undernourished in 19.8 per cent. of the cases. The figures for immigrants from other countries ranged from 17 to 20 per cent.

Malnutrition Among Schoolchildren.

—The bureau of child hygiene of the New York City Health Department has just completed a survey of 171,691 schoolchildren of the borough of Manhattan. This figure was below the registration figures for the borough, as the survey was made during the intensely cold weather. The fact that the children came to school at this time would indicate that they were rather harder than those not examined. The Dunfermline scale was used. Of those examined 29,781, or 17.3 per cent., belonged to the first class, that is, were perfectly normal from the nutritional point of view; 104,908, or 61.1 per cent., belonged to the second class; 31,718, or 18.5 per cent., to class three, the so-called border-

4. Rogers, F. T., and Hardt, L. L. J.: *Am. Jour. Physiol.*, 1915, 38, 274-284.