

no significant difference in either volume or acidity after vagus section.

c. *Gastric Secretion in Response to Caffeine.* Roth, Ivy, and Atkinson² have recently reported that patients with peptic ulcer secrete more gastric juice in response to caffeine than do normal individuals. Using the same method we have studied the effect of caffeine on 17 patients with peptic ulcer. One patient failed to respond either before or after operation. A second patient showed a moderate increase in secretion before the vagus section but not afterward. The other 15 patients responded with an increase in volume and free acidity both before and after operation. The stimulation was as marked after operation as before. In general the effect was less than secured by histamine.

d. *Gastric Secretion in Response to Insulin.* The injection of insulin into experimental animals in doses sufficient to produce hypoglycemia causes a secretion of gastric juice. This stimulating effect seems to be due to the hypoglycemia rather than the insulin since it is abolished by the injection of glucose and it is not seen in the diabetic unless hypoglycemia occurs. Twenty units of crystalline insulin were given to 17 patients with peptic ulcer and subsequently fractional gastric analyses were made on samples of secretion

removed at 10-minute intervals. Two of the patients did not respond but in the remaining 15 an increase in the volume and free acidity of the gastric juice was obtained. This effect was often delayed as long as an hour and was accompanied by a low blood sugar and hypoglycemic symptoms. The stimulation was not as marked as with histamine but approximated that obtained with caffeine. It was completely abolished after the vagus section except in one patient where a slight but definite stimulation was secured. The findings confirm the prediction of Hollander that the abolition of response to insulin may serve as a physiological test for the completeness of the vagotomy in ulcer patients.

e. *Gastric Secretion in Response to the Sham Meal.* Sham meals were given to 10 ulcer patients before and after vagus section. The tests were performed by having the patients chew various foods without swallowing. Ten-minute fractional samples of gastric juice were withdrawn for a 60-minute period. Only 3 of the 10 patients displayed a definite increase in volume and free acidity of the gastric juice in response to the sham meal before operation. None responded after operation. It is likely that this test would prove more satisfactory with further experience and the use of more palatable food for the sham meal.

² Roth, J. A., Ivy, A. C., and Atkinson, A. J., *J. A. M. A.*, 1944, **126**, 814.

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Supra-Diaphragmatic Section of the Vagus Nerves and Gastric Motility in Patients with Peptic Ulcer.

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During the past two and one-half years bilateral section of the vagus nerves to the stomach has been performed on 38 patients with duodenal ulcer, gastric ulcer, or gastrojejunal ulcer. The technic of this operation and some of the results have been reported elsewhere.¹ In this paper we wish to make a

preliminary report of some observations that have been made on the motility of the stomach

¹ Dragstedt, Lester R., and Owens, Frederick M., Jr., *Proc. Soc. Exp. Biol. and Med.*, 1943, **53**, 152; Dragstedt, Lester R., Palmer, Walter L., Schafer, Paul W., and Hodges, Paul C., *Gastroenterology*, 1944, **3**, 450.

in these patients both before and after operation. Some observations have been made on the relation between the contraction of the empty stomach and the sensation of hunger.

Carlson² and others studied the effect of bilateral vagotomy on the gastric motility of normal dogs and found that this procedure usually produced a prolonged decrease in the tonus and a diminution in the number of hunger pangs although the individual contractions remained normal in amplitude. Gastric tetanus was rarely seen. To our knowledge the effect of bilateral section of the vagus nerves on the motility of the empty human stomach has not been reported.

Roentgenologists, as a rule, have reported hypertonicity and hypermotility of the stomach in patients with duodenal ulcer. These observations have been made by fluoroscopic examination of the stomach after the administration of a barium meal. Investigators using the balloon technic for studying the motility of the empty stomach have reported constant motility in some patients and complete atony in others.

In the present study, observations were made on the motility of the empty stomach in 8 patients with peptic ulcer, both before and after bilateral section of the vagus nerves. The experiments were performed in the morning after the patients had fasted since the evening meal the day before. The customary balloon

technic was employed. Hypertonicity and hypermotility of the stomach were found in 7 patients before operation. In the eighth patient the motility of the stomach appeared less than normal and in this patient there was a long standing marked pyloric obstruction. Following operation in these 7 cases the gastric tonus was decreased, the hunger contractions when present were normal in duration and decreased in amplitude. Hunger periods were decreased in frequency and duration. In the eighth patient, the tonus and hunger motility were increased from the pre-operative level. It appeared within normal limits after operation.

There was but one patient in this series with sufficient introspection to recognize hunger contractions. In the interval of two weeks since the vagus section, this patient has not experienced hunger. In general, however, the patients on whom the vagus section has been performed have reported no alteration in their sensations of hunger or appetite following the operation. Many have volunteered the information that following operation they have been able to eat a large meal without experiencing the sensation of distention which was common before operation.

Conclusion. 1. When examined by the balloon technic, the empty stomach of patients with peptic ulcer usually displays hypertonicity and hypermotility. 2. Bilateral section of the vagus nerves in patients with peptic ulcer decreases the gastric tonus and hunger contractions of the empty stomach.

² Carlson, A. J., *The Control of Hunger in Health and Disease*, The University of Chicago Press, Chicago, Ill.