14904

I. Stomal Ulcer Attending Complete Intragastric Regurgitation Influenced by Length of Afferent Duodenojejunal Loop.*

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Intragastric regurgitation of the contents of the duodenal loop has been looked upon as a desirable factor in gastric resection for ulcer. Schmilinsky[1] suggested placement of the afferent duodenojejunal loop in the Billroth II type of gastric resection back onto the stomach in such a manner that complete drainage of all the duodenal contents occurred back into the stomach. He termed this arrangement an "internal pharmacy" for neutralization of gastric acidity. McCann[2] reported that he had produced gastrojejunal ulcer in 80% of 26 dogs operated upon according to the Schmilinsky plan. A number of other investigators, Ivy and Fauley,[3] Weiss, Graves and Gurriaran,[4] Graves,[5] Maier and Grossman,[6] and Wangensteen and his associates,[7] repeated the McCann experiment with rather indifferent results. None of these investigators was able to confirm McCann's observations of a high incidence of gastrojejunal ulcer following complete drainage of the duodenal loop back into the stomach. Wangensteen and his associates indicated that disastrous results attended performance of the Schmilinsky operation on man and suggested that constant regurgitation of the duodenal loop content back into the stomach might stimulate the second or gastric phase of gastric secretion interminably. Kesavalu and Mann[8] have shown, in dogs with isolated gastric pouches, that the Schmilinsky procedure definitely enhances secretion from the pouch. This study was undertaken with the hope that some of the conflicts and confusions hedging about this problem could be resolved.

Methods of Study and Results. A total of 17 dogs was studied. The Schmilinsky-McCann operation of complete intragastric return of the entire content of the duodenal loop was performed in each animal. In the first series of 11 dogs the operation was accomplished in the following manner: These dogs were anesthetized and under aseptic conditions a laparotomy was performed. The pylorus of the stomach was excised. The duodenal end was then closed and inverted in the usual fashion by means of interrupted cotton sutures. At distances of 8 to 15 cm from the inverted duodenal stump, the intestine was transected. The proximal transected intestine was anastomosed onto the stomach. Thereby, complete intragastic regurgitation of the duodenal contents including bile and pancreatic juice was assured. The end of the distal loop of intestine was closed and inverted. A gastrojejunostomy, end-to-side was then performed between the end of the stomach and the side of the distal transected intestine.

Following operation convalescence was rapid. After a brief period of time, normal activity was assumed and appetite regained. At various intervals from 72 to 360 days these

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1 Schmilinsky, H., *Centralblatt f. Chirurgie*, 1918, **45**, 416.

2 McCann, J. C., *Arch. Surg.*, 1929, **19**, 600.

3 Ivy, A. C., and Fauley, G. B., *Tr. Am. Gastro-Enterol. A.*, 1931, **33**, 81.

4 Weiss, A. G., Graves, A., and Gurriaran, G., *Compt. rend. Soc. de biol.*, 1932, **109**, 916.

5 Graves, A. M., *Arch. Surg.*, 1935, **30**, 833.

6 Maier, H. C., and Grossman, A., *Surgery*, 1937, **2**, 265.

7 Wangensteen, O. H., Varco, R. L., Hay, L. J., Walpole, S. H., and Trach, B., *Ann. Surg.*, 1940, **112**, 626.

8 Kesavalu, A., and Mann, F. C., *Surg.*, 1943, **14**, 578.

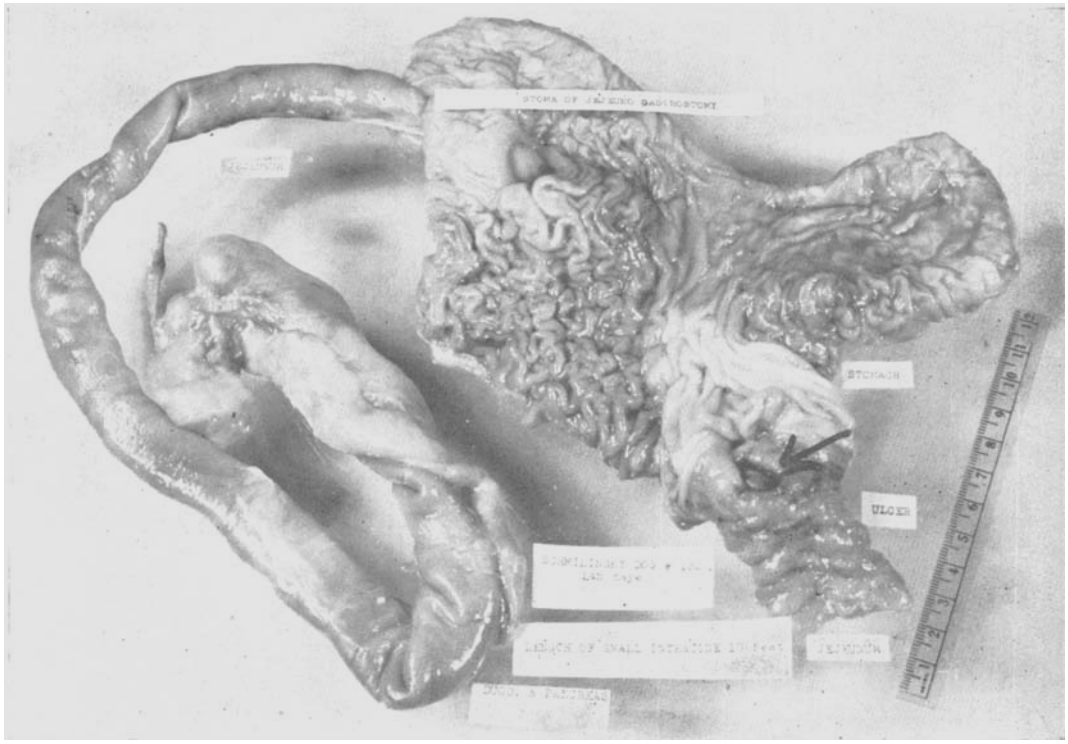

FIG. 1.
(Dog No. 132—Table II.) Photograph of long afferent duodenojejunal loop (76 cm), stomach and perforated stomal ulcer just beyond efferent outlet. (Ulcer at arrow).

animals were sacrificed. The results are recorded in Table I.

In the 11 dogs in which a short proximal duodenal loop was employed in the Schmilinsky-McCann procedure, gastrojejunal ulcer occurred only once (9.1%).

A second series of 6 dogs having the same operation subsequently was studied. The operation was identical in all details with that described in the first series of animals with one exception. In the first series the intestine was transected a short distance from the inverted duodenal stump. Thus, a short proximal loop was obtained. However, in this second series of dogs, the transection of the intestine was carried out at a lower level. The length of the proximal loop from the inverted or "blind" duodenal end varied from 76 to 90 cm. The transplantation of the proximal loops was high on the stomach in some instances, low in others.

In this second series, a short period of normal response was noted. As time progressed, however, the dogs became irritable, anorexic and languid; coma and death followed.

The results are tabulated in Table II.

TABLE I.
Occurrence of Gastrojejunal Ulcer in the Schmilinsky-McCann Procedure Employing a Short Afferent Duodenal Loop.

No. of dogs	Operation	Avg. length of proximal loop	Time of sacrifice of dog	Results
11	Excision of pylorus. Duodenal end closed. Intestine transected 8-15 cm from duodenal closure. Gastrojejunostomy made with distal intestine anastomosed onto stomach.	10 cm from the inverted duodenal stump.	72 to 360 days	One dog developed a gastrojejunal ulcer.

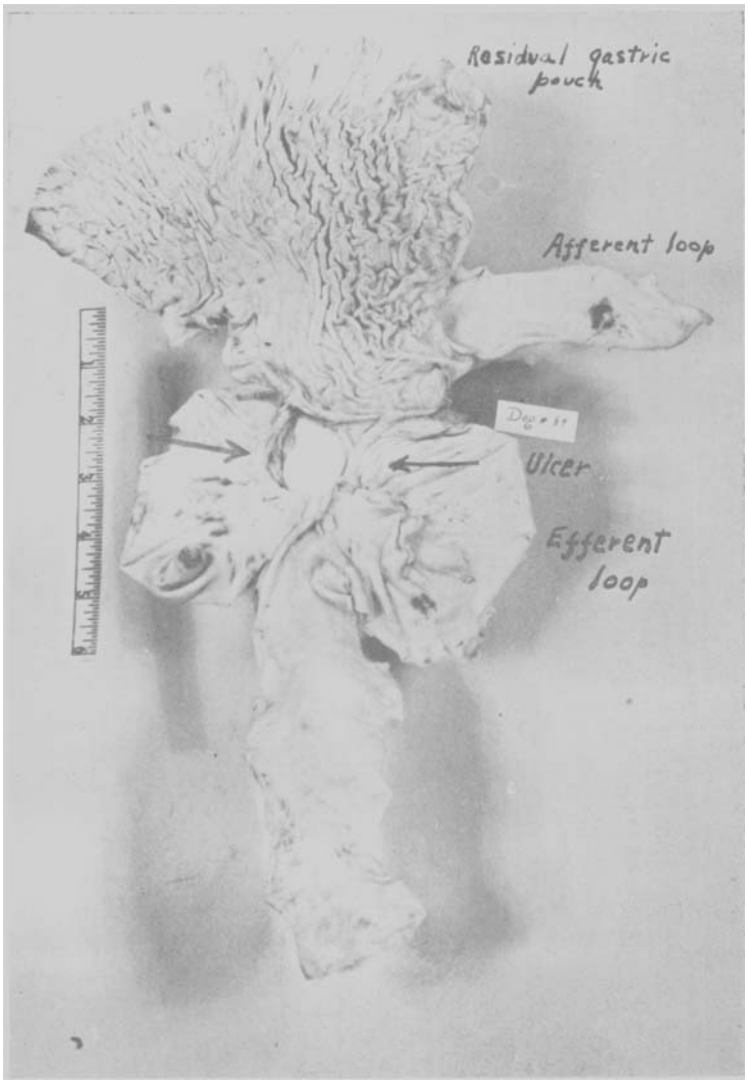

FIG. 2.
(Dog No. 84—Table II.) Photograph of large perforated stomal ulcer. Length of afferent duodenojejunal loop 76 cm.

The average survival period was 79.7 days. The area of the transplantation (high or low) of the proximal loop onto the stomach, did not appear to alter the end result. The incidence of gastrojejunal ulcer in this series was 83.3% (5 out of 6 dogs). Four of the 6 dogs exhibited perforated peptic ulcers. (Fig. 1.) No animal was sacrificed. Histamine was not administered to any of the dogs in this study.

Comment. These results clarify the confusion in the literature, concerning the results of complete intragastric drainage of the duodenal loop in dogs. The results of the experiments reported herein suggest that, the divergent results obtained by previous investigators are explicable on the basis of the length of the afferent loop employed. Our first experiments in this study were begun in 1939 and the problem has been under constant scrutiny in the laboratory in the intervening years.

The agency through which the length of the afferent loop in the Schmilinsky procedure influences so definitely the occurrence of stomal ulcer is not apparent. One thing is clear

TABLE II.
Occurrence of Gastrojejunal Ulcer in the Schmilinsky-McCann Procedure, Employing a Long Afferent Duodenojejunal Loop.

Dog No.	Wt. lb.	Operation	Length of afferent loop from inverted duodenal end cm	Survival days	Results
79	39	Excision of pylorus, duodenal end closed. Jejunum transected 66 cm from ligament of Treitz. Gastrojejunostomy made with distal jejunum and proximal jejunum anastomosed high on stomach.	76	102	Large ulcer in gastric fundic wall; greater curvature 6.6 x 5.5 cm.
81	36	"	76	50	Severe gastritis; many scattered pinpoint erosions.
83	40	" Placement of proximal loop low on stomach.	76	56	Large sealed perforated ulcer just distal to efferent gastrojejunostomy.
84	52	"	76	65	Generalized peritonitis; perforated ulcer 2.7 x 3.3 cm immediately distal to efferent gastrojejunostomy.
132	38	Site of placement of proximal loop on stomach not indicated in operative record.	76	145	Generalized peritonitis; perforated ulcer in efferent gastrojejunal loop.
202	42	"	90	55	Generalized peritonitis; perforated ulcer in efferent gastrojejunal loop.

* The average overall length of the intestine from the duodenum to the ileocecal valve was 292 cm.

however: Exclusion of hydrochloric acid, the best physiologic stimulus for the secretion of pancreatic juice with high buffer value, from contact with the duodenal mucosa the segment of mucosa richest in secretin, affords a plausible explanation for the greatly increased incidence of stomal ulcer in the experiments in which the long afferent loop was employed. Other likely causes would appear to be: The wide distance of spatial separation of alkaline and acid digestive juices by employment of the long efferent loop—in other words, a type of Mann-Williamson operation; and finally, the often suggested increased susceptibility to injury by acid of successively lower segments of intestinal mucosa.

Conclusions. 1. The incidence of gastrojejunal ulcer in dogs attending complete intragastric regurgitation of the duodenal loop contents is dependent upon the length of the afferent duodenojejunal loop. 2. In 11 dogs in which complete duodenal drainage by means of a short afferent loop (8 to 15 cm) was established, only one dog developed a gastrojejunal ulcer, an incidence of 9.1%. 3. Five out of 6 dogs undergoing the same operation in which the proximal jejunal loop was long (75 to 90 cm) developed stomal ulcer, an incidence of 83.3%. Four of these died of generalized peritonitis secondary to perforated ulcers.