A FURTHER STUDY OF THE GASTRIC ULCERS FOLLOWING ADRENALECTOMY.

BY FRANK C. MANN, M.D.

(From the Mayo Clinic, Rochester, Minn.)

PLATES 36 AND 37.

(Received for publication, June 1, 1916.)

In a previous study of adrenalectomized animals, the frequent occurrence of acute ulceration of the gastric mucosa and the occasional occurrence of duodenal ulcer were noted. While these ulcers were not found in adrenalectomized animals subjected to continuous etherization, and were infrequent in animals subjected to the removal of only one gland, they occurred in about 90 per cent of those dying under the characteristic symptoms of adrenal insufficiency after the removal of both glands. The ulcers developed during the moribund period, were apparently peptic, forming at the site of the local hemorrhages in the gastric mucosa, and were true acute ulcers, usually penetrating to the muscularis mucosa, with a total loss of epithelium. While they occurred in the absence of pancreatic secretion and bile, they appeared to develop only in an acid medium.

In order to determine whether the acid medium was the important factor in the production of the acute ulcers, or whether their cause resided in other factors, such as the special nerve or vascular mechanism of the stomach, the following experiments were performed.

A loop of the first part of the jejunum, varying in length from 6 to 12 cm., was functionally resected under anesthesia and implanted in the posterior wall of the stomach in the region of the antrum pylori. The continuity of the intestine was maintained by an intestinal anastomosis.

Dogs operated on in this manner quickly recovered from the operation and maintained excellent health for many months. Animals killed at various periods after operation demonstrated that the transplanted mucosa underwent definite changes, but ulcers did not develop except in one instance in which an ulcer was found around a retained silk suture.

In four of these animals, after a considerable length of time had elapsed, the right adrenal was removed, and a few months later the left gland was extirpated. All developed the typical symptoms of adrenal insufficiency and died at various times after the removal of the last gland.

In all these animals definite lesions of the gastric mucosa were found at autopsy. In three, there were ulcerations, while in one the mucosa was injected only and showed areas of erosion. In three the jejunal transplant appeared exactly similar to the control. In one there appeared to be a slight loss of jejunal mucosa in pin-point areas, which microscopically proved to be small ulcers.

It was hoped that these experiments would prove clearly whether or not free acidity was the primary cause in the formation of these ulcers. If acidity is the primary cause, the jejunal mucosa, to which an acid medium is foreign, should show the most marked changes. If the primary cause lies in the intrinsic mechanism of the gastric mucosa, the latter alone should be involved.

The results of the experiments show that both factors are of importance. In the three experiments in which the gastric mucosa alone was involved, the transplant having been left intact, either the ulcerations and erosions were due to a primary impairment of the gastric mucosa to which the jejunal mucosa was not subjected, or the acidity developed within the gland tubules and produced its destructive action there first. If the latter is true, the jejunal mucosa might become involved afterwards. The experiment in which the transplanted mucosa was involved might be interpreted in this way. The evidence tends to show that the acidity is but a secondary, although necessary factor and that the primary cause lies in the intrinsic mechanism of the gastric mucosa. However, the fact that changes in the jejunal mucosa occurred in one experiment shows the importance of acidity.
Protocols.

Dog 1.—Under ether anesthesia a jejunal transplant was made on June 29, 1915. The animal quickly recovered from the effects of the operation and its health was excellent. Killed Oct. 19.

Autopsy.—The anastomosis and transplant were in good condition. The transplant showed thickening of the muscularis mucosa as compared with the control part of the jejunum. The size of the transplant was 7.5 by 3 cm. The mucosa of the stomach and of the transplant was otherwise negative (Fig. 1).

Dog 2.—Under ether anesthesia a jejunal transplant was made on Oct. 14, 1915. On Feb. 8, 1916, the right adrenal was removed. The condition of the animal was always excellent. On Apr. 11, the left adrenal was removed. The animal died from adrenal insufficiency on Apr. 21.

Autopsy.—The usual findings in animals dying from adrenalectomy were noted. The stomach wascontracted and contained about 10 cc. of bile-stained, acid fluid. The gastric mucosa was injected throughout. In the pyloric region were four ulcers which measured 4 mm. in diameter, and probably extended to the muscularis mucosa. The transplant was 4 by 2.2 cm., and did not differ in any respect from the controls (Fig. 2).

Dog 3.—Under ether anesthesia a jejunal transplant was made on Oct. 12, 1915. On Feb. 8, 1916, the right adrenal was removed. The condition of the animal was always excellent. On Apr. 16, the left adrenal was removed. The animal died from adrenal insufficiency on Apr. 21.

Autopsy.—The usual findings of adrenalectomized animals were noted. The stomach contained 10 cc. of bile-stained, acid fluid. The gastric mucosa was bile-stained and injected throughout. In the pyloric mucosa was one small ulcer. At the edge of the transplant in the gastric mucosa a large ulcer was found. The latter, however, may have been partially due to a retained suture. The transplant was 8 by 2.5 cm., and appeared in every respect similar to the controls (Fig. 3).

Dog 4.—Under ether anesthesia a jejunal transplant was made on Oct. 29, 1915. On Feb. 8, 1916, the right adrenal was removed. The condition of the animal was always excellent. On Apr. 16, the left adrenal was removed. The animal died on Apr. 21 from adrenal insufficiency.

Autopsy.—The findings characteristic of an adrenalectomized animal were noted. The stomach contained a small amount of bile-stained, acid fluid. There were no frank gastric ulcers, but the mucosa was markedly injected and there were many areas of erosion. The transplant was 3 by 1.5 cm., and appeared similar to the controls.

Dog 5.—Under ether anesthesia a jejunal transplant was made on Oct. 13, 1915. The animal continued in excellent health. On Feb. 8, 1916, the right adrenal was removed. The animal remained in perfect condition. The left adrenal was removed on Apr. 24. The animal died from adrenal insufficiency on May 2.
GASTRIC ULCERS FOLLOWING ADRENALECTOMY

Autopsy.—The usual findings in animals dying after adrenalectomy were noted. The stomach contained about 50 cc. of bile-stained, acid fluid. The fundal mucosa was markedly injected and contained many ulcers varying from 0.2 to 0.8 cm. in diameter. The pyloric mucosa showed a few ulcers. In the transplant were a few pitted areas which microscopically proved to be small ulcers. The size of the transplant was 3.5 by 3 cm. (Fig. 4).

SUMMARY.

Acute gastric ulcers are found in a large percentage of animals dying from acute adrenal insufficiency. In dogs in which a portion of the jejunum had been transplanted some time previous to the removal of the adrenals, the gastric mucosa showed more marked changes than the transplanted jejunal mucosa. This tends to show that the gastric juice as the cause of the ulcer is but a secondary although necessary factor.

EXPLANATION OF PLATES.

PLATE 36.

Fig. 1. Gastric and jejunal mucosa of Dog 1. This shows the characteristic appearance of the transplant in normal dogs.

Fig. 2. Gastric mucosa and transplant of Dog 2. Note the ulcers in the pyloric mucosa and the normal appearance of the transplanted jejunal mucosa.

PLATE 37.

Fig. 3. Gastric mucosa and transplant of Dog 3. The large ulceration is probably due to a retained silk suture. Note the injection of the gastric mucosa as compared with the jejunal transplant.

Fig. 4. Gastric mucosa and transplant of Dog 5. Note the marked injection, erosion, and ulceration of the gastric mucosa and the pin-point erosions of the transplanted jejunal mucosa.
Fig. 1.

Fig. 2.

(Mann: Gastric Ulcers Following Adrenalectomy.)
(Mann: Gastric Ulcers Following Adrenalectomy.)