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Gastrocolic and Duodenocolic Fistulas

An Experimental Study

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In an experimental study of gastrocolic and duodenocolic fistulas, it was clearly seen in 10 animals that duodenocolic fistulas result in the most serious loss of nutrition. Death from starvation occurred in all 42 animals in 30 days. Gastrocolic fistulas similarly resulted in weight loss and death of the animals in an average of 42 days. Lengthy fistulas between the stomach and colon caused no obvious disturbances in the physiology of the gastrointestinal tract. The significant microscopic changes included destruction of the mucous membrane and a decrease in size of the villi. The other noteworthy observation was that fistulous aggregations of lymphoid cells in the upper intestine may present the gross appearance of an ulcer.

Gastrocolic fistulas have been of interest to us since we have had the opportunity to treat one patient with gastrocolic communication secondary to malignancy. We have also reviewed our total experience with gastrocolonic communication. Such fistulae produce serious disturbances in physiology and nutrition. Even today the pathophysiology has not been completely explained. We felt that further research into the problem might be useful. These abnormal fistulas were designed to simulate some of the types seen in patients.

Method

Our plan was to investigate the effects of the following types of abnormal communication between the upper and lower gastrointestinal tracts:

I. Direct gastrocolic fistulas—24 experiments.

II. Gastrocolic fistulas with interposition of implants of small intestine measuring six inches in some animals and three inches in others—8 experiments.

III. Duodenocolic fistulas—10 experiments.

The operations were performed upon 42 healthy mongrel dogs in the surgical laboratory under general nembutal anesthesia. During the early postoperative period intravenous fluids were given and the dogs were permitted water ad libitum after the first day. The diet consisted of standard laboratory purina dog chow. The behavior of the animals was considered to reflect the progress or deterioration of nutrition and was recorded twice weekly.

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Results

Direct Gastro-colic Fistulas: The animals with direct gastrocolic fistulas were observed to have loss of appetite in every instance. Vomiting and diarrhea were present in 75% or 18 of 24 animals. Weight loss was also present in every dog. The degree and rapidity of weight loss seen in the various types of gastrocolic communications is shown in Figure 1.

The animals became weaker, showed emaciation and dehydration. This group survived for a considerably longer period of time than those with duodenocolic fistulas, and four were sacrificed to terminate the experiment. The average survival time for 24 animals was 42 days, including those animals sacrificed.

Duodenocolic Fistulas: Duodenocolic fistulas resulted in serious nutritional disturbances in ten experimental animals with rapid weight loss in every instance. The loss of appetite was prompt and severe. Vomiting was recorded in every instance. Diarrhea was observed in all but one of the dogs.

SURVIVAL AFTER GASTRIC & INTESTINAL FISTULAS

This graph shows the rapidity of weight loss after three varieties of gastrocolic and gastro-duodenal fistulas were made in experimental animals. The most rapid deterioration was seen after duodenocolic fistulas were established.
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Lethargy was another common observation. Rapid weight loss was present in every animal. The presence of diarrhea in the absence of food intake were obvious explanations for the malnutrition. Of 10 animals surviving the operative procedure, three survived as long as 30 days. The average survival was 20 days. Every one of these animals showed weight loss. Some lost as much as 50 pounds of body weight in one month.

Gastric Fistulas with Jejunal Interpositions: In this series of experiments carried out in two parts, a six-inch segment group of jejunum was implanted in one group of eight animals between the stomach and colon to serve as a conduit or fistula. In half of the animals, it was isoperistaltic whereas in the rest it was antiperistaltic. In the other group, the direction of flow was from the colon to the stomach.

The animals with six-inch interpositions ate well; they had no diarrhea and could not be considered ill. One of eight animals in this group actually gained weight under the favorable conditions of kennel life. On post-mortem examination, the stomach, colon and interposed segment appeared to be normal (Fig 2).

In four animals with an interposed jejunal segment two inches long, the course was not unlike that seen with direct gastrocolic fistulas. The average survival time was 48 days. All of the animals died of malnutrition.

Observations

The gross and microscopic changes observed were variable, depending upon the particular segment of gastrointestinal tract examined and upon the type of fistula present.

The stomach proximal to the anastomosis showed prominent rugae, while the distal stomach showed atrophy of the mucosa. In most of the animals (approximately 80%), there were no significant gross changes. A hemorrhagic gastritis was present in four of the 42 animals (Fig 3). Dark blood was also present in the upper gastrointestinal tract in this animal. Few ulcers were seen, and rarely did they extend all of the way to the muscularis (Fig 4).

Because rapid autolysis of cells occurs after death, formalin fixation of the specimen must be prompt if acceptable sections are to be obtained. One of the deceptive ulcer-like lesions was proven on microscopic examination to be due to autolytic changes (Fig 5).

Among the microscopic changes seen in the stomach were congestion, edema and the presence of inflammatory cells, none of them marked in degree.

There were few gross changes in the colon. The proximal colon was nearly normal, while the distal colon showed a hemorrhagic reaction in very few animals. There were superficial ulcers on the colonic side of the anastomosis in three animals at post mortem.

Microscopically the colon again showed little or no change, with some congestion seen in but a few animals. Submucosal hemorrhages were seen occasionally and edema and inflammatory cells were not at all uniform in occurrence.

The most significant findings were in the duodenum and jejunum and to a lesser extent in the ileum. Congestion was present microscopically. The glands were reduced in size as were...
the villi. They were described as being shortened. An eosinophilic granular material mixed with mucosal epithelial cells was present in the intestinal lumen. Goblet cells were reduced in number. Grossly, "ulcers" were the single most common finding, but few were actually proven to be ulcers (Fig 2). Again we caution, when studying the gastrointestinal tract of the dog, rapid autolysis makes accurate observation difficult.

A significant microscopic observation was that most of what were thought to be "ulcers" on gross examination were actually aggregates of lymphoid follicles. To the best of our knowledge, these observations have not been recorded previously.

It is suggested that probably two mechanisms operate in production of the clinical picture seen in the gastrocolic fistulas. First, the presence of colonic contents in the small intestine

Figure 2
The stomach, colon, duodenum and jejunal implant of two animals appear quite normal. In these animals the jejunal interposition served as a conduit from the colon to the stomach. These animals remained quite well, showing no significant interference with nutrition.
injure the mucosa either chemically or bacteriologically. Secondly, the denuded surface permits infection which then accounts for the enlarged aggregates of lymphoid cells in the intestinal wall. Injury to the mucous membrane accounts for the impaired assimilation and resultant weight loss seen regularly.

Discussion

Gastrocolic and gastroenteric fistulas generally cause severe nutritional disturbances. Rapid weight loss is evidence of poor absorption and decreased intake. The pathophysiology and clinical course has been of concern to a number of investigators and surgeons.\textsuperscript{1-7} In humans, peptic ulcer disease and malignancies have accounted for most of the gastrocolic or gastrojejunocolic fistulas.\textsuperscript{6,7} The number of such communications has greatly decreased since simple gastrojejunostomy has practically been abandoned as a method of surgical treatment of peptic ulcer.

Pfeiffer and Kent\textsuperscript{6} suggested that the diarrhea seen in gastrocolic fistulas is due to the fact that stool gains access to the upper small intestine.

Bolton and Trotter\textsuperscript{1} observed dramatic improvement in a patient with gastrojejunocolic fistula after performance of a colostomy. They were of the opinion that the direction of flow of content was from the colon into the stomach.
and small intestine. They concluded that the presence of colonic contents in the small bowel caused the diarrhea.

Kiskaddon et al studied the problem of gastrocolic fistulas in dogs. They felt that contact of colonic contents with the small intestine and stomach caused injury to the mucosa.

Nigro et al studied the cause of malabsorption in gastrocolic fistulas in experimental animals. They created a particular type of anastomosis in which the colocolonic anastomosis was made close to the cologastric junction. They found an extensive loss of epithelium and hyperplasia of the epithelium in the basal layer of the mucosa, but little or no evidence of inflammation either in the stomach or upper intestine.

From her basic studies, Padykula formed the opinion that there is a progressive differentiation of the epithelial cells in their migration which ends in the formation of the absorptive surface near apex of the villus, where she found that most absorption occurs.
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She observed that differential replacement of jejunal epithelium is interfered with in nontropical sprue.

It is suggested that besides the presence of bacteria in the upper gastrointestinal tract in gastrocolic fistulas there is a change in the chemical and enzymatic milieu which contributes to the nutritional disturbances associated with such communications. The mucosa of the small intestine is severely compromised with resultant disturbances in absorption.

Summary and Conclusions

Abnormal communications between the stomach and colon and duodenum and colon cause profound nutritional disturbances. Duodenocolic fistulae cause the most rapid wasting of the animals. The average survival time was 20 days. Direct gastrocolic fistulae were usually fatal, but the survival time averaged 42 days.

In those animals with long communications, such as six inch segments of jejunum between the stomach and colon, the survival time was not shortened. Their nutrition was not impaired.

Grossly, the effects of gastro-enteric fistulas are seen near the anastomosis and particularly in the small intestine. There is gross evidence of inflammation in the upper gastrointestinal tract of some animals as manifested by a hemorrhagic reaction.

Microscopically the greatest changes are seen in the upper small intestine.

Figure 5
Autolytic changes develop rapidly after death and may simulate an ulcer as in the above photograph. The reaction typical of ulcer was absent on microscopic section.
Ulcers are seen in some animals. Aggregates of lymphoid cells in the small intestine may present the gross appearance of an “ulcer”.

The epithelium and villi showed consistently significant changes microscopically. There was destruction of the mucous membrane and decrease in size of the villi.

In the lumen of the bowel an eosinophilic granular material with mucosal epithelial cells suggests denudation of the mucous membrane.

It is suggested that alterations encountered in gastrocolic fistulas are secondary to two mechanisms: First, the intestinal mucosa is adversely affected by the colonic contents; secondly, the loss of a protective lining predisposes to infection as supported by the presence of aggregates of lymphoid cells.

The serious disability of gastrocolic communications results from the actual flow of colonic contents into the upper gastrointestinal tract.

A simple non-functioning communication of sufficient length between the stomach and colon, such as a jejunal interposition, seems to protect the experimental animal.

REFERENCES