experimental gastric ulcer in the rat with histidine injections was not confirmed by our investigation. We found the incidence of gastric lesions identical in the groups on the ulcer producing regime, with and without histidine injections.

The high incidence (50%) of gastric lesions in group (C) in which no ulcer producing agent was employed appears to have followed the histidine injections. These ulcers may have been produced by a resultant histamine formation (11), since histidine may be converted by simple decarboxylation into histamine (12). Whether histidine parenterally administered in man, could through a similar conversion adversely influence a gastro-duodenal defect is a subject for future investigation.

**SUMMARY**

1. Experimental gastric ulcers in the rat were produced by our pepsin-hydrochloric acid method.
2. Daily injections of histidine monohydrochloride (Larostidin-Hoffman La Roche) were not effective in preventing experimental gastric ulcers.
3. A high incidence of gastric ulcers subsequent to injections of histidine were observed.
4. The conversion of histidine into histamine is suggested as a possible experimental ulcer producing mechanism.

**REFERENCES**

6. Sandweiss, D. J., Saltstein and Glazer: Comparative Results with Dietetic, Parenteral and Surgical Treatment in Peptic Ulcer. To be published. (Personal Communication).

---

**Studies in Bowel Drainage**

*By*

ANTON W. OELGOETZ, M.D.

PAUL A. OELGOETZ, B.A.

and

J. WITTEKIND, R.N.

COLUMBUS, OHIO

If glucose is given in quantities in excess of 2 grams per hour, the blood sugar level rises and sugar appears in the urine. It has been believed that starch in any quantity is completely hydrolyzed (to sugar) and absorbed. However, when given in large quantities, starch does not effect the blood sugar level; does not appear as sugar in the urine; nor does it appear in the feces as starch or sugar.

It has been believed that the reason why starch does not act like sugar in the gastro-intestinal tract is because starch is often bound up in vegetable or fruit cells and is but slowly absorbed. But preliminary studies indicated to us that ingested starch has a two-fold fate: part of it—that part which comes within the amylolytic threshold—is absorbed into the blood stream as sugar, while the remainder—the excess which cannot be hydrolyzed by the available enzymes during its passage through the upper bowel—passes to the colon, where it becomes the determining factor in the mechanism of normal bowel drainage.

Cannon long ago advanced the hypothesis that the motor mechanism of the bowel depends upon bulk: when the bowel is distended to the "just right" pressure, the intestinal muscles contract, thereby forcing onward the bowel contents. This observation was the basis of the former widespread use of bran and other indigestible bulky substances.

It is true that coarse, bulky roughage stimulates the motor mechanism of the bowel, but this stimulation results from the mechanical irritation caused by large unbroken particles contained in the feces. It is a common datum of observation that irritating roughage, bran for example, often overstimulates the bowel musculature, thereby producing constipation of the spastic type. This observation would seem to indicate that mere bulk or roughage is not the factor concerned in the mechanism of normal bowel drainage.

Schmidt long ago pointed out that there is no distinguishable difference between a "good drainage" stool and a "constipated" stool, although macroscopically and clinically they are as different as day from night. Schmidt believed that constipation resulted because the digestive enzymes did their work too well, so well that little food bulk remained to stimulate the bowel. Our observations indicate that mere bulk as such, is unimportant, but that the colloidal state in which the feces is dissociated is the determining factor which controls normal drainage. Because he believed, erroneously, that ingestion of different foods causes differences in feces, Schmidt introduced his test diet as a starting point, whereby feces of a uni-

Submitted January 30, 1936.
form composition, a normal stool, would be produced. Our observations indicate that normally, feces is always of a uniform composition, irrespective of the kinds of food ingested.

The composition of normal feces is as definite as is sodium chloride. If a bit of feces is rubbed up with distilled water and filtered, practically all will pass through the filter; only the large unbroken particles, such as spinach tissues and stems, seeds, etc., remain in the filter. Under the ultra-microscope the filtrate is seen to be a perfect colloidal suspension, viz., small rounded, rod-shaped particles, approximately 25% of which are colon bacilli, some motile, most of them dead; and approximately 75% cellulose. Normally, in the unfiltered specimen, an occasional meat fiber is seen, very rarely an unbroken vegetable cell. In brief, normal feces produced from a general mixed diet is a perfect colloid; the larger vegetable tissues, seeds, skins, etc., are simply incorporations which are imbedded in the fecal colloid, much as the housewife sometimes incorporates fruits in a gelatine dessert. It is only when such are present in abnormally large quantities that they have any significance. It is the homogeneous, colloidal mass which constitutes normal feces.

Clinically, all normal feces naturally divides itself into two main types: the constipated stool, small in quantity, dark in color, formed, inspissated, expelled with difficulty; and the “good drainage” stool, large in quantity, light brown in color, soft in consistency and easily expelled. In practice we of course, find varying mixtures of these two types, and the degree of drainage depends directly upon which type prevails. The only essential difference between the two types is in the contained water. The good drainage type contains approximately 70% water, while the constipated type contains but 30% water. The water in both instances is held in chemical combination with the colloidal particles; it is never normally present as free water.

Fecal colloids (as well as other colloids) take on water because of a peculiar property known as imbibition, i.e., the power of taking on water without forming liquid solutions. The factors which control the quantity of water which will be taken on by a colloid are the pH of the medium in which a colloid is suspended, and the iso-electric point of the individual colloid. The greater the difference between the pH of the suspending medium and the iso-electric point of the colloid are identical, the particles do not migrate when the circuit is closed. A determination of pH and the iso-electric point of feces requires delicate and expensive apparatus, which, for practical purposes, is unnecessary. Clinically, the degree of drainage and the type of feces can easily be determined by placing a weighed quantity of feces in a Petrie dish and drying in the warm air incubator. A “good drainage” stool contains approximately 70% water, while the constipated stool contains approximately 30% water. The experienced clinician however, can tell at a glance the degree of drainage by noting the color, consistency and quantity of stool.

Inasmuch as the iso-electric point of all feces is approximately 4.5, the practical application of the above observation resolves itself into how to control the pH of the feces. Observation has taught us that this can be done by the administration of large quantities of starch — quantities in excess of the pancreatic threshold, so that all of the starch cannot be hydrolyzed during its passage through the upper bowel. If more starch is taken than can be hydrolyzed by the available amylase, the excess passes to the colon where it meets with bacteria of the acid forming series. As a result of the action of these bacteria upon the starch and sugar, lactic and other acids in large quantities are formed. It is these acids, arising from colon carbohydrates, which determine the pH of the feces.

Practically, normal drainage can be quickly established by having the patient include in the regular diet a large helping (the more the merrier!) of any starch. The stool produced in this manner (which we prefer to call the “good drainage” stool or carbohydrate stool) is large in quantity, light brown in color, soft in consistency, results in but one daily evacuation, can be recognized at a glance, and leaves the patient with a delightful sense of completeness and thoroughness.

It is of course, presumed that the patient has previously been examined so as to preclude all pathological conditions which interfere with or prevent normal drainage. Likewise, the doctor should himself “see” the stool. Patients have many peculiar ideas concerning bowel drainage. They should be informed that