

CHANGES IN THE MUCOSAL PATTERN OF ISOLATED LOOPS OF JEJUNUM IN ALBINO RATS

A DISSECTION MICROSCOPE STUDY

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THE changes in the mucosal pattern of albino rats from birth to adulthood have been described previously (Baker, Mathan and Cherian, 1963). At birth the animals have "finger-like" villi throughout the intestinal tract. As the rats grow older the villi first become broader at the base producing a "tongue-shaped" appearance and later they become "leaf-like" structures which are as broad at the tip as they are at the base. By the time the rats reach adulthood the villi in the upper intestine are replaced by a series of parallel "ridges" which are most prominent in the duodenum and upper jejunum. More distally "leaves" and "tongues" are often present and in the lower ileum "finger-like" villi may persist.

Two possible explanations were suggested for these alterations in mucosal architecture. The first was that these changes may represent a "normal" growth process. The second possibility suggested was a "toxic factor or factors" producing mucosal damage. The present experiment was undertaken to study the effect on villus architecture of isolation of a portion of jejunum from the rest of the intestine.

MATERIALS AND METHODS

Young albino rats from a local laboratory strain were used for the experiment. Fifteen animals survived surgery for a sufficient period of time to be included in the study. At the beginning of the experiment these animals were between 6 and 15 weeks old.

The abdomen was opened under pentobarbitone anaesthesia. A segment of jejunum 4-6 cm. in length beginning about 2 cm. from the duodenojejunal flexure was isolated, keeping its mesentery intact. Continuity of the rest of the intestinal tract was re-established by end to end anastomosis. Biopsies were taken from the ends of the isolated loop for later reference and the ends were then brought out through stab wounds in the anterior abdominal wall and sutured to the skin forming a Vella fistula.

The animals were maintained on a standard diet and re-examined 4 months to 1 yr. after surgery. The villus architecture of the isolated loop was then compared with that of the original biopsies and that of the corresponding area of the upper jejunum. Changes were graded numerically, areas showing all finger-shaped villi as grade "1", tongue-shaped villi as "2", leaf-shaped "3" and ridges "4". Where areas showed a mixture of 2 or more different types they were graded between 2 numbers (*e.g.* a mixture of 50 per cent tongue like villi and 50 per cent finger-shaped villi was graded as 1.5).

RESULTS

Comparison of the villus architecture at the time of surgery with that of the same region in the main part of the intestine at the termination of the experiment showed that what had been "tongue" or "leaf-like" villi had progressed to ridges in most instances (Fig. 1).

In 6 instances nodular elevations of the mucosa were seen at the site of anastomosis. Under the dissection microscope a convoluted appearance of the mucosa was seen at this site, while immediately proximal and distal areas showed ridges and leaves (Fig. 2). Histological sections of these area showed increase in the connective tissue of the lamina propria, irregular bundles of smooth muscle with infiltration by inflammatory cells mainly lymphocytes and plasma cells.

The isolated segment was narrower than the rest of the jejunum but had increased in length corresponding to the growth of the animal. Fig. 1 shows the final appearances of the mucosa of the isolated segments compared with those of

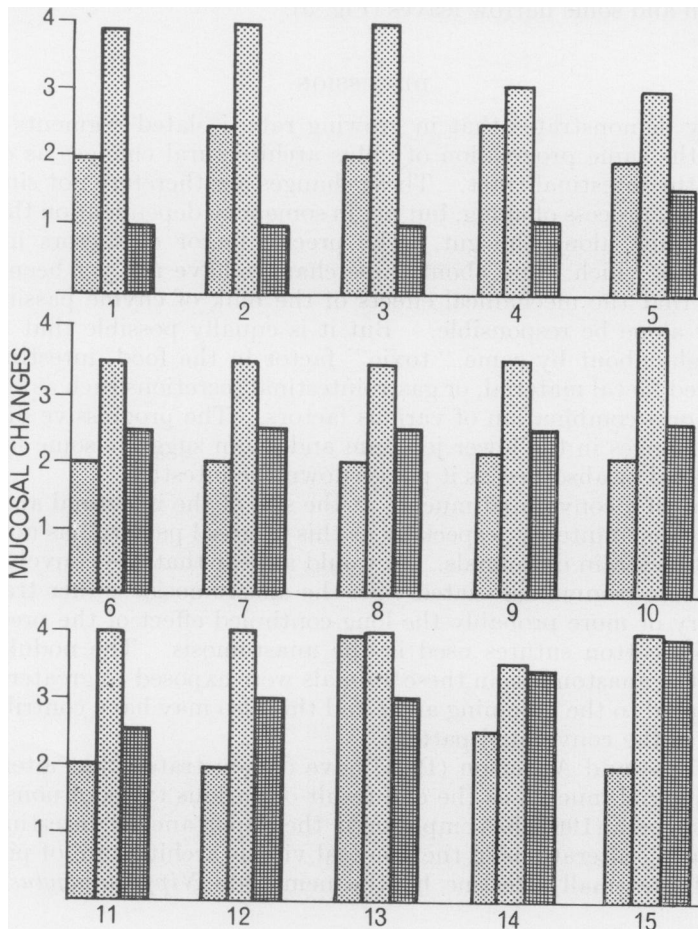





FIG. 1.—Comparison of mucosal appearances:

-  Jejunum biopsy at surgery.
-  Jejunum biopsy at the end of experiment.
-  Jejunum, isolated segment.

Grade 1.—Finger like villi; 2.—Tongue shaped villi; 3.—Leaf like villi; 4.—Ridges.

the original biopsy and the corresponding area of the upper jejunum. In all the animals the changes in the isolated loop were less marked than those in the main intestinal tract. In 5 instances the mucosa in the isolated segment had regressed from its original appearance at the time of surgery, and in 3 animals the mucosal appearance had changed from "tongue" or "leaf-like" villi at the time of surgery to showing only "finger-like" villi. Fig. 3 illustrates the appearance of the jejunal mucosa in a 7 week old rat at the time of surgery showing "tongue" shaped villi. Four months after surgery the main part of the jejunum had progressed to "ridges" and "leaves" (Fig. 4) while the isolated segment showed finger-like villi and some narrow leaves (Fig. 5).

DISCUSSION

This study demonstrates that in growing rats, isolated segments of jejunum do not show the same progression of villus architectural changes as occur in the remainder of the intestinal tract. These changes are therefore not simply part of the physiological process of aging, but are in some way dependent on the passage of intestinal contents along the gut. The precise factor or factors in the intraluminal contents which bring about these changes have not yet been elucidated. It is possible that the mechanical effects of the bulk of chyme passing down the jejunum may alone be responsible. But it is equally possible that the changes may be brought about by some "toxic" factor in the food, intestinal bacterial flora, swallowed faecal material, or gastrointestinal secretions such as the acid from the stomach, or a combination of various factors. The progressive diminution of the mucosal changes in the lower jejunum and ileum suggests some factor that is either neutralised or absorbed as it passes down the intestine.

The finding of a convoluted mucosa at the site of the intestinal anastomosis in 6 of the animals is of interest, especially as this mucosal pattern has not previously been seen in this strain of animals. It would appear that the convoluted mucosa resulted from the trauma associated with the anastomosis—either trauma at the time of surgery or more probably the long-continued effect of the presence of the non-absorbable cotton sutures used in the anastomosis. The nodular swellings at the site of the anastomosis in these animals were exposed to greater mechanical trauma compared to the adjoining areas and this also may have contributed to the development of the convoluted pattern.

Townley, Cass and Anderson (1964) have demonstrated that alterations may occur in the jejunal mucosa as the end result of various types of nonspecific local trauma. Kenworth (1967) has emphasised the importance of intestinal bacterial flora in producing alterations in the mucosal villous architecture of pigs. In rats infestation of the small intestine by the nematode *Nippostrongylus brasiliensis*

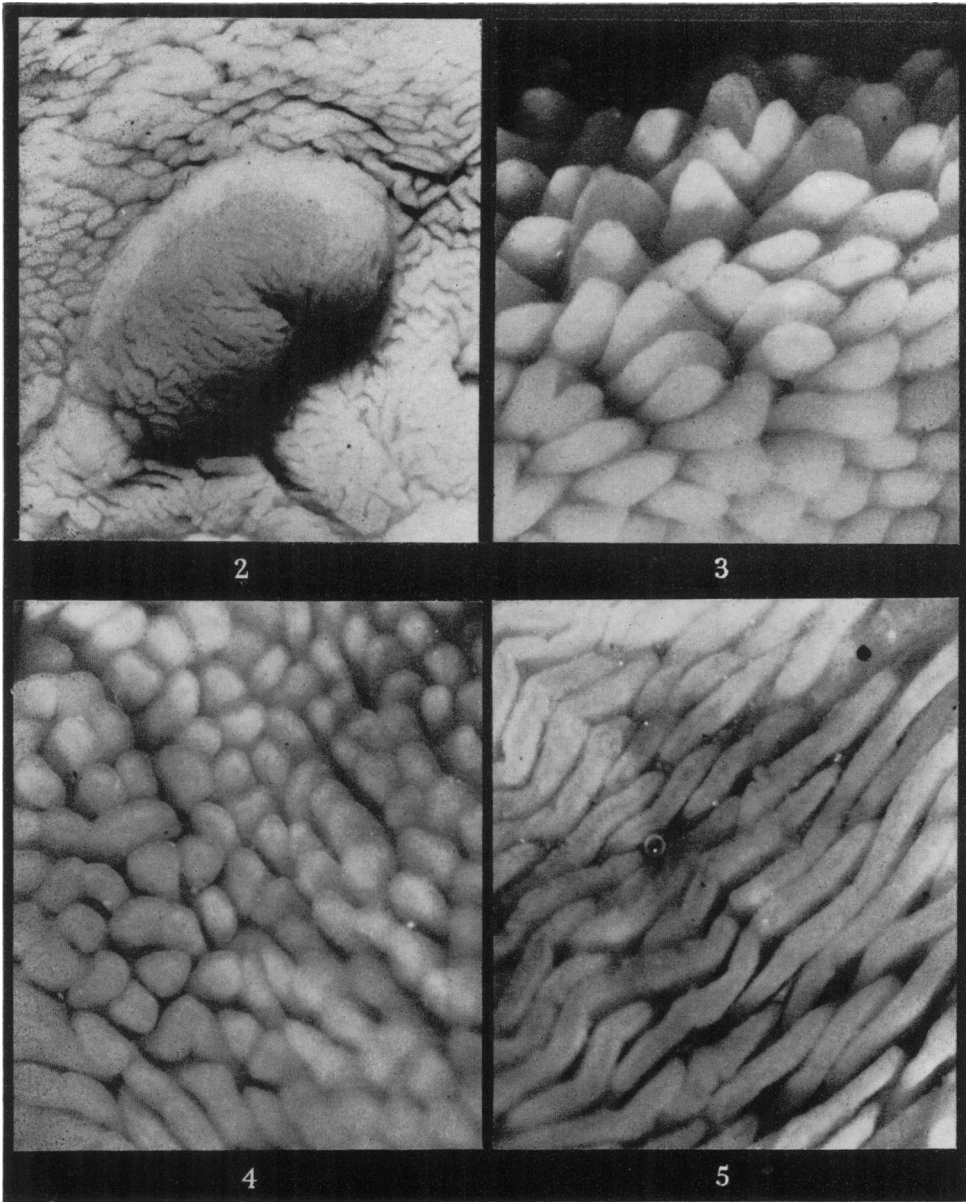
EXPLANATION OF PLATE

FIG. 2.—Anastomotic site in the jejunum showing nodular elevation of the mucosa with a convoluted pattern. $\times 16$.

FIG. 3.—Jejunal mucosa of a 7 week old albino rat showing tongue-shaped villi. $\times 60$.

FIG. 4.—The mucosa of the jejunum in the same animal after four months showing ridges and leaf-like villi. $\times 40$.

FIG. 5.—Appearance of the isolated segment of jejunum showing finger-like villi and leaves. $\times 40$.



has been shown to produce marked alterations of the mucosa (Symons and Fairbairn, 1962). Convoluted mucosal architecture may be seen in human intestinal biopsy specimens in a variety of disease states—*e.g.*, patients with neoplasms (Creamer, 1964), sarcoidosis and lymphosarcoma (Gjone, Myren and Refsum, 1965) and even in apparently normal subjects (Baker, Ignatius, Mathan, Vaish and Chacko, 1962). As pointed out by Ammann (1965) and Collins (1963) the progressive changes in villus architecture from “finger-like” villi to “leaves”, “ridges”, “convolutions” and finally a “flat” mucosa, appear to be the non-specific end results of a variety of damaging agents. Two such “damaging” agents are illustrated in this experiment—the continued passage of chyme and the trauma connected with the intestinal anastomosis.

Removal of the damaging factor may allow the mucosa to return to a more normal state. This return towards normal has been well documented in the case of withdrawal of wheat from the diet in subjects with gluten induced enteropathy (Anderson, 1960; Rubin, 1960; Rubin, Branlberg, Phelps and Taylor, 1960). The lessening or complete reversal of changes in the isolated segments demonstrated in some rats in this experiment appear to have been brought about by a similar mechanism, although the precise nature of damaging factor(s) has yet to be identified. Further work is in progress.

SUMMARY

The effect of isolation of a segment of jejunum on villus architectural changes has been studied in 15 rats.

In every case the isolated segment showed a lesser degree of change than was found in the main jejunum. In 5 cases the villus architecture became less abnormal than the original appearance at the time of surgery, and in 3 instances all the villi in the isolated segment were finger-like.

In 6 cases at the site of intestinal anastomosis the mucosa presented a convoluted appearance.

The changes in the villus architecture appear to be the result of damage to the mucosa associated with the continuing passage of intestinal contents.

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