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Histologic Study of the Intestine in Simple Obstruction.*

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Definite circulatory, inflammatory and degenerative changes occurring in the bowel wall in simple obstruction have been reported by several observers on the basis of anatomical studies. Most of the material has been obtained from dogs with experimental obstruction. Chenut[1] mentioned vascular congestion, desquamation of epithelium, leucocytic infiltration and decreased staining power of the cells. Hartwell, Hoguet, and Beekman[2] described vascular congestion, round cell or leukocytic infiltration, hemorrhages, edema of submucosa, exfoliation of lining cells and necrosis of the mucosa at certain points. VanBeuren[3] also described marked changes occurring in simple obstruction such as areas of gangrene and vascular thrombosis. Braun and Wortmann[4] on the basis of the work of Hoffman, Reichel, Enderlen, Hotz, and others described edema and venous stasis of the proximal bowel segment and a loosening of the fibrous and muscular layers. As venous stasis increased more marked changes were noted, extravasations of blood, thrombosis of small veins, infiltration of the tissues, and finally ulceration of the mucosa and necrosis of the bowel wall. Gatch[5] states that gangrene may regularly occur in simple obstruction as a result of increased intraluminary tension, except in high (duodenal) or low (colonic) obstructions. Elman and Hartmann[6] found examples of discoloration or gangrene of the bowel in dogs with obstructions of the ileum but concluded that death in low intestinal obstruction is not necessarily due to gangrene or necrosis of the obstructed intestine.

The present histologic study of the obstructed intestine was undertaken in order to determine whether the anatomic changes occurring in the bowel in simple obstruction differ only in degree

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1 Chenut, A., *Rev. d. Chir.*, 1926, **64**, 1474.

2 Hartwell, J. A., Hoguet, J. P., and Beekman, F., *Arch. Int. Med.*, 1914, **13**, 701.

3 VanBeuren, F. T., Jr., *Ann. Surg.*, 1930, **72**, 610.

4 Braun, H., and Wortmann, W., *Der Darmverschluss.* Julius Springer, Berlin, 1924, 41.

5 Gatch, W. D., *Ill. Med. J.*, 1931, **60**, 236.

6 Elman, R., and Hartmann, A. F., *Surg. Gynec. and Ob.*, 1931, **53**, 307.

from those occurring in strangulation obstruction and whether circulatory and degenerative changes can regularly be demonstrated in the bowel in the presence of simple obstruction.

Method. In the experiments from which the material was obtained, blockage of the intestine was produced in dogs by dividing the bowel, ligating the 2 ends and inverting them with purse-string sutures. The animals were sacrificed when they appeared moribund and specimens of the intestine removed for microscopic examination. A few of the dogs died unexpectedly and specimens were taken in these at postmortem. Sections showing definite postmortem changes were eliminated from the series. One or 2 specimens were taken from the bowel distal to the obstruction and one to 4 specimens were removed from the obstructed proximal segment at various levels between the pylorus and the point of obstruction. In the earlier cases sections were taken at random but in later experiments the entire bowel was opened and inspected grossly and specimens selected from any areas that appeared to deviate from the normal in gross appearance. The tissues were fixed in either formalin or Zenker's solution, imbedded in paraffin and microscopic slides prepared employing the hematoxylin eosin stain.

The observations are based upon 9 cases of duodenal obstruction (3 to 6 days' duration); 17 of ileal obstruction (2 to 14 days' duration), and 9 of colonic obstruction (2 to 19 days' duration).

Results. The gross appearance of the bowel was of some value in elaboration of the microscopic picture. A redness of the distended obstructed loop was observed almost uniformly. This rubor undoubtedly means congestion and it is our experience that the gross appearance is a more reliable criterion of congestion than the microscopic.

In duodenal obstruction microscopic changes were rarely observed. Edema and congestion of the mucosa and submucosa which are difficult to evaluate on microscopic examination and shortening of the villi occurred, but none of these findings were constant. No interstitial hemorrhages or areas of necrosis were observed.

In the case of ileal obstruction greater changes were noted, probably because some of these animals survived for a longer period of time. But even in this group in many of the sections no distinct difference could be demonstrated between sections taken above and below the obstruction. Edema of the mucosa and shortening of the villi were often observed. A clubbed appearance of the villi was a prominent feature in some of the sections. Congestion of the bowel wall was sometimes noted but was not of severe degree, and in no

instances were any intramural hemorrhages encountered. Leucocytic infiltration of the bowel wall occurred in one animal dying of peritonitis. An ulcer of the duodenum was found in one of the dogs in this series.

Microscopic sections of the colon as late as 19 days after the production of an obstruction of the colon failed to reveal changes other than an ironing out of the plicae and in some instances a slight congestion.

Comment. The findings reported here fail to confirm some of the previous studies on the pathology of simple intestinal obstruction. The loss of epithelium particularly on the tips of villi was noted occasionally both above and below the obstruction and was evidently due in part at least to mechanical removal of epithelium by the microtome knife during preparation of the section. It may occur more commonly in the obstructed loop because of edema of the mucosa. We find no evidence that loss of epithelium is a constant or characteristic feature of the pathology of simple intestinal obstruction.

The marked circulatory changes and necrosis referred to by other authors were not observed in our specimens. The only instance of ulceration was a duodenal ulcer in an animal with an obstructed ileum. The occurrence of such an ulcer is of doubtful significance.

Necrosis of the proximal bowel wall was not encountered in this series of 35 dogs. That it may occur following the establishment of simple obstruction in the colon due to the presence of a competent ileo-caecal valve is not to be denied. Its clinical occurrence is well known in obstructions of the colon and especially due to carcinoma at the sigmoid flexure, the necrosis with ensuant gangrene or perforation being almost invariably found in the cecum, the most distensible portion of the bowel.

Evidence for the presence of vascular disturbances in simple obstruction is to be found in the studies of Van Zwallenburg,[7] Gatch, Trusler and Ayers,[8] and Dragstedt, Long and Millet,[9] which demonstrate stagnation or even complete cessation of the intramural intestinal circulation in loops of bowel artificially subjected to distention. The pressures employed were usually from 30 to 200 mm. of mercury.

However, hollow muscular viscera, such as the bladder, stomach, and intestine, exhibit great ability to accommodate themselves to altered capacities without significant changes in tension, and it would

[7] Van Zwallenburg, C., *Ann. Surg.*, 1907, **46**, 780.

[8] Gatch, W. D., Trusler, H. M., and Ayers, K. D., *Arch. Surg.*, 1927, **14**, 1215.

[9] Dragstedt, C. A., Lang, V. F., and Millet, R. F., *Arch. Surg.*, 1929, **18**, 2257.

appear that the intra-intestinal pressures necessary to arrest the blood flow in the wall of the bowel are in excess of pressures observed in the bowel during the course of obstruction. As a matter of fact, Owings, McIntosh, Stone and Weinberg[10] found in simple obstruction of the small intestine in dogs that the sustained intra-intestinal pressure was only 6 to 8 cm. of water (about twice the normal) although under the influences of vigorous peristalsis the pressure at times reached a maximum of 30 to 60 cm. of water.

Further evidence that the circulatory changes usually are not extreme is afforded by the experiments of Morton,[11] who injected the intestinal vessels with India ink and found that although the vessels of the obstructed segment were dilated, the capillary loops had intact walls.

Conclusions. The material presented here leads to the conclusion that in simple obstruction only slight changes (congestion, edema) can be demonstrated and frequently no alteration of microscopic structure is to be observed. Grossly the bowel regularly appears hyperemic but no inflammatory or degenerative changes are observed on histologic study.

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Length of Life Following Various Types of Strangulation Obstruction in Dogs.*

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In a series of 12 dogs, Foster and Hausler[1] reported the survival period following strangulation obstruction to be less than 30 hours. The lengths of intestine strangulated in their series varied between 5 and 26 inches. They tabulated their results and were able to show that the length of life was inversely related to the length of bowel strangulated. In an earlier paper by Murphy and Vincent[2] the sur-

[10] Owings, J. C., McIntosh, C. A., Stone, H. B., and Weinberg, J. A., *Ann. Surg.*, 1928, **17**, 507.

[11] Morton, J. J., *Arch. Surg.*, 1929, **18**, 1119.

* This work was supported in part by Grant 244 allowed by the Committee on Scientific Research of the American Medical Association.

[1] Foster, W. C., and Hausler, R. W., *Arch. Int. Med.*, 1924, **34**, 697.

[2] Murphy, Fred T., and Vincent, Beth., *Boston Med. and Surg. J.*, 1911, **165**, 684.