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Blood Chemistry in Intestinal Obstruction.

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The work of Tileston and Comfort,[1] Whipple and his associates,[2] Mac Callum,[3] Hastings,[4] Haden and Orr,[5] and others has demonstrated that obstruction in the upper intestinal tract produces characteristic changes in the blood chemistry. These may be summarized as follows: a decrease in the concentration of chlorides, a late increase in non-protein and urea nitrogen, and an increase in the carbon dioxide combining power of the blood plasma. As a result of a number of experiments reported by L. R. Dragstedt,[6] C. A. Dragstedt,[7] P. R. Cannon,[8] and their associates from 1916 to 1921, these authors concluded that the toxemia of intestinal obstruction was due to the absorption of chemical fractions produced by the proteolytic activity of the intestinal bacteria and that the factor permitting their absorption was circulatory damage to the intestinal mucosa as a result of distention. In the present experiments determinations were made of the non-protein nitrogen, urea nitrogen, and chloride concentration in the blood of dogs subjected to the various procedures described in the early reports. The following points are brought out.

(1). The production of isolated closed segments of the lower duodenum or upper jejunum, causes a toxemia similar to that resulting from obstruction at the same level and roughly proportionate to

the degree of toxemia, a fall in the blood chlorides, and a terminal rise in non-protein and urea nitrogen.

(2). The toxemia and decrease in blood chlorides is in turn dependent upon distention of the closed intestinal segment. If this distention is relieved by aspiration of the fluid within the segment by a needle thrust through the abdominal wall, the toxemia is relieved and there occurs a proportionate return of the blood chloride concentration toward the normal level.

(3). The intra-peritoneal injection into normal dogs of the fluid aspirated from such closed segments produces a toxemia accompanied by a fall in blood chlorides, and a rise in non-protein and urea nitrogen.

(4). If isolated segments of the lower duodenum and upper jejunum are left open and permitted to drain freely into the abdominal cavity, many dogs will not develop peritonitis and will continue to live for long periods in good health. Such animals show no significant changes in the blood chemistry. It seems evident that the substances responsible for the toxemia and accompanying fall in blood chlorides and rise in non-protein and urea nitrogen are not present in the fresh secretions of the duodenal or jejunal mucosa.

(5). After varying periods of from 2 weeks to 2 months, a second operation has revealed that these draining segments may become sterilized. In such animals, with sterile segments of the upper jejunum, a ligation of the mesenteric blood supply to the segment and resultant complete autolysis, has not produced any adverse symptoms nor the usual changes in the blood chemistry.

(6). On the other hand, ligature of the blood supply to a similar segment that has not been sterilized by drainage, causes a profound toxemia, fall in blood chlorides and rise in non-protein and urea nitrogen, and death in 24 to 48 hours.

(7). It is significant that histamine, which may be produced by the action of intestinal bacteria from histidine, has been found in the fluid of closed intestinal loops and in the obstructed intestine, by both the method of biological assay and chemical analysis, in amounts sufficient to account for an appreciable part of the toxicity of these fluids. The subcutaneous injection of histamine in dogs produces symptoms of depression not unlike those following injection of obstruction fluids, a similar splanchnic engorgement, a fall in blood chlorides, and a rise in non-protein and urea N.

(8). The toxic fractions in obstruction fluids are powerful secretagogues, and when injected into dogs cause a marked augmentation of gastric, pancreatic, and intestinal secretion. Accordingly it seems probable from this as well as other evidence obtained by other work-

ers, that the fall in blood chlorides in obstruction is due to their accelerated passage into the alimentary tract and failure of reabsorption.

[1] Tileston, W., and Comfort, C. W., *Arch. Int. Med.*, 1914, xiv, 620.

[2] Whipple, G. H., Rodenbaugh, F. H., Kilgore, A. R., *J. Exp. Med.*, 1916, xxiii, 123; Cooke, J. V., Rodenbaugh, F. H., and Whipple, G. H., *J. Exp. Med.*, 1916, xxiii, 717.

[3] MacCallum, W. G., Lintz, J., Vermilye, H. N., Leggett, T. H., and Boas, E., *Bull. Johns Hopkins Hosp.*, 1920, xxxi, 1.

[4] Hastings, A. B., Murray, C. D., and Murray, H. A., *J. Biol. Chem.*, 1921, xlvi, 223.

[5] Haden, R. L., and Orr, T. G., *J. Exp. Med.*, 1923, xxxvii, 365; Dragstedt, L. R., Moorhead, J. J., and Burcky, F. W., PROC. SOC. EXP. BIOL. AND MED., 1916 xiv, 17, and *J. Exp. Med.*, 1917, xxv, 421.

[6] Dragstedt, L. R., Dragstedt, C. A., McClintock, J. T., and Chase, C. S., *J. Exp. Med.*, 1919, xxx, 109.

[7] Dragstedt, C. A., and Moorhead, J. J., *J. Exp. Med.*, 1917, xxvii, 359; Dragstedt, C. A., Dragstedt, L. R., Chase, C. S., *Am. J. Physiol.*, 1918, xlvi, 366.

[8] Cannon, P. R., Dragstedt, C. A., and Dragstedt, L. R., *J. Infect. Dis.*, 1920, xxvii, 139.

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Comparative Sensitiveness of Blood Pressure and Intestinal Motility to Epinephrine.

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General anesthetics have long been known to depress motility of the gastrointestinal tract. This has recently been studied in some detail by Miller,[1] who reports that ether and chloroform have a very marked depressant effect. We have previously reported that the hemodynamic effect of epinephrine is materially altered by general anesthetics (ether).[2] Since previous studies on the comparative effect of epinephrine upon blood pressure response and gastrointestinal motility[3, 4] have been made on animals under general anesthesia it seemed advisable to repeat this on the unanesthetized animal.

Dogs were used. Intestinal motility was recorded from fistulae of the jejunum by the balloon method. Carotid blood pressure was recorded from arteries previously transplanted externally to the skin. Epinephrine was injected intravenously by means of a Woodyatt pump for varying intervals of time from 2 to 10 minutes. Simultaneous records of blood pressure and intestinal motility have