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Intraintestinal Pressure and Absorption from the Intestine.*

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The well recognized changes in the blood chemistry in intestinal obstruction coupled with the clear demonstration of the fatal effects of the loss of gastric or pancreatic juice have brought about a modification of the older theories which held that the cause of death in intestinal obstruction was predominantly if not exclusively a toxemia. A definitely tangible and measurable syndrome of dehydration, hypochloremia, etc., can be shown to indicate, if not determine, the fatal issue in many cases. The conception that a toxemia arises from the absorption of toxic substances from the intestinal lumen has been largely restricted to cases of strangulation obstruction, with considerable skepticism that it plays any rôle even here. However, a number of observations in the literature seem to be reasonably interpreted on the basis that toxic absorption can and does occur, among them the reports of Stone and Firor,[1] Läwen,[2] Dragstedt,[3] Gatch, Owen and Trusler,[4] Roberts and Crandall,[5] and Tonnis and Brusis.[6] In most of these reports such toxic absorption seemed to be conditioned in part on an abnormal intraintestinal pressure either developing as a result of the obstruction or artificially produced.

We have attempted to study the influence of such degrees of intraintestinal pressure as may occur in intestinal obstruction upon the absorption of certain toxic and non-toxic substances from the intestinal lumen. All of the experiments were performed upon dogs anesthetized with sodium barbital.

In a series of 5 dogs efforts were made to note any variability of lymphatic absorption by a study of the thoracic duct lymph, after dyes, colloidal silver, emulsified fats, etc., were introduced into a

* Aided by Grant No. 200 (Van Zwalenburg Fund) American Medical Association.

[1] Stone, H. B., and Firor, W. M., *Trans. South. Surg. Assoc.*, 1924, **37**, 173.

[2] Läwen, A., *Z. fur Chirurg.*, 1927, **54**, 1037.

[3] Dragstedt, L. R., PROC. SOC. EXP. BIOL. AND MED., 1928, **25**, 239.

[4] Gatch, W. D., Owen, J. E., and Trusler, H. M., *West. J. Surg. Obstet. and Gynec.*, 1932, **40**, 161.

[5] Roberts, G. M., and Crandall, L. A., *Arch. Int. Med.*, 1932, **50**, 150.

[6] Tonnis, W., and Brusis, A., *Deut. Z. f. Chirurg.*, 1931, **233**, 133.

segment of bowel which was then subjected to varying levels of distention either with air or water pressure. No definite effects were observed. Inasmuch as short segments of bowel (20 to 40 cm.) were used, such negative results do not preclude the possibility that variations might appear if the whole or major portion of the intestine were employed.

In the second series of dogs, active pharmaco-dynamic agents that are not normally readily absorbed from the intestine were introduced into intestinal loops and these then distended to various pressure levels. Histamine, epinephrine and acetylcholine were used. Histamine in doses up to 100 mg. had little or no effect whether the intestinal loop was distended or not. After prior irrigation of the loop with 50% alcohol, absorption of histamine was indicated by the subsequent fall in blood pressure, and this was increased by mild degrees of distention (20 to 40 cm. water pressure). Distention had apparently no effect on epinephrine absorption. Likewise in only one of 5 experiments with acetylcholine was there any definite evidence that distention of the intestinal loop augmented its absorption.

Gatch and his coworkers[4] call attention to a certain amount of transperitoneal absorption that may occur from intestinal loops distended by rather high pressures, pressures sufficient to arrest most of the mesenteric blood flow. These observations were confirmed by us in the following experiments in a third series of dogs. Two dogs, anesthetized with sodium barbital, were held closely together on a dog board so that an isolated loop of intestine from one dog could be introduced into the peritoneal cavity of the second dog without interfering with the mesenteric blood supply to the loop. Active pharmaco-dynamic agents which are normally readily absorbed (nicotine, synephrin, pilocarpine, ephedrine, and sodium nitrite) were introduced into the intestinal loop which was then distended to various pressure levels. Such mesenteric absorption as occurred would be manifested by the effects produced in the dog to whom the intestinal loop belonged, while such transperitoneal absorption as occurred would be manifested in the reactions of the second dog. It was observed that with all pressure levels below that of the diastolic blood pressure (of the dog to whom the intestinal loop belonged) evidences of mesenteric absorption alone resulted. Variations in pressure did not appear to alter appreciably the rate of this absorption. When the pressure was kept above that of the diastolic blood pressure, no effects whatever were noted in the dog to whom the loop belonged, *i. e.*, mesenteric absorption was com-

pletely arrested. Evidences of transperitoneal absorption occurred in 2 of the 5 experiments in which nicotine was employed, in one of the 5 experiments in which pilocarpine was employed, but in no instance with the other drugs employed. In the 2 positive experiments with nicotine, the dog to whom the loop belonged had died 10 and 20 minutes respectively before evidences of transperitoneal absorption of nicotine were apparent. In the case of the positive experiment with pilocarpine, the distention had been maintained for approximately one hour. These positive results were therefore apparently conditioned by devitalization of the loop.

These observations seem to warrant the following conclusions: Variations in intraintestinal pressure have little effect upon the mesenteric absorption of readily absorbable substances until the pressure reaches that of the diastolic blood pressure, when such mesenteric absorption ceases. Moderate distention occasionally facilitates the absorption of substances not normally readily absorbed. Transperitoneal absorption may occur but is very slow and probably insignificant from viable intestine, while it may become significant from a devitalized segment of bowel subjected to distention.

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Passage of Exogenous Bacteria Through the Wall of an Isolated Stomach.

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Nedzel and Arnold[1] showed the passage of exogenous bacteria from the small intestines into the blood circulation. Boone and others[2] proved the passage of the same bacteria into the portal circulation from the small intestines. Fisher[3] showed the same for yeast. Shuger and Arnold[4] gave evidence of absorption of exogenous bacteria from the large intestine. Fisher[5] does the same for yeast. Nedzel and Arnold[6] prove the passage of bacteria through the wall of the gallbladder. Tsuji[7] states that bacilli introduced into

[1] Nedzel, A. J., and Arnold, L., PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 358.

[2] Boone, T., Chase, E., Brink, E., PROC. SOC. EXP. BIOL. AND MED., 1931, **29**, 113.