

presence of such invisible sub-fibrils is demonstrated by their distorting effects on red corpuscles, by the alternate disappearance and reappearance of sections of the filament, and by the sudden movement of apparently free corpuscles or microcytes.

The rotation or twisting of the fibrin filament is beautifully demonstrated at times by the rotation of a corpuscle stretched out between 2 filaments; the corpuscle changes from a view on the flat to a view on edge and back again.

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### **Loss of Blood as a Factor in Death from Acute Portal Obstruction.**

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Sudden occlusion of the portal vein is followed very rapidly by shock and death within a few hours. The reason has never been explained. The blood pressure falls within a few minutes and soon drops to a shock level and continues downward until exitus. A decrease in the thrombocyte count and in clotting time has been recorded recently.<sup>1</sup> With the idea that a toxemia similar to that assumed to occur in low intestinal obstruction and strangulation might be present, we examined the lymph from the thoracic duct, the systemic blood and the portal blood from animals before and after portal ligation. By injecting the material into guinea pigs no differences in toxicity were observed.

Sufficient blood may have been lost from the general circulation into the engorged mesenteric veins and intestinal capillaries in dogs with obstruction of the portal vein to account for the rapid death. To investigate this both cats and dogs were used. Pairs of the same age, weight and sex were selected as far as possible and starved for 24 hours. The same anesthetic was employed and similar laparotomy at the same time was performed in each pair of animals. A ligature was placed around the lower rectum in each to prevent escape of intestinal contents. The portal vein was isolated in each and was tied in one. As soon as the one with ligation died the control was killed. The entire gastro-intestinal tract of each from the

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<sup>1</sup> Tschernikoff, A. M., Malenjuk, W. W., Jakubovitch, M. I., and Klantaroff, M. Ch., *Arch. f. d. ges. Physiol.*, 1921, 227, 85.

TABLE I.

|         | Controls     |            |      | Portal Ligation |            |      |              |
|---------|--------------|------------|------|-----------------|------------|------|--------------|
|         | Wt.          | Wt.        | %    | Wt.             | Wt.        | %    | % Increase   |
|         | Animal (kg.) | Guts (gm.) | B.W. | Animal (kg.)    | Guts (gm.) | B.W. | over control |
| Average |              |            |      |                 |            |      |              |
| 4 dogs  | 8.07         | 611        | 7.6  | 6.60            | 854        | 12.8 | 5.2          |
| Average |              |            |      |                 |            |      |              |
| 6 cats  | 2.65         | 165        | 6.3  | 2.94            | 282        | 9.7  | 3.4          |

cardia to the anus was removed *in toto* including the spleen and with avoidance of the loss of fluid from them. The results are shown in Table I and are expressed in terms of weight of intestinal tract as percentage of the body weight. By subtracting the weight of the intestinal tract of the controls from that of animals with portal obstruction one obtains a figure which represents the amount of fluid and blood lost into the gut. In the case of the dogs this represented an average of 5.2% of the body weight. This is above the amount necessary to kill dogs by simple hemorrhage as shown by many observers, and particularly by Johnson and Blalock.<sup>2</sup> In cats the amount lost in the intestinal tract was an average of 3.4% of the body weight which is also sufficient to cause death from simple hemorrhage. We have observed death following the loss of 2.7% of the body weight of a few control cats by simple bleeding from the femoral artery.

The behavior of animals after portal ligation is similar to that caused by severe loss of blood from hemorrhage. They become increasingly weak, respirations become rapid and shallow with occasional deep inspirations indicating "air hunger", and thirst seems apparent from their repeated attempts to find water in the empty crocks in the cage. Though prostration becomes increasingly severe, the sensorium is unaffected up to the end. There are no convulsions. At autopsy the tissues of the body are obviously dry and quite bloodless. Section of the intestine reveals tremendous engorgement of the capillaries. Sometimes but not always there is a transudation of bloody fluid into the lumen of the bowel. There is very little peritoneal fluid. Scott and Wangensteen<sup>3</sup> recently reported considerable fluid and blood loss from the general circulation after strangulation or ligation of the veins of a length of intestine. They believe this loss was sufficient to cause death.

<sup>2</sup> Johnson, G. S., and Blalock, A., *Arch. Surg.*, 1931, **22**, 626.

<sup>3</sup> Scott, H. G., and Wangensteen, O. H., *PROC. SOC. EXP. BIOL. AND MED.*, 1932, **29**, 748.