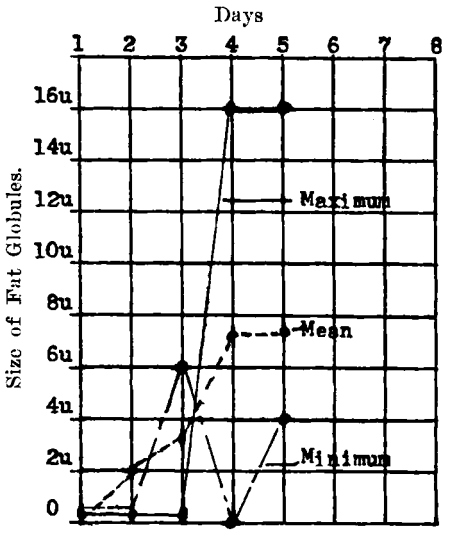

FIG. 4.
Fat in Urine of Control Dogs.

In the control dogs, fat globules were present in the urine and blood plasma from 2nd day after surgery to the time of autopsy. Maximum fat was present from the third day on. The size of fat globules varied from 4 to 20 micra; many were seen per high power field.

After autopsy, formalin fixed, hematoxylin and eosin stained sections of lungs showed fat emboli in all dogs with no appreciable difference between treated animals and controls.

Conclusion. Choline appears on the basis of plasma and urine examinations to have been of value in the management of experimentally produced fat embolism in dogs. Lung sections at five days after trauma proved inconclusive.

Note. Choline has been used in clinical cases of fat embolism with apparently very striking results. This is to be reported.

16918 P

Acute Occlusion by Ligature of the Portal Vein in the *Macacus rhesus* Monkey.*

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It is commonly accepted today that sudden occlusion of the portal vein both in the human and in animals is followed within a matter of minutes to hours by death. The first demonstration of this phenomenon is credited to Oré,[1] who noted that rabbits in which the portal vein was ligated survived but a short time. Since this original observation a large number of confirmatory reports can readily be found. The most definitive study is that of Elman and Cole,[3] who proved not only that ligature of the portal vein in dogs and cats is followed promptly by the death of the animal but also that failure to survive the procedure was due to loss of effective circulating blood volume secondary to pooling within the obstructed splanchnic venous bed. In addition to animal experiments such as these, there are a number of reports in the literature of occlusion of the portal vein in the human by thrombosis, either septic or bland, and by ligature made necessary either in the course of a surgical operation or secondary to intra-abdominal trauma.

The conclusion drawn from the animal experiments is that sudden obstruction of the portal vein is incompatible with life; from a review of the phenomenon as it is reported in the human the implication is also that in general a patient cannot survive sudden portal occlusion. A few reports are available for study, however, which indicate that occasionally the so-called "hepatopetal" veins may be sufficiently well developed to take over im-

* Supported by U. S. Public Health Service grant.

1 Quoted by Neuhof.[2]

2 Neuhof, Harold, *S. G. and O.*, 1913, **16**, 481.

3 Elman, R., and Cole, W. H., *Arch. Surg.*, 1934, **28**, 1166.

mediately the burden of returning sufficient portal blood to the systemic circulation to prevent shock and death.[4] As far as can be determined, however, it has never been conclusively settled whether or not the human can survive sudden occlusion of the portal vein by ligature. Because occasionally a patient with pancreaticoduodenal cancer must be refused radical resection because of invasion of the portal or superior mesenteric veins, it has recently become important to decide whether or not resection of these structures is compatible with life and prolonged survival. Today it is generally accepted that whatever else is done during radical pancreaticoduodenectomy the portal and superior mesenteric veins must preserved.

In an effort to elucidate this problem further, its study has been undertaken in the *Macacus rhesus* monkey. This animal was selected because the anatomy of the portal, superior mesenteric, and splenic veins is nearly identical with that of the human. Furthermore, the anatomical relationships of the pancreas and duodenum approximate the retroperitoneal position of these structures found in man and not present in dogs, cats, rabbits, etc.

Experimental Procedure. Adult *Macacus rhesus* monkeys were operated upon under open drop ether anesthesia and various segments of the portal circulation occluded by double ligature with medium silk. The animals recovered promptly from anesthesia and, except for the discomfort apparently due to the celiotomy wound, gave no evidence of having been disturbed by the procedure. They are all surviving, the postoperative period varying from 16 days to 6 weeks. In an effort to document further these experiments, all of the animals have been subjected to portal venography with 2-4 cc of thorium dioxide injected into mesenteric venous channels at about the level of the mid-jejunum. All of the venograms (for representative venograms see Plates I and II) have demonstrated complete occlusion of the portal vein, blood gaining access to the systemic circulation by various routes, chiefly, however, the right and left colic veins and the small retroperitoneal vessels in the region of the head of the pan-

[4] Colp, Ralph, *S. G. and O.*, 1926, **43**, 627.

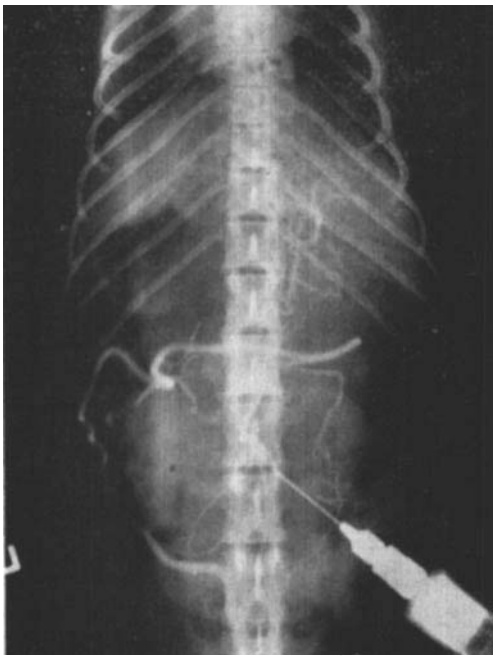

PLATE 1.
Experiment No. 4. Splanchnic venogram (3 cc thorium dioxide) 13 days following ligation of the superior mesenteric vein.

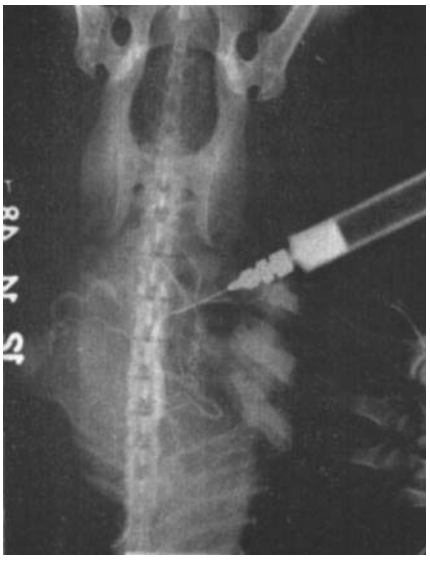

PLATE 2.
Experiment No. 6. Splanchnic venogram (3 cc thorium dioxide) 6 days following ligation of portal, superior mesenteric, and splenic veins.

TABLE I.
Acute Occlusion by Ligature of the Portal Vein in the *Macacus rhesus* Monkey.*
All recovered and present condition is normal.

Exper. No.	Vessels ligated	Sex	Days post-op.	Major collateral circulation
1	Portal vein	F	51	Splenic vein Inferior mesenteric vein Middle colic vein
2	" "	M	50	Same
3	" "	M	49	Same
4	Superior mesenteric vein	F	43	Middle colic vein Retroperitoneal vein Hepatic ligament vein
5	Portal vein Superior mesenteric vein	F	38	Middle colic vein Inferior mesenteric vein
6	Portal vein Superior mesenteric vein Splenic vein	F	23	Retroperitoneal vein Middle colic vein Omental vein
7	Same	F	16	Same

* Seven *Macacus rhesus* monkeys subjected to ligation of various segments of the portal venous system. Survival periods and chief systemic pathways of anastomosis are indicated in the column headed "Major Collateral Circulation."

creas. To date none of the animals has developed clinically detectable nutritional deficiencies or ascites. Table I outlines the seven experiments performed.

Summary and conclusions. Various segments of the portal circulation (including the portal vein) have been suddenly occluded by ligature in 7 adult *Macacus rhesus* monkeys. All of the animals have survived this procedure uneventfully and are in apparent good health from 16 to 51 days postoperatively. By means of portal venography anastomotic channels have been demonstrated by way of which blood is immediately returned to the systemic circulation in sufficient quantities to prevent these animals from succumbing to shock due to depletion of their circulating blood volume.

16919

The Ulcer-Inhibiting Action of Pyrogens.

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A series of urinary extracts under investigation for their ulcer-inhibiting action in the Shay rat, were found to contain a high concentration of pyrogens. Since Necheles[1] had shown that pyrogens suppressed gastric motility in dogs, it seemed desirable to study the inhibitory effect of purified pyrogens in the pylorus-ligated rat. Pyrogens prepared from cultures of *B. prodigiosus, Pseudomonas aeruginosa* and *E. typhi* were investigated.

Method. The assay procedure for estimating anti-ulcer activity was essentially that of Pauls, Wick, and MacKay.[2] Sprague-Dawley male rats of 150-170 g weight were fasted for 48 hours in cages with coarse mesh bottoms. Water was given *ad libitum.* After ether anesthesia, the duodenum was exposed, grasped lightly with fine forceps and ligated at the pyloric sphincter with braided silk thread. The incision was closed with metal clips and painted with collodion solution in order to avoid ingestion of blood residue from the wound.

[1] Necheles, H., *Am. J. Physiol.*, 1942, **137**, 28.

[2] Pauls, F., Wick, A. N., and MacKay, E. M., *Gastroenterology*, 1947, **8**, 774.