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Effect of Therapeutic Venous Ligation on Blood Flow in Cases of Arterial Occlusion.*

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That the incidence of gangrene in a healthy extremity, whose main arterial supply has been suddenly interrupted, is reduced by the simultaneous or early obstruction of the concomitant or proximal venous return has been demonstrated repeatedly by clinical and experimental observers.

The physiological explanation of this phenomenon, however, is in part still the subject of controversy. It is recognized by all recent workers that ligation of the venous return causes an increase in the blood pressure of the affected extremity. Opinions as to its effect upon the flow of blood, however, differ widely. Brooks and Martin¹ believe that this procedure decreases the blood flow, while Holman and Edwards² maintain that the blood supply is increased. Neither of these 2 groups of workers measured the flow of blood directly.

Recently there has been devised in our laboratory a direct, continuous volume flow apparatus, a modification of the Ludwig stromuhr and of Stolnikow's double inlet-outlet apparatus, which is controlled by an electrically regulated valve.³ By means of this instrument we have measured directly the changes in blood flow to an extremity, resulting from ligation of its principal peripheral arterial

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¹ Brooks, Barney, and Martin, K. A., *J. Am. Med. Assn.*, 1923, lxxx, 1678.

² Holman, Emilie, and Edwards, Muriel E., *J. Am. Med. Assn.*, 1927, lxxxviii, 909.

³ Montgomery, M. L., and Lipscomb, T. H., *Am. J. Physiol.*, 1929, xc, 454.

supply and venous return. A preliminary report on this work forms the basis of this paper.

Male dogs, weighing 13 to 17 kg. were anesthetized by the intravenous injection of 200 mg. per kg. of sodium barbital. Coagulation was prevented by 30 mg. of heparin per kg. The volume flow apparatus was placed in the right iliac artery, thus measuring the blood which entered the right femoral artery as well as the chief collateral arterial supply to the right leg. The systemic blood pressure was taken from one of the carotid arteries. The right superficial femoral artery and the right common iliac vein were exposed to permit ligation.

A control record was taken of the blood flow through the iliac artery. Then the superficial femoral artery was ligated and a blood pressure cannula placed in its distal end. After the rate of blood flow then reached an apparent equilibrium, the right common iliac vein was occluded. This caused a sharp fall in the blood flow of from 10 to 15 cc. per minute (a drop of 20 to 30% from the preceding level), which was associated with the expected rise in the peripheral blood pressure of the right leg. To control this result, the occlusion of the common iliac vein was released and there followed a rapid rise in the blood flow of from 10 to 20 cc. per minute. This was accompanied by a fall in the peripheral blood pressure.

We have shown then, by direct measurement, that in a healthy extremity whose blood supply has been reduced by ligation of its main peripheral artery, ligation of its venous return proximal to the point of arterial ligation causes a sharp fall in the per minute flow of blood to the extremity.

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Embryo-Arsenic Tumors in Rats.

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Carrell¹ by the injection of chick embryo pulp in conjunction with dilute arsenious acid obtained in fowls a tumor of sarcomatous type. The result was the same whether the embryo was mixed before injection with the arsenious acid or the two injected simultaneously at different places. White² repeated these experiments and confirmed

¹ Carrell, A., *Compt. rend. Soc. de Biol.*, 1925, xciii, 1083.

² White, A. W. M., *J. Cancer Res.*, 1927, xi, 111.