

Studies in the Pathology of Blood Vessels in Man. IV. Volume Changes in Human Finger-Tip Following Sudden Venous Obstruction.*

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During observations on the rate of blood flow through the finger tip with the use of a sensitive sphygmoplethysmograph,¹ certain results were noted which led to these studies. A cellulose acetate cup without supporting stays was used in place of the one described.¹ Immediately proximal to the cup an occluding air cuff was loosely wrapped so as not to produce any constriction when deflated. The cuff was connected to a pressure reservoir and manometer so that any desired pressure might be suddenly applied. Thirteen normal subjects, ranging from 22 to 52 years of age, were studied under controlled atmospheric conditions ($75 \pm 1^\circ\text{F}$. and $50 \pm 5\%$ relative humidity). They were seated comfortably with the arm resting passively upon a support with the finger-tip at heart level, 30 minutes being allowed to reach a steady metabolic state. Reactions were then noted for obstructing pressures varying from 5 mm. Hg. to diastolic pressure and maintained for 15 to 120 seconds, an interval exceeding the time of obstruction being allowed for recovery between each observation.

For cuff pressures sufficient to cause swelling of the finger-tip and up to a certain critical level, varying for different persons from 15 to 40 mm. Hg. (Table I) there occurred not only the primary swelling of the finger-tip but also a spontaneous secondary diminution in volume (Fig. 1-A). But when cuff pressures above this level were applied only swelling occurred (Fig. 1-B).

The gain in volume of the finger-tip immediately following application of pressure in the obstructing cuff is probably due mainly to distension of small veins, venules and capillaries which are the vessels known to distend to the pressures employed, and the loss of volume which followed under proper conditions is probably due to active constriction of these same vessels. Further evidence to show that they were active in this response is the fact that after the volume had again reached its former level without a change of intravenous

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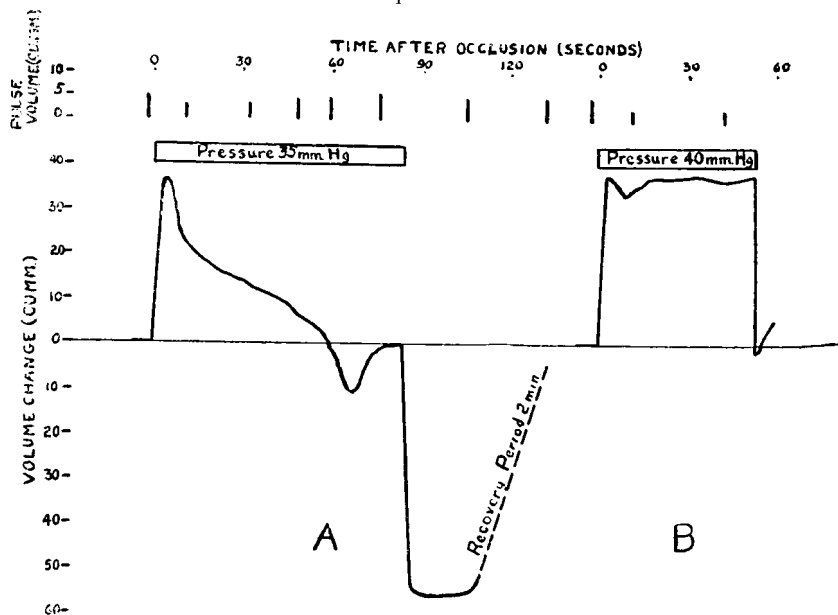
¹ Turner, R. H. To be published.

TABLE I.

Volume changes in the finger-tip following the application of the maximum obstructing pressure following which there was a secondary diminution in volume. Obstructing pressure was usually released as soon as the volume returned to the original value.

Subject No.	Age	Sex	Blood pressure	Pressure in obstructing cuff, mm. Hg.	Immediate increase in vol. following obstruction, cu.mm.	Secondary decrease in vol., cu.mm.	Further decrease in vol. on release of obstruction, cu.mm.
1	27	F	96/68	30	—*	—	—
2	26	M	112/80	20	26.0	33.0	47.2
3	22	M	108/78	35	36.4	46.8	55.6
4	26	M	114/88	30	50.7	50.7	80.2
5	25	M	110/72	20	12.8	17.8	25.9
6	22	M	118/82	15	22.5	31.5	12.5
7	24	M	118/74	15	—*	—	—
8	26	F	114/90	15	13.4	13.4	34.0
9	26	M	110/82	35	26.2	26.2	52.0
10	26	F	108/68	25	16.2	21.6	11.4
11	42	M	116/94	17.5	14.0	14.0	16.7
12	45	M	118/84	40	40.4	40.4	50.0
13	52	M	100/62	15	19.2	19.2	22.3
Mean				24	25.2	28.6	37.1
Max.				40	50.7	50.7	80.2
Min.				15	12.8	13.4	11.4

* Reaction occurred but accurate quantitative data were not available.



Volume changes in finger tip of Subject 3

A. with constricting pressure of 35 mm. Hg.

B. with constricting pressure of 40 mm. Hg.

FIG. 1.

pressure sudden release of the constricting pressure in every instance produced an immediate diminution of finger-tip volume below the original level and usually greater than the volume increase resulting from occlusion. The volume loss may be due entirely to primary, active constriction of the non-arterial vessels or in part to constriction of arterial vessels which could through diminution of blood flow within the capillaries and venules allow a passive constriction of these small vessels. We believe that the constriction is predominantly a non-arterial phenomenon.

The critical pressure at which the type of response changes is an index of tone of the vessels responsible for the volume change at that time. The mechanism of the response is not known but it is likely that it is initiated by increased intravascular tension. That local constricting pressure without venous distension is not an adequate stimulus is evidenced by lack of response to sudden momentary pressure in the cuff. Active responses of veins to other stimuli have been reported by others.²⁻⁵

These phenomena are being studied further in normal and diseased individuals.

Summary. Secondary spontaneous diminution of volume of the finger-tip following sudden partial obstruction of the venous flow from the part is reported. The reaction seems to be due to active constriction of veins, venules and capillaries which may be initiated by increased tension within these vessels.

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Sympathetic Ganglion Cell Changes in Adrenalectomized Animals.

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Recent literature is replete with reports of the functional disturbances in animals deprived of their adrenal glands but offers little

² Hooker, D. R., *Physiol. Rev.*, 1921, **1**, 112.

³ Krogh, A., *The Anatomy and Physiology of Capillaries*, New Haven, 1929, 2nd Ed.

⁴ Lewis, T., *The Blood Vessels of the Human Skin and Their Responses*. London, 1927.

⁵ Capps, R. B., *J. Clin. Invest.*, 1936, **15**, 229.