OXYGEN AND CARBON DIOXIDE SUBCUTANEOUS TISSUE GAS TENSIONS IN CASES OF HYPERTENSION

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We are endeavouring to decide whether the subcutaneous tissue gas tensions O_2 and CO_2 vary from the normal in cases of essential hypertension which we find associated with degenerative arthritis occurring at or about the period of the menopause. In these cases there was considered to be an endocrinal change in the form of an associated thyroid and ovarian dysfunction. Blumgart & Weiss (1927) found that in hypertension most of their subjects had a normal rate of blood flow whilst in a few this flow was slightly retarded. In no case did the increased blood pressure cause an increased velocity of blood flow. This led these authors to suggest that the primary change in hypertension occurs in the peripheral blood vessels and that the rise in blood pressure is a secondary reaction on the part of the body, aimed at maintaining adequate blood supply to the tissues enabling normal gaseous exchange to take place. In subjects whose blood flow is slower than normal the above authors think that the adjustment of the heart to the opposed peripheral resistance is incomplete. In these cases we would expect abnormal CO_2 tensions and subnormal O_2 tensions in the tissues. With regard to blood volume in hypertension Rusznak (1927–8) showed that it was not altered regularly by any consistent changes, although Plesch (1922) observed a tendency to high rather than low values. More recent work by Pickering (1936) has shown that if a person suffers from hypertension, essential or malignant, this has no effect on the rate of blood flow. Blood viscosity also is shown to be normal or less than normal and the resistance offered by the vessels of the forearm is increased. This author states that the increased vascular resistance is of such an order that if generally distributed throughout the body it would account for the level of arterial pressure observed. Prinzmetal & Wilson (1936) also described this increased resistance in persistent hypertension. It was with this in mind that we carried out our work to determine if the gas tensions in subcutaneous tissues differed from the normal in the cases of hypertension. One would expect, if the blood flow through the capillaries were obstructed or if the walls were thickened, that the exchange of gases would be hindered, leading to a rise in CO_2 tension and a fall in O_2 tension. The majority of the patients on whom estimations were carried out were obese and had a hypertension of the so-called essential non-

https://doi.org/10.1017/S0022172400035105 Published online by Cambridge University Press

nephritic type, ascribed by Volhard (1923) to increased peripheral resistance to blood flow, the result of widespread functional or structural vascular change. A few cases were of the essential hypertension type without obesity and arthritis. We do not think it necessary to detail the clinical histories of these characteristic hypertensive subjects. The injection method of measuring the subcutaneous tissue gas tensions is given in a paper by Ellman & Taylor (1935), using a method of analysis described by Campbell & Taylor (1935).

Table I. *Results*

Patient	Blood pressure	Tissue gas tensions (mm. mercury) CO_2	O_2
1	230/140	36·2	45·6
2	175/85	45·2	36·9
3	160/95	41·6	43·4
4	250/100	39·0	46·2
5	170/118	38·7	40·8
6	170/90	40·4	41·4
7	190/90	37·6	37·4
8	260/140	34·0	42·0
9	180/100	42·2	34·2
10	211/95	39·0	42·4
11	200/100	37·3	41·1
12	205/105	39·2	40·3
13	170/90	42·5	42·0
14	210/100	38·9	44·3
15	178/80	37·2	47·0
16	160/105	48·9	45·3
17	180/110	49·0	34·0
18	225/100	39·6	46·5
19	160/70	45·1	44·3
20	180/90	36·3	42·0
21	210/110	34·5	42·6
22	260/160	37·0	38·2
	Mean	39·9	41·8

The mean value for normal persons not suffering from hypertension is in the region of 40 mm. mercury for CO_2 and 40–43 mm. mercury for O_2. Our results (see Table I) show that the mean values we obtained from the hypertensive subjects lie within normal limits, and that in these cases a normal gaseous exchange between blood and subcutaneous tissue takes place.

Summary

From results obtained from the twenty-two patients with essential hypertensions we find that their CO_2 and O_2 subcutaneous tissue gas tensions lie within normal limits. Thus (1) there can be no thickening of the capillary walls, and (2) the blood flow through the capillaries is normal.

Acknowledgement. One of us (H. J. T.) wishes to acknowledge the receipt of a grant from the Medical Research Council whereby expenses incurred were met.

REFERENCES

BLUMGART & WEISS (1927). *J. Clin. Investig.* **4**, 173.
CAMPBELL & TAYLOR (1935). *J. Physiol.* **84**, 219.
ELLMAN & TAYLOR (1935). *J. Hygiene*, **35**, 322.
PICKERING (1936). *Clinical Science*, **2**, 209.
PLESCH (1922). *Z. klin. Med.* **93**, 241.
PRINZMETAL & WILSON (1936). *J. Clin. Investig.* **15**, 63.
RUSZNAK (1927–8). *Deutsch. Arch. klin. Med.* **158**, 98.
VOLHARD (1923). *Verhandl. deutsch. Ges. inn. Med.* **35**, 134.

MS. received for publication 9. I. 1937.—Ed.)