patients with gastrointestinal cancer might not be able to distribute the vitamin normally. It was demonstrated that the administration of choline, yeast, or lipocaic could raise the levels of the vitamin in the plasma. Since both yeast and lipocaic are known to contain choline, their activity conceivably might be due to that compound, and it is possible that in these patients there might exist a deficiency of a substance with a choline-like activity. This possibility still has to be investigated.

Conclusions. The low plasma levels of vitamin A of patients with cancer of the gastrointestinal tract probably are not due to a decreased capacity of the livers of those patients to store the vitamin.

13368

Relation of Arterial Pulse-Pressure to Arterio-Venous Oxygen Difference, Especially in Arterial Hypertension.

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Pulse-pressure in the brachial artery is no longer regarded as a rough measure of cardiac output. Nor can we assume that it gives information concerning what is happening in other arteries. Further, arterial distensibility decreases and pulse-pressure increases as internal pressure is raised, although deviations due to this factor are small in the range of human blood pressures.[1] Comparisons involving pulse pressures from different individuals (varying in size of vessels, muscle masses, metabolic rates, etc.) taken under varying conditions of temperature, humidity, etc., would seem, therefore, to have little justification.

In spite of these considerations an attempt was made to correlate certain data in our possession obtained from 47 patients suffering from a variety of diseases. In Fig. 1 the arterio-venous oxygen differences have been plotted against the products of the pulse pressure multiplied by pulse rate (PP $\times$ PR) as ascertained on the brachial artery. Venous blood was drawn from the median basilic vein. It will be seen that most of these cases fall within a curved area (AA), the mean of which is roughly represented by a curve (DD) such that, for any point on the curve,

[1] Hallock, P., and Benson, I. C., *J. Clin. Invest.*, 1937, **16**, 595.

$$(PP \times PR) \times (A\text{-}V\ O_2\ diff) = K_1, \text{ a constant} \quad (1)$$

The shaded area E represents the "normal" area.

The oxygen consumption of an arm at rest can be assumed to be constant and equal to the product of the volume of blood entering or leaving the arm per minute (V) and the volume of oxygen lost by each 100 cc of blood while traversing the arm, or,

$$V \times (A\text{-}V\ O_2\ diff) = K_2 \quad (2)$$

If equation (1) above correctly expresses a general relationship between these 2 variables it follows that V varies directly as, or is proportional to, PP × PR. The latter can therefore be used as a fair clinical indication of blood flow through the arm.

At present we are concerned only with the relationship between pulse pressure and A-V oxygen difference, and not with the individual diseases in which variations in these factors occur or with the

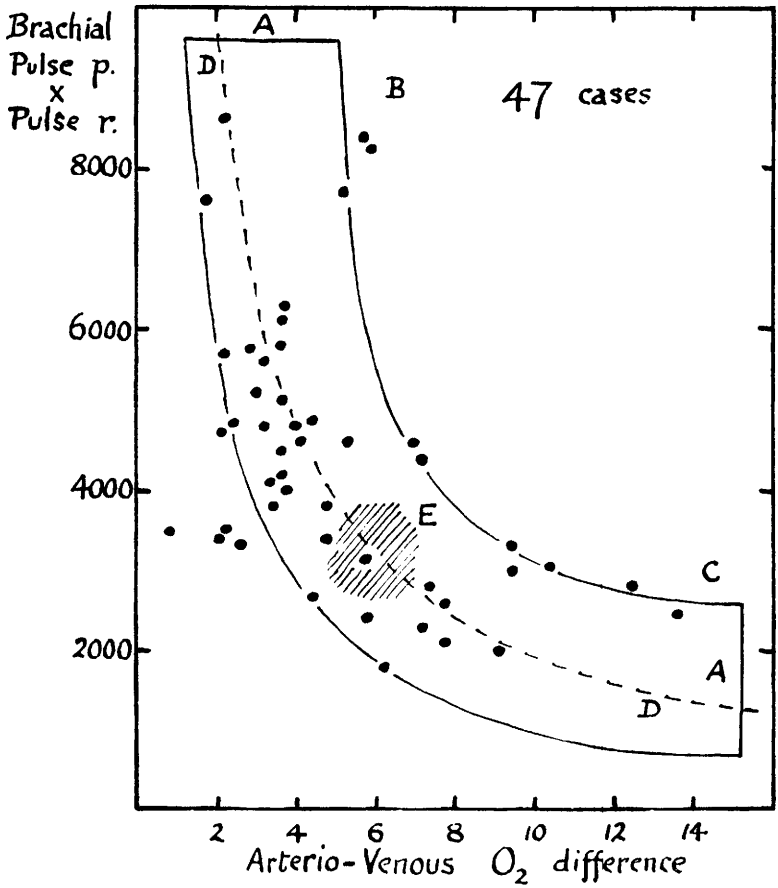

FIG. 1.

reasons thereof. It might, however, be mentioned (a) that those cases falling in the lower portion of the curved area, with circulatory stasis, are all, as might be expected, cases of cardiac disease (valvular disease, calcified pericarditis, emphysema), cancer, certain severe anemias, etc., and (b) that those cases falling in the upper part of the curved area, with a large pulse pressure and a rapid passage of blood through the tissues, are nearly all cases of arterial hypertension and certain other cases of anemia with low diastolic pressures.

In arterial hypertension it has always been assumed that the peripheral vasoconstriction was general throughout the body. Recently, however, Abramson[2] has shown that "in the course of plethysmographic studies on the peripheral vascular responses of hypertensive patients, it was noted that in about 50% of the cases the resting blood flow in the forearm was much greater than in subjects with normal pressure. Such findings differ from those presented previously by Prinzmetal and Wilson,[3] using a similar method, and from those obtained by Pickering,[4] who utilized Stewart's calorimetric procedure. These investigators concluded that the increased vascular resistance in hypertension is generalized throughout the systemic circulation rather than confined to the splanchnic area." Our results, obtained by an entirely different method, showing an increased blood flow through the arm, suggest that, whatever vasoconstriction may occur in the arm, it is relatively less marked than that in the splanchnic area. This interpretation supports Abramson's contentions.

From these results it would seem that, instead of regarding variations in pulse pressure as indications of similar variations in cardiac output, we should rather regard them as indicating the varying use of the arms as a "blood shunt", *i. e.*, that the high pulse-pressure of hypertension and some anemias indicates that a larger (and the low pulse pressure of circulatory failure a lower) proportion of the total blood volume is being shunted through the arms (and possibly all muscle masses). The value of such an arrangement for reciprocally varying muscular and visceral needs is of course obvious.

In 2 cases with increased basal metabolic rate the points fell on the upper right hand edge of the curved area in Fig. 1 as might be expected. As is well known the B.M.R. is also increased in cases where the heart has increased work to do, as in arterial hypertension and in chronic valvular disease. If this higher B.M.R. is due entirely

[2] Abramson, D. I., PROC. SOC. EXP. BIOL. AND MED., 1940, **45**, 127.

[3] Prinzmetal, M., and Wilson, C., *J. Clin. Invest.*, 1936, **15**, 63.

[4] Pickering, G. W., *Clin. Sci.*, 1936, **2**, 209.

to the increased cardiac work we would expect conditions in the arm to be unaffected and therefore the points on the graph to be scattered along the median curve DD. The fact, however, that the points representing these cases tend to approach the right hand edge (BC) of the curved area indicates, unexpectedly, that the oxygen consumption in the arm is also augmented and that probably the increased metabolism is general.

Conclusions. 1. Since pulse pressure × pulse rate × arteriovenous oxygen difference in the arms of different subjects roughly equals a constant, PP × PR is regarded as a fair index of blood flow entering the arm.

2. Since PP × PR is increased and A-V O_2 diff. is diminished in arterial hypertension and in certain anemias (in both of which total cardiac output is not increased), it follows that a larger proportion than normal of total blood flows through the arms (and possibly all limbs), *i. e.,* in these two conditions peripheral vasoconstriction is less marked in the arms than in the splanchnic area.

3. In hyperthyroidism the points on the graph are moved to the right of the normal curve indicating an increased oxygen use in the arm. The fact that many cases involving increased cardiac work also move to the right show that the increased metabolism in these cases is not due to increased cardiac work alone, but takes place in the arms also and is possibly a general condition.

4. It is suggested that the pulse pressure serves as a rough but valuable indication of the reciprocally varying needs and blood supply of the viscera and muscular masses of the body.

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13369

Acute Effects of Smoking on Respiration and Circulation.

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During experiments on the diurnal variations of alveolar CO_2 in man, the question arose as to whether smoking could be permitted occasionally, for it is often a hardship for the subject to refrain from smoking when no good evidence is available to contraindicate