HYPERTENSION

AUTONOMIC AND VASCULAR MECHANISM IN HYPERTENSION

By A. E. Doyle

The role of the sympathetic nervous system in hypertension can be considered in two possible ways. Firstly, in the development of hypertension, it is quite uncertain whether overactivity of the sympathetic nervous system can be implicated in any patient with essential hypertension. In established hypertension however, it is clear that the blood pressure remains under the control of the sympathetic nervous system, since postural and other reflex mechanisms regulating blood pressure are not disturbed. It is not certain however, whether the nervous system is normally active, or whether increased sympathetic nervous discharge, or increased vascular responses, or both, are responsible for the raised blood pressure.

The sympathetic neurotransmitter, noradrenaline, is released at vascular nerve endings by sympathetic impulses; some of the released noradrenaline is retaken up into the nerve storage granules, but some escapes into the circulation. Hence, knowledge of the circulatory levels of noradrenaline may reflect activity of the autonomic nervous system (de Quatro and Chan, 1972; Engelman, Portnoy and Sjoerdsma, 1970). This paper reports levels of plasma noradrenaline in hypertensive patients in relation to their blood pressure.

METHODS

Thirty one untreated patients with essential hypertension were studied. They were admitted to hospital and given, in addition to an unrestricted diet, 100 mEq of NaCl daily. After being in hospital for three days and after being recumbent for one hour, a venous blood sample was taken and blood pressure measured. Pentolinium was then given intravenously at a rate of 1 mg every five minutes. If the diastolic blood pressure fell by 40 mm.Hg., pentolinium was discontinued. Otherwise a total of 5 mg. of pentolinium was given. Further venous blood samples were drawn twenty minutes after the first pentolinium injection, and again thirty minutes later.

Plasma levels of noradrenaline and adrenaline were measured by a double isotopic enzymatic assay (Engelman, Portnoy and Lowenberg, 1968; Louis and Doyle, 1971).

RESULTS

There was a close correlation between the resting diastolic blood pressure level and the level of plasma noradrenaline (Fig. 1) ($r=0{\cdot}729$, $p<0{\cdot}001$), so that patients with the highest blood pressures under these conditions had the highest levels of noradrenaline. By contrast, there was no relationship between blood pressure and plasma adrenaline levels.

Nineteen patients were studied after ganglion blockade with pentolinium. In fifteen the blood pressure fell while in four it was unaltered or rose slightly. There was a close relationship between the magnitude of the fall in blood pressure and the extent to which the plasma noradrenaline fell in individual patients (Fig. 2). Those patients with the highest resting levels of plasma noradrenaline also had the largest falls in blood pressure and the greatest reduction in plasma noradrenaline levels. There was little change in plasma adrenaline levels following ganglion blockade, and no relationship between change in blood pressure and change in plasma adrenaline levels.

DISCUSSION

The fact that ganglionic blockade led to a fall in plasma noradrenaline suggests that the level of this substance in venous blood reflects autonomic nervous activity. Since the highest resting levels of blood pressure are associated with the highest circulatory noradrenaline levels, our results suggest that sympathetic nervous activity may be an important determinant of the height of the blood pressure in patients with hypertension.

An alternative possibility is that there may be an abnormality of storage or release of noradrenaline at the vascular nerve terminals in hypertension. If this were so, a normal level of sympathetic nerve activity could release larger amounts of noradrenaline than in non-hypertensive patients. Such an abnormality might also explain the observed increase in vascular reactivity which occurs in hypertension

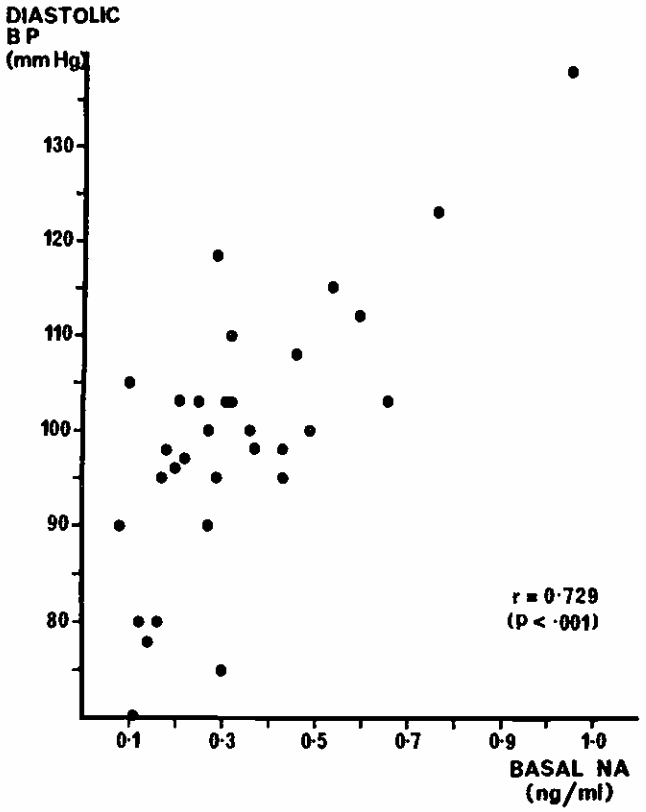

Fig. 1. The relationship between resting diastolic blood pressure and basal noradrenaline (NA) levels in hypertensive patients after three days bed rest.

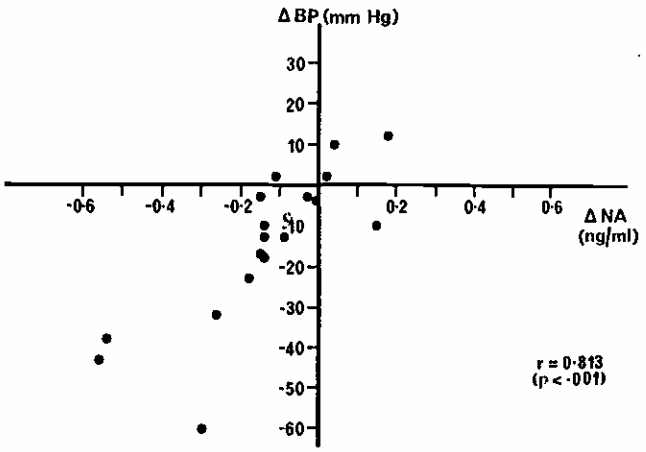

Fig. 2. The relationship between change in blood pressure and change in plasma noradrenaline (NA) levels after ganglion blockade with pentolinium.

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(Doyle, Fraser and Marshall, 1959) and in the children of hypertensive parents (Doyle and Fraser, 1961).

Either increased sympathetic nervous activity, or a local increase in sensitivity to release noradrenaline would also explain the fact that larger falls of blood pressure occur after ganglion blockade in hypertensive than in normotensive patients (Doyle and Smirk, 1955; Barnett and Fraser, 1953). Whether the mechanism is increased sympathetic activity, or a local disturbance at the nerve terminal, it seems evident that the sympathetic nervous system plays an important part in the continued elevation of blood pressure.

SUMMARY

In essential hypertension there is a close relationship between the height of the blood pressure and the circulatory level of plasma noradrenaline. Ganglion blockade reduces both blood pressure and noradrenaline levels, with a close relationship between the changes in both values. These results indicate that the level of sympathetic activity determines the height of the blood pressure in hypertension.

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