

ADRENERGIC RECEPTORS IN THE HYPOTHALAMUS CONCERNED WITH CONTROL OF ARTERIAL BLOOD PRESSURE : ELICITED BY ELECTRICAL AND CHEMICAL STIMULATION

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Summary: The study was made with the help of a chemitrode placed in various areas of the hypothalamus by the stereotaxic technique, for electrical and chemical stimulation (noradrenaline or isoprenaline) before and after microinjection of respective blockers (phenoxybenzamine or practalol). The results indicated the presence of both alpha and beta-adrenoreceptors in the anterior and dorsomedial hypothalamus producing a depressor response, and, the presence of alpha adrenoreceptors in the posterior and lateral hypothalamus producing a pressor response.

Key words : blood pressure
isoprenaline

hypothalamic adrenergic receptors
non-adrenaline

INTRODUCTION

Role of hypothalamus in the modulation of arterial blood pressure is well known (8, 9). Results of intraventricular and intrahypothalamic injection studies have suggested that central adrenoceptors are intimately concerned with control of arterial blood pressure. While intraventricular injection shows that both alpha receptors (1,2,3,4,10,11) and beta receptors (1,3,13) are hypotensive, intrahypothalamic injection gives the opposite results (5, 6, 7). The present study was undertaken in order to elucidate the role of the hypothalamic adrenoreceptors in the control of blood pressure.

MATERIALS AND METHODS

Experiments were conducted in 23 cats of either sex, weighing between 2.5 - 4.0 kg, anaesthetised with intravenous chloralose (60 - 70 mg/kg). Chemitrodes, constructed from 24 gauge hypodermic needle, were implanted stereotaxically in the various areas of the hypothalamus according to the coordinates as per Snider and Niemer (12).

Blood pressure with a pressure transducer (Polyrite-INCO) was recorded. Monopolar electrical stimulation (4.V, 1 msec and 60 cycles/sec) was given at the tip of chemitrode. Steel capillary (32 gauge) was introduced through the needle. Hamilton microsyringe connected to this fine steel capillary through a polythene tubing was used for microinjection 1.0/ μ l of either saline or drug was injected at a time. All the control records were obtained after injection of 1.0/ μ l of saline and the effect of electrical stimulation of the hypothalamus was studied before and after microinjection of phenoxybenzamine (20/ μ g)/practalol (20/ μ g). Chemical stimulation of the hypothalamus with noradrenaline (10/ μ g)/isoprenaline (10/ μ g) was carried out before and after microinjection of respective blockers. Terminally the animals were killed and the brains perfused *in situ* with 10% formalin. The site of stimulation and microinjection was confirmed by histological technique.

RESULTS

Pressor points treated with phenoxybenzamine after electrical stimulation (Fig. 1-A, B) :

Eight locations in the lateral hypothalamus and four in the posterior hypothalamus were studied. Following electrical stimulation, an increase in blood pressure was observed from both lateral and posterior hypothalamus. Pressor responses of all points except one in the lateral hypothalamus were affected by pretreatment with phenoxybenzamine.

Depressor points treated with phenoxybenzamine after electrical stimulation (Fig. 1-C, D) :

Three locations in the dorsomedial hypothalamus and two in the anterior hypothalamus were studied. Following electrical stimulation a decrease in blood pressure was observed. The depressor responses due to electrical stimulation of two points of the dorsomedial hypothalamus and one point of the anterior hypothalamus were blocked by phenoxybenzamine. However, phenoxybenzamine could not abolish the depressor effect due to electrical stimulation of one point of the anterior and one point of the dorsomedial hypothalamus.

Depressor points treated with practalol after electrical stimulation (Fig. 1-E, F) :

Three locations in the dorsomedial hypothalamus and two in the anterior hypothalamus were studied. Depressor responses due to electrical stimulation of two points of dorsomedial hypothalamus and one point of anterior hypothalamus were blocked by practalol. However, depressor responses due to electrical stimulation of one each of the dorsomedial and anterior hypothalamus were not affected by pretreatment with either phenoxybenzamine or practalol.

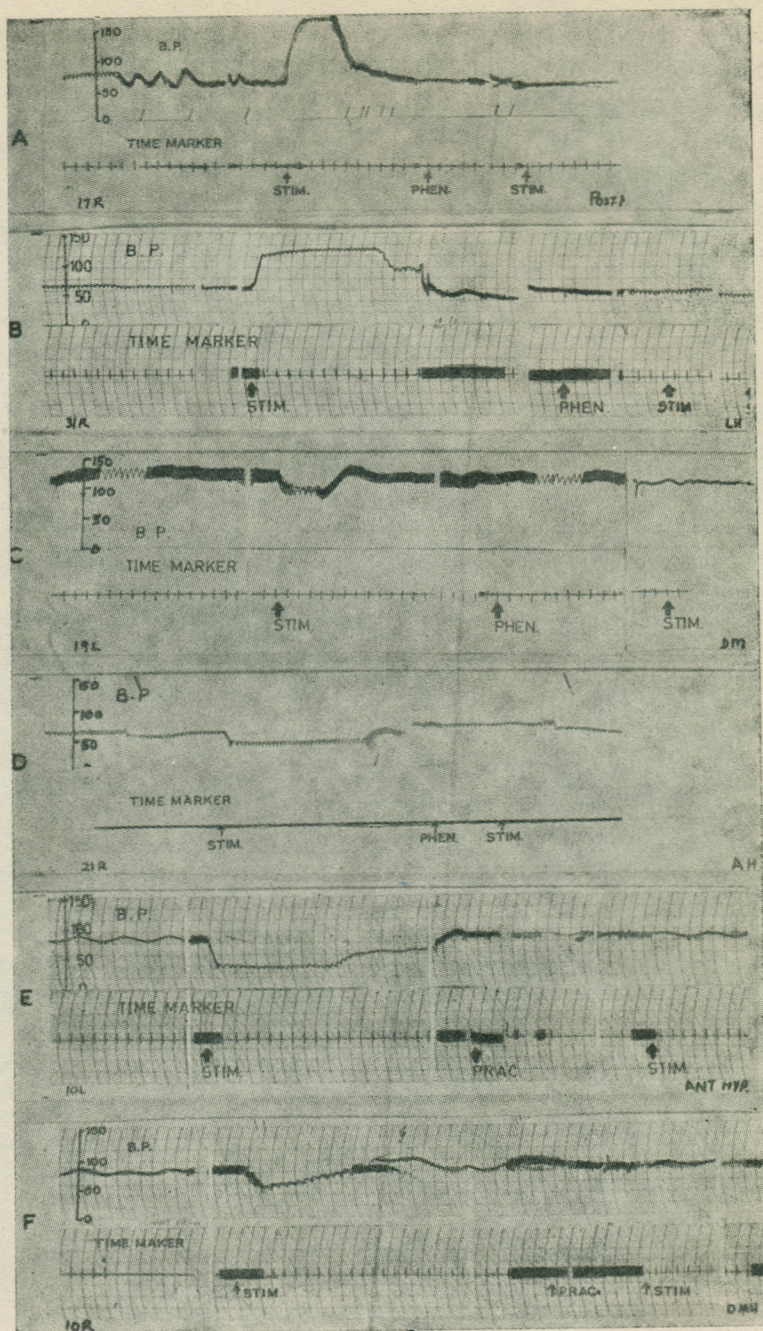


Fig. 1 : Electrical stimulation of various areas of the hypothalamus before and after microinjection of respective blockers. (phenoxybenzamine or practalol) : (A) Posterior hypothalamus, (B) Lateral hypothalamus, (C) Dorsomedial hypothalamus, (D) Anterior hypothalamus, (E) Anterior hypothalamus, (F) Dorsomedial hypothalamus. Duration of electrical stimulation (before and after the use of blockers) was 20 seconds.

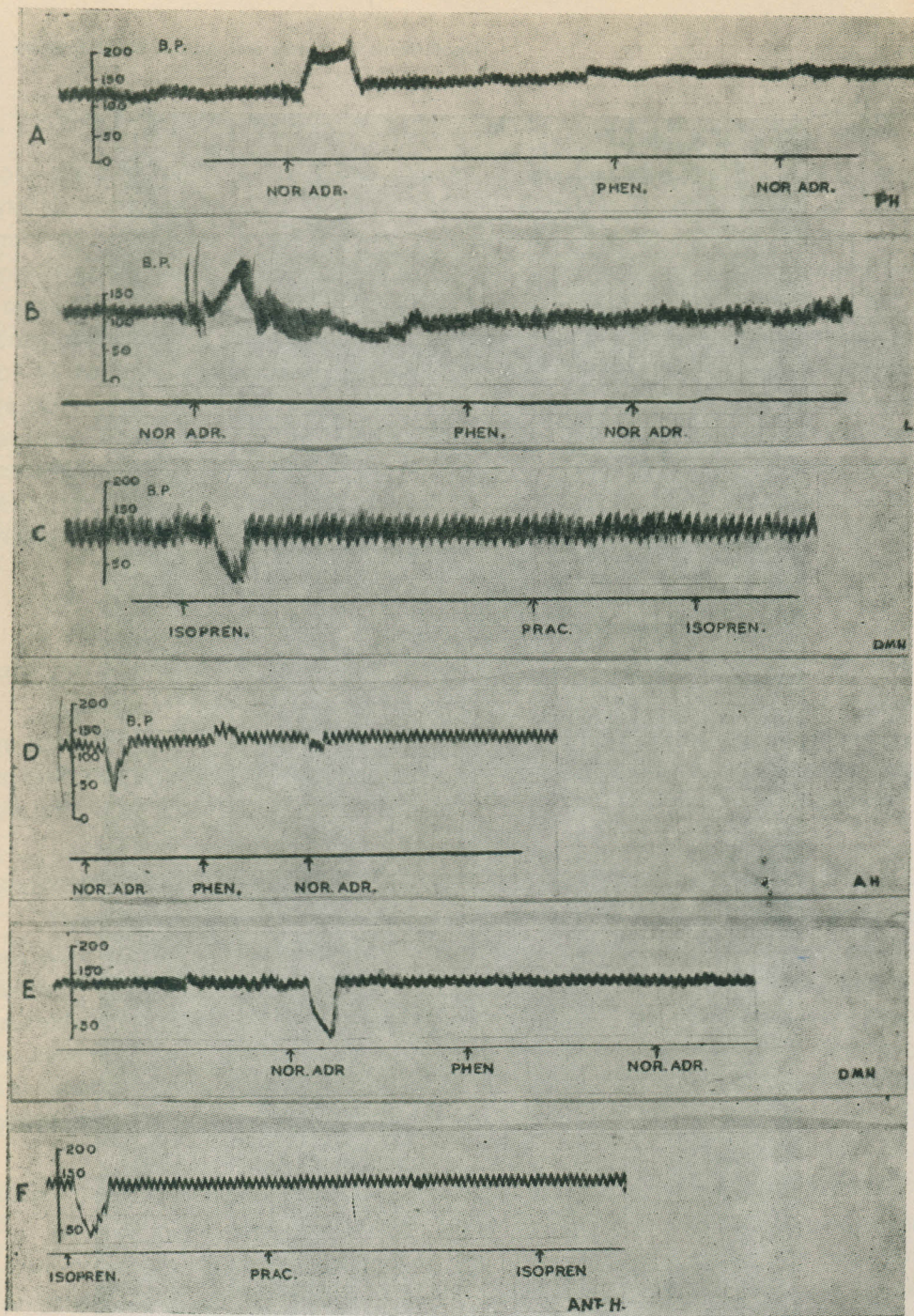


Fig. 2 : Chemical stimulation (noradrenaline or isoprenaline) of various areas of the hypothalamus before and after microinjection of respective blockers : (A) Posterior hypothalamus (1.0 sec), (B) Lateral hypothalamus (0.5 sec), (C) Dorsomedial hypothalamus (1.25 sec) (D) Anterior hypothalamus (0.4 sec), (E) Dorsomedial hypothalamus (0.55 sec), (F) Anterior hypothalamus (0.25 sec). Figures in parenthesis indicate time-durations for the substance to produce response. This also includes time taken for the substance to pass through steel capillary and polythene tubing.

Effect of chemical stimulation of the hypothalamus (Fig. 2) :

Two locations each in the anterior hypothalamus, in the dorsomedial hypothalamus, in the posterior hypothalamus and four in the lateral hypothalamus. Noradrenaline increased blood pressure when injected in the lateral and posterior hypothalamus. (Fig. 3 - A, C). On the contrary, noradrenaline when injected in the anterior and the dorsomedial hypothalamus decreased blood pressure (Fig. 3-B, D). The effect of noradrenaline was blocked by phenoxybenzamine. Isoprenaline also decreased blood pressure when injected in the anterior and dorsomedial hypothalamus. The effect of isoprenaline was blocked by practalol.

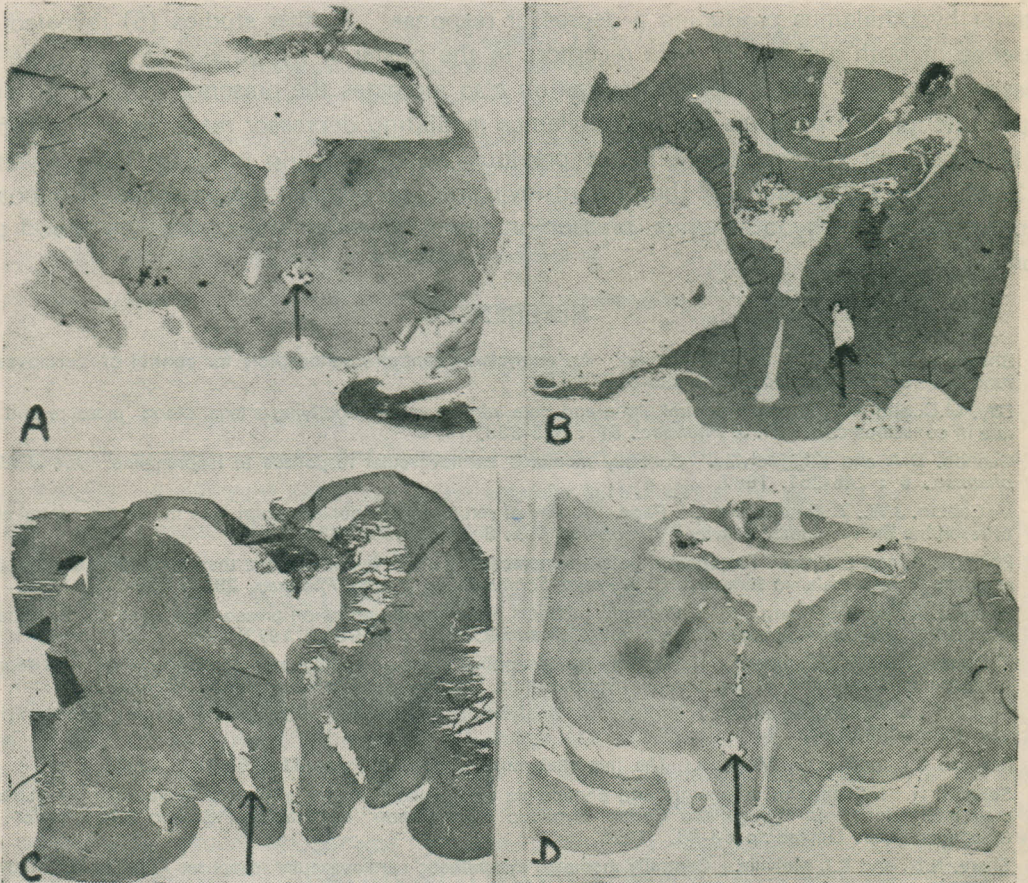


Fig. 3 : Chemitrode and its position in different areas of the hypothalamus.

- A : Post. hypothalamus (A-8.5),
- B : Ant. hypothalamus (A-13.5),
- C : Lat. hypothalamus (A-9.5) and
- D : Dorsomedial hypothalamus (A-9.5).

DISCUSSION

Both electrical stimulation, before and after respective blockers and direct chemical stimulation provide evidence that the posterior and the lateral hypothalamus contain alpha adrenoreceptors resulting in a pressor response while anterior and dorsomedial hypothalamus contain both alpha and beta adrenoreceptors producing a depressor response. The responses were blocked by intrahypothalamic microinjection of respective blockers. The present study is more or less in line with the previous studies. Phillippu *et al.* (6) observed that the pressor response due to electrical stimulation of posterior hypothalamus was blocked by alpha receptors inhibiting drugs such as tolazoline and piperoxan. Phillippu and Schartner (7) also demonstrated the presence of alpha adrenoreceptors in the anterior hypothalamus producing a depressor response. Further studies (5) revealed the presence of both alpha and beta receptors in the posterior hypothalamus producing the pressor response. The present investigation also indicates the presence of beta receptors in the anterior and dorsomedial hypothalamus mediating depressor response. This effect of beta receptor corresponds with the previous work following intraventricular injection (1,3,13). Thus the results of the present investigation suggest the presence of opposing mechanisms in the hypothalamus pressor or depressor receptors, controlling blood pressure.

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