DECREASES IN ARTERIAL PRESSURE AND HEART RATE ELICITED BY ELECTRICAL STIMULATION OF THE ANTERIOR HYPOTHALAMUS OF PENTOBARBITAL ANESTHETIZED DOGS

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The depressor responses, decreases in arterial pressure and heart rate, elicited by electrical stimulation of the anterior hypothalamus have been studied on cats under \( \alpha \)-chloralose anesthesia (1-6), and are attributed to the sympathetic inhibition (1, 2, 5). In order to produce sympatho-inhibitory responses, animals should be under high levels of sympathetic activities (5). This is the reason why most experiments on the "depressor responses" were carried out in cats under light \( \alpha \)-chloralose anesthesia, because pentobarbital depresses sympathetic activities in this animal. Recently, sympatho-excitatory effects of sodium pentobarbital were suggested in dogs (7). Therefore, the use of sodium pentobarbital as an anesthetic must be favorable for analyzing the "depressor responses" in dogs. In the present study, we examined whether the "depressor responses" can be elicited even under pentobarbital anesthesia in dogs.

Sixteen mongrel dogs of either sex, weighing 6-10 kg, were anesthetized with sodium pentobarbital (30 mg/kg, i.v.). The head of the animal was fixed in a stereotaxic instrument. Arterial pressure was recorded from the femoral artery using a pressure transducer (Nihon Kohden MPU-0.5A), and heart rate was also recorded using a cardiotachometer (SAN-EI 2146). Bipolar concentric stimulating electrodes were placed stereotactically within the anterior hypothalamus according to the stereotaxic atlas by Lim et al. (8). The diameter of the center lead tip was 0.2 mm, and the outer electrode shaft diameter was 0.5 mm. Electrical stimulation of the anterior hypothalamus was performed unilaterally by square pulses of 0.5 msec duration with varied frequency and voltage for 30 sec. The statistical significance was calculated by the Student’s \( t \)-test.

Various patterns of cardiovascular responses were obtained by electrical stimulation within the hypothalamus and preoptic area according to the region stimulated. The points of which stimulation induced the "depressor responses" were located just behind and below the anterior commissure and about 1.5 mm lateral to the midline. This region corresponds to the anterior hypothalamus (8). By electrical stimulation of this area, almost identical responses were induced for more than three hours as long as the stimulus intervals were greater than 15 min. The magnitude of the responses was dependent on the stimulus intensity and frequency. The results on the intensity and frequency dependencies were shown in Fig. 1a and b, respectively. In these experiments, even by further increasing the stimulus intensity, decreases in arterial pressure and heart rate were not reversed to increases in arterial pressure and/or heart rate.
Fig. 1. Effects of stimulus intensity (a) and frequency (b) on the "depressor responses" to electrical stimulation of the anterior hypothalamus. MAP, mean arterial pressure; HR, heart rate; n, number of animals studied.

Table 1. Mean arterial pressure (MAP) and heart rate (HR) at rest and on the depressor responses before and after bilateral vagotomy

|                      | Resting | Response |
|----------------------|---------|----------|
|                      | n       | MAP (mmHg) | HR (beats/min) | MAP (mmHg) | HR (beats/min) |
| Before bilateral vagotomy | 5     | 117±6.9     | 195±5.6       | 34±5.5     | 29±1.9       |
| After bilateral vagotomy   | 5     | 119±8.8     | 196±8.4       | 33±4.7     | 21±1.2**     |

The decrease in heart rate in response to electrical stimulation of the anterior hypothalamus after bilateral vagotomy was significantly smaller than that before bilateral vagotomy (**P 0.01). Values are the mean±S.E. and n, numbers of animals studied.

In order to examine a role of the vagal functions in the decrease in heart rate induced by electrical stimulation of the anterior hypothalamus, the response was compared before and after bilateral vagotomy. Just after the vagotomy, a transient increase in resting heart rate was observed. However, the heart rate returned to the level before the vagotomy within 10-15 min. Therefore, the response was examined at least 20 min after the vagotomy. Results are summarized in Table 1. The decrease in heart rate was suppressed by about 30% of that before the vagotomy, but the decrease in arterial pressure was not modified by the vagotomy.

The present study demonstrates that in pentobarbital anesthetized dogs, decreases in arterial pressure and heart rate were elicited by electrical stimulation of the restricted brain area (anterior hypothalamus). In dogs the "vasodilator area" was defined by Eliasson et al. (9), but they did not mention any changes of arterial pressure and heart rate when the "vasodilator area" was electrically stimulated. The "depressor area" defined by our study appears to be quite near the "vasodilator area" (9). Vasodilatation in the skeletal muscles might be elicited by electrical stimulation of the area. This seems to be one reason why the decrease in arterial pressure is induced by electrical stimulation of the anterior hypothalamus. However, stimulation of the anterior hypothalamus also causes sympathetic inhibition (1, 2, 5). In
the present study the decrease in heart rate must be induced mainly by the sympathetic inhibition because the response was suppressed by only less than 30% after the vagotomy. It was reported that the "depressor responses" are obtained only with lightly anesthetized animals (1, 5, 9). Hence the "depressor responses" have been studied with 4-chloralose anesthetized animals. In dogs, however, it has been suggested that sodium pentobarbital activates sympathetic activities (7). This must be favorable to induce the "depressor responses" because it is possible to produce remarkable sympathoinhibitory responses under the high level of sympathetic activities (5). In the present study, we demonstrated that in pentobarbital anesthetized dogs electrical stimulation of the anterior hypothalamic area elicited the "depressor responses". Therefore, it must be better to use sodium pentobarbital for studying the "depressor responses" in dogs.

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