Effect of ether anesthesia on 17-hydroxycorticosteroid secretion in dogs

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Suuki, TatuZi, Kazukuni Yamashita and Takaaki Mitamura. Effect of ether anesthesia on 17-hydroxycorticosteroids (17-OHCS) secretion in dogs. Am. J. Physiol. 195(6): 1261-1262. 1959.—In dogs with previously cut dorsal spinal roots (T1-L3), adrenal venous blood was collected without anesthetic or pain. Ether was then inhaled for 30-60 minutes. During and after ether inhalation, adrenal venous blood was again collected and the plasma was analyzed for 17-hydroxycorticosteroids (17-OHCS). The mean preinhalation control secretion rate of 17-OHCS by one adrenal was 0.10 (0.06-0.20) μg/kg/min. During ether inhalation it increased to 0.34-1.2 μg/kg/min. Thirty to sixty minutes after the end of ether inhalation the secretion rate increased to a maximum of 0.79-1.8 μg/kg/min. and then decreased.

In our previous investigation (1) we evaluated quantitatively the effect of muscular exercise on 17-OHCS secretion into adrenal venous blood in anesthetized dogs. This study is concerned with the determination of 17-OHCS secretion in dogs subjected to ether anesthesia.

METHODS

Mongrel dogs, weighing 7.4-15.5 kg were used. Adrenal venous blood was collected by a modification of the method described by Satake, Sugawara and Watanabe (2). Dorsal spinal roots (T11-L3), through which the sensory nerve fibers from the lumbar area run, were cut under Evipan-sodium and ether anesthesia. About 3 weeks later the lumbar-venous vein was laid bare on one side by the lumbar approach and a small glass cannula inserted into the vein just lateral to the adrenal gland. A short rubber tube was connected to the other end of the cannula, filled with heparin sodium-saline solution and clamped. A silk thread was passed loosely around the adrenal vein between the adrenal gland and the vena cava. These surgical operations were done without anesthetizing the animal.

In our previous studies (1) about 2 hours were allowed to elapse between cannulation and onset of observation. However, we later noticed that the 2-hour interval was not long enough for the animal to recover its preoperative resting condition, so, in the present study, about 18 hours were allowed to elapse. Heparin sodium was given intravenously before and during the experiment. At the time of blood collection, the clamp on the rubber tube was taken off and the silk thread between adrenal gland and vena cava was gently pulled. Immediately after collection, the cannula and rubber tube were again filled with heparin sodium-saline solution. Ether inhalation was then initiated and lasted usually 30-60 minutes. Adrenal venous blood was also collected 30, 60 and 120 minutes and, in some cases, also 10 minutes after the start of ether inhalation. The blood samples were cooled immediately after collection and were centrifuged. The plasma 17-OHCS was determined by the method described by Nelson and Samuels (3).

RESULTS

With initiation of ether inhalation, the animal struggled, but was soon deeply anesthetized. Heart rate and respiration increased considerably. Ten minutes after cessation of ether inhalation, the animal regained consciousness and moved its head and legs. There was then a gradual decrease in heart rate and respiration to normal levels.

Ten minutes after the start of ether inhalation the rate of 17-OHCS secretion was significantly increased. Increased secretion was also observed at the terminal phase of ether inhalation. The adrenal venous blood sample taken 30-60 minutes after cessation of ether inhalation (when the animal had awakened completely from anesthesia) showed in most cases a rate of 17-OHCS secretion definitely higher than that during ether inhalation. Sixty minutes later, the secretion rate was found to decrease.

DISCUSSION

In our previous investigation (1), blood samples were obtained from the adrenal vein 2 hours after completion of the cannulation. The mean secretion rate of the con-
TABLE 1. Effect of Ether on 17-Hydroxycorticosteroid Secretion Rate in the Dog

<table>
<thead>
<tr>
<th>Sex</th>
<th>Body Wt., kg</th>
<th>Ether Inhalation, min</th>
<th>17-Hydroxycorticosteroid Secretion Rate, µg/kg/min.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min. before ether inhalation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>☐</td>
<td>11.5</td>
<td>60</td>
<td>0.06</td>
</tr>
<tr>
<td>☐</td>
<td>7.4</td>
<td>60</td>
<td>0.20</td>
</tr>
<tr>
<td>☐</td>
<td>10.0</td>
<td>30</td>
<td>0.07</td>
</tr>
<tr>
<td>☐</td>
<td>15.5</td>
<td>25</td>
<td>0.10</td>
</tr>
<tr>
<td>☐</td>
<td>10.3</td>
<td>25</td>
<td>0.06</td>
</tr>
</tbody>
</table>

* From one adrenal.

trol value in this procedure was somewhat elevated (0.34 µg/kg/min.). In the present investigation, the blood collection for the control value was made 18 hours after adrenal vein cannulation. The average resting secretion rate of 17-OHCS under these conditions was 0.10 µg/kg/min. It would appear that the 2-hour interval between cannulation and initiation of the experiment may not have been long enough for the return of 17-OHCS values to normal levels in our previous studies.

A marked elevation in 17-OHCS secretion was evoked by ether anesthesia in the present study. Beigelman et al. (4) also demonstrated an increase in adrenal cortical secretion in rats with ether anesthesia. In their experiment, a small cannula was inserted in the left renal vein under ether or Nembutal anesthesia and the venous blood from the left adrenal gland was collected. They found that corticosterone secretion rate was markedly influenced by the nature of the anesthesia employed for the cannulation procedure. The estimate of the secretion rate in rats anesthetized with ether was significantly higher than that observed in rats anesthetized with Nembutal. The difference between the estimates would be, according to them, in part due to the accelerating effect of ether anesthesia upon the pituitary-adrenal system. However, it was not possible in their study to dissociate the effect of adrenal secretion due to the anesthesia from the stress induced by the operative and collection procedure. Nelson, Edgahl and Hume (5) reported on the adrenal secretion in the dog. They performed the adrenal cannulation under ether or Nembutal anesthesia and then collected the adrenal vein blood. The 17-OHCS secretion rate in dogs, in which the cannulation procedure was performed under ether anesthesia, was measured as 10.3 µg/min., on the average. In dogs cannulated under Nembutal anesthesia, the value was found to be 6.1 µg/min. The results showed that ether anesthesia had a more pronounced effect on elevating adrenal cortical secretion than did Nembutal anesthesia.

The 17-OHCS secretion rate at 30-60 minutes after cessation of ether inhalation was found in our studies to be definitely higher than during the period of ether inhalation. This delay in reaching maximal secretion of 17-OHCS may explain the results of Nelson et al. (5) in their study of adrenal secretion of unanesthetized dogs placed in a cold room. They found that, during the exposure of the dog to the cold (−10°C), there was no increase in 17-OHCS secretion; however, a definite increase was observed during the recovery period following exposure to cold.

REFERENCES