

MORPHOLOGICAL ANALYSIS OF THE ADRENAL CORTEX AFTER BILATERAL SUBDIAPHRAGMATIC VAGOTOMY

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In Wistar rats 7 and 45 days after bilateral subdiaphragmatic vagotomy the zona fasciculata and zona reticularis of the adrenal cortex were enlarged and the content of unsaturated phospholipids in their cells was increased. In the medulla the venous sinusoids were greatly dilated. Administration of glucose to the vagotomized animals caused further accumulation of unsaturated phospholipids in the cells of the zona fasciculata but there was no change in the width of the zones. These facts indicate that after vagotomy precursors of steroid hormones accumulate; this is interpreted as a morphological sign of depression of functional activity of the zona fasciculata and zona reticularis of the adrenal cortex.

KEY WORDS: vagotomy; adrenal; phospholipids; hyperglycemia.

Nervous regulation of adrenal function has been inadequately studied [1,5,8]. The role of the vagus nerve has received particularly little attention [2,3,6]. Meanwhile the study of this problem is of great importance not only for the elucidation of the principles of nervous regulation of secretory activity of the adrenal glands, but also for an assessment of changes in the hormonal status of the body after vagotomy, for this operation is used for the surgical treatment of gastric and duodenal ulcer.

Morphological and functional changes in the adrenal cortex were studied after bilateral subdiaphragmatic vagotomy.

EXPERIMENTAL METHOD

Altogether 90 male Wistar rats weighing 120-140 g were used. Bilateral subdiaphragmatic vagotomy was performed under ether anesthesia and, in order to ensure maximal identity of the histochemical reactions, the experimental and control animals were killed in pairs (followed by simultaneous processing of the sections) 7 and 45 days after the operation: after starvation for 24 h and 1,2,3, and 6 h after injection of 20% glucose solution in a dose of 2 g/kg body weight by gastric tube. At each time five experimental and five control animals were used.

The state of the adrenal cortex was studied in sections obtained from the middle part of the gland, by Yaglov's combined method [7], which enables unsaturated phospholipids to be detected in the adrenocorticocytes and adrenalin and noradrenalin in the chromaffin cells. To compare the area of the adrenal cortex in the vagotomized and control animals, a gravimetric method was used. The width of the zones was measured with an ocular micrometer. The content of unsaturated phospholipids in the adrenocorticocytes was expressed in conventional units (points) by Faustov's method [4]. The results were subject to statistical analysis by the Fisher-Student method.

EXPERIMENTAL RESULTS

In the experimental animals 7 and 45 days after the operation a significant increase ($P < 0.05$) was observed in the area of the adrenal cortex on account of widening of the zona fasciculata and zona reticularis (Tables 1 and 2). Injection of glucose caused no significant changes in the width of these zones in either the

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TABLE 1. Degree of Increase in Area of Cortex and of Venous Sinusoids of Adrenals of Vagotomized Rats

Object	Degree of enlargement, %	
	7 days after operation	45 days after operation
Cortex	17,4	15
Venous sinuses	92	73

TABLE 2. Width of Zones of Adrenal Cortex (in ocular micrometer units; $M \pm m$)

Object	7 days after operation		Degree of enlargement, %	45 days after operation		Degree of enlargement, %
	Control	Vagotomy		Control	Vagotomy	
Cortex	522 \pm 6	620 \pm 9	18,7	586 \pm 6	688 \pm 6	16,7
Zona fasciculata	328 \pm 7	415 \pm 12	26	387 \pm 6	462 \pm 6	19,3
Zona reticularis	90 \pm 4	121 \pm 4	34	106 \pm 3	138 \pm 6	30
Zona glomerulosa	61 \pm 3	59 \pm 2	—	65 \pm 3	63 \pm 4	—

control or the experimental animals. However, hyperglycemia led to changes in the content of unsaturated phospholipids in the adrenocorticocytes of the zona fasciculata of the cortex in both groups of animals (Fig. 1). Their content was much higher in the experimental than in the control animals. Repeated observations showed that hyperglycemia, developing 1 h after injection of glucose, was accompanied by a smaller increase in the phospholipid level in the experimental group than in the control. However, because their content was initially higher in the experimental animals, the phospholipid level in the experimental group was higher than the control at this time also. During the next 2 h the phospholipid content in the control animals reached its initial level, whereas in the experimental group (7 days after the operation) it fell below the initial level (Fig. 1). Despite this, however, their level in the experimental group remained higher than in the control, and later, 6 h after injection of glucose, it did not change significantly.

An important factor in the evaluation of the morphological and functional state of the adrenal gland is a change in its blood supply. These observations showed that vagotomy leads to marked dilatation of the internal blood vessels of the gland. The gravimetric method used enabled the degree of dilatation of the venous sinusoids of the adrenal medulla to be determined (Table 1). Comparison of the results for the different times shows that after 45 days there was a tendency for the degree of dilatation to diminish, but it was still above the control value.

The results of this investigation thus indicate that bilateral subdiaphragmatic vagotomy causes widening of the zona fasciculata and zona reticularis of the adrenal cortex and increases their content of unsaturated phospholipids. The experiments with glucose administration showed, however, that hyperglycemia leads to a marked increase in the unsaturated phospholipid content in cells of the zona fasciculata of the adrenals of both groups of animals. However, the fact that fluctuations in their content at different times after administration of glucose did not affect the width of the zona fasciculata and zona reticularis, but were accompanied by considerable dilatation of the blood vessels suggests that the observed widening of the zona fasciculata and zona reticularis in the vagotomized animals was due to two factors: excessive accumulation of phospholipids and changes in the hemodynamics in the adrenal glands. The fact that the content of unsaturated phospholipids is higher in the adrenocortical cells of vagotomized animals is interpreted by the writer as a morphological sign of the depressed activity of the adrenal cortex. This fact is in good agreement with the observations of Wexler and Lutmer [9], who also observed widening of the adrenal cortex, a higher content of unsaturated phospholipids in the adrenals, and a lower blood corticosterone level in alloxan-induced hyperglycemia.

It can be concluded from the facts described above that after bilateral subdiaphragmatic vagotomy there is a definite decrease in function of the zona fasciculata and zona reticularis of the adrenal cortex; this effect persists for 45 days after the operation, evidence of the essential role of the vagus nerve in the maintenance of normal adrenal function.

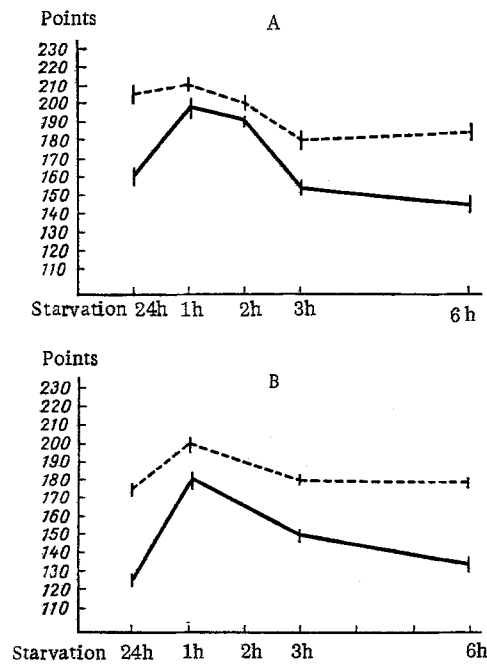


Fig. 1. Content of unsaturated phospholipids in zona fasciculata of adrenal cortex of control and vagotomized animals 7 days (A) and 45 days (B) after operation. Continuous line represents control; broken line vagotomy.

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