

THE EFFECT OF ADRENALIN AND INSULIN ON THE CHEMISTRY OF SMOOTH MUSCLE TISSUE

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Adrenalin and insulin greatly influence the metabolism, especially that of carbohydrates. However, their action is generally antagonistic.

In this work we studied the effect of adrenalin and insulin administration on the glycogen and Vitamin C content, as well as on the activity of the carbonic anhydrase in smooth muscle tissue.

The experiments were carried out on the uterus of healthy rabbits. In the first series of experiments, 0.3 ml of adrenalin (1:1000) was administered to the rabbits; in the second series, 1 unit of insulin per kg. Two hours after insulin administration, the uterus was removed from the rabbits without anesthesia and the analyses were carried out immediately.

Control experiments were carried out for comparison.

Glycogen was determined by Simonovich's method; Vitamin C by Tillman's carbonic anhydrase activity, by Brickman's method modified by Krebs.

As is apparent in Table 1, the glycogen and ascorbic acid content of the uterine muscle was fairly constant in the control experiments.

TABLE 1

Glycogen and Vitamin C Content and Carbonic Anhydrase Activity of Smooth Muscle
Tissue of Rabbit Uterus After Adrenalin Administration

| Control (without adrenalin) | | | | Experiment (adrenalin administered) | | | |
|-----------------------------|----------|-----------|--------------------|-------------------------------------|----------|-----------|--------------------|
| No. of rabbits | glycogen | Vitamin C | Carbonic anhydrase | No. of rabbits | glycogen | Vitamin C | Carbonic anhydrase |
| | in mg % | | | | in mg % | | |
| 1 | 150.0 | 18.5 | 0.25 | 1 | 64.2 | 17.1 | 0.76 |
| 2 | 170.0 | 17.6 | 0.30 | 2 | 74.1 | 12.5 | 0.86 |
| 3 | 183.4 | 15.3 | 0.21 | 3 | 54.5 | 14.9 | 0.93 |
| 4 | 147.7 | 16.7 | 0.35 | 4 | 82.3 | — | 0.73 |
| 5 | 163.5 | 11.5 | 0.40 | 5 | 52.6 | 13.1 | 1.01 |
| 6 | 145.0 | 17.0 | 0.28 | 6 | 86.5 | — | 0.89 |
| 7 | 139.0 | — | 0.46 | 7 | 76.6 | 15.5 | 1.00 |

Under the influence of adrenalin, the glycogen content of smooth muscle tissue decreased sharply, the Vitamin C content stayed the same, while the activity of the carbonic anhydrase increased considerably.

It was found in the experiments that the amount of glycogen in uterine muscle and the activity of the carbonic anhydrase in them were in inverse proportion. Apparently this should not be regarded as accidental, since carbonic anhydrase plays a decisive role in cell respiration, namely, by removing carbon dioxide from the cells.

In view of the fact that, as the antagonist of adrenalin, insulin should act in the opposite direction on the metabolism of smooth muscle tissue, we carried out experiments on rabbits under the same conditions as the first series, but with the administration of insulin (Table 2).

TABLE 2

Glycogen and Vitamin C Content and Carbonic Anhydrase Activity of the Smooth Muscle Tissue of the Rabbit Uterus After Insulin Administration

| Control (without insulin) | | | | Experiment (insulin administered) | | | |
|---------------------------|----------|-----------|--------------------|-----------------------------------|----------|-----------|--------------------|
| No. of rabbits | glycogen | Vitamin C | Carbonic anhydrase | No. of rabbits | glycogen | Vitamin C | Carbonic anhydrase |
| | in mg % | | | | in mg % | | |
| 1 | 194.5 | 14.7 | 0.35 | 1 | 189.5 | 13.6 | 0.43 |
| 2 | 155.4 | 18.8 | 0.43 | 2 | 217.6 | 11.7 | 0.24 |
| 3 | 147.0 | 17.1 | 0.39 | 3 | 199.7 | 12.8 | 0.27 |
| 4 | 157.5 | 14.7 | 0.29 | 4 | 221.5 | 10.6 | 0.41 |
| 5 | 210.0 | 13.4 | 0.30 | 5 | 183.0 | 13.7 | 0.19 |

Comparison of the data shown in Table 2 with the results obtained in the control experiments shows that the glycogen content of smooth muscle tissue increases under the influence of insulin administration, while the Vitamin C content and carbonic anhydrase activity remained practically unchanged.

Thus, under the influence of adrenalin administration the glycogen content of the smooth musculature of rabbit uteri decreased, the carbonic anhydrase activity increased, while the Vitamin C content did not change.

Under the influence of insulin administration, the glycogen content of the smooth muscle of the rabbit uterus increased somewhat; the Vitamin C content and the activity of the carbonic anhydrase remained practically unchanged.

Further investigation in this direction will make it possible to clarify the mechanism of the action of adrenalin and insulin on the metabolism of smooth muscles.