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## EFFECT OF FETAL HYPOXIA AND HYPEROXIA ON GROWTH AND FUNCTIONAL ACTIVITY OF THE ADRENAL CORTEX

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The content of lipids, cholesterol, and ascorbic acid in the adrenal cortex was investigated in rabbit fetuses developing under conditions of normal gestation and during exposure in the last third of pregnancy to hypoxia and hyperoxia. During exposure to hypoxia (of moderate degree) activation of the adrenal cortex was reflected by a marked decrease in the content of lipids, cholesterol, and ascorbic acid. The total weight of the fetal muscle mass was increased under these circumstances. During exposure to hyperoxia the adrenal cortex was inactivated, as reflected in a marked increase in the content of the above-named substances. The total weight of the fetal muscle mass was reduced.

**KEY WORDS:** fetus; growth; adrenal cortex; motor responses; hypoxia; hyperoxia.

Investigations in the writers' laboratory have shown that, during fetal life, growth and formation of the body take place under conditions of natural physiological stress, brought about by episodic deficiencies in the supply of nutrients and oxygen on account of the limited area of the placental surface [1-6]. Acute experiments have shown that the fetus responds to the production of moderate maternal hypoxia by generalized movements of increased intensity and frequency, whereby the necessary supply of nutrients and oxygen is maintained to the fetal blood, whereas during inhalation of a gas mixture with a high oxygen concentration, these generalized movements are inhibited or even disappear completely [2, 3]. Other investigations in the laboratory have shown that motor responses of the developing organism stimulate anabolism, resulting in an increase not only in the mass of the skeletal muscles, but also correspondingly in other systems of organs [2-4, 6].

The object of this investigation was to study the features distinguishing adrenal growth and function in fetal rabbits exposed during the last third of pregnancy to the action of hypoxia or hyperoxia. Fetal adrenocortical activity in rabbits is known to be controlled by the hypothalamic-pituitary system at the beginning of the fetal period [5, 7].

### EXPERIMENTAL METHOD

The state of adrenocortical function was assessed from the content of chemical substances participating in steroid production in the glands: lipids, cholesterol, and ascorbic acid. Histochemical methods of determination were used: lipids by Sudan Black B and Sudan IV, cholesterol by means of the polarization microscope, and ascorbic acid by Backhus' method. The oxygen supply to the fetal blood was reduced by exposure

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TABLE 1. Mean Weight of Fetuses Developing under Normal, Hypoxic, and Hyperoxic Conditions ( $M \pm m$ )

Index	Body weight	Hypoxia	Hyperoxia
Body weight	42,1 $\pm$ 0,6	50,0 $\pm$ 0,9*	24,2 $\pm$ 1,0*
Relative weight Skeletal muscles, % of body weight	22,0 $\pm$ 0,5	26,5 $\pm$ 0,7*	18,5 $\pm$ 0,8*

\* $P < 0.02$ .

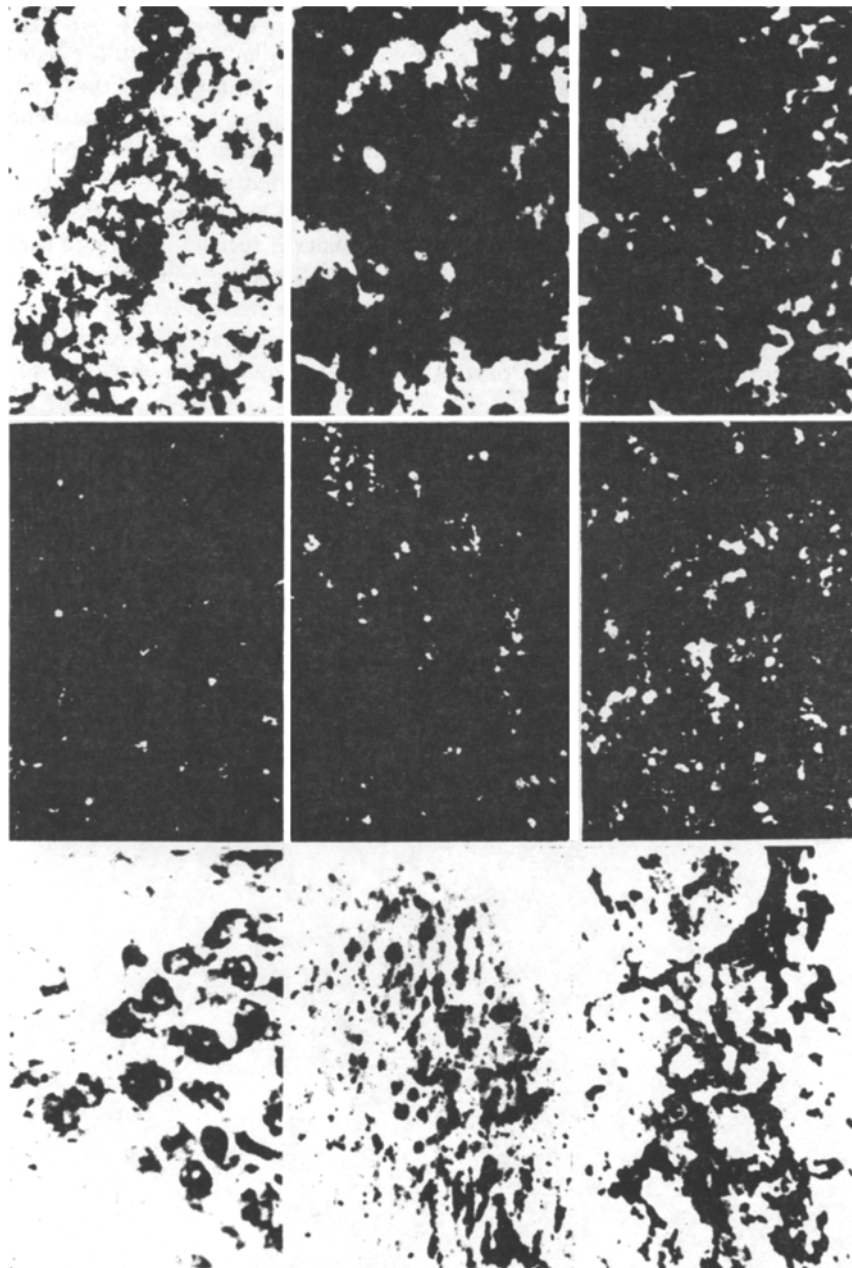


Fig. 1. Lipids (top), cholesterol (center), and ascorbic acid (bottom) in adrenal cortex of rabbit fetuses under normal (middle column), hypoxic (left), and hyperoxic (right) conditions.

of the mother to moderate hypoxia. For this purpose, the pregnant rabbits were kept for 3 h daily, starting with the 23rd day of pregnancy, in an airtight chamber in which the pressure was reduced to that equivalent to an altitude of 4 km (12.75% O<sub>2</sub>). An increase in the oxygen supply to the fetal arterial blood was produced by exposing the mother to hyperoxia. The pregnant rabbits were kept for 3 h daily, starting with the 23rd day of pregnancy, in an airtight chamber with an oxygen concentration of 70-80%. Fetuses for investigation were obtained by Caesarian section on the 29th day of pregnancy. Altogether, 45 normal fetuses (from 19 litters), 30 developing during hypoxia (from five litters), and 35 developing during hyperoxia (from six litters) were studied.

## EXPERIMENTAL RESULTS

As Table 1 shows, after exposure to hypoxia the mean weight of the fetuses was 19% higher than normal, whereas after exposure to hyperoxia it was 40% lower than normal. After exposure to hypoxia the relative weight of the skeletal muscles was 4.5% greater than normal, but after exposure to hyperoxia it was 3.5% less. In fetuses developing under hypoxic conditions the content of lipids, cholesterol, and ascorbic acid in the adrenal cortex was much lower than in normal fetuses, whereas in fetuses developing under hyperoxic conditions the opposite changes were found (Fig. 1). Consequently, exposure to hypoxia, with the effect of accelerating growth of the fetuses, also caused a marked increase in activity of the adrenal cortex. Conversely, exposure to hyperoxia, inhibiting growth of the fetuses through the inhibition of their adaptive motor responses, was followed by weakening of the activity of the glands. It is important to note that under hyperoxic conditions when, according to results obtained in the writers' laboratory, adaptive motor responses are suppressed, and when, consequently, not only the weight of the total muscle mass, but also the weight of the developing fetus was reduced, the content of the substances concerned with steroid biosynthesis was considerably higher than normal. Their lower content in the adrenal cortex of the control fetuses suggests that, under natural conditions, when the fetuses can carry out adaptive motor responses (for the reasons indicated above), the adrenal cortex also performs its activity necessary for this purpose. During exposure to hypoxia, when the performance of adaptive motor responses is intensified even more, a considerable increase in functional activity of the glands and, probably, of the hypothalamic-pituitary-adrenal system as a whole, is observed.

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