

INFLUENCE OF TACTILE-PAINFUL STIMULATION ON THE COURSE OF PREGNANCY AND ON THE VIABILITY OF THE FETUS

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The question of the influence of nervous trauma and of painful stimulations, and the disturbances they cause to higher nervous activity, on the course of pregnancy, and on the development of the human fetus has for long engaged the attention of clinicians, physiologists and pathologists.

The investigations of N. L. Garmasheva [5, 6] and co-workers showed that the processes in the maternal organism and in the fetus are mutually related. In the works of I. A. Arshavsky [1, 2] et al., it is noted that unfavorable factors, e.g., intoxication, starvation, hyposia, etc., frequently have a particularly strong effect on the organism of pregnant animals, bringing about a pathological course of pregnancy and death of the fetus. P. G. Svetlov and G. F. Korsakova [8] found that overheating the organism of pregnant rats negatively affects the development of the fetus, and is accompanied by the interruption of pregnancy. Particularly valuable observations made by the authors showed that in pregnant rats in conditions of disturbed innervation of the uterus (sympathectomy) and overheating of the maternal organism increases the frequency of anomaly in the development of the embryos.

A large number of experimental investigations have been conducted to discover which conditions are unfavorable in the intrauterine life of the fetus. However, the question concerning the influence of the disturbed activity of the nervous system on the course of pregnancy and the viability of the fetus has so far received comparatively little attention.

In the present investigation, we endeavored to trace the influence of nervous trauma in the animal maternal organism, both on the course of pregnancy and on the viability of the fetus, and also to clarify the possibility of the maternal organism of the pregnant animal conditioning itself to tactile-painful stimulation.

EXPERIMENTAL METHODS

100 pregnant rats were used, weighing from 110 to 120 g. Of them, 70 were subjected to the experiment, and 30 served as control. First of all in each rat the state of the sexual cycle was studied. Beforehand, pregnancy was established by the presence of sperm in the vaginas of the rats after coupling (method of vaginal smears).

At different stages of pregnancy, the experimental rats were subjected to tactile-painful stimulation in an electrode chamber according to the method of M. K. Petrova, a method worked out in the I. P. Pavlov laboratory, for inducing weakening of the cortex of the large cerebral hemispheres in rodents.

The pregnant rats were placed in a chamber with glass walls, the floor of which was lined with copper representing multi-plate electrodes. Every hour, a two-minute current of 10, 15 or 20 volts was automatically passed. The strength of the current was regulated by a rheostat in relation to the degree of reaction of the pregnant rats to the tactile-painful stimulation.

The rats of the test and control group were kept on the usual food ration. At intervals between sessions of stimulation, they were given sugar and white bread in the chamber.

As the tactile-painful stimulation was applied to the rats at different stages of pregnancy, the whole of the material, according to experimental conditions, can be divided into 4 series.

30 healthy rats (control group) were observed both in the course of the entire pregnancy and parturition and after birth of the young. No pathological changes were found in any of them, either in the period of pregnancy or in the fetuses.

In order to assess the results of the experiment, observations were made in vivo on the behavior of the animals in the electrode chamber, and the weight of the pregnant rats was recorded. The character of parturition, and the weight of the fetuses, were taken into account. Particular attention was aroused by cases of still-born rats. In each case, the placenta and the internal organs of the fetuses were subjected to morphological examination. The tissue of the placenta was fixed in Bouin's fluid and the tissue of the internal organs in 10% formalin. The microscopic sections, 7-8 microns thick, were cut by aid of celloidin, and stained with hematoxylin-eosin, according to Van Huyson, and also with cosin-azure.

EXPERIMENTAL RESULTS

1st Series of experiments.

A total of 15 rats in an early stage of pregnancy were used on the 5-7 day, that is, before and during implantation of the ovum in the womb. According to P. G. Svetlov and G. F. Korsakova, implantation terminates toward the 7th day of pregnancy. These rats, starting from the time indicated, and up to the end of pregnancy, were subjected to tactile-painful stimulation by a weak electric current in an electrode chamber 5 times a day for 1-1½ to 2 minutes at a time.

At the moment of the switching on of the current at a potential of 18-20 volts, uncertainty of motor action appeared in the rats. They scampered about the chamber, jerking back their paws and squeaking, with dyspnea and urination.

When two rats were in the chamber together, they stood up on their hind paws, holding themselves with their front paws on the one in front and at times, finding themselves on single-plate electrodes, they were insulated from the effect of the current. In a few days, the animals adjusted themselves to the given conditions. Entering the electrode chamber, they took up a definite position for the purpose of insulation at the time of switching on the current. In this series of experiments in all the pregnant rats, no deviations in the course of pregnancy and parturition were noticed. They bore healthy, on-time-delivered young, on the 22-23 day of pregnancy, weighing 5.2-5.6 g. The usual size of the litter was 6-8.

On microscopic investigation of the tissue of the placenta and the internal organs of the young, it was not possible to find any noticeable deviations.

2nd Series of experiments.

15 rats were subjected to tactile-painful stimulation in an electrode chamber, beginning on the 8-10-20 days of pregnancy, i.e., in the period of the completion of implantation of the ovum in the womb. Stimulation continued, as in the 1st series of experiments, up to the end of pregnancy. In these rats, the behavior in the chamber in no way differed from that described in the 1st series. In the rats of this series, no deviations in the course of pregnancy or in parturition could be found. All 15 rats bore on-time-delivered young on the 22-23 day of pregnancy, with 7-8 young per litter 5.2-5.4 g.

Microscopic examination of the tissue of the placenta and also of the internal organs of the fetuses revealed no essential changes.

3rd Series of experiments.

20 rats, starting from the 14-15 day, and up to the last day of pregnancy, were subjected to tactile-painful stimulation in an electrode chamber (4-5 times daily).



Fig. 1. Widespread hemorrhage under the pleura, atelectasis of the lung and venous congestion in rat fetus with intrauterine asphyxia.



Fig. 2 Widespread hemorrhage in the intramuscular layers of the heart with intrauterine asphyxia of the rat fetus.

The behavior of the rats in the chamber in no way differed from that of the previous series of experiments, but they reacted more to tactile-painful stimulation, even from a weaker electric current (10-12 volts). After the end of the stimulation session, they were, so to speak, "frozen" in fear; some rats fell into a state of prostration, they were short of breath for a long time, and did not take food.

Of the 20 rats under experiment, in 5 sanguineous secretion and birth of dead fetuses were noted on the 17-18th day, i.e., 3-4 days after the first stimulation in the chamber.

In some rats, parturition lasted for 2-3 hours and more. The weight of the fetuses was 3.5-3.8 g.

On microscopic examination of the placenta, focal and massive hemorrhage was seen, both in the periphery and at its center. There was exfoliation of the placenta in two rats.

Microscopic examination of the internal organs of the aborted fetuses showed a relationship between the structure of the tissue of the lung, spleen, heart, etc., and the age of the fetus.

In this same series, in 8 rats, stillborn fetuses, weighing 5.2-5.6 g. were noted. In some rats, delayed birth took place. Thus, in two rats, birth occurred on the 24th day of pregnancy, and the act of birth, possibly as a result of weakness of parturition, continued for 4-6 hours.

On microscopic examination of the placenta, infarcts were seen and thrombi here and there. In individual cases, there were inflammatory infiltration foci of the periphery of the placenta. Where intrauterine asphyxia of the fetus was present, considerable changes in the internal organs were observed: In the lungs, signs of a complete or partial atelectasis (Fig. 1), widespread hemorrhage under the pleura, venous congestion; in the liver alongside signs of albumin, dystrophy of the hepatic cells, widespread hemorrhage, and also a large amount of embryonic blood formation nodes; in the heart - hemorrhage in the intermuscular layers (Fig. 2) and also manifestation of venous congestion; foci of hemorrhage in the epicardium.

4th Series of experiments.

20 rats on the 21st day of pregnancy were placed in the electrode chamber, where they were subjected to nervous trauma. At the moment of the switching on of even a weak current, a powerful motor excitement and dyspnea were noted. They scampered about the chamber squeaking. After termination of the session, the rats remained for long in a state of stupefaction, immobile and not taking food.

Of the 20 rats, 11 bore on-time dead young, weighing 5.2-5.4 g.

In these pregnant females, individual cases displayed protracted parturition, and the young were in a state of deep asphyxia. On microscopic examination of the placenta and the internal organs of the dead fetuses, the same changes were noted as in the previous series of experiments.

DISCUSSION OF RESULTS

It is clear from the finding that prolonged tactile-painful stimulation, constituting without doubt a nervous trauma, applied to pregnant rats in the early stages of pregnancy (from 4-7 to 10 days), i.e., before and after implantation of the ovum in the womb, does not exert a harmful influence on the fetus. With this, the pregnant rats bore on-time young on the 22-23rd day weighing 5.2-5.4 g.

It may be said that considerable nervous trauma inflicted in the early stages of pregnancy apparently caused in the maternal organism and then in the intrauterine fetus a peculiar reaction, that is, training and adjustment of cardiac-vascular and nervous system, etc.

In the experiments in the 3rd and 4th series, in the pregnant rats, in 47.5% of the cases there were stillborn young, owing to intrauterine asphyxia of the fetuses. Precisely in this group of animals, parturition was drawn-out, continuing for 4-6 hours. In these cases, of course, it was difficult to determine whether death of the fetuses occurred in the ante- or intranatal period. On microscopic examination of the internal organs of the stillborn fetuses, there were clear indications of changes resembling those which are found in intrauterine asphyxia of human fetuses. In these processes, the state of the maternal organism and also the conditions of uterine blood circulation and placental blood supply must be of great importance. The findings of our present work suggest hemodynamic disturbances in the placenta, manifest in infarcts, edematous and venous congestion conditions.

It follows from the finding of the experiments, that the most intense damage to the fetuses under the influence of over-excitation of the nervous system of the maternal organism is related to the period in the development of the fetus, when the basic processes of formation of the internal organs, and the nervous system, are already completed, and the placenta has been completely formed.

In this respect, our results coincide with the findings contained in the works of other authors.

Thus, L. S. Galeeva [4] noted that widespread experimental hemorrhage in pregnant rabbits (from $\frac{1}{6}$ to $\frac{1}{3}$ of weight) was most injurious to the fetus in the period of the 13-15th day of pregnancy. According to the findings of V. I. Bodyazhina, oxygen starvation of the maternal organism has an injurious influence on the fetus

on the 10-15 day of pregnancy.

Our observations, confirmed by a large number of investigations, make clear the possibility of obtaining experimental intrauterine asphyxia of the fetus by the influence of nervous trauma on the maternal organism.

Our material distinctly shows the significance of training of the maternal organism, adjusting it to long tactile-painful stimuli during the whole of pregnancy. Such rats gave birth to on-time young. On the other hand, analogous stimulation, applied in the "vulnerable" stages of pregnancy, without training of the organism, contributes to intrauterine destruction (asphyxia) of the fetus.

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* In Russian.