

THE INFLUENCE OF A SUPER-HIGH FREQUENCY PULSED
ELECTROMAGNETIC FIELD ON CONCEPTION AND THE COURSE
OF PREGNANCY IN WHITE MICE

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Translated from *Byulleten' Éksperimental' noi Biologii i Meditsiny*, Vol. 51, No. 5,
pp. 103-107.

Original article submitted May 20, 1960

The rapid development of radioelectronics in the Soviet Union and the large part played by women in all branches of the national economy, including the manufacture of radio apparatus, make it essential to study the influence of the super-high frequency (SHF) field on the female organism, especially during pregnancy, and also on the course of pregnancy and on the fetus.

In an attempt to solve this problem, we carried out experiments on female mice exposed to the action of a pulsed SHF field. We studied the time of conception, the changes in the course of pregnancy, and the possible changes in or injury to the fetus in relation to the action of a low-intensity SHF field on the pregnant animal, and also the course of parturition in the mice and the development of their offspring.

EXPERIMENTAL METHOD

In the first series of experiments mice were exposed to the SHF field of power flux density 0.344 mW/cm^2 twenty times, each exposure being for 30 minutes (20 experimental and 10 control animals), and in the second series fifty times with the same power flux density and duration of exposure (20 experimental and 10 control animals). In these two series the animals were irradiated before copulation, and in the third series (35 experimental and 19 control mice) irradiation began immediately after copulation and continued during 12 days of pregnancy. The female mice were exposed daily for 10 minutes to a field of power flux density of 50 mW/cm^2 .

The experimental animals were weighed and their condition was observed every day before, during, and after pregnancy. In some of the female mice the sexual cycle was investigated before copulation and three weeks thereafter for a prolonged period.

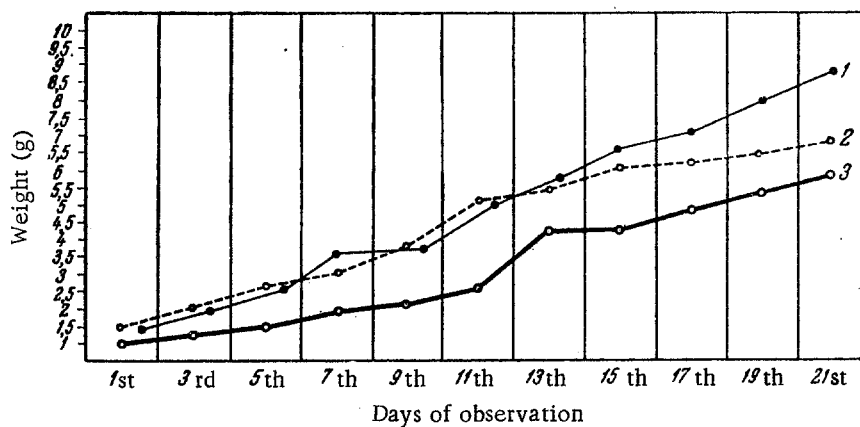
EXPERIMENTAL RESULTS

Prolonged exposure of female mice to the SHF field before copulation had no effect on the onset of pregnancy. In the experimental group pregnancy took place in 23 of the 40 mice (117 fetuses), and in the control group in 13 of the 20 mice (56 fetuses). The number of young mice in the litters of the experimental and control groups was the same.

Exposure to the SHF field was not followed by the termination of pregnancy or the onset of abortion. Only three experimental females showed great distress one or two days before the beginning of parturition. The weight curve of the experimental animals during the whole period of pregnancy showed a gradual increase, to reach a maximum average figure of 33.5-37.5 g when irradiation was given before pregnancy (38 g in the controls), and 33-34.5 g when irradiation was given during pregnancy (12 exposures, with a power flux density of 50 mW/cm^2).

Premature parturition was not observed in any of the experimental mice, but on the contrary there was a tendency for postmaturity to take place: parturition began on the 19th-21st day after the last day of copulation, by comparison with the 18th day in the control group. Among the postmature newborn mice there were four stillborn.

Postmaturity of the fetus may be due to a depression of the function of the afferent system of the uterus as a result of changes in the nervous system of the mouse brought about by exposure to the SHF field. The weakening of the influence and the change in the character of the stimuli coming from the fetuses and affecting the female mice [2, 4, 5] as a result of the action of the SHF field may also explain the later arrival of the fetuses than in the case of the control animals. There are reports in the literature of changes in the central nervous system of animals under the influence of the SHF field [1, 10]. During observation of the animals in the postnatal period no difference from the controls both as regards their general condition and as regards the condition of their organs could be observed.



Change in the weight of white mice under the influence of the super-high frequency field. 1) Control; 2) experiment, exposure before pregnancy; 3) experiment, exposure during pregnancy.

Exposure to the SHF field had a definite influence on the development of the young mice. On the 5th-6th day after birth the skin of the young of the experimental females began to acquire a silvery hue. They were covered with hair on the 9th-10th day (the controls on the 8th-9th day), and with a white fur on the 11th-13th day (the controls on the 9th-12th day). Usually on the 11th-13th day the eyes of the young mice had the appearance of perforated slits instead of the film as previously observed; the eyes were opened on the 14th-15th day (in the controls on the 13th-14th day). The development of the young mice born of the experimental females exposed to the action of the SHF field before pregnancy took place rather faster than in the young of the experimental females exposed to the SHF field during pregnancy.

The subsequent development of the young experimental mice followed the same course outwardly as that of the young of the control female mice. On the 19th day they became mobile and more fluffy, and they tried by themselves to drink and to gnaw grain, which they managed to do perfectly well on the 21st-25th day. The average weight of the fetuses at birth was 1.5 g (according to Kovalevskii [7], the average weight of newborn mice is 1.4-1.5 g, according to Robertson [9]-1.7 g).

At the end of the first week the average weight of the young of the females exposed to the SHF field during pregnancy reached 2.5 g, that of the young of the females exposed to the SHF field before pregnancy was 3.5 g, and that of the young of the control females 3.8 g. At the end of the second week equalization of the weight of the young of the females exposed to the SHF field before pregnancy (5.7 g) and the young of the control animals (6.2 g) took place. The weight of the young of the females exposed to the SHF field during pregnancy lagged behind considerably (4.7 g). At the end of the third week the average weight of the young of all the experimental females was approximately the same (6.7-7.1 g).

The newborn offspring of the control females developed well; their average weight at birth was between 1.5 and 2.0 g, at the end of the second week it reached 6.2 g, and at the end of the third week it was 9.2 g (see figure).

By comparison with the control series, some lagging behind may thus be observed in the weight of the young of the experimental females, especially those exposed during pregnancy.

In the experiments in which the females were exposed for long periods before pregnancy (the first and second), in the first two weeks three newborn mice died, and in the 3rd and 4th weeks 87 of the 117 young mice died. Abnormalities of the gastrointestinal tract, reddening of the eyes, loss of the hair, and general lethargy were observed in these animals. In the control group 11 of the 56 young mice died.

In the third series of experiments two young mice died on the eighth day after birth, two died on the 16th day, and three on the 17th day.

It must be supposed that the action of the SHF field at the beginning of pregnancy on the fetuses is much greater (they have a small birth weight, they lag behind considerably in weight and development, and a high proportion of them die in the third week after birth)*.

The reaction to chorionic gonadotropin was tested in three young mice born of females exposed to the SHF field before pregnancy (from the first two series). It gave a negative result. The analogous reaction in four young mice (from two litters) born of females exposed to the SHF field during pregnancy (third series) gave a negative result in one mouse and a positive in three (from the same litter). In all the young mice born of the control animals, the reaction to chorionic gonadotropin was positive.

Most of the experimental and control animals (whether dying or sacrificed) were examined post mortem. Particular attention was paid to the state of the sex organs (the ovaries and the uterine cornua); these were also examined histologically.

Visible pathologo-anatomical changes in the ovaries of the experimental mice were observed only in isolated cases, in the form of slight cystic degeneration and a decrease in their size and weight. The average weight of the ovaries of the control animals was 19.5 mg, and that of the experimental animals 11.2 mg. The uterine cornua of the experimental mice were less than half the size of those of the control animals. This decrease in the weight of these organs after exposure to the SHF field is evidently the result of atrophic changes.

The greatest weight of the uterine cornua of the experimental and control animals was observed in the stage of oestrus. A few of the sacrificed and dying mice had hemorrhages in the uterine cornua.

In the parturient females, congestion and hemorrhages were also observed in other organs, e. g. the lungs and liver. The uterine cornua of the control females were unchanged. Histological examination of the ovaries of individual experimental female mice revealed a comparatively small number of follicles and corpora lutea, and also some diminution in their volume; certain follicles had undergone cystic degeneration. In the uterine cornua of the experimental females no particular changes were found. In some of them, especially in the stage of oestrus, we observed dilated glands and a more compact interglandular connective tissue, rich in cells. In some experimental female mice no changes whatsoever were found. More significant changes by comparison with the controls were found in the female mice in the stages of pro-oestrus and oestrus than in the stages of metoestrus and dioestrus.

According to reports in the literature [3], the developing and developed Graafian follicles are more sensitive to X-rays than the primordial ovarian follicles. It has also been reported [6] that the ovaries are more sensitive to the action of ionizing radiation during a period of functional activity than during a period of relative functional rest.

The investigations of Pitenin [8] of the testes of rabbits exposed to the action of a weak SHF field (20 exposures, each of 60 minutes), revealed several morphological changes in the form of a slight decrease in the size of the sex cells, some shrinking of these cells, absence of more mature forms and, sometimes, the presence of degenerated cell groups.

Our experimental findings may to some extent be used in the discussion of the question of the possible influence of the electromagnetic SHF field (many repeated exposures to fields of intensities higher than the permissible levels) on women, especially during pregnancy, and also on the course of the pregnancy and on the fetus. These findings may also be of practical importance in obstetric practice for the development of the necessary prophylactic and therapeutic measures.

* Many of the mice of this series were sacrificed so that special investigations could be carried out (histological examination, weighing of the ovaries and the uterine cornua). The fetuses which survived were investigated biologically (by the reaction to chorionic gonadotropin).

SUMMARY

As evidenced, there is a delay in the development and in the weight gain of the female mice progeny after subjecting them to the action of high-frequency electromagnetic field, during pregnancy. There were many stillbirths and deaths during the 3rd week of life among the progeny of these mice. The weight of the ovaries and of the uterine cornua was reduced in experimental animals. Mild histological changes in the ovaries and uterine cornua are not constant and occur mainly during the greatest functional activity of these organs—at the stage of rut.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
