SOME ASPECTS OF THERMOREGULATION DURING PREGNANCY

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(Received February 27, 1958. Presented by Active Member Acad. Med. Sci. USSR, A. I. Serebrov)

Because of the successful use of drugs affecting the thermoregulation [aminazine (largactil) phenergan, etc.] and of methods of general hypothermia into the practice of obstetrics and gynecology, there is great interest in the problems of thermoregulation at the present time.

We know [11 and other] that two types of temperature curve may exist: the male, characterized by uniformity in time and with considerable diurnal variations (up to 0.9-1.0°), and the female, which is established at the time of puberty and which continues until the climacteric; the second type is characterized by monthly variations – a rise of temperature before menstruation and a fall during and after menstruation, with insignificant diurnal variations in the intermenstrual period.

On this account it is natural to expect that during pregnancy the processes of thermoregulation will be different from those at other times. Little work has been done however, on thermoregulation during pregnancy, and in the majority of cases this is concerned with mere statements that the temperature is raised during the first months of pregnancy [1, 3, 6, 9-11, 13 and others]. In certain investigations a fall in temperature before labor is mentioned [2, 4 and other].

The aim of the present research was to study experimentally the special features of the thermoregulation of the pregnant animal during general hypothermia and after administration of aminazine.

EXPERIMENTAL METHOD

Experiments were carried out on 128 pregnant and 63 nonpregnant white rats. Three series of experiments altogether were performed: in the first series of experiments the effect of aminazine alone was studied, in the second series – of a fall in the environmental temperature alone; in the third series of experiments the animals were cooled by a combination of administration of aminazine and the action of a low temperature of the surrounding air. The animals were cooled for 4-6 hours in a double-walled tank containing a cooling mixture (ice and salt) between the walls. The temperature inside the tank at the beginning of cooling was – 16° or – 12°. Aminazine was given in two doses: a minimum to show a hypothermic action, according to M. D. Mashkovskii, S. S. Liberman and A. I. Polezhaeva [5] – 0.55 mg per 100 g body weight, in the form of a 0.25% solution – and a larger dose – 1.2 mg per 100 g body weight in the form of a 0.8% solution.

In the experiments in which administration of aminazine was combined with cooling, the animals were kept in the tank immediately after receiving the drug. The temperature was measured by means of a thermocouple every 30 minutes. The animals were cooled and given aminazine at different periods of pregnancy: on the 4th, 12th and 21st days and the day before labor. In the analysis of the results the statistical significance of the findings was determined.

EXPERIMENTAL RESULTS

Administration of aminazine. This series consisted of 77 experiments. There was no great difference between the behavior of the pregnant and nonpregnant rats after receiving aminazine. Immediately after the injection some animals showed transient motor excitation, evidently the result of a reaction to the painful stimulus. From 30-60 minutes after the injection of aminazine they fell asleep and lay motionless. After administration of the larger doses of aminazine to the pregnant animals, they fell asleep after 15-30 minutes, whereas the nonpregnant animals fell asleep at the same time as after the smaller doses — after 30-60 minutes. The mean values of the changes in the rectal temperature as a result of injection of aminazine are shown in Table 1.

TABLE 1

Rectal Temperature of Pregnant and Nonpregnat Rats after Administration of Aminazine

Group of animals	Number of experiments	Initial rectal temperature	Fall in the rectal temperature in the 1st hour after injection of aminazine	Total fall in rectal temperature	Time of recovery, in hours
1. Aminazine in a dose of 0.55 mg per 100 g body weight					
Nonpregnant . .	18	36,64°	1,98° ±0,18°	3,47°	8,77
Pregnant:					
4th day	9	37,04°	2,13° ±0,3°	3,12°	6,39
12th "	15	36,71°	1,69° ±0,28°	4,28°	5,53
21st "	14	36,16°	0,93° ±0,12°	2,54°	7,08
2. Aminazine in a dose of 1.2 mg per 100 g body weight					
Nonpregnant . .	11	36,4°	2,96° ±0,17°	4,5°	—
Pregnant:					
21st day	10	36,13°	2,21° ±0,32°	5,73°	—

As may be seen from Table 1, the initial rectal temperature of the pregnant animals differed in accordance with the period of pregnancy: at the onset of pregnancy it was higher, and at the end — lower than in the nonpregnant rats. The greatest differences between the reactions of the pregnant and nonpregnant animals were shown on the 21st day of pregnancy, and were apparent within only one hour of the injection: in the nonpregnant animals the rectal temperature fell during the first hour by 1.98 ± 0.18°, and in the pregnant animals — by only 0.93 ± 0.12° (Fig. 1).

After administration of larger doses of aminazine the rectal temperature fell further in the pregnant rats on the eve of labor than in the nonpregnant rats.

Action of a low environmental temperature. In this series we carried out 39 experiments. During physical cooling the reaction of the pregnant animals was different from that found in response to injection of aminazine (Table 2).

The fall in the rectal temperature in the pregnant animals during the period of cooling was greater over the same length of time than in the nonpregnant rats (Figs. 1 and 2): In the nonpregnant rats during cooling for 4-6 hours the rectal temperature fell on the average by 2.2°, and in the pregnant rats during the same time it fell by 5.8-9.8° . The greatest fall of temperature was observed in the rats on the 21st day of pregnancy.

The difference between the falls in rectal temperature in the pregnant and nonpregnant animals was clearly apparent after only one hour of cooling, just as after injection of aminazine. For instance, in the rats on the 21st day of pregnancy the rectal temperature fell in the first hour of cooling on the average by 2.75 ± 0.65° but in the nonpregnant rats by only 0.82 ± 0.18° .

Restoration of the normal rectal temperature in the pregnant animals after cooling took place later than in the nonpregnant animals (see Table 2 and Fig. 2). Whereas in the nonpregnant animals a direct relationship was always observed between the duration of restoration of the rectal temperature and the degree of its fall, in the pregnant animals the duration of its restoration was independent of the degree of fall of the rectal temperature.

Combination of the action of aminazine and low environmental temperature. This series consisted of 75 experiments. Cooling was carried out until the rectal temperature was 20-24°. Immediately after being placed in the tank, both pregnant and nonpregnant rats showed some degree of motor restlessness, although in the majority of cases they rapidly quietened down and sat peacefully.

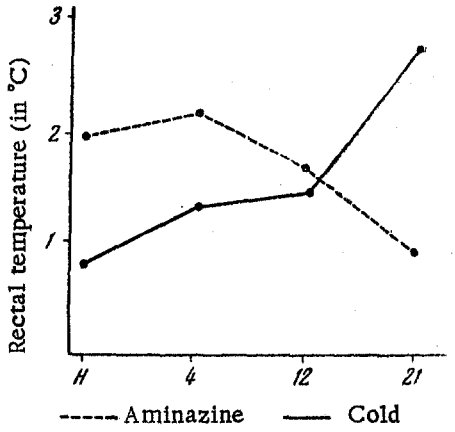

Fig. 1. Comparison of the degree of lowering of the temperature in pregnant rats under the influence of cooling for one hour and of aminazine (0.55 mg per 100 g body weight).
N – nonpregnant animals; 4, 12, 21 – pregnant animals, cooled on the 4th, 12th and 21st days of pregnancy respectively.

The results of the experiments are shown in Table 3.

The initial rectal temperature varied at different periods of pregnancy just as it did in the previous series of experiments.

With a combination of small doses of aminazine and a low environmental temperature, the differences observed between the reactions of the pregnant and nonpregnant rats to the isolated action of cold or aminazine were obliterated. The fall in the rectal temperature of these animals took place in the same way. Restoration of the temperature took slightly longer in the pregnant animals than in the nonpregnant (see Fig. 2).

The total fall in the rectal temperature of the rats in this series of experiments was greater than in response to the action of a low temperature or of aminazine alone (see Fig. 2). With a combination of larger doses of aminazine and a low environmental temperature, the temperature of the pregnant rats on the 21st day fell more in the 1st hour after the injection than in animals at the same period of pregnancy but receiving smaller doses of aminazine.

TABLE 2

The Rectal Temperature in Pregnant and Nonpregnant Rats during the Action of a Low Environmental Temperature

Group of animals	Number of experiments	Initial rectal temperature	Fall in the rectal temperature during 1 hour of cooling	Total fall in rectal temperature	Time of recovery, in hours
Nonpregnant	9	36.6°	0.82° ± 0.18°	2.23°	4.85
Pregnant:					
4th day	9	37.24°	1.32° ± 0.13°	6.63°	5.55
12th day	9	36.94°	1.49° ± 0.16°	5.82°	6.5
21st day	12	36.15°	2.75° ± 0.65°	9.82°	8.11

In the nonpregnant rats there was no difference between the fall of temperatures during the 1st hour after the injection of smaller and larger doses of aminazine (See Table 3).

Pregnant rats were thus more sensitive to larger doses of aminazine, both when given alone and when combined with cold.

The results of the experiments showed that the sensitivity of pregnant rats to a fall in the environmental temperature and to the administration of aminazine changed in opposite directions (see Fig. 1). The reactions to cooling were intensified and those to injection of aminazine were reduced. These relationships no longer held

in the case of extremely large doses of aminazine (1.2 mg per 100 g body weight), the administration of which to pregnant rats produced an even greater fall in the temperature than in the nonpregnant rats.

TABLE 3

The Rectal Temperature in Pregnant and Nonpregnant Rats during the Combined Action of Aminazine and a Low Environmental Temperature

Group of animals	Number of experiments	Initial rectal temperature	Fall in the rectal temperature in the 1st hour of cooling	Total fall in rectal temperature	Time of recovery, in hours
1. Combination of cold with aminazine in a dose of 0.55 mg per 100 g body weight					
Nonpregnat	15	36.38°	5.06 ± 0.65°	13.08°	11.93 ± 0.8
Pregnant:					
4th day	10	37.04°	4.03 ± 0.39°	14.72°	21.55 ± 4.48
12th day	15	36.7°	3.56 ± 0.33°	14.74°	21.9 ± 3.57
21st day	15	36.08°	5.41 ± 0.52°	13.02°	17.26 ± 2.28
2. Combination of cold with aminazine in a dose of 1.2 mg per 100 g body weight					
Nonpregnat	10	36.16°	5.28 ± 0.81°	10.76°	—
Pregnant:					
21st day	10	35.85°	7.71 ± 1.1°	13.04°	—

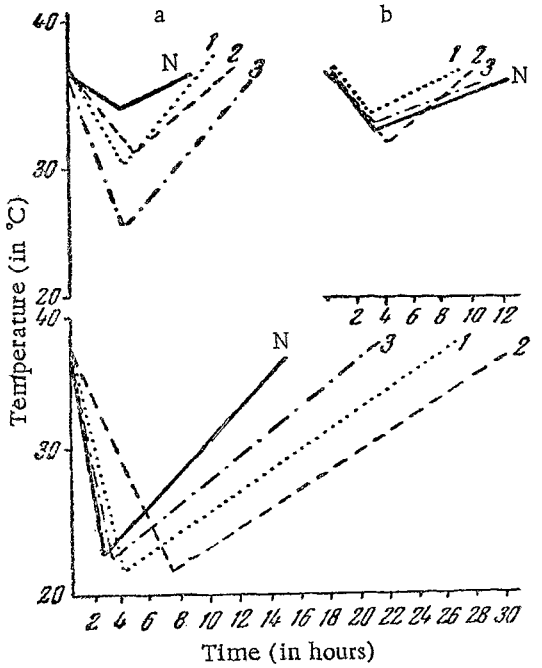

Fig. 2. Changes in the temperature of pregnant and nonpregnant rats in response to different methods of cooling.
a) cooling due to the action of a low temperature of the surrounding air; b) cooling due to administration of aminazine (0.55 mg per 100 g body weight); N) nonpregnant animals; 1, 2, 3) pregnant animals cooled on the 4th, 12th and 21st days of the pregnancy respectively.

Sensitivity to cooling could evidently be connected with the increasing development of a number of functions of the animal concerned in expulsion of the fetuses, the total weight of which often amounts to $\frac{1}{4}$ - $\frac{1}{3}$ of the weight of the rat itself; under these circumstances the weakening of its powers of adaptation to severe changes in the external conditions was understandable. So far as the distinctive features of the reaction of the pregnant animal to aminazine are concerned, it might be suggested that in association with the metabolic changes of pregnancy, because of the increased excitation of the corresponding centers of the brain aminazine does not have the same inhibitory action on these centers as it does in nonpregnant animals.

We know that during pregnancy, especially towards its end, considerable changes in metabolism are observed. According to A. A. Skvortsova, for instance, the basal metabolism and the gas exchange in pregnant women towards term is increased by $\frac{1}{3}$ by comparison with the metabolism of nonpregnant women [7]; a considerable increase in the respiratory gas exchange during the second half of pregnancy, notably at its end, has been pointed out by Zuntz [15], Klaften [12] and others; an increase in the basal metabolism during normal pregnancy has also been observed by Baer [8], Root and Root [14] and others.

SUMMARY

The peculiarities of thermoregulation were studied at various periods of pregnancy (on the 4th, 12th and 21st days) in administration of aminazine (chlorpromazine) and the action of low environmental temperature. The results of experiments demonstrated that the sensitivity of rats to low temperature and to the administration of aminazine (0.55 mg per 100 gms of body weight) is changed in the opposit direction at the end of pregnancy, i. e. it is increased under the effect of low temperature and decreased as a result of administration of aminazine. In simultaneous action of aminazine and low environmental temperature there is almost no difference in the effect produced by these agents on the gravid and nongravid animals.

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