

Impact of Maternal Supine Position on Some Parameters of Fetal Function in Rabbits

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Fixation of a pregnant rabbit in the supine position is shown to result in hemodynamic disturbances in the maternal-placental-fetal system, apparently due to a hypotensive syndrome developing in the mother. The heart rate, body temperature, and motor activity in the fetuses of such mothers were similar to those recorded for fetuses with retarded development. It is concluded that maternal position needs to be taken into consideration in experiments designed to examine interrelated responses of mother and fetus to external stimuli.

Key Words: *maternal-placental blood flow; hypotensive syndrome; rabbit fetuses; body temperature; motor activity*

The most common cause of fetal distress is hypoxia. Oxygen supply to the fetus is largely dependent on the magnitude of the maternal-placental blood flow. Disturbances of fetal gas exchange frequently arise because of uterine congestion occurring in women in the last trimester or last few weeks of pregnancy as a result of lying supine. In this position, the weight of the uterus compresses the inferior vena cava and other vessels, giving rise to what is known as supine hypotensive syndrome. According to the data gathered by our laboratory [5], this syndrome develops in 10% of pregnant women; others have reported incidence rates of 10 to 14% for the overt form of the syndrome and close to 70% for its latent form (detected by special methods of examination) [1]. Similar hemodynamic responses presumably occur toward the end of gestation in animals forced to lie on their back - the position most frequently used in experiments on rabbits and other small mammals.

The aim of the present study on rabbits was to compare body temperature, heart rate, and motor activity in fetuses of mothers allowed to remain in the

natural (sitting) position with those in fetuses whose mothers were immobilized on their backs.

MATERIALS AND METHODS

Two series of experiments were performed on pregnant Chinchilla rabbits. In the first series, electrodes for recording electrocardiograms (ECGs) and thermocouples for recording rectal temperature were inserted into the fetuses of 18 females hysterotomized under intravenous thiopental anesthesia (1 ml/kg of 5% thiopental sodium) on the 28th day of gestation. Details of the method we used for simultaneous recording of body temperature and electrocardiograms in rabbits and their fetuses are described elsewhere [3].

In the second series, 14 females were subjected to hysterotomy under intravenous thiopental anesthesia on day 28 of gestation and three electrodes for bipolar recording of electrocardiograms and electromyograms (EMGs) were inserted into the fetuses. Loop-shaped platinum wire electrodes for electromyography were implanted into both haunches of each fetus.

Maternal and fetal ECGs were recorded with a Bioskript electroencephalograph. The envelopes of the EMGs were recorded with an electronic potentiometer

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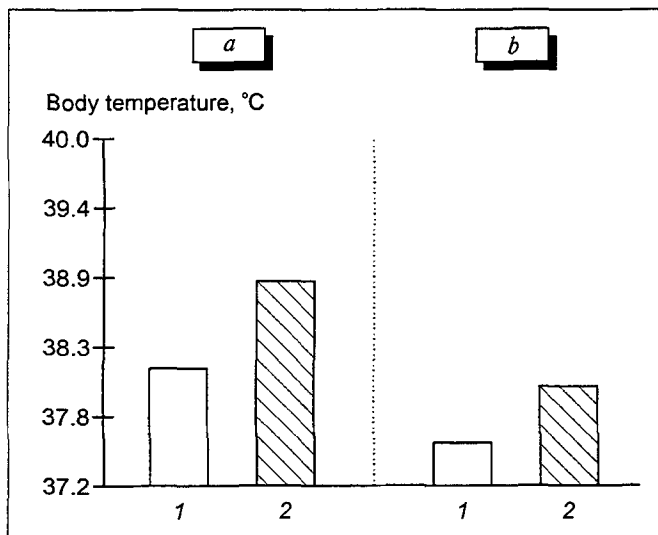


Fig. 1. Maternal (1) and fetal (2) body temperature as measured with the mother in the natural (a) and supine (b) position.

and analyzed as previously described [6,7]. A twofold increase in the amplitude of the record relative to the baseline amplitude was defined as one episode of fetal motor activity, while the ratio of the time during which a fetus was moving to the total time of recording was taken to be the duration (in seconds) of fetal movement per minute. In addition, the mean duration of fetal stirring (in seconds) and the mean number of fetal movements per minute were determined.

In both experimental series, the parameters of interest were continuously recorded for several hours after surgery and on the following day.

RESULTS

The values of the parameters measured were found to depend on the position of the mother. In the natural (sitting) position, the maternal body temperature was significantly higher (by 0.59°C) than in the supine position ($38.15 \pm 0.13^{\circ}\text{C}$ vs. $37.56 \pm 0.15^{\circ}\text{C}$) (Fig. 1), while

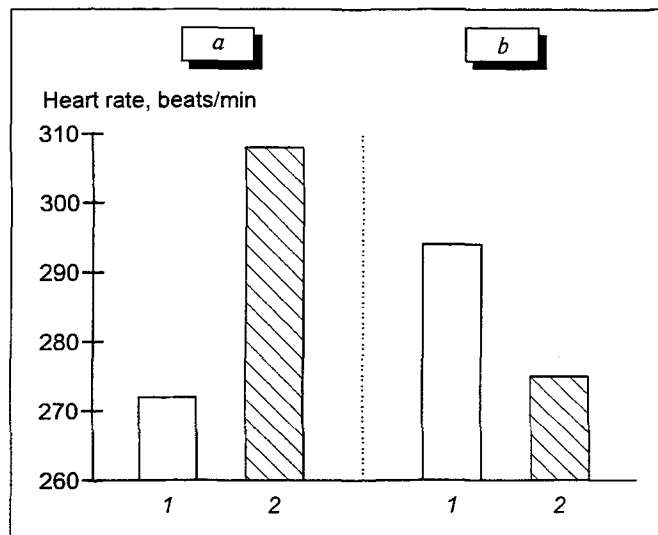


Fig. 2. Maternal (1) and fetal (2) heart rate as measured with the mother in the natural (a) and supine (b) position.

the heart rate was significantly lower (271.57 ± 6.23 vs. 293 ± 17.02 beats/min) (Fig. 2).

When the mother was in the natural position, the fetal body temperature was significantly higher than when the animal was fixed on its back ($38.8 \pm 0.14^{\circ}\text{C}$ vs. $37.99 \pm 0.20^{\circ}\text{C}$) (Fig. 1) and, moreover, the difference between fetal and maternal body temperature was significantly greater ($0.73 \pm 0.12^{\circ}\text{C}$ in the natural and $0.43 \pm 0.14^{\circ}\text{C}$ in the supine position). With the mother fixed on its back, the fetal heart rate was 12.08% lower (275.23 ± 5.42 beats/min vs. 308.49 ± 5.33 beats/min in the natural position) (Fig. 2).

Taking the fetal heart rate as 100%, we calculated that the maternal heart rate was equal to 106.56% of its value in the supine position but only to 87.93% in the natural position. The ratio of fetal to maternal heart rate in the latter position was thus opposite to that in the supine position.

In the mothers lying on their backs, the mean number of fetal movements per minute was signifi-

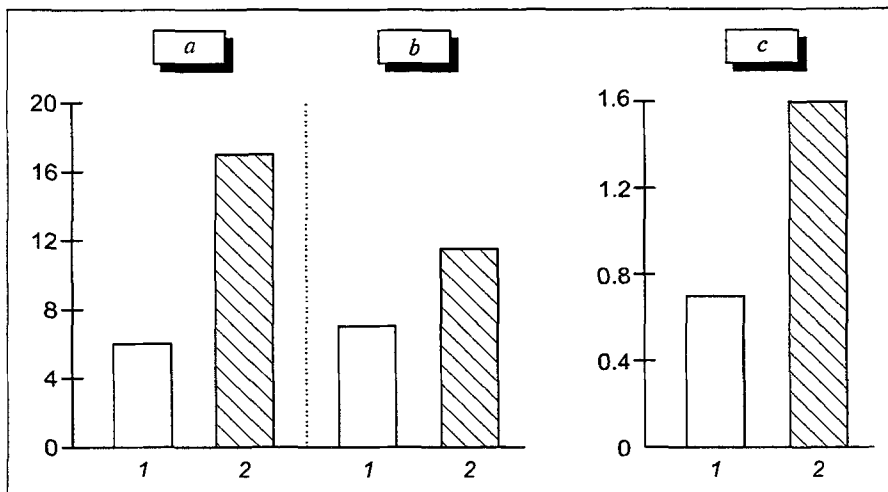


Fig. 3. Parameters of fetal motor activity as determined for the natural (1) and supine (2) position of the mother. a) average duration (in seconds) of motor activity per minute; b) average duration (in seconds) of stirring; c) number of movements per minute.

cantly higher than in those left in the natural position (1.59 ± 0.12 vs. 0.72 ± 0.09 ; $p < 0.05$), as were the mean duration of motor activity per minute (17.36 ± 7.42 sec vs. 5.90 ± 1.41 sec; $p < 0.05$) and the mean duration of stirring (11.52 ± 5.66 sec vs. 7.32 ± 0.97 sec) (Fig. 3).

Our analysis of the parameters characterizing the functional state of fetuses in mothers fixed on their backs showed that these parameters were similar to those recorded for fetuses whose development was retarded because of placental insufficiency caused by ligation of preplacental vessels [2,4]. Thus, both the developmentally retarded fetuses of mothers with placental insufficiency and the normally developed fetuses of mothers lying supine had a lowered body temperature, tended to have bradycardia, and exhibited elevated levels of motor activity. The differences between the fetuses of mothers allowed to remain in the natural position and those of mothers forced to lie on the back may be attributed to the hypoxia developing in the latter fetuses as a result of impaired maternal-placental circulation due to the hypotensive syndrome caused by the gravid uterus compressing the aorta and inferior vena cava.

This study has thus shown that a hypoxic state sets in even in normally developed fetuses if the

mother is in the supine position. Developmentally retarded fetuses of such mothers will be more vulnerable and are bound to suffer more than their normal counterparts. Hence, it can be concluded that maternal postures liable to cause even minor hemodynamic changes in the mother-placenta-fetus system should be avoided in experiments designed to gain insight into the normal maternal-fetal relationships or into the pathophysiological mechanisms through which the condition of fetuses is compromised by the mother being exposed to injurious agents or influences.

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