A METHOD OF RECORDING THE RESPIRATION OF THE MAMMALIAN FETUS

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It is very difficult to record the respiratory movements of animals during the intrauterine period of development. This is primarily due to the small size of the fetus, and also to its imperfect thermoregulation, which necessitates the experiments being carried out in a bath of physiological saline warmed to the body temperature of the animal.

When studying the respiration of the fetus, the majority of workers have observed but not recorded the respiratory movements. Only a few workers such as Büdingen [3], and I. A. Arshavskii [1] have recorded the respiratory movements, for which purpose they inserted a hollow needle into the interpleural space, the free end of the needle being connected to a Marey's capsule by means of a rubber tube. This system was filled with water. Methods of recording the respiratory movements by means of a glass cannula or a rubber pipette, inserted into the esophagus through an incision in the neck, have also been published. These methods of recording inflict trauma on the fetus and do not provide good tracings of respiration during general motor reactions.

In view of these drawbacks, we adapted methods used in our laboratory for recording respiration in the postnatal period of development to make them suitable for recording respiratory movements in the fetus.

Each of the two variants of the method suggested enable respiratory movements of the rabbit fetus to be recorded from the moment that they first appear, i.e., from the 20th-22nd day of intrauterine development, when the weight of the fetus is 3-6 g. This method may be used also for recording respiration in the fetuses of other mammals.

1. Registration of the fetal respiration by means of the thermistor.

For this purpose a conical mask was turned from organic glass (Fig. 1), which concentrated the flow of inspired and expired air and protected the thermistor from the effect of extraneous air currents. The thermistor was fixed in a special opening at the narrow end of the mask (Fig. 1, b). The part of the thermistor inserted in the orifice of the mask, part of the wire, and the place where the wires leading from the thermistor to the Wheatstone bridge were soldered (Fig. 1, c) were all embedded in liquid organic glass.

The fetus was extracted from the abdominal cavity of the mother and then placed on a special organic glass stand (Fig. 2), on which was a hollow (a) which enabled the head of the fetus alone to be kept in the air, and a cut out portion (b) preventing compression of the umbilical cord through which the fetus maintained its connection with the mother.

The mask with the thermistor was applied over the buccal extremity of the fetus and fixed by means of a thin rubber band (Fig. 1, d) which passed from two diametrically opposite holes in the walls of the wide part of the

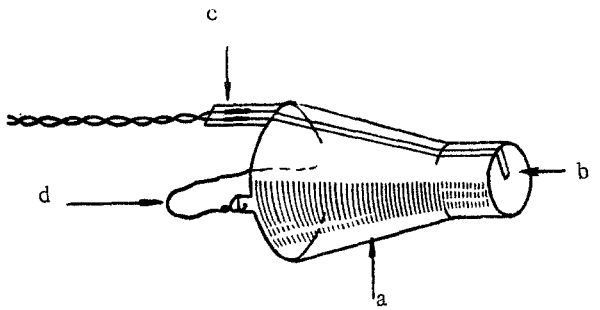

Fig. 1. Mask (a) for recording fetal respiration by means of a thermistor. b) Thermistor; c) point where leads are soldered to wires from thermistor; d) rubber band for fixing mask on head of fetus.

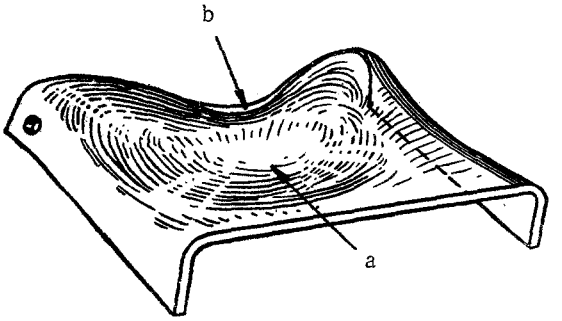

Fig. 2. Stand on which the fetus lies during the experiment. a) Hollow for fetus; b) piece cut out to prevent compression of the umbilical cord.

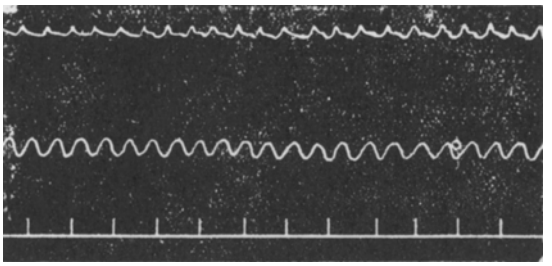

Fig. 3. Recording of respiration in the rabbit fetus. Significance of the curves (from above down): tracing of respiratory movements by the piezocrystal; the same, by the thermistor; time marker (in seconds).

mask, under the ears, and around the occipital part of the fetal head. The thermistor recorded the changes in the temperature of the inspired air by means of the ink-recorder of an electroencephalograph. A detailed technical account and the scheme of the method of recording the respiration by means of the thermistor are given in the article by A. A. Volokhov, V. I. Kobysh, and E. G. Novikova [2].

2. Recording the respiratory movements of the fetus by means of the piezoelectric pick-up.

The ordinary piezocrystal from a pick-up, the metal leads from it, and the point where the leads were soldered to it were coated with several layers of celluloid (cinefilm with the emulsion washed off), dissolved in acetone (thickness of covering (0.5 mm). During recording the piezocrystal was placed in the hollow of the stand for the fetus, beneath its thorax, and responded to all its movements. The currents resulting from deformation of the piezocrystal were amplified and recorded with the ink-recorder of an electroencephalograph. In order to prevent rapid overshoots, a condenser (with a capacity of 4μ in our experiments) was connected in the circuit of the piezocrystal.

In both cases, when the system was assembled, fine multicore leads covered with vinyl chloride insulation (diameter of wire 1 mm) were used. In both methods it is essential that physiological saline should not fall on the uninsulated parts of the thermistor, piezocrystal, or leads, and so they must be carefully insulated with organic glass or celluloid.

This method enables an objective analysis to be made of the respiratory movements of the fetus: their rate, depth and duration, and the pause between the separate phases of respiration. Fig. 3 shows the recording of the respiration of a rabbit fetus on the 29th day of intrauterine life, after cessation of the blood flow in the umbilical cord.

The piezocrystal also records the motor reactions of the fetus, but when this happens the tracing of the respiratory movements is distorted or interrupted. The motor reactions do not affect the registration of respiration by means of the thermistor. It remains only to mention that the mask with the thermistor must not be immersed in the physiological saline while the recording is being made.

SUMMARY

The author recommends a method of recording the respiration in fetuses of mammals with the aid of a thermistor and piezocrystal. By changing the electroconductivity in temperature variations in the inspired and

expired air the thermistor permits graphic registration of respiration in fetuses. The movements of the thoracic wall in fetuses may be recorded by means of a piezocrystal producing currents in deformation. Both variants of the advocated method enable us to register the respiration in rabbit fetuses beginning from the moment of its appearance, i.e., from the 20th-22nd day of intrauterine development when the weight of the fetuses does not exceed 3-6 gms.

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