METHODS

Contractile Activity of Rabbit Uterus at the End of Pregnancy and a Method for Its Registration

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We developed a method for synchronous registration of electrical activity of the myometrium in pregnant rabbit females and electrocardiograms of the female and fetus on a paper tape and on PC in the online mode using an original pickup for registration of intrauterine pressure in awaken animals in a natural (sitting) posture. The method causes no pregnancy complications and is adequate for evaluation of uterine contractility, female and fetal status in different variants of the experiment.

Key Words: *electromyography of the uterus; intrauterine pressure; rabbit female; pregnancy*

Study of the uterine contractile activity (UCA) in health and disease is a pressing problem of obstetrics. Normal labor activity is characterized by interrelated coordinated contractile activity of all compartments of the uterus and pronounced differences in the duration of phases of the uterine contractions cycle. Disorders in one of the above-listed physiological parameters of uterine contractile activity lead to certain clinical forms of labor abnormalities with a risk for the fetus during labor [2,4]. Ten years ago this abnormality was observed in 7-10% cases, and now it occurs in 12.2-17% of all deliveries [1,3,5]. Drug therapy is not always possible in labor abnormalities, and the delivery often eventuates in cesarean section [2,4]. Despite the use of various drugs for UCA regulation (β-adrenomimetics, β-adrenoceptor blockers, calcium antagonists, antioxidants, and antihypoxants), the problem of drug regulation of UCA remains a pressing one.

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Many drugs modulating the mechanisms of muscle contractions, which can be used for UCA regulation, appeared in recent time. However, before introducing these drugs into clinical practice, their effects on the uterine function and maternal and fetal health are to be experimentally studied.

Simultaneous registration of electrical and mechanical activity of the uterus is essential for studies of UCA. Electromyographic activity of the uterus generated by muscle cells was studied in different animals using electrodes placed on the uterine wall or on the abdominal wall surface [11,13, 14]. The electromyographic signal of the uterus positively correlates with intrauterine pressure (IUP) [8,10,13]. Invasive methods were used for IUP registration in experimental animals: introduction of a catheter into the amniotic sac or of a rubber balloon filled with saline into the uterus [8,9,12]. In combination with electromyography, these methods made it possible to evaluate UCA in chronic experiments in awaken animals without their fixation in supine posture. However, introduction of foreign bodies into the uterus for registration of its mecha-

nical activity often disturbs the course of pregnancy and leads to preterm delivery, amniotic fluid discharge, and UCA disorders because of permanent mechanical stimulation of the myometrium [8,9,13].

The aim of this study was the development of a method for IUP registration, causing no disorders in the course of pregnancy and fetal status, and synchronous registration of the electromyographic activity of the myometrium, fetal and female cardiac activities in a chronic experiment.

MATERIALS AND METHODS

Experiments were carried out on 10 pregnant Chinchilla rabbits. The abdominal cavity was dissected on day 28 of pregnancy under thiopental narcosis (1 ml/kg 5% solution) under aseptic conditions and the vaginal part of the uterus was brought into the operation wound. Two electrodes for bipolar registration of electrical activity connected to a cable wire in a Teflon coating were inserted into the surface layer of the myometrium at a distance of 0.5 cm from each other and fixed on the uterus by ligature. An original pickup was developed for IUP registration; it consists of a thin elastic rubber catheter (2 mm in diameter and 2 cm long) filled with graphite; both ends are connected to a Teflon stranded wire. Changes in IUP are indirectly evaluated by the extension of the catheter during myometrium contractions. This pickup (in the form of a cuff) was placed around the uterine horn at a distance of 1 cm from the electrodes for electromyography.

A spear-shaped silver electrode (0.5 cm long) made of a 1-mm-thick plate was inserted through the intact uterine wall into the interscapular area of the fetus for registration of fetal ECG; the electrode was fixed to the skin of the fetus and to the uterine wall by ligature. Then labeled wires from electrodes and IUP pickup were pulled under the rabbit skin (by means of a long probe with a hole at the end) and brought out between the ears. The ECG was recorded through a needle (serving as an electrode) inserted into the right paw. The indifferent electrode consisting of a silver plate connected to the cable wire was placed onto the abdominal wall of the female. The duration of the operation was 10-15 min. After surgery, the animals were placed into the cage, in which they were free. The experiments were carried out 1 day after surgery, when the animals completely recovered after narcosis. During the experiment, the female rabbit was in a natural (sitting) posture in a box limiting its movements. The electrode and pickup wires were soldered to the stationary device (Fig. 1) and the studied parameters were recorded.

The signals of electromyographic activity were recorded on a Bioscript electroencephalograph with simultaneous synchronous recording of the female and fetal ECG (tape rate 7.5 mm/sec). The IUP pickup was included in the half-bridge scheme, the signal was delivered from the pickup to the F-136 photoamplifier and recorded on a KSP-4 single-channel automated recorder. In addition, the signals of all studied parameters were recorded in the on-line mode by a PC using software specially adapted to our experiment.

After the experiments, the animals were sacrificed by air embolism, the abdominal cavity was opened, and the location of inserted electrodes was verified.

RESULTS

In order to verify the adequacy of the method, active contractions of the myometrium were induced by injection of oxytocin (1 U) into the marginal ear vein. A more than 3-fold increase of the electromyographic signal amplitude in comparison with its baseline value recorded synchronously with IUP elevation was considered as an episode of uterine contractions. In rabbits, electrical activity of the uterus before labor is normally absent or is presented by isolated potentials of different amplitude and does not respond to oxytocin injections (even in high doses) until day 29 of pregnancy, therefore the studied parameters were evaluated on day 30 of gestation.

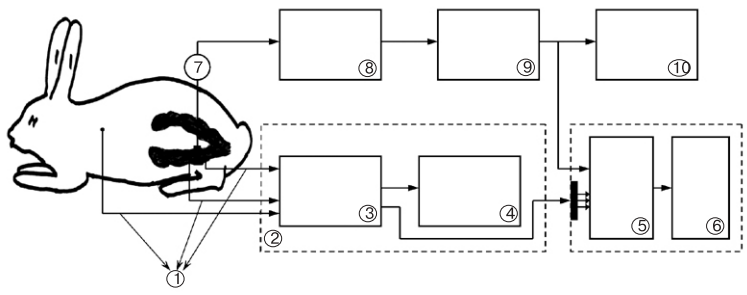

Fig. 1. Scheme of simultaneous recording of electrical and mechanical activities of the uterus and ECG in female rabbit and fetus. *1*) silver electrodes; *2*) Bioscript electroencephalograph; *3*) amplifier; *4*) automated recorder; *5*) analog-to-digital converter; *6*) PC; *7*) original pickup for registration of mechanical activity of the uterus; *8*) half-bridge scheme; *9*) F-136 photoamplifier; *10*) KSP-4 single-channel automated recorder.

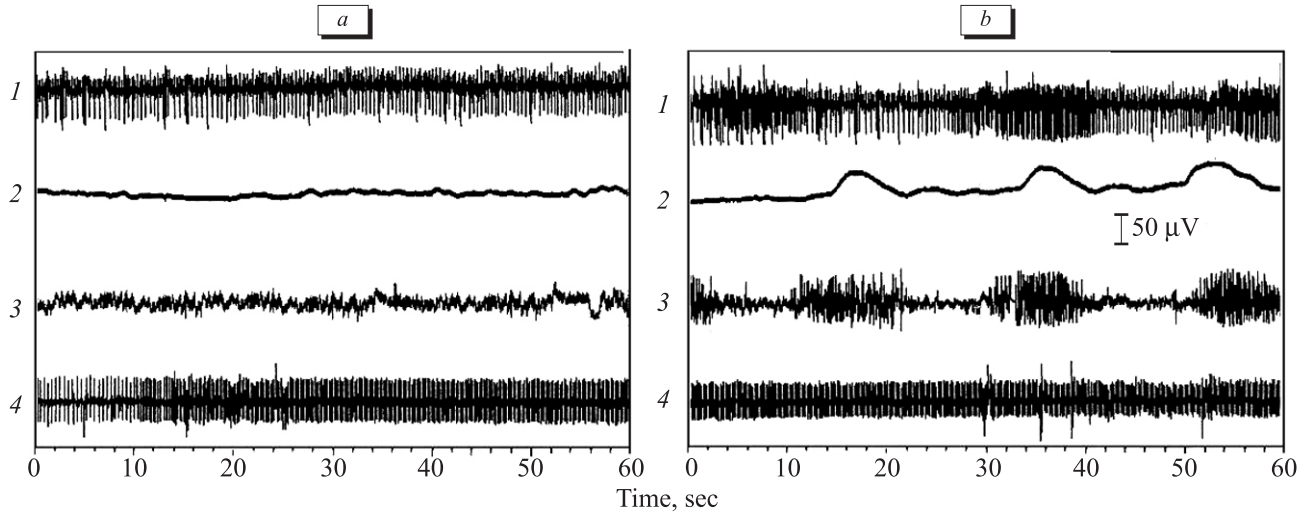

Fig. 2. Fetal (*1*) and female ECG (*4*), mechanical (*2*) and electrical activity of the uterus (*3*) on day 30 of pregnancy before (*a*) and after intravenous injection of 1 U oxytocin to the female (*b*) (online computer recording).

The first episodes of electromyographic activity of the uterus appeared 1-3 min after injection of 1 U oxytocin (Fig. 2). On average 2 groups of spikes were recorded per minute (10 sec duration with 18 sec interval) over 20-min observation. After injection of oxytocin to the female, fetal heart rate decreased by 23% in comparison with the initial value, especially during the first 5 min after injection. No appreciable changes in heart rates of females were noted during the experiment.

Hence, our method for registration of UCA in rabbit females allows its repeated studies during different pregnancy terms in chronic experiments on awaken animals sitting in their natural posture. The method for registration of mechanical activity of the uterus induced no pregnancy complications and in combination with electromyography proved to be adequate for evaluation of UCA. Experiment with oxytocin injection to the female demonstrated that this method was sufficiently sensitive for studies of UCA in health and disease. The proposed method can be used for studies of labor abnormalities in animals and for preclinical trials of drugs used for the therapy of UCA abnormalities and their impact for the fetus.

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