METHODS

A NEW METHOD OF OBTAINING HYSTEROGRAMS BY THE USE OF THE HIGH-FREQUENCY RHEOGRAPH

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The principles of a scheme for using the rheograph to investigate the contractile activity of the uterus are described.

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The principle of high-frequency plethysmography (rheography) consists of recording the electrical resistance of a tissue as it changes depending on its blood supply. The resistance of a tissue to a high-frequency current depends not only on the volume of blood in the blood vessels, but also on the configuration of the cell fields and of the intercellular medium as the muscle tone changes. Consequently, all the intermediate processes from rest to a state of hypertonia modify the electrical resistance of the muscles. This principle applies equally to striped and to smooth muscles. The electrical resistance of the uterus will therefore change during its contractions. Changes in the tone of the abdominal wall muscles and fetal movements naturally will also influence the overall resistance between the electrodes.

The high-frequency field includes deeply lying tissues. Hence, during rheography of the uterus information mainly connected with changes in its tonic states is thus obtained.

The resistance of subcutaneous tissues is readily detected by the use of a frequency of 0.2-0.3 MHz. Within this frequency band polarization resistance is not exhibited and the living tissue can be regarded as an active resistor.

Despite the fact that the optimal frequency of 0.2-0.3 MHz has been known for a long time, recently designed rheographs use a frequency of 30 kHz. This state of affairs makes the use of complex circuits necessary. Bridges at frequencies of 30 kHz require a double balance for active and reactive components.

It is considered that the best technical solution to the problem is given by the use of ring-shaped circuits at a frequency of 0.2 MHz [5]. Such circuits, built on transistors, nowadays can be very simply designed.

When designing a bridge circuit for high-frequency hysterography, the starting point was the parameters of the investigated object and the feasibility of undertaking measurements at high frequency during pregnancy [1-4].

Special measurements were made during the 22nd-40th weeks of pregnancy. Two electrodes with an area of 100 cm^2 were placed on the anterior abdominal wall at the level of the umbilicus at a distance of 300 mm apart; the resistance measured between the electrodes by the high-frequency bridge method (frequency 0.2 MHz) averaged 100Ω.

The interelectrode resistance during diathermy by L. A. Reshetova's method can be regarded as being of the same order. Hence, if the current during this physiotherapeutic procedure reached 0.5 A, the power applied to the woman's abdomen would be 25 W.

For a current of 0.01 A, the power dissipated in the uterus and adjacent tissues is 0.01 W. The power dissipated in the uterus during hysterography is thus 2500 times less than the usual physiotherapeutic value. The small amount of energy directed toward the pregnant uterus in no way disturbs its heat balance and produces no vasodilator responses.

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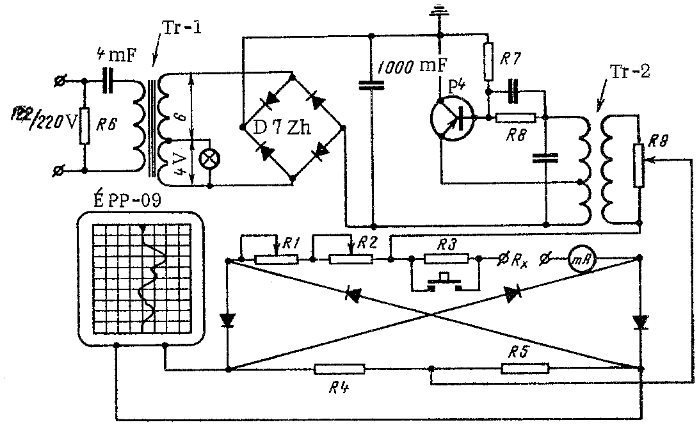

Fig. 1. Circuit of high-frequency rheograph for recording uterine contractions. Explanation in text.

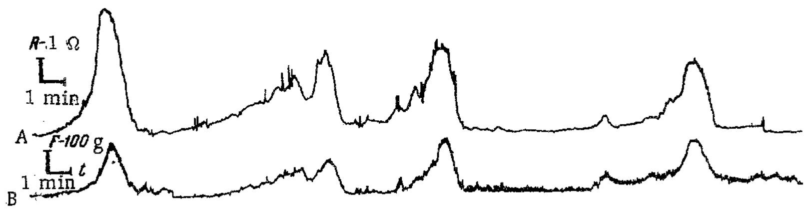

Fig. 2. Recording of spontaneous contractions of the pregnant uterus. Diagnosis: pregnancy near term; head presentation of fetus; nephropathy (reading from right to left). A) High-frequency hysterogram; B) external hysterogram obtained by means of tensometric sensing element.

Our high-frequency hysterograph (Fig. 1) consists of a high-frequency generator on a type P-4 transistor and a measuring bridge with a ring rectifier on type D-223 diodes. The bridge is balanced when resistances $R_1 + R_2$ equal R_X. The lower arms of the bridge consist of constant resistances R_4 and R_5, which are equal to each other. The resistance R_X is the resistance of the zone of living tissue. The knob closing the resistance R_3 calibrates the measuring circuit. The sensitivity of the measuring system as a whole will depend on the position of the regulator R_9 and also on the sensitivity of the self-writing measuring instrument and constructional details of the bridge. The resistor R_9 regulates the current in the measuring bridge circuit and can be controlled by a milliammeter included in sequence with the object to be tested.

By adjusting regulator R_9 and switching on the calibrator knob, the sensitivity of the measuring circuit can be brought to specified values. For example, 1Ω/5 cm where 1 Ω is the resistance of R_3 and 5 cm is the length of deflection of the writing system on the graph paper. This sensitivity matches the self-writing ÉPP-09 electronic potentiometer well.

For hysterograph an ÉPP-09 instrument with a threshold of measurement of 50 mV should be chosen. An instrument without a regulating system should be used.

By the shape of the hysterograms obtained, they agree with the general classification. The volume of information obtained by high-frequency hysterography, it will be noted, is much greater than by mechanography (Fig. 2). On the high-frequency hysterogram, for example, fetal movements are reflected.

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