SIMULTANEOUS RECORDING OF THE CONTRACTILE ACTIVITY OF THE UTERUS AND ITS FILLING WITH BLOOD

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Investigations of the physiological state of the uterus during pregnancy and labor can help to reveal the mechanisms of occurrence and regulation of labor activity. Of particular interest is a study of the relationships between the contractile activity of the uterus and its filling with blood during labor [3]. The authors of [2, 4] judged the hemodynamics of the uterus on the basis of rheographic indices of the lower uterine segment, and the contractile activity was recorded from adjacent portions of the uterus. However, this method does not permit determining the actually existing interrelations between blood filling and the contractile ability of the same portion of the uterus.

We developed a method of simultaneous determination of blood filling and contractile activity of the same portion of the uterus. This is achieved by combining the strain gauges of the hysterograph and the electrodes of the electroplethysmograph into one combined sensor. In this case the electrode of the electroplethysmograph is the receiving element of the sensor of the gauge of the hysterograph. Thus the electrode of the electroplethysmograph attached on the anterior abdominal wall in the region of the projection of the portion of the uterus to be investigated detects not only vasomotor reactions but also contractions of this same portion of the uterus.

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Fig. 1. Diagram of combined sensor. 1) Frame; 2) spring; 3) strain gauges; 4) sensor leads; 5) electrode; 6) hinged leg of electrode; 7) disk electrode.

Fig. 2. Block diagram of device for studying the functional state of the uterus. 1) Combined sensor; 2) multichannel recorder; 3) impedance meter; 4) electroplethysmograph; 5) hysterograph.

Fig. 3. Parallel simultaneous recording of calibration signals on mechano-hysterographs (1 and 3) and electoplethysmographs (2 and 4).

Fig. 4. Interrelation between blood filling of the body of the uterus and lower uterine segment during coordinated (a) and dis-coordinated (b) labor activity. 1) Mechanohysterogram of body of uterus; 2) electoplethysmogram of body of uterus; 3) mechanohysterogram of lower uterine segment; 4) electoplethysmogram of lower uterine segment; 5) time marker 5 sec. The numbers at the end of the electoplethysmogram are the values of the interelectrode impedance of the tissue.

As a prototype we used the strain-gauge transducers proposed by G. A. Shminke [5] for recording uterine contractions.

The diagram of the combined sensor is shown in Fig. 1. The sensor consists of a flat frame on which is fastened cantilever-fashion a laminated spring with glued-on strain gauges equipped with an electrode on a leg with a hinge, which passes through the frame and is rigidly connected with the free end of the spring. A second, disk electrode is fastened immovably on the frame of the sensor.

Figure 2 shows the block diagram of the device for simultaneous determination of the physiological parameters of the same portion of the uterus. The combined sensor is attached on the anterior abdominal wall in the region of the projection of the investigated portion of the uterus by an elastic belt, and the leads of the sensing elements are connected by shielded wires with the hysterograph, electoplethysmograph, and impedance meter. The force of pressing of the sensor against the anterior wall is determined by the amount of displacement of the pen of the recorder, as was proposed earlier by one of the authors [6].

In place of the second electrode of the combined sensor we also used a laminated electrode and placed it in the sacral region, as was done before by many investigators [2, 4].