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SIMULTANEOUS RECORDING OF THE TRANSPULMONARY PRESSURE AND ELECTROMYOGRAM OF THE DIAPHRAGM

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To record the hysteresis loop and electromyogram of the diaphragm simultaneously it is recommended that a standard probe of the sort used to record the intraesophageal pressure, on which silver electrodes are mounted, be used. This method provides fuller information on the work of the respiratory muscles.

KEY WORDS: transpulmonary pressure; electromyogram of the diaphragm; electrode-probe.

The methods nowadays most widely used to investigate the work of the respiratory muscles are calculation of the work done in overcoming the elastic and nonelastic resistance to respiration from the pressure–volume curve (hysteresis loop) and electromyography of the respiratory muscles. The first method yields data which are integral indices of all forces taking part in the mechanics of the respiratory act; the second method gives an idea of the relative role of particular respiratory muscles in the work of respiration in the different phases of the respiratory cycle.

Usually the two methods are used separately, but this makes comparison of their results difficult. It seemed worthwhile to combine these clinical-physiological methods of investigation in order to be able to obtain fuller information on the biomechanics of respiration.

For this purpose the writers have used an esophageal probe, forming part of the set of instruments used to study the elastic properties of the lungs and the work of respiration and, in particular, part of the "compliance test" apparatus manufactured by the firm of Godart. The pressure measured in the lower third of the esophagus corresponds most adequately to the true intrathoracic pressure [1-5]. With the pressure transducer located there the coefficient of correlation between the intraesophageal and intrapleural pressure is 0.99 [6]. Usually the intrathoracic pressure is measured by a differential manometer relative to the pressure in the mouth. In this case the resistance of the instrument is automatically subtracted and the manometer shows the true intrathoracic, or so-called transpulmonary, pressure, one of the most important parameters for the calculation of many indices of the biomechanics of respiration.

When the probe is located in the lower third of the esophagus, after slight modification it can also be used as a bipolar electrode for electromyography of the diaphragm. The modification is as follows. Two silver electrodes 5 mm in diameter and 0.3 mm thick are glued to the thin-walled rubber balloon of the standard probe for recording the intraesophageal pressure, at a distance of 10 and 30 mm from its "blind" end. A lead made from copper wire 0.06 mm in diameter, with Viniflex insulation, is soldered to each electrode. The wires run

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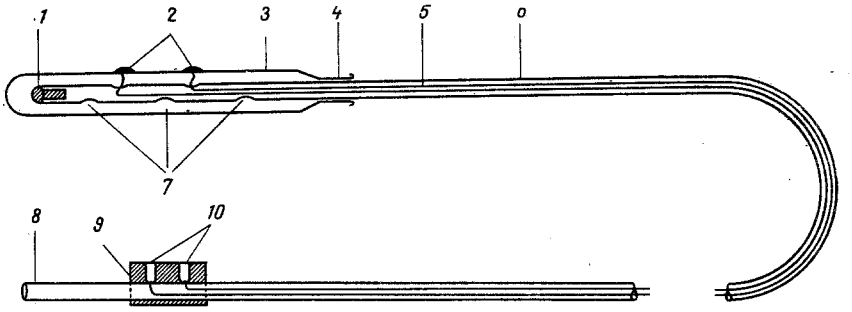

Fig. 1. Construction of transducer for simultaneous recording of intraesophageal pressure and electromyogram of diaphragm. 1) Round-headed stopper; 2) silver electrodes for recording electromyogram of diaphragm; 3) rubber balloon of intraesophageal pressure transducer; 4) mouth of balloon; 5) leads conveying biopotentials of diaphragm; 6) tube transmitting intraesophageal pressure; 7) holes transmitting pressure from balloon to tube; 8) aperture for connecting transducer to "compliance test" apparatus; 9) electrical connecting unit; 10) sockets for connection to electromyograph.

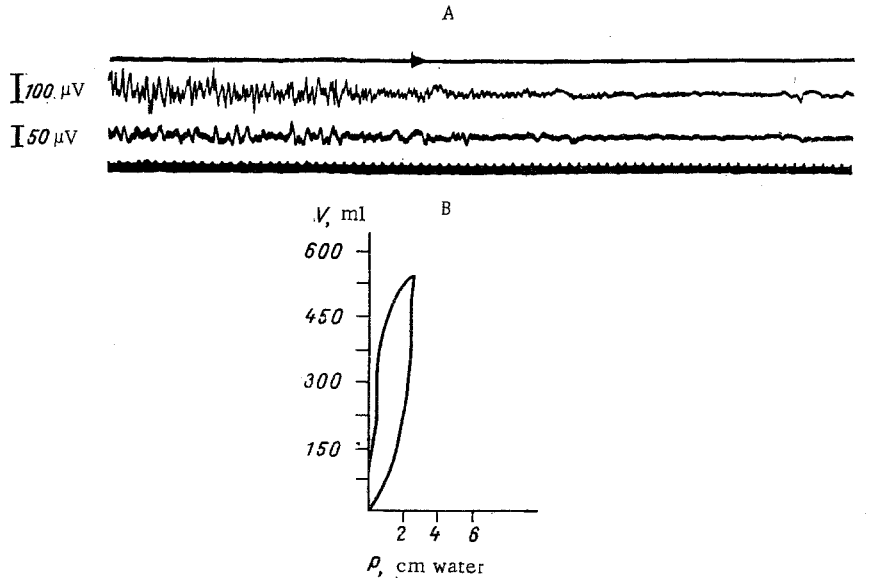

Fig. 2. Samples of records of electromyogram of diaphragm and hysteresis loop obtained by means of the electrode-probe. A) From top to bottom: pulse on top line marks end of inspiration phase; electromyogram of diaphragm; electromyogram of intercostal muscles; time marker (0.1 sec). B) Hysteresis loop.

inside a hollow and practically incompressible polyethylene tube, which serves to transmit air into the balloon and the air pressure from the balloon to the amplifier, and they are soldered to the connector unit mounted on the outer end of the tube. The body of the connector unit is molded from epoxide resin and it is 18 mm long, 9 mm wide, and 18 mm high. The points of contact of the electrodes with the balloon, of the neck of the balloon with the tube, and of the connector unit with the tube are made thoroughly airtight with a mixture of 88 glue and rubber glue in the proportion of 1:3. The construction of the suggested electrode probe is illustrated in Fig. 1, and samples of the EMG of the diaphragm and the hysteresis loop obtained with its aid are given in Fig. 2. Special tests showed no significant difference between the values of the fluctuations of transpulmonary pressure recorded by means of the "compliance test" probe and the electrode probe of the writers' own design.

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CULTURE OF STRAIN L MOUSE FIBROBLASTS ON SILICA-GEL SLIDES

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A method of culturing strain L mouse fibroblasts on silica-gel slides, prepared from KSK silica gel, has been developed. Sterile silica-gel slides, free from organic impurities, suitable for petri dishes or test tubes, can be used successfully as supporting media for the normal development of this culture.

KEY WORDS: culture of mouse fibroblasts; silica-gel slides.

Culture of fibroblasts, especially from strain L mice, is carried out on very complex liquid media containing many components. As they develop, the cells of this culture become attached to the smooth surface of the slide, flask, or tube, to form a continuous monolayer. On a solid water-repellant surface or a soft hydrophilic surface the cells do not form a monolayer and, consequently, they do not develop. Maroudas [7] considers that in such cases it is the structure of the medium on which the fibroblasts develop which is mainly responsible.

Rovenskii et al. [3, 4, 9] describe a series of investigations which indicate that cultures of strain L mouse fibroblasts can be grown on various supporting substrates with an oriented structure. They include fibrous gels, fish scales, and also slides prepared from various chemically inert polymers, such as polyvinyl chloride, polymethacrylate, and polyethylene. By means of the scanning electron microscope, these workers observed the dynamics of development and attachment of mouse fibroblast cells to a polyvinyl chloride slide 40 μ thick. They found that cells can attach themselves to such slides, on which intensive growth of the culture was possible.

In the course of work connected with selection of the mold Asp. terricola strain No. 5, the writer found it necessary to devise a method of culturing strain L mouse fibroblasts on a solid sterile medium that would promote its normal development. Furthermore, the supporting medium must be free from organic impurities and suitable for direct microscopic examination of the growing culture by means of an ordinary, and not an inverted, microscope.

The results of these investigations are described below.

EXPERIMENTAL METHOD

Experiments were carried out with a well-developing 3-day culture of strain L mouse fibroblasts grown on liquid medium No. 199 [8]. In view of the demands with respect to the medium listed above, and in the attempt to create conditions for growth of the culture similar to those usually obtaining when grown on glass, an attempt was made to grow this culture on thoroughly washed cellophane and on silica-gel slides. The experiments with cellophane were unsuccessful. For the work with silica-gel slides, the KSK brand was used. The silica sol for these slides was obtained by Kryukov by Gal'chenko's method* [1].

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