AN EXPERIMENTAL ELECTROGRAPHIC METHOD FOR STUDYING THE MOTOR ACTIVITY OF THE GALL BLADDER

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M. A. Sobakin and D. P. Todorov

Laboratory of Physical Methods of Investigation of Physiological Functions (Head, Professor M. A. Sobakin), Institute of Nutrition (Director, Corresponding Member AMN SSSR A. A. Pokrovskii), AMN SSSR, Moscow
(Presented by Active Member AMN SSSR V. V. Parin)
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Experimental work on the development of an electrographic method of investigation of the motor actvity of the stomach has shown that the principles embodied in this method may be applied also to the study of the motor activity of other parts of the gastro-intestinal tract [3, 5]. This conclusion has been confirmed by the development of experimental methods of investigation of the motor function of the duodenum [6] and the large intestine [2]. On the basis of this experimental work a method of electrogastrography was subsequently evolved and used for clinical purposes [4]. Since, in this case, the investigation is conducted from the body surface, without catheterization, the method has become widely adopted in clinical practice.

The present investigation represents the further development of an experimental technique of electrography of the organs of digestion. Few attempts have been made to study the motor activity of the biliary tract and, in particular, of the gall bladder. The use of balloons and kymographic recordings, and of manometric and roentgenographic techniques has revealed the principal types of movements of the gall bladder wall (rhythmic and tonic contractions); the effect of various alimentary and pharmacological agents on its motor activity was been studied, and many facts have been collected in relation to the nervous-reflex and the humoral regulation of bile secretion. The results of these investigations have been used as the basis for several methods of diagnosis and treatment of diseases of the biliary tract.

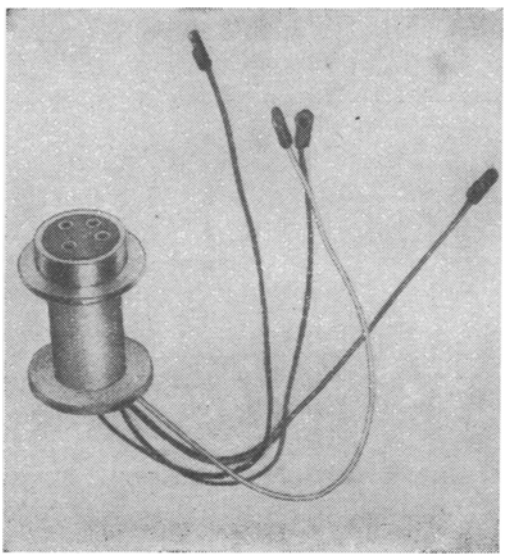

Fig. 1. External view of the rosette.

Despite the fact that it has been used for so long, manometry has not been widely adopted in chronic experimental procedures. The roentgenographic method of investigation of the gall bladder yields only cumulative information regarding the emptying of the viscus, so that only an approximate estimate of the active movements of its wall can be obtained. Moreover, it cannot be used for continuous or prolonged observations. During the study of the motor activity of the gall bladder in chronic experimental conditions the best results are obtained by use of the balloon and kymograph method. Nevertheless, whether during the investigation of other functions of the body or in this present case, this method is not free from disadvantages. It cannot be used without a fistula into the gall bladder. The operation interferes with a large proportion of the organ and gives rise to traction on it and to adhesions between it and the abdominal wall. The presence of foreign bodies (the end of the fistula tube and the rubber balloon) in the lumen of the viscus acts as a powerful stimulus to the receptor apparatus of the organ.

The fistula is a portal of infection. The method does not yield direct information concerning the motor activity of the gall bladder wall, but only allows the variations in pressure within the organ to be recorded. This pressure, in turn, is the resultant of the interaction between several factors: the activity of the muscular apparatus, the resistance to the flow of bile from the organ, the intensity of secretion of bile, and the initial state of filling of the gall bladder. Yet the study of the individual components of the act of bile secretion is an important prerequisite of the correct understanding of this process and of its disturbances. In addition, unless a patient by chance happens to have a fistula, the balloon and kymograph method cannot be used for clinical investigation of the gall bladder.

The method of recording the action potentials of organs and tissues is free from all these disadvantages. It can therefore be used to study the motor activity of the gall bladder in close to natural conditions, and can provide continuous and prolonged recordings of the true motor activity of this organ.

METHOD OF RECORDING

Implanted electrodes were used to record the action potentials of the muscles of the gall bladder wall of dogs in chronic experimental conditions, and selective amplification was applied to the electrical waves corresponding in frequency to the rhythm of the motor activity of the organ.

Unipolar leads were used to record the potentials. The active electrode, which was inplanted into the gall bladder wall, consisted of a platinum loop, soldered to a multiple-strand conductor with vinyl chloride insulation. A small plastic deflector was fixed to the loop. The electrode was passed through a small incision in the serous and muscular layers into a pocket dissected out between the muscles and the mucous membrane. The electrode was anchored by fixing the deflector externally to the gall bladder wall. In some dogs, in order to allow parallel recordings of gastric peristalsis to be obtained, a Basow fistula tube, made of plastic, was inserted into the stomach. In these animals the other end of the conductor was led, as in the procedure with electrogastrography, to a socket made in the wall of the gastric fistula tube. In other dogs, instead of the fistula tube a special rosette was used (Fig. 1), implanted into the abdominal wall. This is shaped like a bobbin. One or more wires pass through its

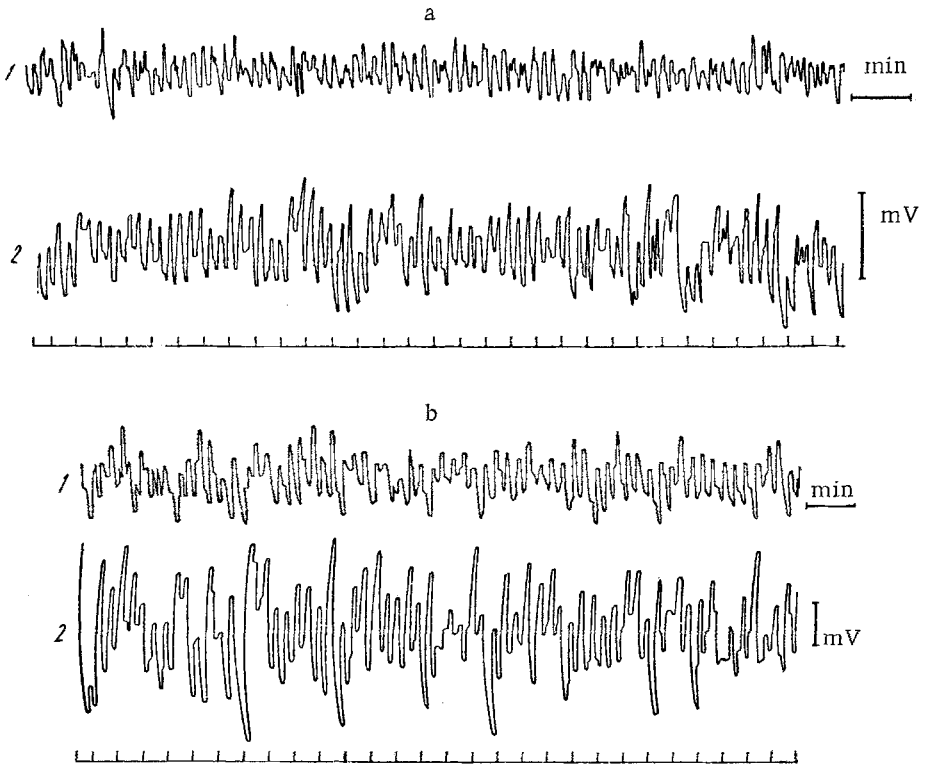

Fig. 2. Parallel recordings of the mechanical (1) and electrical (2) activity of the gall bladder in the dogs Chernysh (a) and Gek (b).

body, terminating on the outer surface of the rosette in sockets to receive pins. The rosette was placed in the abdominal wall in the same manner as the Basow's fistula tube, but its inner disk lay freely in the abdomen, wrapped only in omentum. When inserted in this manner, the rosette was secured as firmly as the fistula tube. The advantage of the rosette over the fistula is that the stomach was left intact, and the possibility of its mechanical stimulation was ruled out. Judging by published data [1], such stimulation might be reflected in the motor activity of the gall bladder. The indifferent electrode consisted of the bath of physiological saline in which the dog's hind limbs were immersed.

Since the frequency of the rhythmic contractions of the gall bladder is very close to the frequency of gastric peristalsis, the potentials were amplified and recorded by means of an electrogastrograph. A multichannel electrogastrograph was used, allowing simultaneous recording of the electrocholecystogram and of the variations in pressure inside the gall bladder (mechanocholecystogram) on the same tape.

In order to record the mechanical contractions of the gall bladder, a small balloon of about 15 ml capacity was introduced into the cavity of the viscus after evacuation of the bile through the fistula. By means of a special device (constructed by engineer E. Yu. Vende) the mechanical contractions detected by the balloon were converted into electrical pulses, which were recorded with the electrogastrograph.

Parallel electrographic and mechanographic investigations showed that the recorded waves of potentials corresponded accurately in rhythm to the motor activity of the gall bladder. Parallel recordings of this type are shown in Fig. 2.

This newly developed electrographic method may be used for accurate investigations to study the effect of various factors on the motor activity of this organ. We hope that these investigations will contribute towards the future development of a clinical and physiological method of electrocholecystography, in the same way as the development of experimental electrogastrography has led to its modification into a clinical method.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
