

# THE RECEPTOR FIELD OF REFLEX CONTRACTION OF THE MUSCLES OF THE ANTERIOR ABDOMINAL WALL IN MAN

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Tension in the muscles of the anterior abdominal wall is an indication of a pathological process in the abdominal cavity and constitutes a segmental, restricted, and extremely long visceromotor reflex [2-12], whose mechanism at the present time remains undetermined.

Some investigators [2-4, 7] consider that the contraction of the abdominal muscles occurs as a result of the stimulation of the parietal peritoneum, and represents a peritoneal-motor reflex. Other authors [1, 8] have shown that the *défense musculaire* develops during stimulation of the viscera themselves and the parietal peritoneum is not necessarily involved.

In the present work we have set out to determine which of the receptor fields of the abdominal cavity - the parietal peritoneum or the viscera themselves - represents the origin of the stimulation initiating the reflex contractions of the abdominal muscles. For this purpose we investigated the electrical activity of the abdominal muscles in 24 human subjects at various times after appendectomy.

## EXPERIMENTAL METHOD AND RESULTS

We used a transistor amplifier [5] and recorded the results by means of a N-10 string oscillograph. The inherent noise of the amplifier had an amplitude of  $2 \mu V$ , the input resistance was 500,000 ohm, the frequency response was from 10 to 5,000 cycles, and the amplitude characteristic from 3 to 5 mV. Potentials were picked up from the 'motor point' of the muscle on the abdominal wall, i.e., from that part of the muscle which was most richly innervated by branches from motor neurones. We used bipolar silver-plated plate electrodes ( $3.5 \times 2$  cm) separated by 2 cm, and they were placed on the skin of the belly (which had been cleaned with ether) 2-3 cm medial to the superior anterior iliac spine.

Potentials were picked up from the left hypogastric region, because leading off from the right side would have interfered with the operation. After electromyographic recording of the initial level of electrical activity of the muscles of the left hypogastric region during relaxation (Fig. 1, I) the operation was begun under anesthesia by local infiltration (A. V. Vishnevskii's method). When the whole layer of the abdominal wall except for the peritoneum had been anesthetized, an operative approach was made to the parietal peritoneum which was picked up in Mikulich forceps and pulled into the wound made in the abdominal wall. During this time a record was made of the amplitude and frequency of the volleys of potentials (Fig. 1, IIa); they were reduced when the mechanical stimulus to the peritoneum was removed. After anesthesia and division of the peritoneum the cecum and the terminal portion of the ileum were pulled into the wound. In most cases, when the intestine was brought out vigorous electricity of the abdominal muscles occurred either with or without a painful response from the subject.

In order to exclude pain as a factor during the time the intestine is drawn into the wound, pain which is frequently caused by pulling on the mesentery of organs, we stimulated the wall of the appendix and intestines deep in the abdominal cavity by finger pressure, without withdrawing the organs into the abdominal wall. In this case also there was an increase of electrical activity of the abdominal muscles (Fig. 1, IIb, c, d), and it was reduced after anesthesia and after division of the mesentery of the appendix (Fig. 1, IIe, f). A volley of potentials was generated at the moment that the needle penetrated the cecum while a purse-string suture was being made.

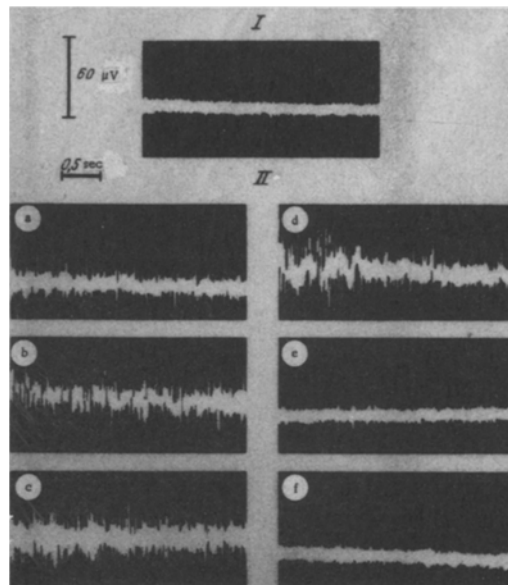


Fig. 1. Electromyogram of the left hypogastric region of the anterior abdominal wall in a patient with acute appendicitis, before operation, and during relaxation of the abdominal muscles (I) and during appendectomy (II): (a) during mechanical stimulation of the parietal peritoneum, (b) of the cecum, (c) of the ileum, (d) of the appendix, (e) of the appendix after infiltration of the mesentery with anesthetic, (f) after an incision had been made in the mesentery of the appendix.

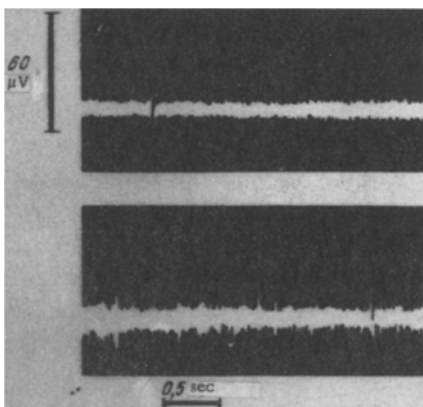


Fig. 2. Electromyogram of the right iliac region of the anterior abdominal wall in a patient with a nonstrangulated right-sided hernia (1) during relaxation of the abdominal muscles, and (2) during mechanical stimulation of the hernia.

The results obtained indicate that not only the parietal abdomen but also the organs themselves within the abdominal cavity are involved in the generation and the discharge of impulses to the abdominal muscle. The question as to whether the impulses originate in receptors of an organ or from the visceral layer of the peritoneum covering the organ requires further study. If during anesthesia the mesentery is cut the electrical activity of the muscles in response to stimulation of a viscus (appendix) is reduced; this result indicates that the procedure destroys the reflex visceromotor arc of which the mesentery forms one link.

Information concerning the visceromotor nature of the *défense musculaire* is provided not only by the results given above but also by investigations on patients with a non-strangulated inguinal hernia. The method described above was used to record the electrical activity of the abdominal muscles of the iliac region on the side of the hernia during relaxation of the abdominal muscle. While the position of the patient and electrodes was maintained unaltered, pressure was applied to the hernia containing a loop of intestine covered by parietal peritoneum, and in such as to cause no pain to the patient. When the pressure was applied the electrical activity of the abdominal muscles was increased considerably (Fig. 2).

Thus during mechanical stimulation of the peritoneum and intestine a response was produced consisting of an increased electrical activity of the abdominal muscles.

The sum total of the results obtained in the present investigation leads to the conclusion that not only are organs within the abdominal cavity (intestine) part of the receptor field of the visceromotor reflex leading to enhancement of tone of the muscles of the anterior abdominal wall, but so also is the parietal peritoneum.

#### SUMMARY

A study was made of the electrical activity of the muscles of the anterior abdominal wall and of the left iliac area in 24 patients with acute appendicitis.

In most of the cases mechanical stimulation of the parietal peritoneum and viscera provoked a rise in the electrical activity of the abdominal muscles. A similar increase was observed also during the mechanical stimulation of the hernial sac in patients with a nonstrangulated inguinal hernia. These results indicate that *défense musculaire* is a visceromotor reflex, the parietal peritoneum and visceral organs being included in its receptor link.

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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.

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