

# PERIODIC MOVEMENTS OF THE DIGESTIVE TRACT IN EXPERIMENTAL LEAD POISONING

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Too little is known of the causes and mechanisms of development of the disturbances of the motor function of the digestive tract in lead poisoning. The few investigations of this problem have been carried out mainly on isolated organs [1, 3, 4, 12-14], and they do not provide the answer to the problem. The same is largely true also of the few clinical investigations [2, 5]. Almost nothing is mentioned in the literature of experimental physiological investigations on the intact organism aimed at elucidating the pathogenesis of the disturbances of the movements of the digestive tract in lead poisoning. However, the study of this aspect of the problem is most important because disturbances of the movements of the gastro-intestinal tract lie at the basis of lead colic.

For this reason for a number of years the author has studied various aspects of the motor activity of the digestive apparatus and the mechanisms of its disturbance in experimental lead poisoning [7, 8, 9, 10]. The present investigation forms part of this study.

## EXPERIMENTAL

Observations were made of the fasting periodic motor activity of the stomach, duodenum, and jejunum (the proximal third) in the course of poisoning with lead acetate. The experiments were carried out on 18 dogs with a Basow gastric fistula subjected to chronic and subacute poisoning (104-246 days). Lead acetate (1-3% solutions) was given to the dogs daily together with milk in doses of 1 ml/kg body weight. The blood picture, the changes in weight, and the general condition and behavior of the experimental animals were the criteria of the development of lead poisoning.

The movements of the stomach and intestine were recorded by the three-balloon mechanokymograph perfected by V. F. Mostun [11]. The experiments were carried out 16-18 h after the animals had fed, before poisoning (10-15 background experiments) and every 7-10 days in the course of poisoning. The volume of the recording balloon in the stomach was 10-12 ml, and of the two balloons in the duodenum and jejunum 0.7-0.8 ml. Altogether 364 experiments were carried out on this group of animals.

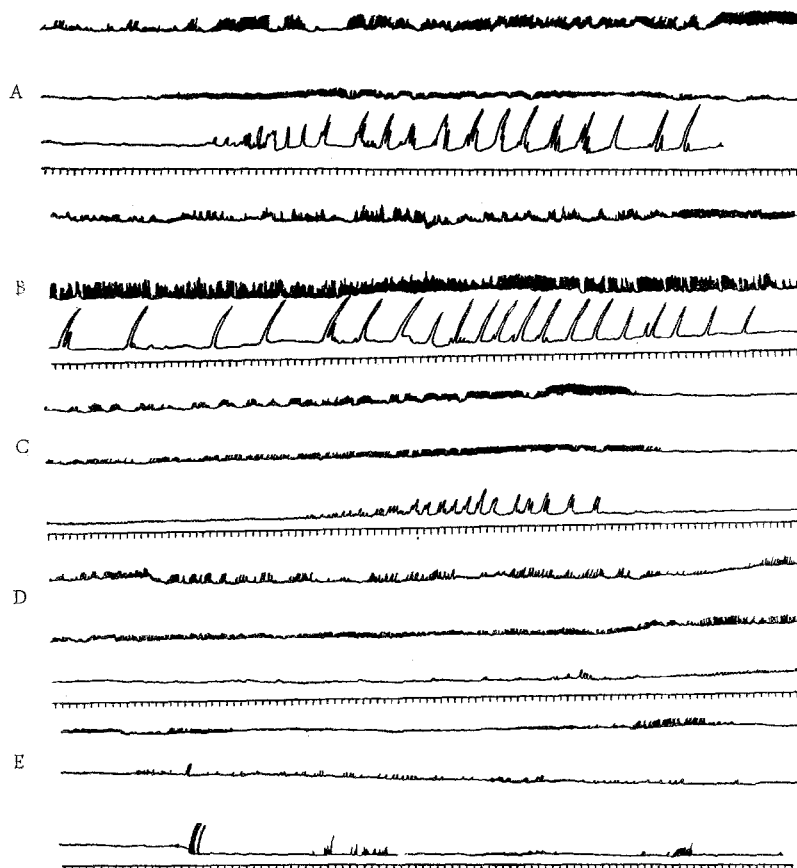
## EXPERIMENTAL RESULTS

In the course of development of chronic lead poisoning in the animals (5-9 months) a regular pattern was observed in the order and character of the disturbances of motor activity in the different parts of the digestive tract.

After some increase in the duration of working of all three divisions (8th-14th days of poisoning; acid movements appeared in the stomach, associated with an increase in the spontaneous secretion) followed by restoration to normal over a variable period of time, in most dogs the periodic rhythm of the stomach, duodenum, and proximal portion of the jejunum became faster. On the following days the movements of the stomach were depressed—the amplitude of the contractions was reduced and the relationships between the phases of the cycles were disturbed as the result of shortening of the periods of work. With an increase in the severity of poisoning, the disturbances of the motor activity of the digestive tract progressively increased, and the periods of depression and recovery (incomplete) of the stomach movements alternated several times.

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Cuts of the kymograms (in a time interval corresponding to one period of work in the initial background experiment) of fasting peristalsis of the stomach, duodenum, and jejunum of the dog Zhuk at various periods of chronic lead poisoning. A) Background experiment; B-E) different stages of poisoning (explanation in text). In all the kymograms the top curve represents the contractions of the jejunum, the middle curve, the duodenum; the lower curve, the stomach. Time marker 30 sec.

In severe poisoning the contractions of the stomach were absent for one or several days. Complete suppression of gastric movements was preceded by days in which the periods of work were sharply reduced in number—down to one per experimental day, and shortened in duration (the rhythm of the periodic activity was apparently little affected), and the number of contractions in the resting period was reduced, i.e., the background peristalsis of the stomach was depressed. The amplitude of the gastric contractions was considerably reduced. It is interesting to note that in some dogs during this period very weak (amplitude 0.2–0.3 cm) grouped contractions resembling those found in the periods of work were observed. In the period of recovery, the gastric contractions temporarily became continuous, with a lowered amplitude. Subsequently, the periodicity of working was restored, although the cycles followed each other at a rather faster rate and the amplitude of the contractions was lower than normally.

Alternation of periods of excitation (prolonged periods of work or continuous contractions with high amplitude) with periods of a return to normal were also observed in the motor activity of the duodenum and jejunum. To correspond with these periods, the rhythm of the periodic activity of these parts of the digestive tract also changed. In most dogs complete suppression of gastric movements was accompanied by continuous contractions of the duodenum and jejunum, evidently reflecting the beginning of discoordination in the work of the digestive tract (see figure). Depression of the motor activity of the duodenum and jejunum appeared with the development of a severe degree of poisoning. The curve of the tracing in these conditions became interrupted by short intervals; the frequency and amplitude of the contractions were reduced and the tonic elements disappeared (see figure). The movements of the jejunum were the last to be depressed.

In four dogs with subacute lead poisoning the disturbances of the movements of the digestive tract developed as described above, except that they had much shorter periods of recovery and the pattern of the changes was less complete because the animals survived for a much shorter time.

The changes in the motor activity of the digestive apparatus in the recovery periods after the end of poisoning, which was observed in three dogs for periods of 79-95 days, occurred in the reverse order. The work of the stomach, duodenum, and jejunum was fully restored to normal three months after the end of poisoning.

The results of the experiments described above reveal some of the mechanisms of the disturbance of the motor and evacuatory functions of the gastro-intestinal tract on animals with lead poisoning, revealed by the author's previous roentgenologic observations [10].

Delay in the time of evacuation of food from the stomach during the first 2-3 weeks of poisoning was evidently associated with weakening of the stomach movements at the time of spontaneous secretion. Later, after a certain period of recovery, the slowing of evacuation was evidently due to depression of the gastric motor activity (shortening of the periods of work, reduction in the amplitude of the contractions), and the prolonged retention of food in the stomach in subacute poisoning was due to the complete absence of gastric contractions. This terminal stage of poisoning was preceded by a period of weakening and slowing of the background gastric peristalsis as revealed by fluoroscopy, and by the slowing of the contractions of low amplitude detected on the kymogram.

The more rapid evacuation from the stomach and intestine was evidently associated with stimulation of their motor function. The balloonographic recording confirmed the previous findings that the movements of the intestine are disturbed later than the gastric movements.

The results of the author's two investigations are thus complementary and they demonstrate profound changes in the motor-evacuatory activity of the digestive tract in lead poisoning.

The signs of disturbance of periodic activity described above are not specific for saturnism. Changes of a similar type have been described in the literature in various logical conditions: radiation sickness, experimental tuberculosis, various types of poisoning, peptic ulcer, and so on [6]. However, taking account of several factors, including the specific properties of the toxic agent, lead ions, it can be assumed that the concrete mechanisms of the developing changes are different in each case. In particular, the fluctuating course of the clinical picture of the poisoning and the disturbances of the motor function of the digestive tract may be attributable to the ability of lead compounds to be deposited in the organs and tissues of the body, from which they may enter the blood stream under the influence of unfavorable factors producing exacerbations.

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