Functional State of the Esophagus in Cardiospasm According to Esophagomanometry Data

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Functional changes occurring in the esophagus at different stages of cardiospasm revealed by esophagomanometry are presented. Esophagomanometry is helpful for making a more precise diagnosis, for identifying the stage of the disease, and determining treatment.

Key Words: *cardiospasm; stomach; esophagomanometry*

Examination of digestive organs with the aid of new equipment has improved the differential diagnostics of diseases of the esophagus (ES). Esophagomanometry (ESM) allows for the analysis of the full range of functional disorders. Research into the motor function of the ES and of the esophagus-stomach transfer using a cavity pneumotensiometer has been carried out at the Surgical Research Center since 1964.

MATERIALS AND METHODS

Nine hundred seventy-six esophagograms from 602 women and 374 men were analyzed during the 1980-1993 period. In 16 patients the probe could not be passed through the lower esophageal sphincter (LES).

RESULTS

The pressure in the LES varies from 15 to 30 mm Hg. In the fundal part of the stomach intracavitary pressure varies from 3 to 10 mm Hg and is elevated upon inspiration.

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During the investigation positive pressure was recorded with the aid of a sensor placed in the stomach; unidirectional waves (respiratory and those of the pneumogram) were determined from the pressure curve. The nature of the curve was preserved until the sensor was placed in the physiological cardia, which was recorded as a zone of elevated pressure from 3 to 5 cm long (in health, more than 2/3 of the cardia is located in the abdominal cavity [2]). The pressure in this area of the ES gradually increased, reaching values of 20-30 mm Hg (inspiration) and 10-15 mm Hg (expiration). In the LES area the pressure was 14.5 mm Hg higher than that in the stomach. The valve function of the cardia reflected the difference between the pressure under the diaphragmal orifice of the ES upon inspiration and expiration. In health, reflex relaxation of the LES is observed 0.5-1.2 sec after swallowing, i.e., prior to the peristaltic wave; this relaxation lasts 5-15 sec and is followed by a slight transient increase of tone. At the moment of maximum LES relaxation the pressure in the sphincter was 3-5 mm Hg higher than in the stomach. A wavelike slow rise and gradual fall of pressure were also observed [3].

A curve consisting of waves with an amplitude of 25-35 mm and a duration of 4-8 sec was recorded in the lower third of the ES; abrupt rises and falls of pressure were observed.

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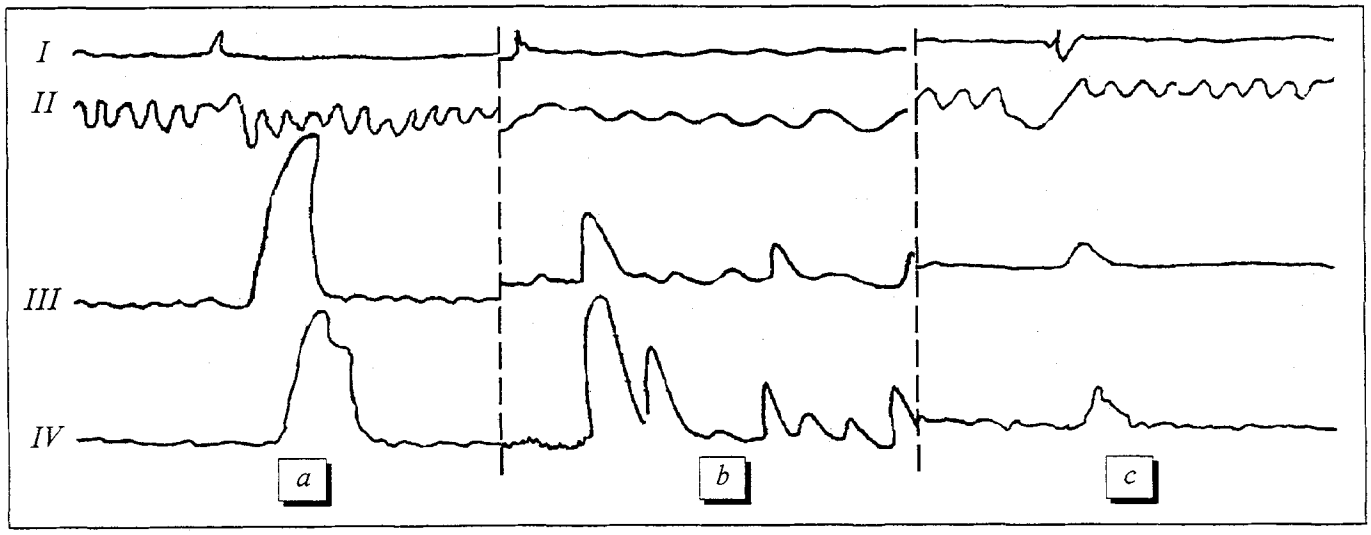

Fig. 1. Esophageal peristaltics in cardiospasm. *a*) the first stage (isolated contractile waves after swallowing, their amplitude and duration increased); *b*) the second stage; *c*) the third stage. Here and in Fig. 2: *I*) swallowing; *II*) pneumogram; *III*) postswallow contractile waves in ES; *IV*) response of cardia.

Incomplete opening of the LES with weakened but propulsive peristaltics was characteristic of senile patients. Presumably, the weakened primary peristaltics in old age are a factor in this incomplete opening. In these patients, atherosclerotic vascular lesions in all organs led to microcirculatory and trophic disorders in tissues. These age-related changes in neuromotor ES disturbances can be designated "ES of old age". In cardiospasm (CS), ESM revealed the stage of the disease, allowed for a differential diagnosis, choice of therapy, and evaluation of its efficacy.

According to Petrovskii's classification [1], CS has four stages. In the first stage, it can be seen from the manometric curve recorded with the aid of ESM (Fig. 1, *a*) that the peristaltics is enhanced along the entire ES and the reflex relaxation of the LES is delayed, while the time of opening is simultaneously shortened. This leads to hypertrophy of ES muscles and tonogenic dilatation, which is accompanied by an increase in the intraesophageal pressure. Analysis of ES peristaltics revealed that in CS the first peristaltic wave appears at the same moment at different levels, i.e., its craniocaudal spread is impaired. A simultaneous constriction of the entire ES after swallowing impeded the passage of food, and was manifested in dysphagia and substernal pain.

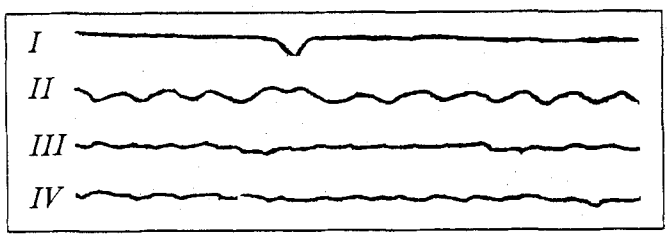

Fig. 2. Absence of ES peristaltics at the fourth stage of cardiac spasm.

At the first stage of CS, the amplitude of the swallowing wave, which is the main criterion of the propulsive ability of the ES, was increased in only 38% of patients. In the other 62% it was lowered in the upper and middle thirds of the ES and preserved or elevated in the lower third.

X-rays of patients with the first stage of CS revealed no dilatation of the ES. The patients experienced discomfort or had a feeling of food being stuck behind the sternum; in almost all of them swallowing was accompanied by dull chest pain.

Episodes of reflex relaxation of the LES were recorded at the first stage of CS; at rest the pressure in it often increased. The segment of increased pressure was elongated.

These ESM changes reflecting the functional state of the ES allowed us to regard this disorder as CS. Increased pressure in the ES at rest was recorded in 352 patients (36%). However, both normal and elevated pressure was recorded in the LES at the first stage of CS.

There was no correlation between the degree of dysphagia and pressure gradient in the LES.

Heartburn was caused not only by regurgitation of stomach contents into the ES but also by spastic contraction of the ES itself.

At the first stage of CS, the severity of the burning sensation in the pit of the stomach was dependent on the increased peristaltics of ES and stomach; acid production (pH) also played a significant role.

Double respiratory reversion was observed in some patients (27.2%), indicating a functional

shortening of the ES, which is an indication of hiatus hernia. This shortening impaired the closing function of the cardia and facilitated regurgitation of acid stomach contents. This resulted in a reflex increase in the tone of the lower ES.

A "pressure plateau" was recorded in 240 (37%) of patients. Usually, it appeared at a length of the supradiaphragmal zone of pressure increase equal to 1-2 cm. These parameters of the esophagogram were characteristic of hiatus hernia. Weak and moderate reflux was recorded in 78 and 22% of patients, respectively.

At the second stage of CS, the ESM curve was characterized by an increase in the number of contractile waves after swallowing in the lower third of the ES (Fig. 1, *b*). Increased peristaltics along the entire ES was less frequent.

Tertiary waves lacking propulsive ability appeared against the background of a gradual decrease in the force of primary and secondary contractions. This type of peristaltics was preserved in the upper segment and was not observed in the lower segment of the ES. This is due to the transition from tonogenic to myogenic dilatation of ES muscles caused by additional mechanical distension by food and damage to the peripheral nervous system induced by inflammatory-degenerative alterations.

Tertiary waves did not spread along the ES, but disappeared at the site where they arose. Clinically, this was manifested in dysphagia, pain behind the breastbone, heartburn, and regurgitation.

The absence of propulsive peristaltics led to food stagnation in the ES, which became more dilated. Degenerative-trophic and sclerotic alterations developed along with an inflammatory process (due to stagnation from above and reflux from below). This impaired LES function and the closing of the cardia. The vicious circle closed and the inflammatory process intensified. This resulted in a loss of the contractile function of ES muscles. The esophagus became infiltrated and edematous; it turned into a passive, dilated muscular tube, where food moved by the force of its own weight and mechanically passed through the LES.

At the second stage of CS, there was no reflex opening of the cardia in response to swallowing. Moderate dilatation of the ES and retention of the contents were revealed by X-ray.

At the third stage of CS, primary peristaltic activity was weakened in most of the patients (89.1%), and the reflex opening of the cardia in response to swallowing was absent (Fig. 1, *c*).

At this stage of the disease, ESM revealed a drop of pressure gradient between LES and stomach (up to 5 mm Hg). Reflex opening of the cardia was not recorded. Esophageal peristaltics decreased and was characterized by a reduced amplitude and duration of the postswallow contraction wave.

As the disease advanced (the fourth stage), the peristaltic response of the ES declined, and the pressure gradient dipped sharply, the zone of increased pressure becoming shorter. Relaxation of the cardia in response to swallowing was absent (Fig. 2).

X-ray examination of patients at this stage revealed S-shaped and saclike alterations in the ES, widening of the mediastinum shadow, mechanical opening of the LES, and megaesophagia (clouding of ES contours).

X-ray examination and endoscopy revealed ES ulceration in patients with the fourth stage of CS. They had strong manifestations of food stagnation in ES: nocturnal retching, shortness of breath, and weight loss. In the anamnesis of these patients there was mention of lung complications. At the same time, there was no relationship between the history of the disease duration and the alterations revealed by ESM and X-ray. Some patients developed megaesophagia quite rapidly.

It should be recognized that the longer the disease lasts, the more pronounced are the alterations in the ES function. We believe that individual constitutional parameters (nervous system and collagen-connective system) and the severity of damage to the ES nerves play an important role along with the disease duration.

Thus, ESM is helpful for fine-tuning the diagnostics and identification of the stage of disease. The results of ESM should be taken into consideration when a mode of therapy is chosen.

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