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Review Article

Cross-Section of Functional Diseases of the Gastrointestinal Tract: Focus on Disorders of The Motor Function of the Digestive System

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Summery

Functional diseases of the digestive system (FZOP) is a group of disorders characterized by a violation of the interaction between the central (brain) and peripheral parts of the nervous system, which ensures the activity of the organs of the gastrointestinal tract (GIT). Overlap-syndrome - a syndrome of overlapping functional diseases of the digestive system, in which two or more disorders are combined, united by common pathogenetic mechanisms. The goal is to identify the role of gastrointestinal motility disorders in the intersection of functional diseases of the gastrointestinal tract - functional dyspepsia and GERD. Results and discussion. Identified disorders of motor function include hypomotor dyskinesia of the stomach (77.5%), small intestine (35%) and right colon (53.8%). The results indicate the development of SIBO in the small intestine and dysbiosis in the ascending colon intestines. The predominant spastic activity of the right and left parts of the colon indicates the development of constipation.

Keywords: Crossover of functional diseases; Constipation; Functional dyspepsia; Gastroesophageal reflux disease

Functional diseases of the digestive system (FZOP) is a group of disorders characterized by a violation of the interaction between the central (brain) and peripheral parts of the nervous system, which ensures the activity of the organs of the Gastrointestinal Tract (GIT). This pathology is not associated with organic lesions of organs detected by standard diagnostic methods, and develops as a result of the development of a syndrome of increased epithelial permeability, impaired motor function of the gastrointestinal tract at different levels, and visceral hypersensitivity. Overlap-syndrome - a syndrome of overlapping functional diseases of the digestive system, in which two or more disorders are combined, united by common pathogenetic mechanisms. EPEP is a syndrome of increased epithelial permeability, one of the basic elements in the development of human pathology, including functional diseases of the digestive system (FZOP), which develops under the influence of both exogenous and endogenous factors of aggression: pathogenic microorganisms, chemical stimuli, psycho-emotional stress, etc. [1].

At present, the so-called Rome IV Revision Criteria (Rome IV), which largely determine the provisions of the recommendations adopted by the medical communities, including Russian ones, are the fundamental international document for the diagnosis and treatment of FZOP [2,3].

Dyspepsia is a digestive disorder. Initially, dyspepsia was defined as any symptom related to the upper GI tract [4]. In 2016, according to the Rome criteria, the last, fourth, edition of this agreement was presented, according to which, FD is a condition that has a significant impact on the daily life of the patient and is characterized by one or more of the following symptoms: a feeling of fullness in the epigastrium after eating, feeling of rapid satiety, epigastric pain, burning sensation in the epigastrium, which cannot be explained after a standard clinical examination [5]. The high degree of FZOP overlap is explained by a common link in the pathogenesis of all these diseases - the presence of SPEP, as a

factor that causes visceral hypersensitivity and motor disorders. life of the patient, but is characterized by a persistent, therapy-resistant course, and is associated with a significant decrease in QoL [6].

According to leading international experts [2], in the development of functional diseases at all levels of the gastrointestinal tract, psychosocial factors play a decisive role, often acting as a trigger for the FZOP. It is the dysfunction of the central nervous system that is most often fundamental not only in the occurrence, but also in the progression of functional disorders of the gastrointestinal tract. It is assumed that the complex interaction of psychosocial, physiological (increased visceral sensitivity) and environmental factors from an early age disrupts the interaction of the Central Nervous System (CNS) with the peripheral link of the nervous system, which ensures the activity of the gastrointestinal tract (the so-called "brain-GIT" axis) [1]. With functional disorders of the gastrointestinal tract, there is a decrease in the activity of stress-limiting systems, due, in particular, to a decrease in the level of γ-Aminobutyric Acid (GABA) and, accordingly, the activity of the GABAergic inhibitory system. Under these conditions, the activity of the stress-realizing system begins to predominate and conditions are created for the development of biologically negative stress (distress), and later for the formation of a stable pathology (anxiety, depression, etc.). The etiological factors of FD are dysmotility and sensory function of the gastrointestinal tract, dysregulation of the gut-brain axis, inflammation, and increased mucosal permeability [7]. An increase in mucosal permeability that is not detected by endoscopy provokes inflammation of a low degree of activity, with an increase in the number of mast cells and eosinophils. nerve fibers in SO, leading to an increase in visceral sensitivity and motor disorders [8].

The development of the intersection of Gastroesophageal Reflux Disease (GERD) and Functional Dyspepsia (FD) may be associated with impaired motility of the esophagus, stomach, which induces, along with other mechanisms, the development of functional diseases of the gastrointestinal tract. .Change in the motor function of the digestive organs is characterized by a violation of the frequency-amplitude characteristics of slow waves and spikes, the power of phase and tonic contractions. Slow-wave activity is determined by the frequency of generation of the basic bioelectric rhythm of the pacemakers of the esophagus, stomach, small and large intestine and is modeled by nerve impulses of the extraorganic and intramural nervous system. Spike activity is due to the bioelectrical activity of neurons of the intermuscular (Auerbach) plexus. Neurons of the subserous plexus (Vorobievskoe) and neurons of the submucosal plexus (Meissner) can play a modulating effect on the activity of the intermuscular plexus due to the activity of interneurons. This phenomenon is demonstrated by the simultaneous activation of the secretory process, regulated by the Meissner's plexus of the esophagus and stomach, and the motor function of these organs, regulated by the Auerbach's plexus. Violation of evacuation from the stomach. Slow gastric evacuation occurs in a significant proportion (25%-35%) of unselected FD patients, while rapid gastric evacuation occurs in less than 5% of cases. The correlation between gastric emptying and dyspeptic symptoms remains undetermined [8].

Approximately one-third of patients with FD have a decrease in the relaxation response of the stomach after a meal, and this seems to be more likely in dyspepsia that developed after infections. The potential association between impaired gastric accommodation and dyspeptic symptoms also remains unclear [9]. Hypersensitivity of the stomach and duodenum is also one of the reasons for the development of FD [10]. Hypersensitivity of the stomach and upper small intestine to mechanical stimulation and distension, and to chemical stimuli (such as the presence of acid and lipids in the gastric lumen) is common in patients with FD. In every third patient, FD is associated with the presence of SIBO. In a meta-analysis of 7 studies involving 1248 patients, the pooled incidence of SIBO in patients with FD was 34.73% (95% CI: 24.807-45.380). When a study that examined the incidence of SIBO in patients with refractory FD was excluded from the meta-analysis, the pooled prevalence was 38.98% (95% CI: 28.964-49.490) [11].

The etiology and pathogenesis of dyspepsia is multifactorial and not fully understood. Dyspepsia is more common in women, smokers, and people taking non-steroidal anti-inflammatory drugs [12].

The etiological factors of FD are dysmotility and sensory function of the gastrointestinal tract, dysregulation of the gut-brain axis, inflammation, and increased mucosal permeability [13]. The syndrome of increased epithelial permeability in FD is caused by a decrease in the expression of tight junction proteins, degranulation of mast cells in the immediate vicinity of nerve fibers in the SO, leading to an increase in visceral sensitivity and motor disorders [14]. Violation of accommodation of the stomach. Gastric accommodation is controlled by the vago-vagal reflex, which is triggered by food intake, and is mediated by the activation of nitroergic nerve endings in the stomach wall [15]. Approximately one-third of patients with FD have a decrease in the relaxation response of the stomach after a meal, and this seems to be more likely in dyspepsia that developed after infections. The potential association between impaired gastric accommodation and dyspeptic symptoms also remains unclear [9].

Hypersensitivity of the stomach and duodenum. Hypersensitivity of the stomach and upper small intestine to mechanical stimulation and distension, to chemical stimuli (such as the presence of acid and lipids in the gastric lumen), is common in patients with FD, but the evidence presented to date is not conclusive [16]. However, comprehensive studies of the motor function of the digestive system in case of crossover between FD and GERD have not been conducted.

The goal is to identify the role of gastrointestinal motility

disorders in the intersection of functional diseases of the gastrointestinal tract - FD and GERD. Materials and methods. The study included 32 patients (21 women and 11 men) aged 32 + 5.8 years. Clinical symptoms that fit the criteria for FD: feeling of fullness in the epigastrium after eating; feeling of rapid satiety; epigastric pain; burning sensation in the epigastrium and met the criteria for FD proposed by the Rome criteria 1U. The diagnosis of GERD was verified on the basis of the clinical picture, esophagogastroduodenoscopy data, which excluded the presence of esophageal erosions. The control group consisted of patients with gastritis C. Electromyography was performed after a standard breakfast using bipolar silver skin electrodes placed in the area of the organ projection on the anterior abdominal wall. On the electromyogram, the amplitude-frequency characteristics of slow waves and spikes, the power of phase and tonic contractions, and propulsive activity were determined using an electromyograph manufactured by Nihon Kohen (Japan). Statistical analysis was performed using the Mann-Whitney small sample method at $p < 0.05$.

Research Results

The results of the study of the motor activity of the stomach at the intersection of the FZ are presented in Table 1.

Research Group	Slow Waves		Spike Activity				Propulsive Activity
	frequency	Wave amplitude	Power of tonic contractions	frequency	Wave amplitude	Power of phase contractions	
Crossroads FZ	7.4 ± 0.5	0.06 ± 0.001	0.444 ± 0 0.0113	1.2 ± 0.18	0.2 ± 0.003	0.24± 0.005	1.85± 1.1
Control	5.5 ± 0.3	0.15 ± 0.001	0.825 ± 0.062	1.0 ± 0.06	0.1 ± 0.0012	0.1 ± 0.003	8.25±0.43

Table 1: Parameters of electromyography of smooth muscles of the stomach in patients with overlapping functional diseases in various conditions.

From Table 1 it follows that the propulsive activity of the stomach in patients with crossover FA is reduced by 77.5% ($p < 0.05$), the power of tonic contractions is reduced by 46.2% ($p < 0.05$), the power of phasic contractions is increased by 140% ($p < 0.05$). That is, at the intersection of the FZ, hypomotor dyskinesia of the stomach is observed, however, there is a pronounced hypersensitivity of the circular muscle layer.

The results of the study of the motor activity of the small intestine under various conditions are presented in Table 2.

Research Group	slow waves		spike activity			propulsive activity	
	frequency	Wave amplitude	Power of tonic contractions	frequency	Wave amplitude	Power of phase contractions	
Crossroads FZ	12.0 ± 1.3	0.06 ± 0.004	0.72 ± 0.125	1.4 ± 0.3	0.03 ± 0.002	0.042± 0.006	14.3 ± 0.4
Control	22.0 ± 0.9	0.1 ± 0.003	2.2 ± 0.06	1.0 ± 0.1	0.1 ± 0.002	0.1 ± 0.003	22.0±0.5

Table 2: Parameters of electromyography of smooth muscles of the small intestine in patients with overlapping functional diseases in various conditions.

From Table 2 it follows that the propulsive activity of the small intestine in patients with FZ is reduced by 35% ($p < 0.05$), the power of tonic contractions of the longitudinal muscles is reduced by 67.2% compared with the control ($p < 0.05$), the power of phase contractions - by 58% ($p < 0.05$). That is, at crossover FZ revealed hypomotor dyskinesia of the small intestine, expressed to a lesser extent than in the stomach, due to a decrease in the excitability of the circular muscle layer. This may also indicate the development of SIBO.

The results of the study of motor activity of the right sections of the colon at the intersection of functional diseases are presented in Table 3.

Slow waves				Spike activity			propulsive activity
Research Group	frequency	Wave amplitude	Power of tonic contractions	frequency	Wave amplitude	Power of phase contractions	
Crossroads FZ	11.0 ± 0.5	0.06 ± 0.002	0.66 ± 0.15	1.3 ± 0.03	0.03 ± 0.0013	0.039± 0.004	16.9± 0.4
Control	11.0 ± 1.2	0.1 ± 0.002	1.1 ± 0.13	1.0 ± 0.04	0.1 ± 0.005	0.1 ± 0.003	11.0 ± 1.0

Table 3: Parameters of electromyography of smooth muscles of the right sections of the colon in patients with overlapping functional diseases in various conditions.

From Table 3 it follows that the propulsive activity of the right sections of the colon in patients with crossed FA is reduced by 53.8% ($p < 0.05$), the power of tonic contractions of the longitudinal muscles is reduced by 40% compared with the control ($p < 0, 05$), the power of phase contractions - by 61% ($p < 0.05$). That is, at the intersection of FD and GERD, hypomotor dyskinesia of the right sections of the colon was detected, which may indicate the development of intestinal dysbiosis.

The results of the study of the motor activity of the left sections of the colon at the crossing of the FZ are presented in Table 4.

Research Group	slow waves			spike activity			propulsive activity
	frequency	Wave amplitude	Power of tonic contractions	frequency	Wave amplitude	Power of phase contractions	
Crossroads FZ	5.3 ± 0.4	0.05 ± 0.003	0.265 ± 0.2	1.2 ± 0.2	0.04 ± 0.005	0.048± 0.003	5.52± 0.8
Control	6.0 ± 0.3	0.1 ± 0.002	0.6 ± 0.01	1.0 ± 0.12	0.1 ± 0.004	0.1 ± 0.005	6.0±0.2

Table 4: Parameters of electromyography of smooth muscles of the left sections of the colon in patients with functional diseases overlap in various conditions.

From Table 4 it follows that the propulsive activity of the left sections of the colon in patients with FD chiasm and GERD of the liver is reduced by 8% ($p < 0.001$), the power of tonic contractions of the longitudinal muscles during FA chiasm is reduced compared to the control by 55.8% ($p < 0.05$), the power of phase contractions is reduced by 52% ($p < 0.05$). The presence of spastic contractions of the circular muscles of the left and right sections of the colon determine the development of constipation.

Recognized in the Rome criteria 1U, the syndrome of crossover of functional disorders of the upper parts of the digestive organs made it possible to identify the transition of one form of the disease to another. The pathogenetic factors of FD in patients aged 26-38 years include, first of all, gastrointestinal motility disorders and visceral hypersensitivity.

Motility disorders include hypomotor dyskinesia of the stomach and small intestine and spastic activity of the right and left sections of the colon. The results obtained indicate the development of SIBO in the small intestine and dysbiosis in the ascending colon. An additional factor leading to the development of SIBO may be hypomotor dyskinesia of the biliary system with a decrease in the flow of bile into the duodenum and the development of SIBO, which is confirmed by other studies. In every third patient, FD is associated with the presence of SIBO. In a meta-analysis, the pooled incidence of SIBO in patients with FD was 34.73%, and the pooled prevalence was 38.98% (95% CI: 28.964-49.490). In one study using the hydrogen breath test with lactulose, it was shown that the incidence of SIBO in patients with FD exceeds 50% [17]. Reported incidence of dyspepsia varies greatly in different populations due to different interpretations of symptoms, diagnostic criteria used, environmental factors, and the local prevalence of organic disorders such as peptic ulcer and gastric cancer. Among all gastroenterological complaints with which patients turn to specialists, dyspepsia accounts for about 20%, FD accounts for 5-15% of all those who applied for dyspepsia [18]. The SIBO and intestinal dysbiosis identified in our studies suggests the development of pronounced disorders of the microbiota of the gastrointestinal tract.

Conclusions

- The intersection of FD and GERD is accompanied by the development of hypomotor dyskinesia of the stomach (77.5%), small intestine (35%), and right colon (53.8%), which accompanies the development of SIBO and intestinal dysbiosis.
- The predominance of spastic contractions of the circular muscles of the left and right sections of the colon determine the development of constipation.

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