

Pathogenetic justification of digestive tract dysfunction correction to reduce the risk of ventricular extrasystoles after coronary bypass grafting

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Abstract

Introduction: In heart pathology, abdominal pathology is often detected, but due attention has not been paid to this issue, and algorithms for predicting, preventing, and correcting the coefficient of endothelial dysfunction (CED) after coronary artery bypass grafting (CABG) with the use of artificial circulation (AC) have not been developed.

Aim: To substantiate the pathogenetic expediency of correction of postoperative intestinal paresis after coronary artery bypass grafting for the prevention of functional cardiac complications.

Material and methods: 147 men were divided into 2 groups. Statistical processing of the obtained data was performed using Windows Microsoft Excel software and parametric methods of variational statistics, and the reliability of differences was determined using Student's formula and table.

Results: It was found that in group II, after coronary artery bypass grafting, the clinical symptoms of intestinal dysfunction were significantly less ($p = 0.019$), and the recovery of defecation was significantly faster ($p = 0.033$) than in group I. After coronary artery bypass grafting, the frequency of high-grade extrasystoles in group II was significantly lower than in group I ($p = 0.033$).

Conclusions: The application of the digestive tract dysfunction correction program is pathogenetically justified because it provides a reduction in the frequency of intestinal paresis and hence a reduction in the frequency of development of ventricular extrasystoles of high gradations after coronary artery bypass grafting.

Introduction

Even though in abdominal surgery, many publications have been devoted to the study of pathogenetic features, prevention and correction of postoperative dysfunctional disorders of peristaltic activity, and the passage of chyme through the intestine [1–4], the functional state of the digestive tract has not been given due attention in cardiac surgery practice. Moreover, single publications devoted to digestive tract dysfunction

in cardiological pathology and after cardiac surgical interventions are episodic, uninformative, and do not allow assessment of the significance of this problem [5].

The dynamics of postoperative motor and evacuation intestinal dysfunction (POMEID) reflect the peculiarities of the course of the postoperative period and are a prognostic criterion for the outcome of surgery and the risk of intra-abdominal complications [5, 6]. It is noteworthy that one of the “most important general surgical problems of transplantology and cardiac sur-

gery remains the diagnosis and tactics of treatment of complications from the abdominal organs” [7]. Despite the low frequency of abdominal complications after heart surgery using artificial circulation (AC), estimated at only 0.4–5.0%, these complications lead to a fatal outcome in 28.4–60% of cases [7, 8]. At the same time, it should be considered that postoperative intestinal paresis leads to an increase in pressure in the lumen of the digestive tract and in the abdominal cavity. This leads to the prerequisites for the development of cardiorespiratory complications [9, 10].

In the pathogenesis of postoperative intestinal paresis, a significant role is played by disturbances in neuro-humoral regulation. This encompasses reflexive disruptions in the regulation of peristaltic activity within the digestive tract, where pathological impulses from the primary affected area are transmitted to different intestinal segments. These segments often share common innervation sources with the primary focus. Therefore, in cases of abdominal organ pathology, various types of viscer-enteral inhibitory reflexes can manifest, impacting intestinal function. In this case, if the primary focus of arousal is caused by a pathology of the heart, pathological impulses can be transmitted to various parts of the digestive tract. Against this background, cardiac-pyloric, cardiac-enteral [11], cardiac-ileocecal [12], and cardiac-anorectal inhibitory reflexes develop [13] with a priority lesion of any motor zone (anatomical sphincters) of the digestive tract. This causes an increase in intraluminal pressure in the proximal parts of the digestive tract, and the remaining parts of the intestine react to pathological impulses to a lesser extent, which leads to the clinical manifestation of intestinal paresis [6].

Special emphasis should be placed on the perspective that in the pathogenesis of Postoperative Mesenteric Ischemia following Elective Cardiac Surgery (POMEID), the pivotal factors are not solely the surgical trauma associated with Coronary Artery Bypass Grafting (CABG). Rather, significant contributors are the hypoperfusion of organs and the subsequent development of reperfusion syndrome following the use of Artificial Circulation (AC) [14, 15]. Moreover, against the background of chronic ischaemia [16], even before surgical treatment of coronary heart disease (CHD), oxygen debt and the development of functional disorders in all organs and systems of the body, including the digestive tract, are formed [17], which increases the risk of POMEID after CABG. In heart pathology, given the presence of common sources of innervation, abdominal pathology is often detected, including from various parts of the digestive tract, which can cause complications after CABG. Simultaneously, due attention has not been

paid to this issue, and, accordingly, algorithms for predicting, preventing, and correcting CED after CABG with the use of AC have not been developed [6]. The reflex mechanism of the development of POMEIDs after CABG and their effect on the functional state of the heart in the postoperative period has not been considered, which determines the prospects and relevance of research in this direction.

Aim

The purpose of the study was to substantiate the pathogenetic expediency of correction of postoperative intestinal paresis after coronary artery bypass grafting for the prevention of functional cardiac complications.

Material and methods

Depending on the correction of postoperative motor and intestinal evacuation dysfunction, patients were divided into 2 groups. The average age of patients in group I was 49.8 ± 5.3 years, and in group II – 52.3 ± 4.6 years. There were no significant differences between the groups ($p = 0.176$).

Group I included 69 patients who had not been given targeted prevention after CABG. In group II, 78 patients who underwent CABG underwent a program for the prevention and correction of POMEID. The programme included catheterisation of the retroperitoneal nerve plexus area for permanent blockages in the postoperative period, considering the localisation of the violation of the passage of chyme, in combination with decompression and gastric lavage with ozonated water and anal dilation, which was performed under anaesthesia at the end of the operation. Considering that, against the background of circulatory insufficiency leading to oxygen deficiency at the systemic level, in combination with drug treatment accompanied by inhibition of intestinal peristaltic activity (calcium antagonists, ACE [angiotensin-converting enzyme] inhibitors, nitrates), prediction of localization of predominant violation of the passage of chyme through the intestine is of great importance for the prevention and effective correction of POMEID. The risk zones for passage disorders in various parts of the digestive tract are motor zones, which is accompanied by the development of proximal intraluminal hypertension. Together, postoperative pylorospasm will be accompanied by nausea and vomiting [18] caused by intraluminal hypertension in the stomach, and concomitant cardiospasm may negatively affect the development of functional cardiac complications.

To prevent and correct the increase in intraluminal pressure in the stomach in group II, all patients underwent nasogastric insertion of a catheter into the

stomach, which provided evacuation of stagnant gastric contents in case of violation of passage into the duodenum, prevention of gastroesophageal reflux, and decompression of the upper digestive tract. To predict the localisation of a violation of the passage of chyme around the ileocecal angle of the intestine explained by intestinal spasm and in the sigmoid and rectum against the background of anal spasm of the anal sphincter before surgery, anthropometric parameters of the anterior abdominal wall were studied before and after meals [19, 20]. The criteria for the analysis were changes in the distances between the navel and the spina iliaca anterior superior dextra et sinistra, as well as between the navel and the symphysis. After eating for 30–120 min, bloating was noted, which led to an increase in the distance between the navel and the spina iliaca anterior superior dextra in violation of the passage from the ileum blindly (ileocecal angle zone) and/or between the navel and the spina iliaca anterior superior sinistra in violation of the passage through the sigmoid and rectum (anal spasm). A more pronounced increase in the distance in the right or left iliac region indicated a priority localisation of the risk of violation of the passage of chyme in the postoperative period. With a parallel increase in the distance between the navel and the symphysis, in combination with the studied indicator on the left or right, it indicated the development of a passage violation in the corresponding zone.

Considering the results obtained, catheterisation of the retroperitoneal plexus area on the right or left was performed before the operation under the control of ultrasound with Dopplerography. To carry out permanent blockade of retroperitoneal nerve plexuses on the right through a puncture of the anterior abdominal wall in the right iliac region between the outer and middle third line connecting the symphysis and spina iliaca anterior superior dextra, catheterisation of the retroperitoneal space was performed. The catheter was placed between the projection of the caecal dome and the bifurcation of the common iliac artery on the right. A 100.0 ml 0.25% solution of novocaine was injected through the catheter, which ensured the blockade of not only the ileocecal plexus, but also the infiltration of pelvic tissue, in which the lumbosacral, coccygeal, and rectal plexuses are located, which take part in the innervation of the distal colon and anal sphincter [21]. To carry out a permanent blockade of retroperitoneal nerve formations on the left through a puncture of the anterior abdominal wall on the line connecting the symphysis with the spina iliaca anterior superior sinistra between the outer and middle third, a catheter is installed in the area of the rectosigmoid transition retroperitoneally and 100.0 ml 0.25% novocaine solution is inject-

ed through the catheter, which ensures normalization of passage through the distal colon and regression of spasm anal sphincter [22].

In the postoperative period, 100.0 ml of 0.25% novocaine solution is administered via catheters 4 times a day, which, considering the duration of direct action and the aftereffect, provides a permanent blockade effect during the day. The blockade was carried out for 5–6 days until complete normalisation of the functional state of the intestine. In addition, under intubation anaesthesia, after completion of the operation, all patients of group II underwent anal dilation, which ensured its overstretching, and, in combination with the permanent effect of blockades, regression of anal spasm of the sphincter. Considering that even with the defeat of the coronary arteries, atherosclerosis can occur for a long time without a pronounced clinical manifestation, with episodes of pain-free myocardial ischaemia that are not accompanied by clinically significant symptoms, it is not possible to determine the duration of CHD disease. Seeking medical help also occurs only against the background of the appearance of clinical symptoms of myocardial ischaemia, which leads to a late referral for coronary angiography and verification of the diagnosis: atherosclerotic lesion of the coronary arteries, followed by referral for surgical treatment.

The main research method was comparative analysis. Statistical processing of quantitative data was carried out by the authors using a standard statistical analysis system based on parametric methods of variation statistics.

Ethical considerations

The study was approved by the local Ethics Committee of the IMO NovSU of the Novgorod State University of the Ministry of Education and Science of Russia from 21.05.2015 (protocol No. 2).

Results

Comparative analysis of concomitant pathology did not reveal significant differences between the comparison groups. At the same time, arterial hypertension was detected in 42 (60.8 ±5.8%) in group I, in 52 (66.7 ±5.3%) in group II ($p = 0.133$), pathology of the circulatory organs (obliterating endarteritis, atherosclerosis of the arteries of the lower extremities, varicose veins of the lower leg) in 13 (18.8 ±4.8%) in Group I and 13 (16.7 ±4.1%) in II ($p = 0.338$), respiratory pathology in 11 (15.9 ±4.3%) in group I and 16 (20.5 ±4.5%) in II ($p = 0.135$), urinary pathology in 11 (15.9 ±4.3%) in group I and in 13 (16.7 ±4.1%) in II ($p = 0.721$), and digestive organs in 6 (8.7 ±3.2%) in group I and in 8 (10.3 ±3.3%) in II ($p = 0.286$).

A comparative analysis of the duration of the operation in group I (3.5 ± 0.5 h) and group II (4.1 ± 0.4 h) showed that there were no significant differences between them ($p = 0.107$). Moreover, there were no significant differences between group I (86.0 ± 17.0 min) and group II (91.0 ± 13.0 min) in the duration of AC application ($p = 0.426$). The criteria for analysing the effectiveness of the application of the POMEID correction program and its impact were a comparative analysis of the results of anthropometric indicators of the anterior abdominal wall and clinical symptoms of POMEID 3 days after CABG. The expediency of conducting a study of the dynamics of anthropometric indicators of the anterior abdominal wall is explained by the fact that intraluminal hypertension in the proximal part of the digestive tract located above the motor zone will lead to an increase in its size and, accordingly, to an increase in the local anthropometric indicator in its projection on the anterior abdominal wall.

Thus, an increase in the distance between the navel and the xiphoid process, or additionally between the navel and the right costal arch, will indicate the following:

- a violation of the passage from the stomach to the duodenum;
- an increase in the distance between the navel and the spina iliaca anterior superior dextra, especially in combination with an increase in the distance between the navel and the symphysis, is an indicator of a violation of the passage of the chyme from the ileum to the blind.

Considering that food intake leads to activation of the motor and evacuation functions of the digestive tract, postoperative dysfunctions of the pylorus, ileocecal angle, and anal sphincter will lead to the development of intraluminal hypertension above their localization. Accordingly, it is advisable to record, in parallel with the change in the anthropometric parameters of

the anterior abdominal wall, the dynamics of clinical symptoms of digestive tract dysfunction, as well as the dynamics of electrocardiogram (ECG) indicators (Table I). The development of POMEID after CABG will indicate the implementation of various variants of the pathological cardiac-abdominal inhibitory reflex. In contrast, the registration of ECG indicators before and after meals, against the background of changes in the anthropometric parameters of the anterior abdominal wall and clinical symptoms, allows us to assess the negative impact of the ECG on the functional state of cardiac activity after CABG. Together, the analysis of changes in the frequency of detection of ventricular rhythm disorders seems to be the most promising. It should be noted that the most frequent increase in cases of ventricular arrhythmias is noted during the first 48 h after CABG [23, 24]. The greatest interest is in the identification of ventricular extrasystoles of high gradations, which in the postoperative period can lead to unstable haemodynamics, myocardial ischaemia, congestive heart failure, an increase in the risk of thromboembolic complications, and, most importantly, to the sudden death of the patient [25].

Considering the probability of a negative effect of the POMEID on the functional state of cardiac activity, we assumed that an increase in intraluminal pressure in various parts of the digestive tract would lead to the appearance of a source of pathological impulses in them, which would trigger the development of pathological gastric-cardiac, ileocecal-cardiac, and anal-cardiac inhibitory reflexes. Simultaneously, the development of these pathological reflexes initiated by POMEID may be the cause of dysfunctional disorders of cardiac activity. The quantitative and morphological characteristics of ventricular extrasystoles of high gradations in B were taken as the basis for the selection of criteria for assessing the response of cardiac activity after a meal. Megoran

Table I. Comparative analysis of anthropometric parameters of the anterior abdominal wall in the study groups 3 days after CABG

Investigated indicators	Group I (n = 69)		Group II (n = 78)		P-value
	Abs	%	Abs	%	
Increasing the distance between the navel and the xiphoid process	17	24.64 ±5.13	2	2.63 ±1.54	0.023
Increasing the distance between the navel and the costal arch on the right	16	23.23 ±5.12	2	2.63 ±1.54	0.024
Increasing the distance between the navel and the symphysis	38	55.13 ±5.97	10	12.92 ±2.73	0.017
Increasing the distance between the navel and <i>spina iliaca ant. sup. Dextra</i>	47	68.12 ±5.62	19	24.42 ±4.83	0.015
Increasing the distance between the navel and <i>spina iliaca ant. sup. Sinistra</i>	22	31.88 ±5.62	10	12.92 ±2.73	0.016

and M. Wolf (1971), in their modification of M. Ryan's 1975 classification, delineated ventricular arrhythmias into several categories: class 3 (polytopic ventricular extrasystoles), class 4A (monomorphic paired ventricular extrasystoles), class 4B (polymorphic paired ventricular extrasystoles), and class 5 (ventricular tachycardia, defined as three or more consecutive ventricular extrasystoles) [26].

When performing this section of our work, we conducted a comparative analysis of the ECG results before and 30, 60, and 120 min after meals to identify the negative effect of POMEID on the functional state of cardiac activity, in particular the frequency of detection of ventricular extrasystoles of high gradations. The timing of the study was determined by the detection of changes in the anthropometric parameters of the anterior abdominal wall in the proximal parts of the digestive tract above the motor zones. Statistical processing of quantitative data was carried out using a standard statistical analysis system based on parametric methods of variational statistics. The arithmetic mean (M) and the standard error of the arithmetic mean (m) were calculated using the statistical processing module of Microsoft Excel Windows programmes. The reliability was determined using Student's formula and table.

Discussion

A comparative analysis of the results of anthropometric parameters of the anterior abdominal wall in the study groups 3 days after CABG showed (Table I) that before eating, in group I, where prevention of postoperative disorders of motor and evacuation dysfunction of the digestive tract was not carried out, an increase in the distance between the xiphoid process and the navel was noted in significantly more patients than in group II, where, in the postoperative period, a nasogastric probe was installed in the lumen of the stomach, which provided decompression and reduced the likelihood of developing a gastro-cardiac reflex. Notably, a significant increase in the distance between the navel and the symphysis during a permanent blockade on the right was observed in more patients in group I, compared with those in group II. In this case, there were no clinically significant changes in this indicator on the left (more than 15%) in the study groups. Considering that the increase in anthropometric indicators was noted most often in the lower right quadrant of the abdomen on the right, it can be seen that the zone of the ileocecal angle is the most vulnerable to the development of POMEID. Violation of passage along the distal colon was noted less frequently, but in group I significantly more often than in group II, where not only permanent blockages of retroperitoneal nerve formations were carried

out, but also after the operation was completed, the anus was devolved under anaesthesia.

A comparative analysis of clinical symptoms showed (Table II) that when assessing the frequency of clinical symptoms outside of meals, the frequency of clinical symptoms of POMEID in group I significantly exceeded the indicators in group II ($p = 0.026$), while defecation and gas discharge in group II normalised significantly faster than in group I ($p = 0.036$). Special attention should be paid to the fact that after eating, there was a significant increase in the frequency of almost all symptoms in the study groups. However, the reliability of the differences between groups I and II increased ($p = 0.019$), which indicated the clinical significance of food intake in the clinical manifestation of POMEID. The frequency of the use of additional measures aimed at the correction of POMEID in group I was significantly higher ($p = 0.018$), and the intensity of clinical symptoms were expressed to a greater extent than in group II, where a targeted program aimed at the prevention and correction of POMEID was carried out.

Thus, the results obtained by comparative analysis of the results of anthropometric changes in the anterior abdominal wall and clinical symptoms showed that the use of a program allowed substantiation of the pathogenetic expediency of its implementation after CABG with the use of AC. This program is aimed at the prevention and correction of POMEID after CABG, including intraoperative anal dilation under anaesthesia and postoperative nasogastric decompression of the stomach and permanent novocaine blockades of retroperitoneal nerve plexuses, taking into account the predicted localization of the priority violation of the functional state of the ileocecal angle intestinal spasm and anal spasm of the sphincter. Special attention should be paid to the results of the study of the negative effect of POMEID on cardiac activity, depending on the programme for their prevention and correction (Table III).

It was found that there were no significant differences in the frequency of detection of ventricular extrasystoles in groups I and II before meals ($p = 0.122$). In contrast, when examining the frequency of detection of ventricular extrasystole after eating, it significantly increased and in group I was detected in 31 (44.92 \pm 5.98%) patients, and in group II in 17 (21.79 \pm 4.68%) patients. The indicators in group I significantly exceeded the results obtained in group II ($p = 0.033$). The results recorded at various intervals after meals deserve special attention. Thus, 30 min after eating in group I, ventricular extrasystoles were detected in 11 (15.94 \pm 4.41%) patients. Of these, 8 (11.76 \pm 3.87%) had only polytopic ventricular extrasystoles, and the remaining 3 (4.18 \pm 2.38%) had a combination of polytopic and

Table II. Clinical symptoms of impaired motor and evacuation bowel function in the study groups after CABG

Symptoms	Group I		Group II		P-value
	Abs	%	Abs	%	
Belching	23	33.33 ±5.63	2	2.63 ±1.54	0.019
Constipation	37	53.62 ±6.01	13	16.74 ±4.13	0.020
Alternation of constipation and diarrhoea	11	15.94 ±4.41	10	12.92 ±2.73	0.171
Heaviness in the epigastric region and bloating after eating	22	31.88 ±5.62	3	3.79 ±1.93	0.021
Bloating of the abdomen (intestines) 30–120 min after eating	31	44.92 ±5.98	18	23.07 ±4.76	0.034
Abdominal pain on the background of bloating	34	49.27 ±6.02	7	8.86 ±3.22	0.015
Total, violations after eating	42	60.87 ±5.89	18	23.07 ±4.76	0.019
Clinical symptoms outside of meals	19	27.53 ±5.37	4	5.13 ±2.46	0.026
Restoration of defecation and gas discharge (M ± m) [days]	4.21±0.33		2.84 ±0.32		0.036
Correction of POMEID:					
Drugs that stimulate peristalsis	23	33.33 ±5.63	4	5.13 ±2.46	0.022
Cleansing enemas	19	27.53 ±5.37	2	2.63 ±1.54	0.022
Total	28	40.58 ±5.91	4	5.13 ±2.46	0.018

Table III. Comparative analysis of anthropometric parameters of the anterior abdominal wall in the study groups 3 days after CABG

Investigated indicators	Group I (n = 69)		Group II (n = 78)		P-value
	Abs	%	Abs	%	
Ventricular extrasystole (VES) before meals	7	10.14 ±3.61	5	6.41 ±2.77	0.122
Ventricular extrasystole after eating	31	44.92 ±5.98	17	21.79 ±4.68	0.033
ZHES in 30 min	11	15.94 ±4.41	2	2.63 ±1.54	0.035
ZHES in 60 min	26	37.68 ±5.83	14	17.95 ±4.35	0.037
ZHES in 120 min	23	33.33 ±5.63	13	16.74 ±4.13	0.041

monomorphic paired ventricular extrasystoles. In contrast, in group II, only 2 (2.63 ±1.54%) patients had polytopic ventricular extrasystoles. At the same time, differences in the frequency of detection of ventricular extrasystoles 30 min after meals in the study groups were significant ($p = 0.035$).

Sixty minutes after eating in group I, ventricular extrasystoles were detected in 26 (37.68 ±5.83%) patients. Of these, 16 (23.23 ±5.12%) patients had only polytopic ventricular extrasystoles, 7 (10.27 ±3.66%) had them combined with monomorphic paired ones, and 2 (2.89 ±2.02%) had a combination of polytopic and polymorphic paired ventricular extrasystoles. Simultaneously, 1 (1.44 ±1.36%) patient was diagnosed with ventricular tachycardia with a run of 4 extrasystoles in a row. In group II, ventricular extrasystoles were detected in 14 (17.95 ±4.35%) patients. Of these, 10 (12.92 ±2.73%) patients had only polytopic ventricular extrasystoles, 2 (2.63 ±1.54%) had them combined with monomorphic paired ones, and 2 (2.63 ±1.54%) had polymorphic paired ventricular extrasys-

toles. Together, differences in the frequency of detection of ventricular extrasystoles 60 min after meals in the study groups were significant ($p = 0.037$). 120 min after eating in group I, ventricular extrasystoles were detected in 23 (33.33 ±5.63%) patients. Of these, 16 (23.23 ±5.12%) patients had only polytopic ventricular extrasystoles, 3 (4.18 ±2.38%) had them combined with monomorphic paired ones, 2 (2.89 ±2.02%) had polymorphic paired ventricular extrasystoles, and 2 (2.89 ±2.02%) had ventricular tachycardia with a run of 4 extrasystoles in a row.

In group II, ventricular extrasystoles were detected in 13 (16.74 ±4.13%) patients. Of these, 11 (14.11 ±3.94%) patients had polytopic, and 2 (2.63 ±1.54%) had monomorphic paired ventricular extrasystoles. Altogether, the differences in the frequency of detection of ventricular extrasystoles 120 min after meals in the study groups were significant ($p = 0.041$). Notably, in group I, after 30 min, rhythm disturbances were observed in 3 (4.18 ±2.38%) patients, and after 120 min in 2 (2.89 ±2.02%) patients. Ventricular ar-

rhythmias were detected in the remaining 26 (37.68 ±5.83%) patients at all study periods. In Group II, abdominal complications were observed in 2 (2.63%) patients after 30 min, and in 1 (1.31%) patient after 60 min. Ventricular extrasystole was detected in the remaining 13 (16.74 ±4.13%) patients after 60 and 120 min.

Notably, the appearance of ventricular extrasystoles after eating was mainly registered in patients with an increase in the anthropometric parameters of the anterior abdominal wall and pronounced symptoms of postoperative intestinal paresis. This indicated that there is a relationship between POMEID and the development of ventricular extrasystoles after CABG. In cardiac surgery, due attention is not paid to the analytical approach in considering abdominal complications from the standpoint of the pathogenetic significance of pathological cardiac-abdominal inhibitory reflexes as a trigger in the development of POMEID. Moreover, the pathogenetic significance of the negative effect of intraluminal hypertension in various parts of the digestive tract against the background of POMEID initiated by CABG in AC conditions on cardiac activity in the postoperative period seems to be a promising scientific direction for the study of cause-and-effect mechanisms of complications after cardiac surgery. CABG is one of the most common cardiac surgeries performed with or without AC [27, 28]. The development of reperfusion syndrome negatively affects not only the myocardium [29], but also the functional state of organs and systems at the organizational level.

No less important is the development in the postoperative period of pathological reflexes initiated by surgical trauma and tissue hypoxia, the development of which is due to circulatory insufficiency before surgery. The innervation of the abdominal and thoracic cavities is inextricably linked, which is confirmed by the abdominal form of myocardial ischaemia, occurring under the guise of acute pathology of the abdominal organs and the appearance of cardialgia in diseases of the abdominal cavity and retroperitoneal space. In the differential diagnosis of cardiogenic myocardial ischemia and abdominal pathology of various localizations, a promising approach involves the use of technologies aimed at interrupting the pathological cardiac-abdominal and abdominal-cardiac reflex arcs. These technologies, when used in conjunction with dynamic ECG monitoring, can significantly enhance diagnostic accuracy [11]. It significantly reduces the time of diagnosis of the abdominal form of cardiogenic myocardial ischaemia or abdominal pathology that causes not only cardiogenic pain syndrome as well as ECG changes characteristic of myocardial ischaemia [12, 13].

In abdominal surgery, much attention is paid to the prevention of postoperative disorders of motor and evacuation bowel function. For these purposes, it is pathogenetically justified to use permanent blockades of retroperitoneal nerve plexuses and peridural anaesthesia, providing interruption of the reflex arc of pathological viscer-enteral, entero-enteral, parietal-enteral inhibitory reflexes. In this case, much attention is paid to the restoration of the motor zones of the digestive tract (the pylorus, ileocecal angle, sphincter of the rectum), which carry out reflex regulation of the passage of gastric contents into the duodenum, providing the transition of chyme from the ileum to the cecum and regulation of bowel movements, thus ensuring the emptying of the distal colon. The use of permanent retroperitoneal blockades in cardiology and cardiac surgery for the correction of intestinal dysfunction seems promising [30].

The innervation of the motor zones is more intense than the rest of the digestive tract and is more susceptible to reflex influences. They are the priority targets for pathological cardiac-gastric, cardiac-ileocecal, and cardiac-anal inhibitory reflexes. The accumulation of contents proximal to the motor zones of the digestive tract leads to the development of intraluminal hypertension, the increase of which is due to the hypercolonization of the digestive tract by microflora, the predominance of fermentation processes, putrefaction, and gas formation, which replace parietal digestion. The increase in intraluminal pressure in various parts of the digestive tract leads to the appearance of sources of pathological impulses in the stomach, ileum, and distal colon, which can initiate recurrent pathological gastric-cardiac, ileocecal-cardiac, and anal-cardiac inhibitory reflexes that will affect cardiac activity after CABG. POMEID will manifest in clinical symptoms characteristic of intestinal paresis, and intraluminal hypertension leads to bloating of the corresponding parts of the digestive tract. This leads to an increase in the anthropometric parameters of the anterior abdominal wall above the zone of intraluminal hypertension.

The time of the study of the anthropometric parameters of the anterior abdominal wall is also important. So, the study on an empty stomach allows the basic dimensions of the studied parameters to be obtained. The study 30 min after eating allows assessment of the state of the passage of contents from the stomach to the duodenum, 60 min after eating to determine the violation of the passage from the ileum blindly, and 120 min after eating to assess the functional state of the passage in the distal colon. Correction of a violation of the functional state of the pylorus and an increase in pressure in the lumen of the stomach is provided by

decompression of the stomach through a nasogastric probe.

In contrast, the prevention and correction of passage disorders in the area of the ileocecal angle and/or distal sections is provided through the use of 2 variants of permanent blockages of retroperitoneal nerve plexuses developed by us. For faster normal defecation and regression of anal spasm of the sphincter, under anaesthesia, after completion of the operation, the anus is devolved, which in combination with a permanent blockade on the left ensures normalization of the functional state of the distal colon and defecation. A set of methods for correcting the violation of the functional state of various parts of the digestive tract were included in the comprehensive program of prevention and correction of POMEID. The use of this program is pathogenetically justified because it is aimed at interrupting the reflex arc of pathological reflexes and normalizing the functional state of the digestive tract in the postoperative period.

Conclusions

The application of the developed program for the prevention and correction of POMEID has significantly reduced the frequency of violations of the motor and evacuation function of the digestive tract after CABG in IC conditions. Its effectiveness is reliably confirmed by the results of a comparative analysis of the dynamics of anthropometric indicators of the anterior abdominal wall and the manifestation of clinical symptoms of intestinal paresis during the correction of the POMEID and without it. In addition, the study revealed the dependence of the development of ventricular arrhythmias of high gradations according to the classification by B. Megoran and M. Wolf (1971) with modification by M. Ryan (1975) with food intake against the background of the development of POMEID after CABG in the conditions of AC application.

A comparative analysis of the ECG results in the study groups showed that in group I, where the prevention of POMEID was not carried out, the frequency of ventricular extrasystoles significantly exceeded the indicators in group II ($p = 0.033$). It seems promising to continue research in this direction. The application of the digestive tract dysfunction correction programme is pathogenetically justified because it provides a reduction in the frequency of intestinal paresis and hence the frequency of development of ventricular extrasystoles of high gradations after coronary artery bypass grafting with artificial blood circulation.

Conflict of interest

The authors declare no conflict of interest.

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