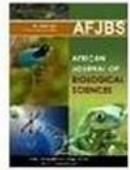


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**METHODS OF PREDICTION AND PREVENTION OF POSTOPERATIVE  
COMPLICATIONS OF ACUTE INTESTINAL OBSTRUCTION IN ELDERLY AND  
ELDERLY PATIENTS**

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## ABSTRACT

**Background:** Acute intestinal obstruction (AIO) in elderly and senile patients presents distinct challenges due to concurrent pathologies and altered clotting mechanisms, leading to increased postoperative complications and mortality.

**Purpose:** This study aims to develop predictive and preventive methods for postoperative complications of AIO in elderly and senile patients.

**Methods:** Pathogenetic mechanisms underlying AIO manifestations, such as Intraperitoneal hypertension and Intraenteric hypertension, were analyzed for their clinical and laboratory correlations. Retrospective analysis of postoperative courses in 53 patients categorized into survivors and deceased subgroups was conducted.

**Conclusion:** The use of the therapeutic and diagnostic algorithm developed by us, based on the prediction and prevention of postoperative complications of acute intestinal obstruction in elderly and senile patients, has significantly reduced the cases of deaths, especially from various pathologies associated with increased thrombosis and, first of all, from pulmonary embolism.

**KEYWORDS:** Intestinal obstruction, elderly and senile age, prognosis, prevention.

## INTRODUCTION

As a result of a retrospective analysis of the results of the use of traditional methods of treating AIO in elderly and senile patients, it was revealed that, firstly, obstructive intestinal obstruction with a peculiar clinical manifestation and course of the pathological process is most common against the background of a large number of concomitant pathologies, including from vital organs (heart, lungs, liver, brain) (1,3,5,7,9,11,14,16,18); secondly, AIO in elderly and senile patients occurs with pronounced disorders in the blood clotting system, with a tendency to thrombosis, which lead to ischemia of tissues and, first of all, of the intestine itself (2,4,6,8,10,12,20,22,24). All this ultimately leads to an increase in the proportion of postoperative complications of AIO and mortality in elderly and senile patients (13,15,17,19,21,23,25,26). In this regard, we believe that the development of new pathogenetically sound methods for predicting and preventing postoperative complications of AIO in elderly and senile patients is a priority area of surgical gerontology.

**The purpose of the study.** Development of methods for predicting and preventing postoperative complications of acute intestinal obstruction in elderly and senile patients.

## MATERIALS AND METHODS

The analysis of pathogenetic mechanisms of interrelation of such known manifestations of AIO as Intraperitoneal hypertension and Intraenteric hypertension with identified common clinical and laboratory manifestations of this disease, in our opinion, will allow to develop methods of predicting the development of unsatisfactory results and postoperative complications of this disease in elderly and elderly patients.

After a retrospective analysis of the features of the postoperative course in AIO in elderly and senile patients, the average value of all the studied parameters was revealed. However, as is known, the identification of points of contact of unsatisfactory variants of the course of the postoperative period is possible by randomizing patients into survivors (the first subgroup) and deceased (the second subgroup). This division showed that out of 53 patients, 38 patients were included in the first subgroup, and 15 patients in the second.

Graphical analysis of the dynamics of the change curve Intraperitoneal hypertension and Intraenteric hypertension in patients of the above subgroups showed opposite directions of their change.

## RESULTS AND DISCUSSION

It should be noted that intraperitoneal hypertension in the patients of the first subgroup, throughout the study, progressively decreased, whereas in the patients of the second subgroup, after a moderate decrease, starting from the 2nd day of the postoperative period, it tended to decrease gradually, and in the following terms – a progressive increase in its importance. This trend reduced the correlation between these indicators ( $R=-0.381$ ). At the same time, Intraenteric hypertension showed no signs of decrease in patients of the second subgroup and, accordingly, had only an increase, which accordingly increased the importance of the inverse correlation between the first and second subgroups of patients ( $R=-0.789$ ). A different picture of the graphical curve was noted by us according to the studied general clinical indicators of AIO.

The temperature curve had a moderate inverse correlation relationship ( $R=-0.403$ ) between the subgroups, which was associated with a double leveling of the dynamics at 1 and 3 days of the postoperative period. However, in the case of analyzing the level of Systolic blood pressure, the value of correlation relationship ( $R=-0.368$ ) was the same between the patients of both subgroups. An even smaller correlation value could be noted in relation to the Frequency of Respiratory

Movements ( $R=-0.231$ ). The heart rate was distinguished by a high inverse correlation ( $R=-0.943$ ) between patients of the first and second subgroups.

A graphical analysis of the dynamics of changes in general clinical laboratory and biochemical blood parameters in patients of various subgroups with acute intestinal obstruction in leukocytes, Leukocyte index of intoxication and hematocrit had an identical curve with matching correlation values ( $R=-0.963$ ;  $R=-0.939$  and  $R=-0.642$ , respectively). All of them had an inverse correlation relationship.

We noted a direct correlation between the first and second subgroups of patients with AIO in relation to creatinine ( $R=0.597$ ). Progressive decrease in creatinine levels was noted in patients of the first subgroup. At the same time, we did not observe such a critical decrease in patients of the second subgroup.

We noted a low direct correlation among patients of two subgroups in terms of plasma potassium ( $R=0.259$ ). This was due to a double leveling of the indicator in blood plasma in the preoperative period and on the 3rd day of the postoperative period. At the same time, in patients of the first subgroup, the level of potassium in the blood plasma was amenable to correction, but this did not happen in the second subgroup.

The rate of thrombosis in patients of the first subgroup on average decreased with the exception of Prothrombin time. In contrast, in patients of the second subgroup we noted only a tendency to acceleration of thrombosis processes.

Graphical analysis of the dynamics of changes in thrombosis time parameters showed that Prothrombin time had a high direct correlation between the dynamics of both subgroups ( $R=0,743$ ).

The proximity of the parameters Activated partial thromboplastin time between patients of the first and second subgroups in the preoperative period and on 1-2 days of the postoperative period determined the mutual correlation between these parameters (at the level of  $R=-0.933$ ), although the graphical picture shows how much this value diverged. Nevertheless, the acceleration of the time of this studied parameter indicated that in patients of the second subgroup, the tendency to thrombosis was maximally high.

Thrombin time between the patients of the first and second subgroups was at an intermediate level, but with an inverse correlation between them ( $R=-0,611$ ).

The main indicators of endothelial system disorders had direct correlation dependence. The dynamics of C-reactive protein changes can be emphasized in the first place ( $R=0,940$ ).

The next in correlation significance were D-dimer ( $R=0.885$ ) and fibrinogen ( $R=0.405$ ). With such high correlation parameters, it should be noted that in patients of the second subgroup, the level of vascular endothelial damage was higher than in patients of the first subgroup.

The next type of analysis was reduced to the comparative cloud coverage of the dependence of the studied parameters depending on the dynamics of the Intraperitoneal hypertension and Intraenteric hypertension level change in the patients of the first and second subgroups.

In patients of the first subgroup the cloud coverage of the level of Intraperitoneal hypertension showed its dependence on such investigated parameters as the number of leukocytes, Leukocytic Intoxication Index, C-reactive protein, heart rate, creatinine and body temperature. In this segment of the virtual cloud, the level of dependence Intraenteric hypertension was not high and was at a level below the mean value.

The increase in this value is in relation to parameters such as Systolic blood pressure, hematocrit, D-dimer, fibrinogen, plasma potassium, and all parameters of clot formation rate. All of them were dependent on Intraenteric hypertension in patients of the first subgroup.

In patients of the second subgroup the cloud coverage of the studied parameters was similar between Intraperitoneal hypertension and Intraenteric hypertension. All parameters at the maximum significant level of correlation coefficient were attributed exactly to the endothelial system disorder and acceleration of thrombosis process.

Thus, the conducted studies at this stage showed that in patients of the second subgroup there is an increase in Intraperitoneal hypertension and Intraenteric hypertension. This can be

interpreted as the initial phase of the pathogenesis of postoperative complications. All of them are united by a single mechanism of pathological processes, which are based on a violation in the microcirculation system of the intestine itself. This process is aggravated in conditions when the patient has strangulation intestinal obstruction, in which additional compression of the vessels of the intestinal mesentery occurs. Functional changes occur in the intestine, among which there are violations of motor evacuation, secretory and suction functions.

It is known that long-lasting Intraenteric hypertension leads to ischemic damage to the wall of the intestine itself. As a result, damage to the mucous membrane of the organ occurs, leading to disruption of the intestinal barrier function. This process, in a more severe variant, occurs in patients with colonic obstruction as a result of early translocation of microorganisms from the intestinal cavity, first into the local, and later into the systemic meatus through the portal vein and the lymphatic vessel system. In such a situation, the intestine acquires the role of a source of intoxication. This leads to an aggravation of homeostasis, which undoubtedly contributes to the formation of a closed circle of a chain of pathological processes and creates conditions for the development of postoperative complications and mortality. This mechanism of pathological processes is very typical for elderly and senile patients.

This mechanism may have been related to information about the role and place of the nitroxydergic innervation system, which is involved in the regulation of motility and secretion, in premembrane digestion and absorption. All nitroxydergic regulation is provided by the auto- and paracrine mechanisms of nitric oxide synthesis by intramural neurons of the enteric nervous system, the epithelium lining the digestive tube, and muscle tissue cells - the endothelium of microvessels.

Based on the conducted multifactorial analysis of the main studied indicators, we were able to build a ROC analysis diagram, which allowed us to identify the value of the main predictive parameters. This method also allowed us to identify the priority of independence in the development of unsatisfactory results of AIO treatment in elderly and senile patients.

As shown in this graphical division, it is possible to identify the main parameters that differ in their maximum reliability. They are characterized by two stages of the processes occurring in the postoperative period: in the first phase, the markers of the inflammatory reaction we studied were more active in the ROC curve, and in the second phase– the indicators of the rate of thrombosis (thrombin and prothrombin time, Activated partial thromboplastin time) and endothelial dysfunction (D-dimer, C-reactive protein, fibrinogen). These data formed the basis for the formation of a matrix for the possible development of an unsatisfactory outcome of AIO treatment in elderly and senile patients. The resulting digital matrix became the basis for creating a software product called "PURTAP" (Prognosis of Unsatisfactory Results of Treatment of Acute Intestinal Obstruction in Elderly and Senile Patients). At the same time, we divided the probability of developing unsatisfactory results of AIO treatment into low and high. In the absence of coincidence of the studied criteria with the developed software product, the probability of impaired development of postoperative complications, which are based on a violation of microcirculation in the intestine.

The software product developed by us is available for wide implementation in practical healthcare, as it can function on any computer platform in various modes. This, in turn, allows you to minimize the estimated time on the part of the medical staff.

Thus, our developed methodology for predicting postoperative complications of AIO in elderly and elderly patients includes the most optimal parameters selected by ROC-analysis and represents the coefficient integration of the level of intraperitoneal hypertension and intraenteric hypertension, thrombosis rates (prothrombin time, thrombin time and activated partial thromboplastin time), endothelial dysfunction (fibrinogen and D-dimer) and markers of inflammatory response (leukocytes, eukocyte intoxication index and C-reactive protein). They served as a basis for the construction of the corresponding program "PURTAP". In this case, the prognostic probability of unsatisfactory results of AIO treatment in elderly and elderly patients is subdivided into low and high.

The tactical algorithm for the application of methods for the prevention of postoperative complications in patients of the main group was based on the data obtained using the prognostic program "PURTAP". According to the results of the study, we obtained the probability of developing postoperative complications in the form of low and high values. The third variant of the value was designated as zero probability – that is, its absence.

A comparative assessment of the timing of admission of patients to the hospital from the onset of the disease revealed that the high probability of unsatisfactory treatment results is directly related to the duration of the period. These data confirm the well-known information and indicate the logical polarity of the values obtained. Thus, a high probability of developing postoperative complications in 55.8% of cases was when patients were treated 24 hours or more after the onset of the disease. The low probability occurs in the time interval between 12-24 hours (15.4%) from the onset of the disease. In the case (3.8%) of patients who went to the clinic less than 6 hours after the onset of the disease, the probability of developing postoperative complications was equal to zero.

The type of intestine also had a certain role in increasing the likelihood of postoperative complications of AIO in elderly and senile patients. Thus, for patients with a high probability of developing unsatisfactory results of AIO treatment, a combination of lesions of the large and small intestines was characteristic (25.5%). To a lesser extent, it was noted in relation to the large intestine (21.8%) and the small intestine (20.7%).

With a low probability of developing postoperative complications of AIO in elderly and senile patients, colon damage was a priority (16.4%). At the same time, damage to the small intestine was noted in only 7.3% of patients. 9.1% of patients had no chance of developing postoperative complications. All of them were represented by colonic intestinal obstruction.

The probability of postoperative complications was high in patients with lesions of the ileum (28.8%) and the transverse colon (11.5%). Among the possible, but with a low value, lesions were the descending part of the large intestine (9.6%) and the sigmoid intestine (7.7%). Only 1.9% were affected by the caecum. In 17.3% of cases, the lesion of the descending colon had a low probability of developing unsatisfactory treatment results. Lesion of the jejunum, which was in the priority group where there was no probability of developing postoperative complications of AIO (5.9%).

The low probability of developing postoperative complications of AIO in elderly and senile patients was noted as a priority of the strangulation type of lesion (30.8%) of AIO. At the same time, in cases of a combined type of lesion, a high probability of developing postoperative complications of AIO was noted in elderly and senile patients (26.9%). The absence of the probability of developing postoperative complications of AIO in elderly and senile patients was characterized mainly by an obturation (5.8%) and strangulation (1.8%) type of lesion.

Acute adhesive intestinal obstruction (34.6%) was the basis for a high probability of developing postoperative complications of AIO in elderly and senile patients. The remaining causes of AIO were in a minor part in this predictive category. The low probability of developing postoperative complications of AIO in elderly and senile patients was characterized by the priority of the cause in the form of a strangulated hernia (23.1%). The other causes of AIO were accounted for only in 1 case. With a tumor lesion of the intestine, the probability of developing postoperative complications of AIO in elderly and senile patients was absent (34.6%).

Among the concomitant diseases with a high probability of developing postoperative complications of AIO in elderly and senile patients, diseases of the cardiovascular system (34.8%), to a lesser extent pathology from the respiratory system (26.1%) and an absolutely low value of the disease from the endocrine system (6.5%) were manifested.

For patients with a low probability of developing postoperative complications of AIO, the presence of concomitant diseases from the respiratory system (17.4%) and gastrointestinal tract (4.3%) was noted in elderly and senile patients. The remaining types of concomitant diseases were not directly related to the likelihood of developing postoperative complications of AIO in elderly

and senile patients. Among them are diseases of the genitourinary system, musculoskeletal system, and central nervous system (all 0.9%).

Thus, by randomizing the patients of the main group, depending on the probability of developing postoperative complications of AIO, it seems possible to develop differentiated therapeutic, preventive and tactical approaches to achieve improved treatment results for patients with this pathology.

The developed algorithm was based on data obtained by estimating the probability of postoperative complications in the categories high, low and absent probability.

According to the conditions of the therapeutic and diagnostic algorithm developed by us, all patients with AIO in the elderly and senile age are hospitalized in the surgical department. A collegial examination of the patient is carried out by a surgeon, a general practitioner and an anesthesiologist-resuscitator.

In the case of diagnosis of pathologies such as strangulated hernia, intestinal inversion, intestinal nodulation, that is, in which there is a complete block of compression of the mesentery vessels, the following measures should be carried out for no more than 2 hours: Ultrasound of the abdominal organs, installation of a nasogastric probe and a urinary catheter; intraperitoneal hypertension is measured; the patient begins to receive antibacterial therapy and drug correction of somatic disorders. After completing the 2-hour preoperative preparation, the patient is operated on urgently.

Elderly and senile patients with compensated AIO, who had no signs of strangulation and were diagnosed with a low probability of developing postoperative complications, were hospitalized in the emergency surgery department. For 24 hours, the patient is undergoing standard conservative therapy aimed at resolving AIO. In this period of time, additional examination of the patient is also carried out in dynamics (repeated ultrasound of the abdominal organs, contrast radiology passage through the gastrointestinal tract). In the case of AIO relief, it is indicated to continue conservative therapy and a more detailed examination. If the signs of AIO persist, the patient is operated on urgently.

Patients with decompensated AIO and possibly a high probability of developing postoperative complications are hospitalized in the intensive care unit.

Over the next 6 hours, the patient is undergoing intensive therapy, which includes the elimination of hypovolemia, detoxification therapy, correction of microcirculatory disorders. Gastric tube and urinary catheter are inserted, intraperitoneal hypertension is measured, and antibacterial therapy is performed. After completion of 6-hour preoperative preparation, the patient undergoes emergency surgery.

All operations were completed with nasointestinal intubation of the small intestine without fail. According to the indications, a probe was also transanally inserted into the large intestine. In addition to all standard resuscitation measures, immediately after surgery, prognostic monitoring of the likelihood of postoperative complications was started and specific corrections were made according to the scheme developed by us.

The absence of probability (from 0 to 25 points) of the development of postoperative complications of AIO in elderly and senile patients, all therapeutic measures were carried out in accordance with approved standards of medical and diagnostic care. The prognostic assessment of the possible development of postoperative complications was monitored daily using the PURTAP program developed by us.

With a low probability (from 26 to 50 points) of the development of postoperative complications of AIO in elderly and senile patients, standard therapeutic measures were supplemented by the use of intravenous infusions of 250 thousand units per 250 ml of 0.9% sodium chloride solution for 3 days against the background of subcutaneous administration of heparin solution in a daily dose of 5000 units.

Moreover, an oxygenated 0.9% sodium chloride solution was injected into the gastrointestinal tract via a nasointestinal probe. Oxygenation of the solution was carried out using a standard system for oxygen therapy. To do this, the distal end of the oxygen catheter was

immersed in the bottom of a container with 0.9% sodium chloride solution. Oxygen flow was supplied through it at a rate of 2.0-2.5 l/min. Oxygenation of the solution was carried out in a continuous mode throughout the entire session of enteral sanitation.

It is known that Kontrical, being a polypeptide, blocks the kallikrein-kinin system. This drug has the property of inhibiting proteases, including those that activate fibrinolysis. Its use was also justified by the presence of the effect of adjunctive therapy – coagulopathy, which are characterized by secondary hyperfibrinolysis in endotherliitis. There is also information about its effectiveness in the prevention of adhesive disease.

The combined regimen of administration of kontrical in combination with heparin also provides effective treatment of endogenous intoxication syndrome caused by proteolysis by blocking fibrinolysis, since being a direct-acting anticoagulant in blood plasma, this drug activates antithrombin III, accelerating its anticoagulant effect. Disrupts the transition of prothrombin to thrombin, inhibits the activity of thrombin and activated factor X, to some extent reduces platelet aggregation, which is very necessary for intestinal insufficiency syndrome.

The use of lavage of the intestinal cavity with an oxygenated 0.9% sodium chloride solution helps to prevent the development of enterogenic intoxication by reducing the recovery time of the barrier, evacuation and trophic function of the gastrointestinal tract. In our studies, it has been proven that hypoxic damage to the intestinal wall on the background of AIO in elderly and senile patients is one of the leading predictors of the development of enteral distress syndrome. Circulatory disorders and prolonged intestinal ischemia as a result of strangulation compression of intestinal vessels, and subsequent development of intestinal ischemia, damage to the villi of the mucous membrane occurs. All this is the starting point for the translocation of intestinal microflora into the systemic circulation and the development of postoperative complications.

With a high probability (from 51 to 100 points) of the development of postoperative AIO complications in elderly and senile patients, standard therapeutic measures were supplemented by the use of intravenous infusion of freshly frozen plasma in a volume of up to 200 ml per day, to which 10 thousand units of heparin solution were necessarily added for 3 days under further prognostic control.

Moreover, an ozonated 0.9% sodium chloride solution was injected into the gastrointestinal tract using a nasointestinal probe. Ozonation of the solution was carried out using the ozonator "O-3" (Kazakhstan). To do this, the distal end of the catheter connected to the device was immersed in the bottom of a container with 0.9% sodium chloride solution and bubbled for 45-60 minutes. After that, the solution was disconnected from the ozonator and connected for intraenteric passive infusion. Ozonation of the solution was carried out in a continuous mode throughout the entire session of enteral sanitation. The session was conducted every 12 hours until the prognostic index of low probability or its absence was reached.

It is known that transfusions of freshly frozen plasma are the basic and most important components of the treatment of endothelial dysfunction and disseminated intravascular coagulation. The inclusion of this drug in the algorithm we developed was associated with the restoration of the antithrombotic potential of the blood in patients. This also made it possible to achieve replenishment of all physiological anticoagulants and components of the plasmin and kallikrein-kinin blood systems, which is necessary for unblocking microcirculation in organs, and primarily in the focus of inflammation – the intestine. Transfusion of freshly frozen plasma should be performed under the mandatory cover of heparin.

It is known that the use of intra-cavity administration of an ozonated solution in complex therapy, due to the release of free atomic oxygen, achieves a high concentration of it, which directly has a corrective effect on inhibition of villi destruction processes and stimulation of antioxidant protection enzymes, while reducing hypoxia and ischemia. This ultimately locally blocks the inflammatory process resulting from ischemia of the intestinal wall.

Thus, the method developed by us for the prevention of postoperative complications of acute intestinal obstruction in elderly and senile patients is based on determining the likelihood of their development and the use of differentiated anticoagulant and infusion therapy (Kontrical,

freshly frozen plasma, Heparin) according to the scheme developed and justified by us, against the background of enteral decompression and lavage, oxygenated (with low probability) and ozonated (with high probability) with a warm 0.9% sodium chloride solution. At the same time, the scheme of preventive measures is subject to change depending on the change in the degree of probability of developing postoperative complications of acute intestinal obstruction in elderly and senile patients.

Before proceeding to describe the chronology of the development of methods for the prevention of postoperative complications of AIO in elderly and senile patients, it seemed necessary to give brief information about the patients of the main group in the context of the results of predicting postoperative complications.

The main group of patients consisted of 52 patients with AIO who were treated and examined in our clinic for the period from 2020 to 2023.

The distribution of patients by gender and age in the main group showed the prevalence of male patients (51.9%) in the elderly (40.4%) – Table 1. In comparison with the age category of elderly patients, there was an increase of 12.4% among men. Regarding the female sex, the priority was also noted in the senile age category by 12.4%. In general, there were 2.7 times more elderly patients than senile patients.

The priority was given to patients who went to the clinic between 24-48 hours and more than 48 hours from the onset of the disease (75%) – table 2. The least number of patients who went to the clinic before 12 hours from the onset of the disease.

In terms of age categories, among elderly patients, patients who applied to the clinic within 24 hours or more (84.2%) were in the lead, and among senile patients – in the period from 12 hours to 48 hours from the onset of the disease (92.9%).

In half of the cases, the type of intestinal obstruction in patients of the main group was colonic (Table 3). This type of acute intestinal obstruction was noted among elderly patients, whereas among senile patients, the lesion was noted to a greater extent in the small intestine. It should be noted that if the combined type of acute intestinal obstruction was minimal among elderly patients (2.6%), then among senile patients it equated to the amount of acute colonic obstruction.

In patients of the main AIO group, the ileum was more affected, and among elderly patients, this variant of the pathological process was 2.1 times greater than in senile patients.

Pathologies of the descending part of the large intestine were noted in the second place. At the same time, among senile patients, pathology of the descending part of the large intestine was noted in 50% of cases, while among elderly patients it was 2.7 times less.

In 1 (7.1%) elderly patients and in 8 (21.1%) elderly patients, the lesion was in the transverse colon of the large intestine. Patients with sigmoid bowel pathology among elderly patients turned out to be 2 times more. In isolated cases, lesions of the jejunum, caecum and ascending colon were noted. We did not notice any damage to the rectum disease among the patients of the main group.

To a greater extent, patients with acute strangulation intestinal obstruction were noted. Moreover, she was the leader among elderly patients than among senile ones (4 times more). Among senile patients, the obturation type of AIO was in the lead (2 times more than among elderly patients).

The primary causes of AIO in patients of the main group were intestinal tumor and strangulated hernia.

If in the first case a situation was created for carrying out preparatory preoperative measures, then in the second case, performing a surgical operation was a priority and there was almost no time in preparing the patient. To a lesser extent, acute adhesive intestinal obstruction, inversion and intussusception of the intestine were diagnosed. We have not noted any cases of intestinal obstruction by bile concretion among patients of the main group.

Almost half of the patients in the main group had concomitant diseases of the cardiovascular system (Table 6). This type of pathological process was noted by us both in elderly

patients (42.6%) and in senile patients (41.2%). We also noted a large proportion of patients with type 2 diabetes mellitus.

In the patients of the main group, a total of 101 varieties of the main stages of the operation were performed, which accounted for an average of 1.9 stages per 1 patient. 75 (74.3%) names of the stages of surgery were for elderly patients, and 26 (25.7%) names were for senile patients. At the same time, there were 2 surgical stages per 1 elderly patient, and 1.8 stages per 1 elderly patient.

The main share (32.7%) of surgical stages in operations for AIO in elderly and senile patients were intestinal resections. Among them were various options for colon resection and combined anastomoses. At the same time, they were in the lead among elderly patients and accounted for almost half of all stages of surgery – 46.2%, whereas among elderly patients – only 28.0% (Table 7). Partial and total enterolysis, as well as enterolysis with intestinal resection, were performed in 22.8% of cases. Among elderly patients, the proportion of such operations was 24%, and among senile patients – 19.2%. In 19.8% of cases, various stomas were applied, and in senile patients there were more of them (23.1%) than among elderly patients.

In 17.8% of patients, the removal of strangulated hernias of the anterior abdominal wall, including with resection of the intestinal loop. Such operations were performed almost 3 times more often among elderly patients (21.3%) than among senile patients (7.7%). In 6.9% of patients, such stages of surgery as straightening of the intestinal inversion and deinvagination were performed. Such operations were leading among elderly patients, exceeding the indicators of senile patients by more than 2 times (8% and 3.8%, respectively).

In the postoperative period, general complications were noted in 11.5% of patients in the main group. The structure of general postoperative complications was the same as in patients of the control group. Among the patients of the main group with general postoperative complications, cases of severe sepsis and septic shock due to the development of purulent complications in the postoperative period were in the lead. However, the proportion of this type of complications was 1.7 times less than among patients in the control group. The development of postoperative pneumonia was also 4.5 times less, and the development of hepatic-renal insufficiency was 2.0 times less.

A comparative evaluation of the effectiveness of the prognostic program developed by us was carried out on the basis of a ROC analysis between "M-SAPS" (traditional) and "PURTAP" (original).

In the preoperative period and on the 1st day after surgery, the difference in sensitivity of the prognostic coefficient was not significant ( $p > 0.05$ ). The average level of difference was from 1.1 to 1.2 times. However, starting from the 3rd day of the postoperative period and until the end of the study, the prognostic sensitivity of the PURTAP method developed by us increased ( $p < 0.05$ ) from 1.4 times to 3.7 times.

Regarding the specificity of the original method of predicting the development of general postoperative complications, a significant increase can be noted already from the preoperative period to the end of the study ( $p < 0.05$ ).

Thus, the effectiveness of the therapeutic and diagnostic algorithm developed by us, based on predicting the development of postoperative complications and carrying out specific preventive measures, made it possible, compared with the control group of patients, to avoid such common complications as pulmonary embolism, acute myocardial infarction and acute cerebral circulatory disorders.

Local postoperative complications were noted in 38.5% of cases, which was 2.2 times less than among patients in the control group.

The number of cases of postoperative wound suppuration among patients of the main group was almost the same as among patients of the control group.

The decrease in the relative reduction coefficient was only 1.1 times. Most of all (by 8 times), a decrease in the frequency of marginal necrosis with suture failure of the postoperative wound and the formation of postoperative abdominal abscesses was achieved (by 2.3 times). Also, the use of the therapeutic and diagnostic algorithm developed by us made it possible to reduce the

proportion of complications such as perforation of the deserialized part of the intestine (by 1.7 times) and the formation of early adhesive intestinal obstruction (by 1.4 times).

A comparative assessment of the sensitivity of the prognostic program developed by us regarding the development of local postoperative complications in the preoperative period showed that already at this time its level was 1.7 times higher, relative to the prototype.

Subsequently, on 1-2 days of the postoperative period, an increase in the difference was noted by 3.2 and 3.4 times, which increased the share of reliability of our development ( $p < 0.05$ ). Starting from the 3rd day of the postoperative period, we noted an increase in the sensitivity of "M-SAPS" relative to the development of postoperative local complications, which reduced the differentiated value relative to the "PURTAP" method by up to 3 times. This trend continued throughout the subsequent study periods, in which the differentiated difference between the sensitivity of "M-SAPS" and "PURTAP" decreased to 1.6 times ( $p < 0.05$ ).

Regarding the specificity of the developed program, it can be noted that already in the preoperative period, the differentiated difference relative to "M-SAPS" was 1.5 times ( $p < 0.05$ ). On 1-2 days of the postoperative period, this indicator increased to 1.9 times ( $p < 0.01$ ), and starting from the 3rd day of the postoperative period, the growth progress was noted throughout the subsequent entire period up to 3 times on the 7th day after surgery ( $p < 0.001$ ).

Thus, the effectiveness of the therapeutic and diagnostic algorithm developed by us, based on predicting the development of postoperative complications and carrying out specific preventive measures, made it possible, compared with the control group of patients, to avoid such local complications as the eventration of internal organs, anastomosis failure, necrosis of colostomy and ileostomy.

It should be noted that as a result of increasing the effectiveness of AIO treatment methods in elderly and senile patients, it led to a significant reduction in the duration of treatment and inpatient treatment. Thus, in the control group of patients, the average length of bed days was  $18.9 \pm 4.5$  days, whereas in the main group it decreased to  $12.6 \pm 2.1$  days ( $p < 0.05$ ).

Lethality among the patients of the main group was noted by us in 5 patients in chronological order it was distributed as follows.

The first fatal case was noted by us on the 2nd day after surgery, when 1 patient died with concomitant cirrhosis of the liver and diabetic nephropathy, as a result of the progression of acute liver and kidney failure. Another 1 patient died on the 3rd day of the postoperative period, due to the development of septic shock, as a result of a massive outpouring of feces from a perforated deserialized area of the large intestine. We noted a similar nature of complications in 2 patients who died on the 4th day of the postoperative period. Another 1 patient died on the 5th day after surgery as a result of the progression of postoperative pneumonia.

The sensitivity of the developed method for predicting mortality in patients of the main group averaged  $86.6 \pm 2.9\%$ , while when predicting using the "M-SAPS" method, the average value was  $56.0 \pm 6.5\%$  ( $p < 0.01$ ). The maximum (2 times) peak of differentiated significance occurred on the 2nd day of the postoperative period.

As for the specificity of the developed method for predicting mortality in patients of the main group, it averaged  $90.4 \pm 4.1\%$ , whereas when predicting using the "M-SAPS" method, the average value was only  $31.0 \pm 8.1\%$  ( $p < 0.001$ ). The maximum (3.3 times) peak of differentiated significance occurred on the 7th day of the postoperative period.

## CONCLUSION

In general, the use of the therapeutic and diagnostic algorithm developed by us, based on the prediction and prevention of postoperative complications of AIO in elderly and senile patients, has significantly reduced the incidence of deaths, especially from various pathologies associated with increased thrombosis and primarily from pulmonary embolism.

Thus, a comparative assessment of the effectiveness of the developed methods for predicting and preventing postoperative complications of acute intestinal obstruction in elderly and senile patients allowed in the main group of patients, compared with the control group, to reduce the frequency of general postoperative complications by 4.2 times, the frequency of local postoperative complications by 2.2 times, mortality from 28.3% to 9.6% and the average number of bed days from  $18.9 \pm 4.5$  days to  $12.6 \pm 2.1$  days, that is, 1.5 times. All this indicates that the goal of improving the results of treatment of acute intestinal obstruction in elderly and senile patients has been achieved.

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