

Techniques for Forecasting Acute Intestinal Obstruction Postoperative Complications in Elderly and Senile Patients

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Abstract The degree of intra-abdominal pressure was found to have an impact on the development of intestinal wall microcirculation disorders and postoperative complications in elderly and senile patients with acute intestinal obstruction. The researchers also evaluated the contribution of intra-abdominal hypertension syndrome to the development of postoperative complications in these patients. Our analysis of statistical data on the mortality rate in the general structure of emergency diseases for the period from 2000 to 2020 showed a variation in acute intestinal obstruction among elderly and senile patients ranging from 14.8% to 19.2%.

Keywords Intestinal Obstruction, Postoperative Complications, Senile Patients

1. Introduction

In elderly and senile patients, the complexity of pathophysiological changes in the body leading to severe forms of acute intestinal obstruction in the postoperative period is recognized, which in turn contribute to a high frequency of fatal outcomes [1,3,5]. According to VN Bernakinas, the presence of a large number of concomitant diseases also plays a major role in this [2,4,6].

Our analysis of statistical data on the mortality rate in the general structure of emergency diseases for the period from 2000 to 2020 showed a variation in acute intestinal obstruction among elderly and senile patients ranging from 14.8% to 19.2% [5,7,9,11].

Acute intestinal obstruction in elderly and senile patients is characterized by the vagueness of the clinical manifestations of the disease. Often difficulties arise even in determining the anamnestic onset of the disease, which is due to the chronic course of transient intestinal dysfunctions, dementia in elderly patients and the high frequency of other concomitant diseases [8,10,12].

Also, so-called false intestinal insufficiency may be characteristic of elderly and senile patients. Among young patients, this disease is almost never encountered. In 2019, a group of clinicians led by JL Perez-Lara et al. presented a

description of such a pathological condition, which is characterized by functional expansion of the colon, occurring without signs of intoxication [13,15]. Considering that intestinal obstruction is not mechanical, patients experience bloating, anxiety, nausea and vomiting. However, the duration of this pathological process can lead to death. A high level of suspicion is of paramount importance for early diagnosis and surgical intervention.

The development of substantiated criteria for differential diagnostics and early prediction of disease outcome can be considered one of the priority areas for research. In this area, multicenter studies play a major role, allowing for the development of specific practical recommendations and optimal standards for the provision of treatment and diagnostic care. The importance of such studies has been repeatedly expressed and reflected in resolutions of major international congresses and conferences [1,2,7,15]. All of the above determined the main direction of this work.

2. The Aim of the Study

Development and implementation of methods and prediction of postoperative complications of acute intestinal obstruction in elderly and senile patients.

3. Research Materials and Methods

The analysis included the results of a retrospective and

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prospective study of 105 elderly and senile patients with acute intestinal obstruction who underwent comprehensive examination and treatment at the clinic of the Syrdarya regional branch of the Republican Scientific and Practical Medical Center for Emergency Medical Care from 2016 to 2023.

A retrospective analysis was performed in 53 (50.5%) patients of the control group (2016-2019 treatment years). A prospective analysis was performed in 52 (49.5%) patients of the main group (2020-2023 treatment years).

The selection of case histories and patients for the study was carried out on the basis of criteria approved by the Ethics Committee of the Republic of Uzbekistan, including: elderly and senile age of the patient (according to the WHO criteria of 1992); diagnosis of acute complete intestinal obstruction; emergency or urgent surgery; absence of peritonitis as a complication of another destructive or purulent-inflammatory pathological process; absence of concomitant diseases in the acute stage and confirmed diagnoses of malignant neoplasms.

Elderly patients accounted for 73.3%, and senile patients accounted for 26.7%. The majority of elderly patients were male (51.4%) (73.3%).

Distribution of patients with acute intestinal obstruction depending on the time of admission to the hospital from the onset of the disease showed that among the patients of the control group, in 15.1% of cases, patients were admitted up to 12 hours from the onset of the disease, in 20.8% of cases - in the period of 12-24 hours from the onset of the disease, in 35.8% of cases - in the period of 24-48 hours and in 28.3% of cases - more than 48 hours after the disease. Among the patients of the main group, the patients who sought medical help within 24 to 48 hours (40.4%) and more than 48 hours from the onset of the disease (34.6%) prevailed. The least number of patients (3.8%) were elderly patients who sought medical help in the period more than 12 hours from the onset of the disease.

In 51.4% of patients, acute intestinal obstruction was caused by pathology of the large intestine. Moreover, among patients in the control group, this indicator was 53.8%, and among patients in the main group - 50.0%. Combined forms of damage to the small and large intestines averaged 6.7% and were predominantly represented among patients in the main group.

The predominant (37.1%) lesion was the ileum, descending (23.8%) and transverse (21.9%) sections of the large intestine. At the same time, among patients in the control group, in 35.8% of cases, the lesion was the ileum, and among patients in the main group, this indicator was higher and equaled 38.5%.

Distribution of patients depending on the type of acute intestinal obstruction showed the same leading values for obstructive and strangulation intestinal obstruction (41.9% each). At the same time, in the control group, patients with obstructive intestinal obstruction prevailed (43.4%), while in the main group - with strangulation (46.2%). The least number of patients were with combined acute intestinal obstruction (16.2%).

The main cause of acute intestinal obstruction was intestinal tumor (37.1%) and strangulated hernia of the anterior abdominal wall (33.3%). This distribution pattern of patients depending on the cause of acute intestinal obstruction was also noted among patients in the control (35.8% and 32.1%, respectively) and main (38.5% and 34.6%, respectively) groups.

Almost half of the patients (41.4%) had concomitant cardiovascular diseases. The same can be noted in relation to patients in the control (42.4%) and main (40.5%) groups. Further, in descending order, diseases of the gastrointestinal tract (14.5%), central nervous system (11.8%), diseases of the genitourinary (9.9%), musculoskeletal (8.8%), respiratory (7.3%) and endocrine (6.1%) systems were diagnosed.

Hartmann's operation and intestinal stomas were performed in equal proportions (10.5% each). Enterolysis (partial or total) was performed in 16.2% of cases.

In the control group of patients, the volume of laboratory tests performed was based on the protocol of standards for providing medical and diagnostic care to patients with acute intestinal obstruction, as well as special research methods. Unification of a number of parameters was carried out using special integral scales, including "M - SAPS" (I.E. Soloviev, 2000). This scale reflected the clinical condition of the patient and was used for randomization of the control group of patients and prediction of complications and mortality.

In order to develop methods for predicting postoperative complications of acute intestinal obstruction in elderly and senile patients, we conducted an additional study of the following blood parameters: prothrombin time (sec), thrombin time (sec), activated partial thromboplastin time (sec), fibrinogen (g/l), D-dimer (mcg/ml) and C-reactive protein (mg/l).

Instrumental diagnostic methods included plain and contrast radiography of the abdominal organs, complex ultrasound examination of internal organs, and measurement of intraperitoneal and intraenteric hypertension.

To measure intraperitoneal hypertension, a traditional method was used - determination through a catheter installed in the bladder. In this case, based on the results of the studies, 4 degrees of intraperitoneal hypertension were distinguished, which were subdivided according to the classification proposed by B.R. Gelfand et al. in 2008: normal value - from 0 to 11 mm Hg; I degree - 12-15 mm Hg; II degree - 16-20 mm Hg; III degree - 21-25 mm Hg; IV degree - above 25 mm Hg.

Intraenteric hypertension was determined using a modified method by Y. Avitzur and G. Courtney - Martin (2016) by passive infusion and measurement of fluid levels through a nasointestinal tube using a low-pressure measuring device.

The results obtained as they were received were systematized in a consolidated unified table in the Microsoft program. Excel, processed using the Statistica program for Windows (version 5.12). In accordance with the goals and objectives of the study, elementary statistical indicators (mean values, errors of means, standard deviations, range of data dispersion) were calculated, and data scatter diagrams were constructed and visually analyzed. Indicators were compared using signs of nonparametric criteria.

The reliability of differences between samples, close in nature of distribution to the norm, was established by parametric Student's criterion with a 95% reliable interval of probability. The criterion of statistical reliability of the obtained conclusions was considered to be the generally accepted value in medicine $p < 0.05$.

The results obtained were systematized as they were received in The prognostic value of the developed diagnostic program was determined using the method described by R. Fletcher (2008) based on the calculation of the frequency of occurrence of false negative and positive, true positive and negative results; specificity and sensitivity of the test, as well as the positivity of reliability or expected value. For this, we used ROC analysis.

ROC analysis, or curve, was used by us to present the results in a binary system. For this purpose, classes were divided into two types - with positive and negative outcomes. This type of analysis allowed us to identify the number of correctly classified positive examples from the number of incorrectly classified negative examples.

4. Results and Discussion

In our opinion, the analysis of pathogenetic mechanisms of the relationship between such known manifestations of ACI as IPG and IEG with the identified general clinical and laboratory manifestations of this disease will allow us to develop methods for predicting the development of unsatisfactory results and postoperative complications of this disease in elderly and senile patients.

After a retrospective analysis of the features of the postoperative course in ACI in elderly and senile patients, the average value of all the parameters under study was identified. However, as is known, identifying 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 curve of changes in IPG and IEG in patients of the above-mentioned subgroups showed the opposite directions of their changes.

It should be noted that IPG in patients of the first subgroup, throughout the entire study, progressively decreased, whereas in patients of the second subgroup, after a moderate decrease, starting from the 2nd day of the postoperative period, it tended to gradually, and in subsequent periods - progressively increase its value. This trend reduced the correlation dependence between these indicators ($R = -0.381$). At the same time, IEG did not show signs of decrease in patients of the second subgroup and, accordingly, only increased, which accordingly increased the significance of the inverse correlation relationship between the first and second subgroups of patients ($R = -0.789$).

We noted a different picture of the graphical curve based on the general clinical indicators of OKN studied.

The temperature curve had a moderate inverse correlation ($R = -0.403$) between the subgroups, which was associated with double leveling of the dynamics on the 1st and 3rd day of the postoperative period. However, in the case of analyzing the level of SBP, the value of the correlation ($R = -0.368$) between patients of both subgroups was the same. An even smaller correlation value could be noted in relation to the respiratory rate ($R = -0.231$). Heart rate was distinguished by a high inverse correlation ($R = -0.943$) between patients of the first and second subgroups.

Graphical analysis of the dynamics of changes in general clinical laboratory and biochemical blood parameters in patients of different subgroups with acute intestinal obstruction by leukocytes, LII and hematocrit had an identical curve with coinciding 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 ACI in relation to creatinine ($R = 0.597$). In patients of the first subgroup, a progressive decrease in creatinine levels was noted. At the same time, in patients of the second subgroup, we did not note such a critical decrease.

We noted a low direct correlation dependence among patients of two subgroups for the plasma potassium index ($R = 0.259$). This was due to the double leveling of the index in the 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 potassium level in the blood plasma was amenable to correction, but this did not happen in the second subgroup.

The rate of thrombus formation in patients of the first subgroup decreased on average, with the exception of PTV. In contrast, in patients of the second subgroup we noted only a tendency to accelerate the processes of thrombus formation.

Thrombus formation time indicators showed that PTT had a high direct correlation between the dynamics of both subgroups ($R = 0.743$).

The closeness of the APTT parameters between patients of the first and second subgroups in the preoperative period and on days 1-2 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 the tendency to thrombus formation was maximally high in patients of the second subgroup.

At an intermediate level, but with an inverse correlation, there was TV between patients of the first and second subgroups ($R = -0.611$).

The main indicators of endothelial system disorders had a direct correlation dependence. In this case, the dynamics of changes in CRP can be highlighted in the first place ($R = 0.940$).

The next in correlation significance were D- dimer ($R = 0.885$) and fibrinogen ($R = 0.405$). Given such high

parameters of correlation dependence, it should be noted that in patients of the second subgroup, the level of vascular endothelial damage indicators was higher than in patients of the first subgroup.

The next type of analysis was reduced to conducting a comparative cloud coverage of the dependence of the studied parameters depending on the dynamics of changes in the level of IPG and IEG in patients of the first and second subgroups.

In patients of the first subgroup, the cloud coverage of the IPG level showed its dependence on such studied parameters as the number of leukocytes, LII, CRP, pulse, creatinine and body temperature. In this segment of the virtual cloud, the level of IPG dependence was not large and was below the average value.

The growth of this value occurs in relation to such indicators as SBP, hematocrit, D-dimer, fibrinogen, plasma potassium, and all parameters of the rate of thrombus formation. All of them were dependent on IEG in patients of the first subgroup.

In patients of the second subgroup, the cloud coverage of the studied parameters was similar between IPG and IEG. All parameters at the maximum significant level of the correlation coefficient were attributed specifically to the disruption of the endothelial system and acceleration of the thrombus formation process.

Thus, the studies conducted at this stage have shown that the patients of the second subgroup experience an increase in IEG and IPG. 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 we can highlight violations of the motor-evacuation, secretory and absorption functions.

It is known that long-term IEG 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 a breakdown of the barrier function of the intestine. This process in a more severe form occurs in patients with colonic obstruction as a result of early translocation of microorganisms from the intestinal cavity first to the local, and then to the systemic bloodstream through the portal vein and the lymphatic system. In such a situation, the intestine becomes a source of intoxication. This leads to aggravation of homeostasis, which undoubtedly contributes to the formation of a vicious circle of pathological processes and creates conditions for the development of postoperative complications and mortality. Such a mechanism of ongoing 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 nitroxidergic innervation system, which participates in the regulation of motility and secretion, in perimembranous digestion and absorption.

All nitroxidergic regulation is provided by auto- and paracrine mechanisms of nitric oxide synthesis by intramural neurons of the enteric nervous system, epithelium lining the digestive tract, and muscle tissue cells - the endothelium of microvessels.

Based on the conducted multivariate analysis of the main studied parameters, we were able to construct a ROC analysis diagram, which allowed us to identify the value of the main prognostic parameters. This method also allowed us to identify the priority of independence in the development of unsatisfactory results of the treatment of acute coronary artery disease in elderly and senile patients.

As shown in this graphic division, the main parameters that are distinguished by their maximum reliability can be identified. They are characterized by two stages of the processes occurring in the postoperative period: in the first phase, the markers of the inflammatory reaction that we studied were more active in the ROC curve, and in the second phase, the indicators of the rate of thrombus formation (thrombin and prothrombin time) and endothelial dysfunction (D-dimer, CRP, fibrinogen). These data formed the basis for the formation of a matrix of possible development of an unsatisfactory result of the treatment of acute coronary artery disease in elderly and senile patients. The obtained digital matrix became base for creations software product under called "PURTAP" (Prognosis of Unsatisfactory Results of Treatment of Acute Intestinal Obstruction in Elderly and Senile Patients). In this case, we divided the probability of developing unsatisfactory results of treatment of AIO into low and high. In the event of no coincidence of the studied criteria with the developed software product, the probability of a violation of the development of postoperative complications, which are based on a violation of microcirculation in the intestine.

The software product we have developed is available for wide implementation in practical healthcare, as it can operate on any computer platform in various modes. This in turn allows minimizing the estimated time on the part of medical personnel.

Thus, the method of predicting postoperative complications of acute coronary artery disease in elderly and senile patients developed by us includes the most optimal parameters selected using ROC analysis and represent the coefficient integration of the IPG and IEG levels, thrombus formation rate indicators (PTV, TT and APTT), endothelial dysfunction (fibrinogen and D-dimer) and markers of the body's inflammatory response (leukocytes, LII and CRP). They served as the basis for constructing the corresponding program "PURTAP". In this case, the prognostic probability of unsatisfactory results of acute coronary artery disease treatment in elderly and senile patients is divided into low and high.

5. Conclusions

The developed method for predicting postoperative complications of acute coronary artery disease in elderly and senile patients includes the most optimal parameters selected using ROC analysis and represent the coefficient integration

of the IPG and IEG levels, thrombus formation rate indicators (PTV, TT and APTT), endothelial dysfunction (fibrinogen and D- dimer) and markers of the body's inflammatory response (leukocytes, LII and CRP). They served as the basis for building the corresponding program "PURTAP". In this case, the prognostic probability of unsatisfactory results of acute coronary artery disease treatment in elderly and senile patients is divided into low and high. The developed software product is available for wide implementation in practical healthcare, as it can function on any computer platform in various modes. This in turn allows minimizing the estimated time on the part of medical personnel.

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