ADHESIVE OBSTRUCTION OF THE SMALL INTESTINE: FEATURES OF DIAGNOSIS AND TREATMENT IN THE CONTEXT OF MINIMALLY INVASIVE TECHNOLOGIES (REVIEW)

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Abstract

The review presents a modern view on the features of the course and treatment of adhesions of the small intestine, based on modern epidemiological data, accepted guidelines for the diagnosis and nature of the treatment of different categories of patients. It is noted that adhesive intestinal obstruction is a symptom complex due to violation of the movement of contents through the intestines due to the presence of adhesions in the abdominal cavity after operations and injuries. Attention is drawn to the peculiarities of diagnostics of various forms of the disease, which include the leading clinical symptoms, data of X-ray methods (X-ray and CT of the abdominal cavity), MRI, assessment of various biomarkers, indicators of the severity of the patient's condition. It is noted that at present the primary task in solving this problem is to study several controversial issues in this area. The main provisions of measures for the treatment of adhesive obstruction of the small intestine, based on the principles of non-surgical treatment in a certain category of patients, the use of surgical interventions strictly according to indications, especially in patients who require repeated operations, were highlighted. Among them, special attention is paid to the features of open and minimally invasive surgical interventions. It is emphasized that at present, minimally invasive surgical interventions perform the main tasks of surgical treatment for adhesive ileus of the small intestine and significantly reduce surgical trauma in comparison with "open" methods of treatment, but these interventions have not widespread in the world yet.

Keywords: *adhesive obstruction of the small intestine, epidemiology, diagnostic, surgical treatment, open surgery and laparoscopy.*

Introduction.

Adhesion disease (AD) is the most common disease of the small intestine and according to 87 studies involving 110,076 patients, the incidence of adhesive obstruction of the small intestine (ASBO) after all types of abdominal surgery was 2.4% [1]. There are more than 300,000 ASBO hospitalizations in North America each year, amounting to 850,000 days of inpatient care, costing more than $ 1.3 billion in medical expenses and contributing to more than 2,000 deaths per year. The first data on the induction of adhesions was in the animal model von Dembowski published in 1889, and in the following, more than 120 years, extensive research was conducted both in vitro and in vivo on the causes of its occurrence [2,3]. Over the last decade, the availability of limited clinical trials has caused some uncertainty in the world regarding best practices with further international differences in the assessment of treatment outcomes in patients with hypertension. Nowadays, there is a diagnostic dilemma as to how to distinguish between ASBO and its other causes, as well as how to distinguish between ASBO, which requires urgent surgery, and ASBO, which can be successfully treated conservatively.

It should be noted that ASBO after abdominal surgery and trauma is a well-known disease that still has problems in terms of prevention, diagnosis and treatment, despite the overall improvement in treatment. Good surgical techniques, such as laparoscopy and antiadhesive barriers during the initial operation,

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seem to reduce ASBO, but reports have conflicting results and provide only general (CT) has improved the diagnosis of SBO in general, but it cannot be performed on every patient with severe vomiting and dehydration, shock, renal failure, etc., and it often fails to accurately identify adhesions as the cause of obstruction. In addition, the world is discussing the issue of predicting what treatment should be established at the beginning for the success of treatment of patients after contrast-enhanced CT without strangulation of the small intestine. As it is well understood that in patients with strangulation it is necessary to perform emergency surgery. In terms of surgical treatment, laparoscopy has become popular but is also associated with an increased risk of iatrogenic complications. In particular, it is difficult to identify patients who may benefit from laparoscopic adhesiolysis and who should use open surgery nowadays.

Epidemiology

Intra-abdominal adhesions after abdominal surgery and trauma are a serious unresolved problem worldwide: in patients with abdominal pain, ASBO is a common cause, accounting for about 4% of all admissions to emergency departments and 20% of all emergency surgical procedures [4]. Currently, it is estimated that fibrous cords in the abdominal cavity are found in 93% of patients who underwent abdominal surgery and significantly complicate the operation for SBO [5]. According to some data, adhesions are the cause of SBO in 74% of adults with this pathology and in about 30% of patients with readmission after intra-abdominal surgery after four years after surgery [6]. Today, it remains unclear whether the increase in the number of laparoscopic intra-abdominal operations led to a decrease in postoperative complications such as ASBO, although there were some reports of a decrease in adhesion formation after laparoscopy, these studies were controversial [7, 8]. In particular, some of the available data indicate that this reduction in adhesions does not necessarily mean a decrease in small bowel obstruction associated with adhesion. A recent randomized multicenter study comparing laparoscopic versus conventional approaches in colorectal cancer surgery indicated that there was no difference between the two groups for complications associated with obstruction during the 3-year follow-up consultation and study [9]. In a study on the frequency of hospitalizations for ASBO patients and operated with suspected acute appendicitis, the laparoscopic approach led to significantly lower rates than open surgery. However, it was noted that the incidence of ASBO after surgery was low in both groups [10].

Diagnosis

Since small bowel obstruction (SBO) occurs in about 5 cases per 100 thousand of the population, diagnostic errors at the prehospital stage reach about 51%, and in the hospital up to 19%, the relevance of the diagnosis of its is beyond doubt. With mechanical ASBO, occlusion of the lumen of the intestinal tube occurs at some level, which leads to a violation of the transit of intestinal contents. With strangulation ASBO, the blood circulation of the person involved in the pathological process suffers first of all [11]. A section of the intestine, which is associated with compression of the mesenteric vessels due to infringement, volvulus or nodulation, and which causes a rather rapid, within several hours, development of necrobiotic processes in the wall intestines. Timely diagnosis is essential to prevent mortality from late surgical treatment [12], as the causes for the death of patients in 24 - 58% of them are the development of necrosis of the intestine, severe pathological changes in water-electrolyte metabolism, multiple organ failure and sepsis.

The variety of forms and pathogenetic features of SBO cause polymorphism of clinical symptoms and create the basis for diagnostic difficulties and delayed treatment. In this regard, a huge role, along with clinical and laboratory data, belongs to instrumental diagnostic methods, the reasonable and timely use of which provides successful resolution of treatment issues. Since up to 80% of SBO cases are resolved with conservative treatment [13], it is important to identify patients in diagnostic procedures who can be treated conservatively for the resolves of obstruction to prevent unnecessary surgery and the risk of a new disease associated with it and developing. Moreover, such an approach aims to prevent new adhesions in the abdominal cavity after surgery [14]. Technological advances in diagnosis have significantly improved the ability to identify such patients for whom conservative treatment is likely to be more effective, but the accurate and early identification of those patients

who will ultimately require surgery remains a challenge, especially if the clinical symptoms of the disease are not entirely clear.

The 2010 Bologna Guidelines for the Diagnosis and Treatment of ASBO indicate that all patients with suspected disease should be evaluated with abdominal x-rays (level 2b). X-ray polypositional examination allows, in the shortest possible time and with high efficiency, to ascertain obstruction and, in some cases, diagnose its cause. The effectiveness of the method is high and according to numerous studies it reaches 87% in ascertaining the fact and the level of obstruction. For small bowel obstruction, it is typical to have swollen bowel loops of more than 3 cm above the obstruction, containing gas and fluid levels (Kloyber's bowls; fluid levels are usually wide with a low gas bubble), transverse striation corresponding to the Kerkring folds, and the absence of contents in the colon. The sensitivity of the method in solving this diagnostic problem is 60-85% [15]. According to the Bologna Recommendations of 2013, the use of X-ray examination of the abdominal cavity as soon as possible will allow paying attention to those patients who require conservative treatment upon admission to the hospital since there are currently several tools to improve the effectiveness of NOM, as well as to clarify the indications and timing for surgery [16]. On the contrary, W. Laméris et al. [17] showed that the assessment of patients with acute abdominal pain using standard radiography is useless to improve the above sensitivity and specificity, suggesting that it does not play any role in the diagnostic examination or its role is not so important.

Ultrasound of the abdominal organs allows you to effectively supplement the diagnostic program and ascertain AIO in 72-94% of patients, its level in 66.7-80%, the cause in 48-63% of patients and assess the functional state of the intestine. Typical ultrasound signs of intestinal obstruction are: 1) expansion of the bowel diameter more than 25 mm, associated with the deposition of fluid in its lumen; 2) thickening of the intestinal wall due to its edema; 3) visualization of the folds of the mucous membrane of the small intestine; 4) availability free fluid in the abdominal cavity; 5) pendulum movement of the contents of the intestine.

In cases with suspected SBO, using ultrasound, one can distinguish between partial intestinal obstruction and complete mechanical obstruction, since peristalsis can be visualized using this method, among other things [18]. The detection of fluid in the abdominal cavity from the intestinal lumen by ultrasound is of great clinical importance since this instrumental sign is usually used to make clinical decisions, including which surgical approach will be most tolerable and useful for a particular patient [19]. Contrary to the findings of this study, the Bologna Guidelines state that the value of ultrasound is limited (level 2c) because the accumulation of air in the digestive tract in ASBO limits the transmission of ultrasound, making it a useful diagnostic tool only when used by technical experts [16].

The use of computed tomography (CT) as an additional imaging modality to evaluate all patients after inconclusive use of simple radiological techniques has been very helpful in diagnosing SBO [20]. Computed tomography with double (oral and intravenous) allows to determine the localization and cause of obstruction, the diameter and pneumatosis of the intestine, the presence and amount of effusion in the abdominal cavity, to assess the arterial blood supply to the organ (celiac trunk, superior mesenteric artery, inferior mesenteric artery), to diagnose other abdominal pathology. CT has high sensitivity and specificity for SBO (> 92% and 93%, respectively); in addition, additional information provided by CT can help detect signs of ischemia or bowel perforation [21]. D. Maglinte et al. [22] reported that CT can be as sensitive as conventional abdominal x-rays to distinguish small bowel obstruction and strangulation in SBO, and this has been shown (detection rates 86% versus 82%). It is important to note that patients with possible signs of ischemia remain a major clinical problem for diagnosis [23].

Evidence suggests that magnetic resonance imaging (MRI) plays a role in the diagnosis of ASBO, but the method has not yet found a definite place in the diagnostic algorithm for SBO. According to some researchers, it is comparable in efficiency with computed tomography and ultrasound - the sensitivity in the detection of AIC is 86-100%, and the specificity is 90-100%. Although MRI provides approximately the same sensitivity and specificity for diagnosing all causes of SBO in patients as CT, the current recommendations for MRI in standard clinical practice have not been applied in patients

with SBO. The main advantage of the method is its high resolution, the ability to capture morphological changes in the wall of the small intestine, characteristic of a tumor, inflammation, ischemia andnecrosis, as well as to determine the motor activity of the small intestine. However, MRI, despite its low invasiveness and potentially high efficiency in the diagnosis of AIO, has not yet found wide application in clinical practice. This is due not only to the high cost of the equipment and the study itself, the complexity of its implementation in an urgent situation, but also, most importantly, lack of sufficient clinical material and experience to determine the place of these studies in the diagnostic algorithm for intestinal obstruction [24].

Interestingly, the combination of a dynamic X-ray approach with assessing the passage of contrast through the small intestine with a water-soluble contrast agent can help predict whether they can be treated conservatively if clinical signs of ASBO are present or whether surgery is required [25]. This study is indicated in all cases of small bowel obstruction in the absence of signs of strangulation and peritonitis. The method allows you to confirm with high accuracy the fact of intestinal obstruction, determine the severity, level of obstacle (high, low), the nature of intestinal obstruction (mechanical, functional) and the dynamics of the course of the disease. It should be noted that water-soluble contrast is not only a useful diagnostic tool, but also a therapeutic tool, which, due to its hyperosmolarity, has a therapeutic effect due to its ability to "absorb" fluid into the lumen, reduce swelling of the intestinal wall, eliminate obstruction and hyperperistalsis [26]. A randomized controlled trial J. Burge et al. [13] also showed a noticeable therapeutic effect when using gastrographin as a contrast agent for evaluating patients with ASBO: accelerated elimination of obstruction was observed in 75% of patients within 24 hours after contrast using. Although the precise benefits of contrast agents in reducing the need for surgery have not yet been systematically proven, a study has shown a link between their use and reduced length of hospital stay [27]. There is no doubt that ASBO patients, whose contrast does not penetrate the colon, require urgent surgical treatment.

Conservative therapy aimed at resolving SBO is carried out in patients with an obstructive form of SBO when the absence of pronounced introductory electrolyte disturbances and short (up to 36 hours) terms of the disease. Type of conservative therapy, its duration depends on the cause, the severity of the disease, the level of obstruction, features clinical picture. Very often in these situations it is difficult to distinguish obturation with strangulation of the small intestine, despite the use of many instrumental diagnostic methods in these cases. In recent years, several serum markers have been identified that can be detected in small bowel entrapment [28, 29]. These markers include factors released by damaged enterocytes, such as intestinal fatty acid-binding protein (I-FABP) and α-glutathione S transferase (α-GST). Enterocytes are rapidly damaged in the early stages of intestinal health and these biomarkers can be easily detected in both urine and plasma, which opens up promising opportunities for their use as markers of early detection of small bowel strangulation. Several studies on the equation of the cytosolic protein α-GST in plasma have shown the level of this protein gave various results as a diagnostic tool with a sensitivity of 20% to 100% and a total specificity of 85% [29, 30]. Because of this, α-GST might be also useful as an indicator for an effective treatment, as were evidenced by the authors of the study. Another biomarker I-FABP is a cytosolic protein found in tissues that are involved in the absorption. It was shown that I-FABP is a good and early indicator for damage to the small intestine, making it a very useful indicator in patients with suspected strangulation of the small intestine [31]. According to some studies, patients with obstruction of the small intestine had lower levels of I-FABP in serum or urine compared to patients with strangulation [32, 33]. Perhaps, I-FABP may be a significant indicator in the selection of candidates to continue to conservative treatment and choice those of patients to surgery of the small intestine. Also, the intestine includes D-lactate and Claudine [34, 35], but the low specificity of D-lactate and absence of important evidence of the role of claudin-3 in the diagnosis of different types of SBO made it difficult to determine the clinical potential of these biomarkers. However, the diagnostic model for the diagnosis of SBO, where in addition to these markers for prediction to include older age, large-volume drainage through of the nasogastric tube after three days

of the treatment was considered.

Laboratory assessment of patients with suspected small bowel obstruction should include a complete blood count and metabolic panel, taking into account the development of hypokalemic, hypochloremic metabolic alkalosis in all forms in patients during the progression of the disease. Increased levels of leukocytes in the blood, hemoglobin and hematocrit, blood urea nitrogen correspond to the degree of dehydration of patients. Unfortunately, all these data do not help to identify patients with small bowel strangulation. It should be noted that the evaluation of complete analysis of blood, electrolytes, blood urea nitrogen and creatinine, C-reactive protein, serum lactate, lactate dehydrogenase (LDH) and creatine kinase CC) is of great importance in this category of patients and systemic signs of fever, arthritis, tachycardia hypothesis, change in mental state, etc.) additional laboratory tests should include arterial blood gases together with the assessment of clinical symptoms of ASBO [36]. Unfortunately, the treatment of ASBO is less consistent transmissions for the differentiation of intestinal compression, which require immediate medical treatment [37]. Laboratory tests may be more useful for assessing the level of systemic response than confirming clinical results. The types of markers chosen as the number of key factors and the level of cardiovascular resuscitation cannot distinguish between choices caused by ASBO and those caused by other inflammatory conditions [28]. In the case of intestinal diseases due to suffocation of markers, there can be no variety of useful conservative treatment and those who need treatment [39]. However, when there are intestines, the level of serum lactate, LDH and CC may increase due to intestinal hypoperfusion. However, therefore LDH and CPK increase in any average condition, they, therefore, are nonspecific. Instead, the level of another status, the number of which is not enough to spread the intestine, is already well established to increase lactate is very sensitive, not specific to my intestines, but in the case of ASBO [40, 41]. As a result, studies can simply indicate the overall severity of the disease and can be used to support or link inappropriate treatment choices only in the context of several other clinical and instrumental data to detect the location of obstructions and complications of further NOM: the presence of ascites, CT such as ischemia, necrosis, and perforation [42].

Treatment. For patients on ASBO without signs of small bowel strangulation, peritonitis, or severe intestinal insufficiency, there is strong evidence to support the effectiveness of non-surgical treatment (NOM). The presence of free intraperitoneal fluid, oedema of the mesentery and its increase, signs of devascularized small intestine during CT, frequent vomiting in the anamnesis, severe abdominal pain on a visual analogue scale > 4, the presence of protective abdominal tension on palpation, increased white blood cell count predicts the need for laparotomy [16]. The authors point out that the selection of patients who may benefit from early surgery should be done with caution, especially in patients with recurrent episodes of ASBO, many previous laparotomies for adhesions and long-term conservative treatment [16]. Data from many studies have shown that NOM can be successful in approximately 90% of patients without peritonitis and small bowel ischemia [43]. In contrast, delayed surgery in patients with signs of small bowel ischemia creates an increased risk of intestinal resection for many patients. A retrospective analysis by the authors showed that only 12% of patients underwent bowel resection with conservative treatment time or waiting time before surgery ≤ 24 hours, and with waiting time before surgery ≥ 24 hours, 29% of patients required bowel resection [44]. D. Schraufnagel and co-authors [45] showed that in their large cohort of patients, the incidence of complications, resections, prolonged stay and death was higher in patients admitted with ASBO and who was operated on after some time≥ 4 days. The recommendations of the World Society of Emergency Surgery in 2013 stated that NOM in the absence of signs of strangulation or peritonitis can be extended to 72 hours in most patients, and after 72 hours of NOM without positive dynamics, surgery was recommended [16]. It should be noted that currently there are no objective criteria to determine those patients who are likely to respond only to conservative treatment because less clear is the way to predict disease progression to strangulation of the small intestine, or improvement in conservative treatment ASBO. To improve our understanding of this, some authors suggested using the following signs as fairly objective predictors of the impossibility

signs of complete ASBO (no signs of air in the colon), increased serum creatine phosphokinase, and an increase ≥ 500 ml of the liquids from the nasogastric tube on the third day of NOM [16]. It is clear that at any time if there are signs of strangulation of the small intestine, peritonitis or severe intestinal damage due to intestinal ischemia and perforation, NOM was recommended to stop with further surgery. Randomized clinical trials have shown that there are no differences in clinical efficacy between the use of nasogastric tubes compared with the use of long bowel decompression using a long tube [46]. In any case, early decompression of the digestive tract is useful for the initial treatment of these patients together with intravenous fluid and correction of electrolyte imbalance [47]. The introduction of gastrografin into the lumen of the small intestine to study the level of its obstruction was positive in treatment, as it activates the movement of water in the lumen of the small intestine, reduces swelling of the small intestine and can increase smooth muscle activity, which can create effective peristalsis and overcome obstruction [48]. The use of gastrografin and its positive therapeutic effect has been demonstrated in several randomized trials and meta-analyses. However, three recent meta-analyses did not show an advantage in waiting longer than 8 hours after administration and showed that contrast in the colon for 4-24 hours is a precursor and a sign of positive dynamics in the treatment of ASBO patients. Moreover, for patients who underwent HOM, the introduction of gastrografin reduced the need for surgery and length of hospital stay [49]. However, the use of gastrografin did not affect the recurrence rate of ASBO or recurrences that required surgery. Oral therapy with magnesium oxide and simethicone can be considered as helping patients with partial ASBO with positive results in reducing hospital stay [50], and the use of hyperbaric oxygen therapy may be an option for treating patients at high anaesthesia risk who should avoid surgery [51]. Current studies and guidelines do not agree on the risk of recurrence of obstruction, but factors associated with a higher risk of recurrence include age < 40 years, adhesion disease, and postoperative surgical complications [52].

Open operation

Until recently, open surgery was the best method for surgical treatment of ASBO in case, of suspected strangulation of the small intestine or after unsuccessful conservative treatment, and laparoscopy was offered only to a selected group of patients (preferably in the first episode of ASBO). More recently, the use of laparoscopy has become widespread and has become the best choice in treatment centres. Jacek Szelig and Marek Jackowski [53] in the review wrote that there was no statistically significant difference between open and laparoscopic adhesiolysis in the number of intraoperative bowel injuries, wound infections, or overall mortality. Conversely, there was a statistically significant difference in the incidence of general and pulmonary complications and a significant reduction in long-term obstruction. The authors concluded that in patients with SBO, laparoscopy is a technique showing its advantages resulting from a minimally invasive approach but SBO is still a condition where the use of laparoscopy is limited mainly to selected cases such as SBO caused by single adhesions or foreign bodies. A basic limitation of using this technique is advanced and complicated SBO and lack of sufficient technical skills of the surgeon. However, to date, no randomized controlled trials are comparing open-label laparoscopic adhesiolysis, and both the exact indications and the specific results of laparoscopic adhesiolysis in ASBO remain poorly understood. The only randomized controlled trial to provide evidence of level Ib evidence to assess the use of laparoscopy in the treatment of adhesive obstruction of the small intestine is currently ongoing, the main endpoint of which is the duration of postoperative hospital stay, and duration of hospitalization, frequency of ventral hernia and recurrence of small bowel obstruction during long-term follow-up are secondary and tertiary endpoints [54].

Laparoscopy

Laparoscopic adhesiolysis in small bowel obstruction has several potential benefits, including less postoperative pain, faster recovery of bowel function, shorter hospital stays, shorter recovery times, allowing you to return to full activity earlier, fewer wound complications, and reduced postoperative adhesions [15].

A recent extensive population-based analysis of selected indicators involving 6,762 patients showed [55] that laparoscopic treatment of ASBO was associated with lower rates of postoperative complications, including infectious,

and intraoperative transfusion, and an overall reduction in resource utilization compared to laparotomy and length of stay. hospitals. Laparoscopic treatment of ASBO was not associated with a significant difference in surgery duration, recurrence rate, or mortality within 30 days of surgery. Subsequent reports have confirmed that laparoscopic surgical treatment of ASBO is associated with faster recovery of the gastrointestinal tract, shorter length of stay (LOS) and reduction of overall complications compared to open surgery, without significant differences in the duration of surgery [56]. In addition, after the exclusion of bowel resection as a stage of surgery, secondary results continued to favour the use of laparoscopy over laparotomy. Although laparoscopic adhesiolysis requires a certain set of skills and may be unacceptable to all patients, it demonstrates a clear advantage in 30-day morbidity and mortality (lower incidence of serious complications and local infectious complications after incisions), as well as shorter postoperative LOS and surgery. In an analysis of the treatment of more than 9,000 patients in the United States, the authors concluded that increasing the use of laparoscopy may be a possible way to reduce costs and improve outcomes in this patient population [57].

The selection of patients for laparoscopic treatment of ASBO is still a controversial issue nowadays. At a recent consensus conference [58], a group of experts recommended that the only absolute criteria for excluding laparoscopic adhesiolysis in ASBO were those related to the use of pneumoperitoneum (eg, hemodynamic instability or cardiopulmonary disorders); all other contraindications are relative and should be evaluated in each case depending on the laparoscopic skills of the surgeon. In addition, it is necessary to take into account the research results, which indicate that the immune response correlates with markers of inflammation associated with the severity of the injury, and as a result, the extent of surgery may affect clinical outcomes due to adverse action of molecular factors that may eventually cause systemic inflammation reply. Therefore, the benefits of using minimally invasive surgery and avoiding laparotomy in ASBO are even more relevant in weak patients [59].

Conclusion.

Despite significant advances in the diagnosis of ASBO, the problem of determining how to most effectively and safely treat patients in all cases of manifestation of this disease remains. Objective instrumental or laboratory indicators that would allow the surgeon to reliably select the most appropriate tactics in each situation in the analysis of existing literature are not found. Through numerous efforts, the ability to identify patients in clinical practice who require conservative treatment has improved significantly. At the same time, there remain the problems of early identification of patients who require urgent surgical intervention. The choice of an adequate volume of intervention is made intraoperatively and based on visual evidence of intestinal viability. Data analyzing prognostic markers of adverse treatment outcomes are contradictory and dictate the need for further research, as well as the use of various markers, which may improve the diagnosis and early detection of patients with small bowel strangulation in the opinions of lots of surgeons

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The author has no ethical conflicts to disclosure.

Consent for publication

The author gives her consent to publication.

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