Review

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Systematic Review of the Clinical Efficacy of Various Terms of Non-Surgical Treatment in Patients With Acute Adhesive Intestinal Obstruction

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BACKGROUND The question of the duration and volume of conservative measures in patients with acute adhesive intestinal obstruction (AAIO) remains the subject of numerous discussions.

AIM OF STUDY To evaluate the efficacy and safety of various periods of conservative therapy in patients with AAIO using a systematic review.

MATERIAL AND METHODS Criteria for inclusion in the systematic review were cohort studies investigating various regimens and duration of conservative therapy in adult patients with AAIO. The search for primary sources was carried out in the CENTRAL, PubMed and eLibrary databases. The assessment of the safety of various terms of AAIO was carried out by comparing the immediate results of treatment.

RESULTS The review included 19 papers with a total of 2,570 observations. At the first stage, the effectiveness of various conservative therapy regimens was evaluated by calculating the risk ratio for the success of non-surgical treatment. Taking into account the significant statistical heterogeneity of the participants, the calculation of the final risk ratio was carried out using a random effects model. The hazard ratio for nonoperative success was 1.91 (95% CI 1.2–3.1) in favor of gastrografin and 3.71 (95% CI 1.3–10.6) in favor of preoperative intestinal intubation. Taking into account the multidirectional pathogenetic action of the studied methods of conservative therapy, the obtained results suggested that the probability of success of non-surgical treatment correlates to a greater extent with the total duration of the AAIO episode than with the duration of conservative therapy, which was indirectly confirmed by constructing scattering graphs with approximation lines and calculating the coefficients determination, which amounted to 0.69 and 0.77 for the subgroups of standard therapy and undiluted gastrografin, respectively.
Subsequently, the impact of different duration of an episode of AAIO on the immediate outcomes was assessed: mortality, frequency of resection interventions, complications, and total bed-day. There were no statistically significant differences in favor of early interventions (up to 48 hours) for all compared parameters; an increase in the total duration of AAIO up to 89 hours was not associated with worse results.

CONCLUSION The total duration of the episode of acute adhesive intestinal obstruction, including both the pre-hospital duration and the duration of non-surgical treatment is prognostically significant. In other words, when calculating the allowable duration of conservative measures, one should proceed from the total duration of intestinal passage disturbance, which should not exceed 89 hours.

Keywords: acute intestinal obstruction, acute adhesive intestinal obstruction, non-surgical treatment, systematic review

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AAIO - acute adhesive intestinal obstruction
CI - confidence interval
NST - non-surgical treatment
RR - relative risk
ST - surgical treatment

INTRODUCTION

Despite the proven etiological factor in the development of adhesive disease, which is surgical trauma, surgical treatment (ST) of patients with acute adhesive intestinal obstruction (AAIO) is characterized by a lower recurrence rate compared to its non-surgical resolution [1]. At the same time, urgent surgical treatment, obviously, is characterized by worse immediate results, which is why therapeutic measures are often reduced to attempts at non-operative resolution of AAIO phenomena, followed by the discharge of the patient for outpatient treatment, if successful.

A compromise solution seems to be the practice of planned surgical interventions for recurrent AAIO, which, in the absence of intestinal passage disorders, could lead to better immediate results and a decrease in the frequency of repeated hospitalizations for recurrent adhesive ileus. The first step towards implementing this practice should be to reduce the proportion of patients operated on for AAIO urgently.

When comparing the success criteria for non-surgical treatment (NST) of AAIO listed in the Russian clinical guidelines, it was found that, in general, they correspond to foreign analogues (with the exception of the recommended maximum duration of non-surgical therapy, which, according to foreign authors, can be safely extended up to 72– 96 hours from the moment of admission of the patient) [2, 3]. In addition, the analysis of foreign literature demonstrates the absence of such a thing as decompensated long-term AAIO requiring urgent surgical intervention.

In other words, according to foreign authors, all patients are subject to trial conservative therapy in the absence of signs of strangulation, intestinal ischemia or peritonitis, regardless of the duration of the disease, the severity of water and electrolyte disorders and other signs [4], which in domestic practice are interpreted as indications for emergency operation. The only systematic review that we have found, dedicated to comparing the results of using different terms of conservative therapy, analyzes studies that include patients with signs of strangulation intestinal obstruction, peritonitis, and obstruction of tumor etiology [5], which limits the application of the results obtained in the practice of treating AAIO.

The aim of the review. This systematic review is aimed at evaluating the efficacy and safety of various periods of conservative therapy in patients with AAIO.

MATERIAL AND METHODS

CRITERIA FOR INCLUSION OF STUDIES IN A SYSTEMATIC REVIEW

The review included cohort-controlled studies that included information on the duration, nature of conservative treatment of patients with AAIO and immediate results.

Thus:

1) Study participants were adult patients with acute adhesive intestinal obstruction. Patients with signs of strangulation intestinal obstruction and peritonitis who were operated on an emergency basis were excluded from the systematic review. In addition, the study did not include patients with metastatic and early AAIO, the criterion for which was the presence of an anamnestic surgical intervention within 6 weeks prior to admissoin.

2) The typical intervention included in the review was the non-operative treatment of patients with AAIO, which consisted of fluid, decompressive therapy of varying duration, as well as the use of undiluted gastrografin and preoperative nasointestinal intubation.

3) The proportion of successful non-operative resolution of AAIO events was chosen as the primary outcome, reflecting the effectiveness of the considered scheme of conservative therapy. To assess the safety of the studied terms of non-surgical treatment, a number of secondary outcomes were also analyzed: overall, postoperative mortality, the frequency of resection interventions, complications, and the total length of a bed-day.

THE STRATEGY OF SEARCH AND SELECTION OF LITERARY DATA

The search for the literature primary sources was performed in *CENTRAL*, *PubMed* and *eLibrary* databases published up to December 2021 inclusive. Full-text randomized, cohort-controlled, and case series studies were selected that included information on the duration and nature of non-surgical treatment in patients with AAIO.

Additionally, a search was made for works matching the search criteria in the lists of references of selected studies. Unpublished papers, as well as information obtained from abstracts of articles, were not included in the review. Studies in Russian and English are included. Literature search, selection of works, and data extraction were carried out independently by two researchers, followed by a collective discussion of the identified disagreements until an acceptable Cohen's consensus kappa was obtained.

Below is a diagram of search queries made in English-language databases:

1. *"abdominal adhesions"*
2. *"intestinal obstruction"*
3. *"small bowel obstruction"*
4. #1 *OR* #2 *OR* #3 [*All fields*]
5. *non-operative management*
6. *non-operative management*
7. *"conservative management"*
8. *"non-surgical treatment"*
9. *nonoperative treatment*
10. *"conservative treatment"*
11. #4 *AND* (#5 *OR* #6 *OR* #7 *OR* #8 *OR* #9 *OR* #10) [*All fields*]
12. *"surgical operation"*
13. *"laparotomy"*
14. *"laparoscopy"*
15. *"surgical management"*
16. *"operative management"*
17. *"adhesiolysis"*
18. #11 *AND* (#12 *OR* #13 *OR* #14 *OR* #15 *OR* #16 *OR* #17) [*All fields*]

Key words searched in the *eLibrary database* : "adhesive disease", "adhesive ileus", "acute adhesive ileus", "peritoneal adhesions". Subsequently, duplicate studies were excluded and articles were screened for relevance to the topic of the systematic review. The selected full- text articles were checked for compliance with the inclusion criteria.

STATISTICAL PROCESSING OF THE EXTRACTED DATA, ASSESSMENT OF PUBLICATION BIAS AND STATISTICAL HETEROGENEITY OF INCLUDED PAPERS

Statistical heterogeneity of the studies was determined by conducting a χ^2 test, while I2 criterion exceeding 40% at a significance level of p <0.1 was considered statistically significant heterogeneity. Relative risk (RR) and 95% confidence interval (CI) were calculated for dichotomous variables. The resulting difference in the effects of various interventions and their 95% CI were calculated by the Mantel-Haenszel method using a random effects model for studies with significant statistical heterogeneity. Publication bias was assessed by constructing and visually evaluating a funnel chart. The results of the study are graphically presented by building forest diagrams using the software *Review Manager*, version 5.3. The types of correlations were determined by constructing scatter plots with approximation lines, the severity of the detected dependencies was estimated according to the coefficients of determination calculated using the *SPSS software*, version 26.0. Comparison of outcomes in different subgroups of patients was carried out by conducting analysis of variance.

RESULTS

LITERATURE SEARCH

After implementing the above database search strategy, 3,262 studies were selected. The exclusion of duplicate articles made it possible to reduce the resulting list to 1,220 titles, of which 86 full-text papers were selected after screening. The analysis of these studies for compliance with the inclusion criteria and the absence of exclusion criteria made it possible to select 19 studies containing information on the nature and duration of conservative measures in patients with AAIO with a total number of 2570 participants in a systematic review.

Of note: 25 full-text articles were excluded because the duration of conservative therapy was only approximate, which would have prevented inclusion of study data in quantitative analysis. Another 19 papers did not meet the inclusion criteria: the analyzed groups included patients with colonic, strangulation obstruction, strangulated hernias, etc., as well as pediatric patients. In addition, 11 studies did not contain their own clinical material and naturally were not included in the review. Of the 19 included studies, 13 controlled studies are devoted to the comparative effectiveness of various methods of conservative therapy (standard, the use of undiluted gastrografin and placement of the probe behind the ligament of Treitz), the remaining 6 are uncontrolled studies of a series of cases of AAIO (Fig. 1).

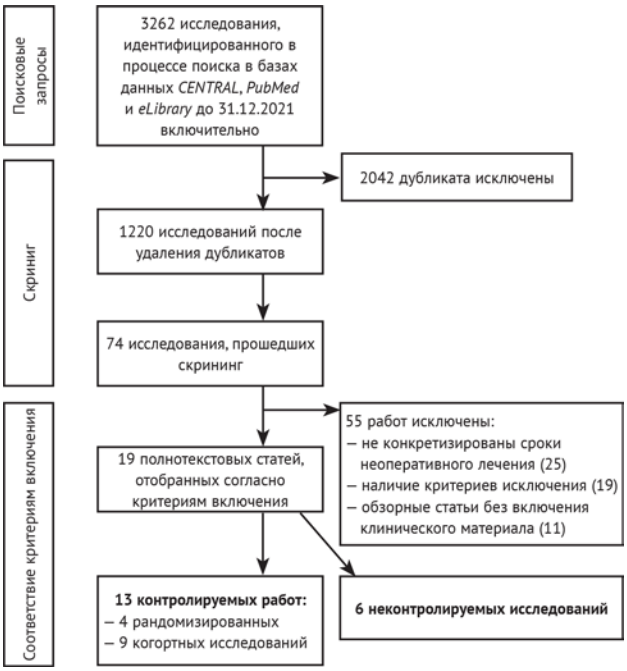

Fig. 1. Results of literature search

In the course of the literature search, only 3 works were identified [6-8], directly devoted to comparing different terms of conservative therapy in patients with acute intestinal obstruction, however, they were not included in the systematic review due to the presence of exclusion criteria (patients operated on an emergency basis, tumor intestinal obstruction, strangulated hernia, etc.). However, the included 19 studies had indications for the duration of conservative therapy and targeted outcomes, and the patient groups met the inclusion criteria, which allowed these studies to be used to achieve the goal of a systematic review. Of course, some inconsistency with the general rules for conducting meta-analyses does not contribute to increasing the reliability of the findings, on the other hand, the lack of an interesting research format dictates the need to determine the optimal timing based on the available clinical data.

ANALYSIS OF THE INFLUENCE OF VARIOUS SCHEMES OF CONSERVATIVE THERAPY ON THE DURATION OF NON-SURGICAL TREATMENT

A comparative assessment of the effect of the duration of non-surgical treatment on the analyzed outcomes is complicated by the heterogeneity of conservative measures carried out in different groups of patients. The selected

studies included the following conservative therapies that could potentially influence the time to resolution of AAIO events:

- standard treatment implemented by correcting water and electrolyte disorders and decompressing the gastrointestinal tract by installing a nasogastric tube (infusion, decompression).

- in addition to standard treatment, the introduction of 100 ml of an undiluted water-soluble contrast agent (gastrografin and its analogues) into a nasogastric tube, followed by an X-ray examination performed within 2 to 24 hours (a technique referred to abroad as "gastrografin challenge"*)*. Due to the significant osmotic effect, the administered drug contributes to the sequestration of fluid into the intestinal lumen with an increase in intraluminal pressure, as well as to a decrease in edema and normalization of peristalsis, which should contribute to the resolution of AAIO phenomena.

- instead of standard nasogastric intubation - insertion of an enteral tube behind the ligament of Treitz. The pathogenetic explanation of the effectiveness of this measure in terms of resolving AAIO has a diametrically opposite basis, the peristaltic activity of the intestine is normalized by reducing intraluminal pressure and, as a result, improving tissue perfusion of the intestinal wall.

The second and third options for conservative therapy, according to the conclusion of many authors, contribute both to an increase in the frequency of non-surgical resolution of AAIO, and to a reduction in the terms of conservative therapy required to achieve a result. With this in mind, in order to determine the optimal duration of non-operative treatment of AAIO, a preliminary assessment of the clinical significance of various variations of conservative measures that appeared in the included studies was necessary.

Table 1 summarizes some information about the studies included in the systematic review, focusing on comparing the efficacy of various methods of conservative therapy with the standard scheme: 10 studies evaluated the effectiveness of introducing undiluted gastrografin into a gastric tube, 3 more articles are devoted to the analysis of the results of intestinal intubation as an option for conservative therapy of patients with AAIO.

Table 1

Features of the included controlled studies

Metadata	Study period	Country	Sample size		NST duration in groups, hours		Duration of an episode of AAIO in groups, hours	
			ST	NST	Main	Comparisons	Main	Comparisons
Comparison of the efficacy of standard treatment and the use of undiluted gastrografin								
Biondo, 2003 [9]	02.2000–11.2001	Spain	13	77	48	112.8	n/a	n/a
Di Saverio, 2008 [10]	09.2003–11.2006	Italy	24	52	6.4	43.0	41.6	14.3
Farid, 2008 [11]	04.2005–09.2007	Egypt	27	83	19.5	42.6	35.4	31.6
Feigin, 1996 [12]	1990–1993	Israel	7	43	25.7	28.7	28.4	38.4
Kostenbauer, 2018 [13]	12.2010–09.2012	Australia	41	122	71.0	53.2	n/a	n/a
Kumar, 2009 [14]	01.2005–12.2005	India	9	32	7.5	35.2	20.8	75.6
Rahmani, 2013 [15]	n/a	Iran	12	72	96	96.0	n/a	n/a
Scotte, 2017 [16]	10.2006–08.2009	France	53	189	48.0	48.0	6.0	36.0
Yagci, 2005 [17]	1998–2004	Turkey	50	264	16.8	39.2	n/a	n/a
Zielinski, 2017 [18]	n/a	USA	99	217	3.0	2.0	38.4	45.6
Comparison of the effectiveness of standard treatment and insertion of a probe behind the ligament of Treitz								
Chen, 2012 [19]	09.2007–02.2011	China	58	128	98.4	204	12.0	12.0
Fleshner, 1995 [20]	07.1986–07.1989	USA	21	34	65	60	n/a	n/a
Larichev, 2021 [21]	2015–2018	RF	42	89	8,8	14.4	18.4	47.6

Notes: n/a — no data; ST — groups of operated patients; NST — groups of non-operated patients; AAIO — acute adhesive intestinal obstruction

Information about the efficacy of various options for conservative therapy compared with standard schemes is shown in the forest diagrams (Fig. 2 and 3). The data obtained indicate that both the use of undiluted gastrografin and the introduction of an enteral tube into the initial sections of the small intestine contribute to an increase in the frequency of successful non-surgical elimination of AAIO. Conservative resolution of AAIO was achieved in 83.2% (95% CI 80.6-86.0%) of patients treated with undiluted gastrografin, which was statistically significantly higher than this indicator among patients in the combined comparison group, 71.4% (95% CI 68 .1–74.6%). Similar values for studies evaluating the effectiveness of preoperative nasointestinal intubation were 82.9% (95% CI 77.3–88.3%) of successful cases of non-operative treatment in the experimental group versus 52.9% (95% CI 45.8–60, 0%) of the comparison group. Taking into account the significant statistical heterogeneity of the included studies (for studies of gastrografin $\chi^2 = 23.6$, $p = 0.005$, $I^2 = 62\%$, intestinal intubation - $\chi^2 = 8.9$, $p = 0.01$, $I^2 = 77\%$), the calculation of the final risk ratio was carried out using a random effects model. The RR for nonoperative success was 1.91 (95% CI 1.2–3.1) in favor of gastrografin and 3.71 (95% CI 1.3–10.6) in favor of preoperative intestinal intubation. Given that none of the 95% confidence intervals presented crossed the no-effect axis, it can be argued that the differences were statistically significant.

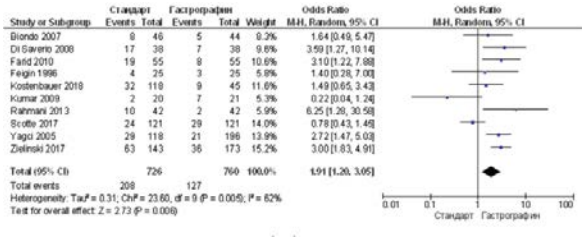

Fig. 2. Individual and generalized risk ratios for the success of non-surgical treatment of patients with acute adhesive intestinal obstruction (standard vs undiluted gastrografin)

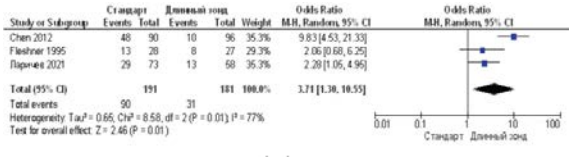

Fig. 3. Individual and generalized risk ratios for the success of non-surgical treatment of patients with acute adhesive intestinal obstruction (standard vs preoperative intestinal intubation)

Publication bias was estimated by plotting funnel scatterplots (Fig. 4).

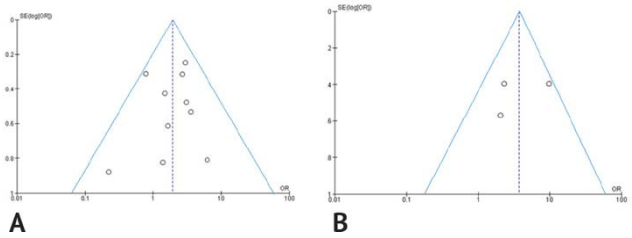

Fig. 4. Funnel charts for studies of the frequency of non-operative resolution of acute adhesive intestinal obstruction: A, standard therapy vs gastrografin; B, standart therapy vs preoperative nasointestinal intubation), measure of effect — risk ratio

A fairly even distribution of results relative to the axis of the central tendency indicates the absence of a significant publication bias of the included studies. Thus, it can be assumed that the total effect obtained is not biased relative to the true value, and the therapeutic effect of the studied conservative therapy regimens does take place.

Unfortunately, it was not possible to subject the mean NST durations in these studies to a similar objective comparative analysis due to the fact that in most cases standard deviations or standard errors of the mean were not given. As a result, an isolated calculation was made only of the average values of the duration of conservative therapy, which amounted to 57.5, 27.7 and 64.7 hours in the subgroups that received standard therapy, undiluted gastrografin and preoperative intestinal intubation, respectively. Without focusing on the statistical significance of the differences in the data obtained, it can be assumed that the use of undiluted gastrografin helps to reduce the time of conservative therapy required to resolve AAIO, while the insertion of an enteral tube behind the ligament of Treitz, on the contrary, slightly increases the required time. Taking this into account, as well as the fact that both methods contribute to an increase in the percentage of non-operated patients, it should be assumed that the probability of success of conservative therapy depends on the third factor, which, most likely, is intra-intestinal pressure, on which the studied therapy regimens have a multidirectional effect.

Since this parameter was not measured in any of the included studies, its significance can only be judged indirectly, based on the total duration of the AAIO episode, including both the duration of NST and the time from the onset of an episode of intestinal passage disorder. In 8 studies [10–12, 14, 16, 18, 19, 21] there were indications of the duration of an attack of AAIO before admission to the hospital, which made it possible to calculate the average value of the duration of intestinal passage disturbance, which was 67.5, 47.3 and 79.1 hours in subgroups treated with standard therapy, undiluted gastrografin, and preoperative intestinal intubation, respectively.

In order to determine which of the parameters under consideration (total duration of AAIO or duration of non-surgical treatment) is a priority in predicting the success of NST, dot plots were constructed, with approximation lines, reflecting the dependence of the percentage of non-surgical resolution of AAIO on a specific time parameter (Fig. 5 and 6). Taking into account the previously identified therapeutic effect, separate diagrams were constructed for patients receiving gastrografin and standard therapy; correlations in the subgroup of patients treated with intestinal intubation were not studied due to the small number of included studies.

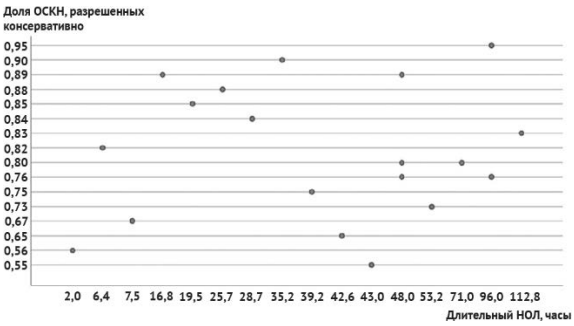

Fig. 5. The diagram of the proportion of non-operated patients versus the duration of non-operative treatment among subgroups of patients receiving standard therapy
Notes: NST — groups of non-operated patients; AAIO — acute adhesive intestinal obstruction

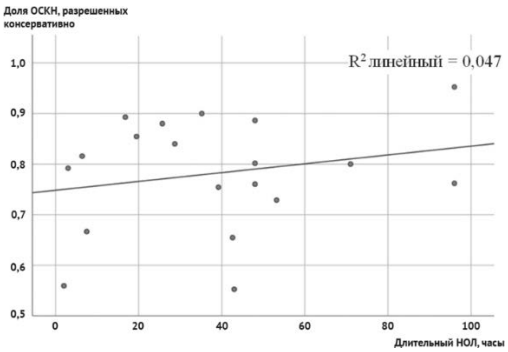

Fig. 6. The diagram of dependence of the proportion of non-operated patients on the duration of non-operative treatment among subgroups of patients treated with undiluted gastrografin
Notes: NST — groups of non-surgical treatment; AAIO — acute adhesive intestinal obstruction

The analysis of the diagrams obtained did not reveal any significant correlation between the duration of NST and the proportion of successful conservative resolution of AAIO, as evidenced by the absence of any effective approximation line in the case of standard therapy (Fig. 5) and the low linear coefficient of determination ($r^2 = 0.047$) in patients treated with gastrografin (Fig. 6). On the contrary, similar dot plots in relation to the total duration of the AAIO episode demonstrate rather high coefficients of determination, while the approximation lines in patients who received standard therapy (Fig. 7) and gastrografin (Fig. 8) have a logarithm-like shape. In other words, the revealed correlation is not linear; if a certain period is exceeded, a further delay in surgical treatment does not contribute to a significant increase in the percentage of successful conservative therapy. Calculation of the mentioned "threshold" period is difficult due to the fact that the curves are rather flat course.

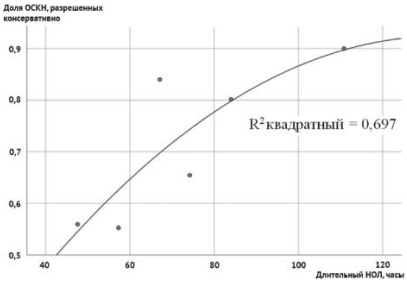

Fig. 7. The diagram of dependence of the proportion of non-operated patients on the total duration of an episode of acute adhesive intestinal obstruction among subgroups of patients treated with standard therapy
Notes: NST — groups of non-surgical patients; AAIO — acute adhesive intestinal obstruction

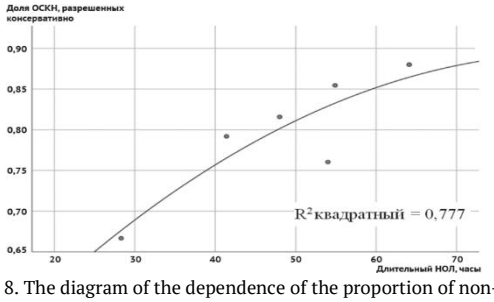

Fig. 8. The diagram of the dependence of the proportion of non-operated patients on the total duration of an episode of acute adhesive intestinal obstruction among subgroups of patients treated with undiluted gastrografin
Notes: NST — groups of non-operated patients; AAIO — acute adhesive intestinal obstruction

In a number of studies, a linear regression analysis of the dependence of the success of NST on the duration of the disease is carried out, which does not contradict the above conclusions, since the resulting logarithm-like curves indeed have a course close to linear.

Summarizing the above, the use of gastrografin helps to resolve the phenomena of intestinal obstruction (in the absence of a significant mechanical obstruction), which is most likely due to an accelerated increase in intra-intestinal pressure compared to patients receiving standard therapy. This is supported by the opposite effect of the use of intestinal intubation, which increases the required period while maintaining a positive effect on the percentage of successful non-operative resolution. In general, the success of non-operative treatment is determined by the total duration of the AAIO episode to a greater extent than the duration of non-operative treatment, and the dependence is somewhat non-linear. Based on these data, the purpose of this study should be rephrased as follows: to identify the maximum allowable duration of an episode of AAIO, the excess of which is an indication for intervention due to the futility of further conservative therapy and the risk of complications. Difficulties are due to the definition of the onset of an episode of AAIO, since it is based on subjective data obtained from the patients themselves. The timing of the start of treatment is determined exactly by the time of hospitalization and the data of the medical history.

ANALYSIS OF TREATMENT OUTCOMES IN SUBGROUPS OF PATIENTS WITH DIFFERENT DURATION OF THE AKI EPISODE

To achieve the reformulated goal of the study, a comparative analysis of primary and secondary outcomes was carried out among subgroups of patients with different duration of an episode of intestinal passage disorders and a different nature of conservative therapy. In order to increase the sensitivity of the current study to the 8 already reviewed studies that contained data on the pre-hospital duration of an episode of AAIO, the results of 6 uncontrolled studies that meet the inclusion criteria above are added. Of these studies, 4 studies [22-25] reported on the results of the use of gastrografin, and 2 more studies [26, 27] were devoted to the study of the outcomes of standard therapy in patients with AAIO (Table 2).

Table 2

Features of the included uncontrolled studies containing information on the total duration of an episode of acute adhesive intestinal obstruction

Metadata	Study period	Country	Sample size		Duration of an AAIO episode, hours*
			ST	NST	
Use of undiluted gastrografin					
Choi, 2002 [22]	07.1999–12.2000	China	22	114	81.8
Bueno-Lledo, 2019 [23]	08.2008–04.2013	Spain	37	198	72
Kapoor, 2006 [24]	2001–2005	India	2	60	85.4
Tresallet, 2009 [25]	Well	France	28	59	43.4
Standard treatment					
Ayushinova, 2016 [26]	2006–2010	RF	76	78	43
Donckier, 1998 [27]	01.1995–06.1997	Belgium	9	29	89

Notes: * — including the duration of non-operative managment (NST) at the hospital stage; ST — surgical treatment; AAIO — acute adhesive intestinal obstruction

To determine the effect of the duration of AAIO on the prognosis in patients with various methods of conservative therapy, a comparative analysis of the levels of overall, postoperative mortality, the frequency of resection interventions, complications, and the total bed-day was carried out among subgroups of patients with an attack of intestinal passage disorders corresponding to time intervals of less than 48, 48–72 and 72–89 hours.

The study of the results of treatment of patients with an average duration of AAIO of longer periods was not carried out due to the absence of such patients - the maximum period in the included studies was 89 hours [27]. Also, groups of patients who underwent preoperative intestinal intubation were not analyzed, due to the small number of available works that meet the inclusion criteria. Information about the outcomes of interest is summarized in Table 3.

Table 3

Outcomes of treatment of patients with different duration of acute adhesive intestinal obstruction

Metadata	Sample size	Lethal outcomes	Resections	Complications	Bed-day average
Use of undiluted gastrografin					
Di Saverio, 2008 [10]	38	n/a	1	3	4.7
Farid, 2008 [11]	55	n/a	2	n/a	3.8
Feigin, 1996 [12]	25	0	1	n/a	6.1
Kumar, 2009 [14]	21	n/a	n/a	n/a	8.7
Scotte, 2017 [16]	121	2	8	n/a	3.8
Zielinski, 2017 [18]	173	n/a	12	17	4
Choi, 2002 [22]	136	2	n/a	2	n/a
Bueno-Lledo, 2019 [23]	236	n/a	7	n/a	5.3
Kapoor, 2006 [24]	62	0	n/a	0	n/a
Tresallet, 2009 [25]	87	0	0	3	5.9
Standard treatment					
Larichev, 2021 [21]	73	1	n/a	n/a	5.2
Di Saverio, 2008 [10]	38	n/a	2	2	7.8
Farid, 2008 [11]	55	n/a	4	n/a	6.8
Feigin, 1996 [12]	25	0	0	n/a	6.8
Kumar, 2009 [14]	20	n/a	n/a	n/a	8.6
Scott, 2017 [16]	121	2	4	n/a	3.5
Zielinski, 2017 [18]	143	n/a	30	26	5
Ayushinova, 2022 [26]	154	9	n/a	n/a	6.2

Notes: n/a - no data

The comparison of the obtained results was carried out by conducting analysis of variance separately for subgroups of patients who received standard therapy and undiluted gastrografin. The results of comparison with the obtained significance levels are given in Table 4.

Table 4

Results of comparison of outcomes among subgroups of patients with different durations of an episode of acute adhesive intestinal obstruction and ongoing conservative therapy

The duration of the AAIO episode, hours	Postoperative mortality		Overall lethality		Resection frequency		Postoperative complications		Total bed-day
	%	*p*	%	*p*	%	*p*	%	*p*	
Use of undiluted gastrografin									
<48	0	0.33	0	0.57	18.81	0.81	32.30	0.07	4.9
48–72	6.25		1.37		23.42		n/a		4.1
72–89	8.33		1.01		18.90		8.31		5.3
Standard treatment									
<48	11.84	0.34	5.84	0.05	47.62	**0.0004****	41.27	0.06	5.6
48–72	3.03		1.02		15.00		11.76		6.2
72–89	9.09		1.89		18.18		22.22		5.0
All treatment regimens									
<48	8.65	0.57	3.73	0.08	32.10	**0.04***	36.56	**0.005****	5.3
48–72	4.61		1.23		19.67		11.76		4.9
72–89	8.77		1.40		19.10		12.12		5.2

Notes: * – $p<0,05$; ** – $p<0,001$; AAIO – acute adhesive intestinal obstruction

Based on the data obtained, a statistically significant difference was obtained in the structure of the frequency of resection interventions in patients receiving standard therapy (p <0.01) and all treatment regimens (p <0.05). There was also a significant difference in the incidence of postoperative complications when comparing outcomes, regardless of the specific method of conservative therapy (p <0.01).

In all cases, the obtained differences were not in favor of early interventions, in which the duration of an episode of AAIO, including NST, did not exceed 48 hours. As for the general and postoperative lethality, there was no significant effect of the studied terms on the specified parameters. An objective comparison of mean bed-days was not possible due to the lack of standard deviation in most of the included studies.

However, taking into account the obtained values of total bed-days, even if there was a statistically significant difference, the latter would probably not be large. Thus, the duration of the AAIO episode within the indicated time frames (up to 89 hours) did not have a significant negative impact on outcomes, in other words, the total prehospital duration of the AAIO episode and the duration of NST can be relatively safely increased up to 89 hours, which can lead to an increase in the frequency of non-operative resolution of AAIO. The available data from the included studies do not allow judgments about the safety and efficacy of longer durations of AAIO.

Two large studies excluded from the review [6, 7] containing 9,297 and 9,991 participants and devoted to comparing the results of treatment of patients with acute intestinal obstruction with different durations of AAIO should also be mentioned: a significant increase in the incidence of deaths and postoperative complications was detected when the NST was exceeded in 168 and 72 hours respectively. These data, despite the presence of exclusion criteria in the 2 studies mentioned, generally correlate with the data obtained, indicating that the “unsafe” duration of AAIO is beyond 89 hours.

CONCLUSION

Summarizing the above, a more prognostic parameter for determining the probability of success of conservative treatment in patients with acute adhesive intestinal obstruction is the total duration of an episode of intestinal passage disorder, and not the intrahospital duration of non-surgical treatment, which is indirectly confirmed by the revealed correlations.

In addition, the multidirectional effect of the considered methods of conservative therapy speaks in favor of the decisive role of intraluminal pressure (mediated by the total duration of the phenomena of acute adhesive intestinal obstruction), which have an opposite effect on the duration of non-surgical treatment, subject to a positive effect on the frequency of successful non-surgical treatment.

Thus, the duration of conservative therapy in patients with acute adhesive intestinal obstruction in the absence of signs of strangulation or peritonitis should probably depend on the duration of the episode of impaired intestinal passage. The total duration of ileus can be safely extended up to 89 hours regardless of the method of conservative therapy practiced, whether it is standard treatment or the administration of undiluted gastrografin. Exceeding the specified period can be considered as an indication for urgent surgical intervention, since a further delay in surgical intervention is unsafe and ineffective. Such a tactic, on the one hand, does not contradict the standards of long-term non-surgical treatment adopted abroad, and on the other hand, it expands the concept of "neglected" intestinal obstruction requiring urgent surgical intervention.

A number of limitations should be noted that encourage caution in the conclusions drawn:

- ambiguity and heterogeneity of the success criteria for non-surgical treatment. Independent stool [11, 17], clinical improvement [15, 19, 20, 22, 24], the presence of an X-ray contrast agent in the large intestine [21, 26], food intake without dyspepsia [13, 14, 16, 23]. In the 6 included studies, success criteria for non-operative treatment were not specified [9, 10, 12, 18, 25, 27];

- the subjectivity of the parameter of the duration of the episode of acute adhesive intestinal obstruction, due to the need to focus on the patient's complaints and history data;

- the design of the included studies, predominantly represented by cohort controlled [10–13, 17–21] case series studies [22–27], and only in four cases by randomized controlled trials [9, 14–16];

- the postulate about the decisive role of intra-intestinal pressure in the non-operative resolution of acute adhesive intestinal obstruction is problematic to verify due to the fact that the practice of direct measurement itself is not common, and indirect intra-abdominal pressure is only indirectly related to the targeted parameter.

Conducting appropriate clinical trials, as well as retrospective cohort studies of treatment tactics focused on the total duration of an episode of acute adhesive intestinal obstruction, and not the duration of in-hospital conservative therapy, can help overcome these limitations.

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