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Research Article

Early Intervention on Small Bowel Obstruction. Is There Time to Wait?

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Abstract

Background: Timely surgical intervention is essential for optimizing outcomes in Adhesive Small Bowel Obstruction (ASBO) cases. This study evaluated the relationship between the timing of surgery and patient outcomes, focusing on hospital length of stay (LOS) and postoperative complications.

Methods: A retrospective analysis included 2,210 ASBO patients undergoing surgery, grouped by time from admission to surgery: urgent (<12 hours), early (12-24 hours), and delayed (>24 hours). Outcomes assessed were postoperative complications, LOS, reoperation rates, and approach (laparoscopic vs. open).

Results: Of the patients, 63% underwent delayed surgery (>24 hours), 19% early surgery (12-24 hours), and 18% urgent surgery (<12 hours). Delayed surgery was linked to longer LOS (4.48 days) than urgent (0.95 days; $p<0.001$) or early surgery (1.25 days; $p<0.001$). Laparoscopic surgery had fewer complications than open surgery (11.4% vs. 20.1%, OR 0.69, $p=0.001$). Delayed surgery and older age were associated with higher reoperation rates (OR 1.82, $p=0.049$; OR 1.02, $p=0.007$). Postoperative complications were twice as high for surgeries after 12 hours (24.6%) compared to within 12 hours (11.4%, $p=0.005$).

Conclusion: Delayed surgery in ASBO patients correlates with longer LOS and higher complication rates. Laparoscopic surgery, appears to reduce complications, emphasizing the benefit of early intervention in ASBO management.

Keywords: Early Operation; Outcomes; Small Bowel Obstruction

Introduction

There is no evidence regarding the optimal timing for non-surgical treatment of Adhesive Small Bowel Obstruction (ASBO), but the latest guidelines from Bologna (2017) indicate that a 72-hour period is safe and appropriate [1]. Continuing non-operative treatment for more than three days in cases with persistent high output from a decompression tube, but no other signs of clinical deterioration, however, remains subject to debate. However, there is evidence that surgical intervention after this period increases the odds of prolonged mechanical ventilation, infectious, thromboembolic, and acute cardiac complications [2]. Other guidelines recommend surgical consultation for any ASBO patient that does not improve after 24 - 48 hours of non-operative management [3]. According to Behman study, operative management of ASBO is associated

with significantly reduced risk of recurrence [4]. Thus, it is evident that the selection of a specific time frame for surgical intervention in ASBO remains an unresolved and highly relevant issue. The objective of this study was to determine the relationship between surgical timing and clinical outcomes in patients with ASBO. We hypothesized that patients undergoing earlier surgical intervention would experience better clinical outcomes.

Method

This study was approved by the Helsinki Committee of Soroka University Medical Center (approval number: 0131-21-SOR). This is a retrospective cohort study of patients who underwent surgery for adhesive bowel obstruction at Soroka University Medical Center, Israel, from 2000 to 2021 (Figure 1). The patients were divided into three groups based on the timing of surgery: within 12 hours of admission (Group 1), between 12 and 24 hours (Group 2), and more than 24 hours after admission (Group 3). Inclusion criteria for the study were non-elective patients over 18 years of age, admitted with a primary diagnosis of small bowel obstruction (SBO), identified by the ICD-10 code. Exclusion criteria included patients with bowel obstruction caused by strangulated hernia, neoplastic processes, internal hernia, inflammatory process and infections (Crohn disease, tuberculosis etc.), intussusception, intraluminal obstruction due to a foreign body, as well as patients with signs of strangulated bowel obstruction (persistent severe pain, elevated blood lactate levels greater than 2 mmol/L). These criteria effectively excluded any other causes of bowel obstruction except adhesive small bowel obstruction. Patient data were obtained from electronic medical records at a single medical center. The dependent variables examined in the study were sex, age, length of hospital stay, postoperative complications, operation time, need for reoperation, emergency room readmission and mortality within 30 and 60 days. The postoperative complications analyzed included wound infections (surgical site infections, sepsis, pneumonia, urinary tract infections), cardiovascular events (pulmonary edema, arrhythmia, myocardial infarction, venous thromboembolism), acute kidney injury and wound dehiscence.

Statistical Analysis

Descriptive statistics were used to summarize the data through summary tables. For continuous variables, the median along with the first and third quartiles (Q1 and Q3) were presented, supplemented by means and standard deviations where applicable. Categorical variables were described using counts and percentages, rounded to one decimal place. Between-group comparisons were conducted using 95% confidence intervals and/or p-values, with percentages rounded to one decimal place. The Mann-Whitney test was employed for non-normally distributed continuous variables, while the chi-square test was utilized for categorical variables. Separate logistic regression models were constructed for each dependent variable, including second SBO surgery, complications after surgery, Deep Vein Thrombosis (DVT), and Urinary Tract Infection (UTI). The independent variables analysed included age at the time of surgery, gender, and the urgency of the SBO surgery (categorized as non-urgent if more than 12 hours). The results were reported as odds ratios (ORs) with 95% Confidence Intervals (CIs). All analyses were conducted using RStudio, version 1.1.423.

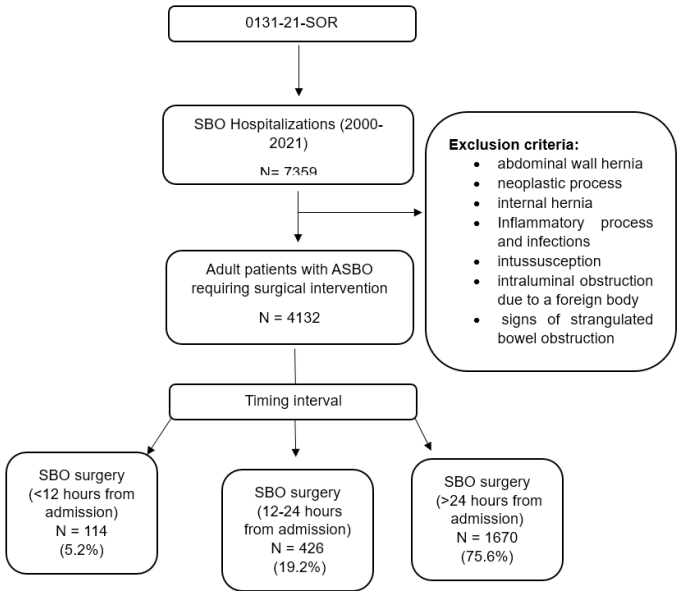

Figure 1: Cohort diagram of patient selection criteria. SBO = small bowel obstruction, ASBO = adhesive small bowel obstruction.

Results

According to the inclusion criteria, 2210 individuals were included in the study. Of these, 114 (5.2%) underwent surgical intervention within the first 12 hours of admission, 426 (19.2%) patients underwent surgery between 12 and 24 hours, and 1670 (75.6%) patients were operated on after 24 hours (Table 1). A total of 814 (36.8%) men and 1396 women (63.2%) were included in the study. There is a statistically significant difference in gender distribution across the three groups. Males comprised 33.3% of those operated within 12 hours, 43.7% in the 12-24-hour group and 35.3% in the >24 - hour group (p= 0.0046). Female made up a larger portion of patients, particularly in the >24-hour group (64.7%). The median age significantly increases with delay in surgery: 34.9 years for patients in the first group, 40.3 years in the second group and 50.3 years in the third group ($p < 0.001$). The need for reoperation is low in all groups, but it increases with surgical delay (0% within 12 hours, 5.6% for 12-24 hours, and 2.4% for>24 hours, $p<0.001$). Overall, 29.1% of patients experienced ER readmission with no statistically significant difference between groups (p=0.44). Mortality rates within 30 and 60 days are very low, with only one

death reported in each timeframe across all groups, showing no significant difference (p=1.000). The median duration of surgery does not significantly vary across groups, ranging around 1.22 to 1.34 hours (p= 0.211). Hospital stay duration (Figure 2) increases notably with delayed surgery, with mean stay of 0.95 days for surgeries within 12 hours, 1.25 days for 12-24 hours, and 4.48 days for >24 hours (p<0.001). The percentage of patients undergoing laparoscopic surgery is higher thazln patients underwent open surgery, from 60.5% within 12 hours to 58.5% in the 12-24-hour group, and 64.6% in the >24-hour group (p=0.051). Complication rates increase with surgical delay (Figure 2). Patients operated within 12 hours had an 11.4% complication rate, compared to 24.6% in the 12-24-hour group and 20.1% in the >24-hour group (p=0.005). According to a multivariate analysis of parameters such as reoperation (Table 2), a statistically significant correlation with patient age was observed (OR 1.02; 95% CI 1.00-1.03; p=0.007). For each additional year of age, the odds of reoperation increase by 2%, like the risk of postoperative complication increases by 1% (OR 1.01; 95%CI 1.00-1.01; p=0.005). Surgical interventions performed more than 12 hours after patient admissions were associated with more than twice complication rate than those operated on within the first 12 hours (OR 2.48; 95%CI 1.38-4.82; p=0.004). Surgeries performed more than 24 hours after admission have 82% higher odds of complications compared to surgeries done within the first 12 hours (OR 1.82; 95%CI 1.04-3.45; p=0.049). Laparoscopic surgery was associated with 31% lower odds of complications compared to open surgery (OR 0.69; 95%CI 0.56-0.86; p=0.001). Additionally, a statistically significant association was identified between postoperative complications and reoperation (OR 1.9; 95%CI 1.09-3.60; p=0.033). Patients who need reoperation have significantly higher odds of developing complications.

	SBO urgent surgery (<12 hours from admission) (N=114)	SBO surgery (12-24 hours from admission) (N=426)	SBO surgery (>24 hours from admission) (N=1670)	Total (N=2210)	p -value
Male (N - %)	38 (33.3%)	186 (43.7%)	590 (35.3%)	814 (36.8%)	**0.0046**
Female (N - %)	76 (66.7%)	240 (56.3%)	1080 (64.7%)	1396 (63.2%)	**0.005**
Age of patients - (Median, Q1,Q3)	34.9 (25.7,45.4)	40.3 (28.6, 60.1)	50.3 (32.9, 69.8)	46.8 (31.2, 67.7)	**<0.001**
Reoperation - (N - %)	0 (0.0%)	24 (5.6%)	40 (2.4%)	64 (2.9%)	**<0.001**
Mortality within 30 days - (N - %)	0 (0%)	0 (0%)	1 (0%)	1 (0%)	1
Mortality within 60 days - (N - %)	0 (0%)	0 (0%)	1 (0%)	1 (0%)	1
ER-Readmission - (N - %)	37 (32.5%)	115 (27.0%)	492 (29.1%)	644 (29.1%)	0.44
Length of surgery - hours (Median, Q1,Q3)	1.22 (0.905, 1.931)	1.29 (0.934, 1.893)	1.34 (0.93, 2)	1.33 (0.92, 2.03)	0.211
Length of hospital stay - days (Mean, Q1, Q3)	0.95 (0.51, 3.87)	1.25 (0.54, 4.056)	4.48 (1.135, 20.969)	3.34 (0.76, 12.45)	**< 0.001**
Laparoscopic / Open surgery	69 (60.5%) / 45 (39.5%)	249 (58.5%) / 177 (41.5%)	1078 (64.6%) / 592 (35.4%)	2210(63%/37%)	**0.051**
Postoperative Complications - (N - %)	13 (11.4%)	105 (24.6%)	335 (20.1%)	453 (20.5%)	**0.005**

Table 1: Patient and hospital characteristics.

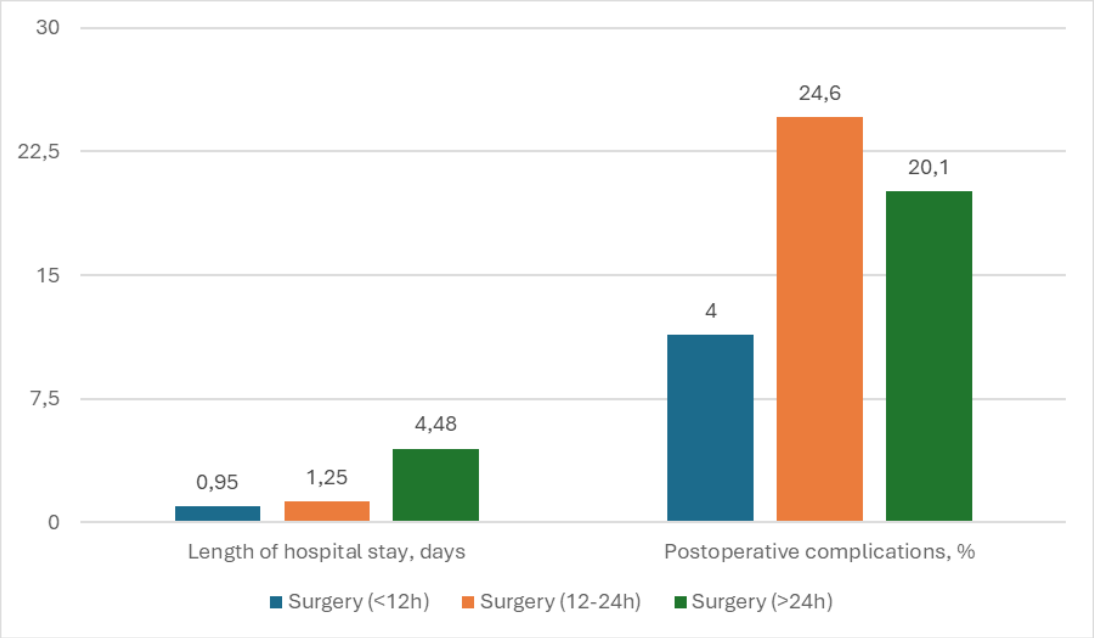

Figure 2: Distribution of Length of Hopsital Stay (LOS) and postoperative complication for Adhesive Small Bowel Obstruction (ASBO) in three surgical group of patients.

Predictors	Reoperation			Postoperative Complications		
	Odds Ratios	CI	p - value	Odds Ratios	CI	p - value
Age of patients	1.02	1.00 - 1.03	**0.007**	1.01	1.00 - 1.01	**0.005**
Gender (Male)	1.08	0.64 - 1.80	0.755	0.88	0.71 - 1.10	0.258
Reoperation				1.9	1.09 - 3.60	**0.033**
Surgery (12-24h)				2.48	1.38 - 4.82	**0.004**
Surgery (>24h)				1.82	1.04-3.45	**0.049**
Laparoscopic/Open surgery				0.69	0.56-0.86	**0.001**

Table 2: Multivariate analysis of predictors for reoperation and complications parameters.

	SBO surgery (> 12 hours from admission) (N=114)	SBO surgery (12 -24 hours admission) (N=426)	SBO surgery (< 24 hours from admission) (N=1670)	Total (N=2210)	p value
Sepsis (N- %)	0 (0.0%)	6 (1.4%)	26(1.6%)	32 (1.4%)	0.403
Pneumonia (N- %)	2 (1.8%)	11 (2.6%)	73(4.4%)	86 (3.9%)	0.112
Pulmonary edema (N- %)	0 (0.0%)	1 (0.2%)	4(0.2%)	5 (0.2%)	0.872
Surgical site infection (N- %)	3 (2.6%)	10 (2.3%)	74(4.4%)	87 (3.9%)	0.109
Urinary Tract infection (N- %)	4 (3.5%)	7 (1.6%)	65(3.9%)	76 (3.4%)	0.075
Dehiscence (% - N)	0	3(0.7%)	13(0.8%)	16(0.7%)	0.637
Deep Vein Thrombosis (N - %)	3 (2.6%)	1 (0.2%)	15(0.9%)	19 (0.8%)	**0.045**
Arrhythmia (N - %)	1 (0.9%)	1 (0.2%)	18(1.1%)	20 (0.9%)	0.26
Myocardial infraction (N - %)	0	3 (0.7%)	25(1.5%)	28 (1.2%)	0.197

Table 3: Postoperative complications.

According to postoperative complications (Table 3), the risk of developing deep vein thrombosis (DVT) in the lower extremities was observed in 3 patients (2.6%) in the first group, 1 patient (0.2%) in the second group, and 15 patients (0.9%) in the third group (p=0.045). The other presented parameters did not demonstrate statistical significance. Based on multivariate analysis (Table 4), the risk of lower extremity thrombosis was dependent on the timing of the surgery, indicating that patients who undergo surgery after a 12-hour delay have a lower risk of DVT compared to those operated on <12 hours. (OR 0.27; CI 0.08-1.19; P=0.044). Urinary tract infection were identified in 4 (3.5%), 7 (1.6%) and 65 (3.9%) in the three groups respectively, with the highest rate observed in the >24 hour group (Table 3)**.** This trend approached but did not reach statistical significance (p=0.075). But urinary tract infection was dependent on the patient's age in multivariate analysis (OR 1.02; CI 1.00-1.03; P= 0.005). This result is statistically significant, suggesting that increasing age is associated with a slightly higher risk of developing UTI. Each additional year of age increases the odds of UTI by 2%. There is no statistical significance among postoperative complications such as sepsis (p=0.403), pneumonia (p=0.112), pulmonary edema (p=0.872), surgical site infection (p=0.109), dehiscence (p=0.637), arrhythmia (p=0.260) and myocardial infarction (p=0.197) between three groups of patients.

Predictors	Deep Vein Thrombosis (DVT)			Urinary Tract Infection (UTI)		
	Odds Ratios	CI	p-value	Odds Ratios	CI	p-value
Gender (Male)	0.6	0.19-1.59	0.337	0.87	0.53-1.40	0.58
SBO non urgent surgery (>12 hours)	0.27	0.08-1.19	**0.044**	0.8	0.32-2.68	0.671
Age of patients	1.01	0.98-1.03	0.571	1.02	1.00-1.03	**0.005**

Table 4: Multivariate analysis of predictors for Deep Vein Thrombosis (DVT) and Urinary Tract Infection (UTI).

Discussion

Duration of the period in which non-operative management of ASBO can be tried is subject to debate. Evidence for the optimal duration of non-operative is absent, but consider a 72-h period consider as safe and appropriate [1], while others authors noted observation of adhesive SBO to be appropriate for no more than 5 days [5]. Th eEAST Practice Management Guidelines for Small Bowel Obstruction also suggest that non operative management can be attempted for up to 3 to 5 days [6]. Cox et al. demonstrated in their study involving 123 patients with SBO that 88% of the obstructions were resolved within 48 hours. They suggested that a majority of this patients can be managed conservatively within this time frame [7]. In our study, we hypothesized that earlier surgical intervention in patients with adhesive small bowel obstruction (ASBO), performed in the earlier time out of 72 hours of non-operative management window, improves clinical outcomes and reduces postoperative complications. Accordng to our data, a significant proportion of surgical interventions were performed in female patients (63.2% vs 36.8%, p=0.005), that also observed by several other authors [2,5]. Our results indicate that the mean age of patients selected for the study was 46.8 years. It can also be noted that older patients (mean age 50.3 years) underwent surgery at later time points, after 24 hours (p <0.001). Our study demonstrated that older patients and females are more likely to experience delayed surgery. Table 1 shows that the need for reoperation is time dependent, with 0% of patients requiring reoperation when surgery performed within 12 hours of admission, compared to 5.6% and 2.4% patients who underwent surgery after 12 and 24 hours, respectively (p<0.001). This demonstrates a reduction in the need for reoperation in patients who underwent early surgical intervention. In the study by Texeira, conducted on 4,163 patients with ASBO, early surgical intervention within the first 24 hours and beyond this time frame did not show a significant association with the need for reoperations (p=0.264) [8]. But in a study of Bickell performed on 141 patients, it demonstrated that the risk of bowel resection significantly rises when surgery is delayed for more than 24 hours. The risk of resection was 4% among patients with 24 hours of unresponsive symptoms and it increased to 10% to 14% through 96 hours [9]. Our data demonstrate a 2-fold increase in postoperative complications in patients who underwent surgery after 24 hours (11.4% vs 20.1%, p=0.005). Delayed surgery more than 12 hours from admissions was significant predictor for postoperative complications in surgery in both delayed surgeries > 12-hours (OR 1.82; CI 1.04-3.45; p=0.049) and > 24-hours (OR 2.48; CI 1.38-4.82; p=0.004) in multivariate analysis. Prolonged surgery may lead to increased physiological stress, tissue trauma, and anesthesia-related complications. These are confirmed with the findings by Joseph et al. where a retrospective analysis of 91 patients undergoing laparotomy for ASBO in which a delay of more than 48 hours was associated with a 2-fold increase in the rate of postoperative complications [10]. Our data indicate a statistically significant association between postoperative complications and patient age (OR 1.01; CI 1.00-1.01; p=0.005).

For each additional year of age, the odds of complications increase by 1%. Older age patients raise the likelihood of complications. In the study by Texeira on patients with SBO, a significant association was demonstrated between patients aged over 60 and an increased mortality rate [8]. This highlights age as an important risk factor for worse outcomes in SBO, suggesting that elderly patients require closure monitoring and more aggressive management to mitigate mortality risks. Reoperations significantly increase the odds of postoperative complications (OR 1.9; CI 1.09-3.60, p=0.033). This suggests that patients undergoing repeated surgeries are at heightened risk of postoperative complications, potentially due to adhesions, tissue damage and altered anatomy, which may complicate subsequent surgical interventions. Laparoscopic surgery was associated with a reduced likelihood of postoperative complications (OR 0.69; CI 0.56-0.86; p=0.001), indicating a protective effect compared to open surgery. This aligns with exiting literature advocating for minimally invasive techniques due to their reduced impact on the body and faster recovery. In a systematic review and meta-analysis of 14 non-randomized studies, laparoscopic adhesiolysis reduced risk of morbidity, in-hospital mortality, and surgical infections [1]. In the meta-analysis performed by Quah et all [11]. Showed that laparoscopic surgery for SBO has decreased overall mortality (LA = 1.6% vs. OA = 4.9%, $p < 0.001$) and morbidity (LA = 11.2% vs. OA = 30.9%, $p < 0.001$), also there are significantly lower reoperation rate (LA = 4.5% vs. OA = 6.5%, p = 0.017). In this study, 63% of patients underwent laparoscopic surgery, indicating a high adoption rate of this method in our clinic. A study conducted by Richardson [2] demonstrated an increased risk of thromboembolic complications in patients with SBO who underwent surgery after 72 hours of observation (AOR 2.22, 95 CI 1.59-3.09). But in the present study, an increased risk of DVT was observed in patients who underwent surgery within 12 hours in multivariate analysis (OR 0.27; 95%CI 0.08-1.19; P=0.044). We supposed, that early surgical patient might have less time for preoperative optimization, which is crucial for reducing DVT risk. The different studies demonstrate increase risk of postoperative complications in patients with delayed surgery group. Richardson et al [2]. Showed a 30% of increasing relative odds of major adverse event in patients within delayed surgery group (>72 hours). Texeira et al [8]. Reported similar findings, noting more than double rate of mortality in the delayed operation group (>24 hours). Fevang et al [12]. In a study of 496 patients with ASBO demonstrated significant trend of increasing postoperative complications associated with surgery delay. A higher rate of postoperative complications in patients undergoing delayed surgeries impacts the length of hospital stay (LOS) [2,5,8]. One study demonstrated that patients who underwent surgery within the first 24 hours had a LOS on average 2 days shorter than those who had delayed surgery [8]. This data is supported by our study, which shows that patients who underwent early surgery within 12 hours had an average LOS 3 days shorter compared to delayed surgery > 24 hours (0.95 days vs. 4.48 days, p.<0.001). A controversial issue in the treating ASBO is the concern that surgery may cause additional adhesions and increase recurrence. However, current literature does not support this. Data indicate that surgically treated patients have a lower recurrence rate and longer time to recurrence compared to those managed conservatively [13,14]. According to the gastrografin study, the absence of water-soluble contrast in the colon after 24 of administration accurately predict the need for surgery in patients with SBO [15]. Given the data showing an increase in postoperative complications in patients with delayed surgery, as shown in present study, we recommend taht patients with SBO should receive water-soluble contrast earlier upon admission and undergo surgical intervention if there is no progression of the conrast. The retrospective design of the study is a primary limitation. Additionally, this study did not assess the risk of recurrence of SBO in surgical intervention groups, as it was not the primary focus of the investigation.

Conclusion

Based on the findings in this study, it can be concluded that early surgical intervention, particularly within the first 12 hours, plays a critical role in improving patient's outcomes for those with adhesive small bowel obstruction. Immediate surgery is associated with reduced hospital stay and lower rates of postoperative complications, supporting the importance of prompt intervention. Additionally, the high utilization of laparoscopic surgery in our study population, even among delayed cases, suggests a preference for minimally invasive approaches when feasible. These results highlight the potential for enhanced recovery and resource optimization by prioritizing early surgical management in appropriate ASBO cases, particularly in older and female patients who may be at higher risk for delays.

Abbreviations: ASBO**:** adhesive small bowel obstruction**,** DVT**:** deep vein thrombosis**,** UTI: urinary tract infections, LOS: length of hospital stay, OR: Odds ratio, LA: laparoscopic approach, OA: open approach.

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Authors contribution: Dr. Ivan Kukeev; conceptualization, investigation, writing and original draft preparation, Mr. Yuval Arnon; data analysis, Dr. Elchanan Quint; supervision, resources, Dr. Anton Osyntsov; formal analysis and editing of the manuscript, Dr. Oleg Dukhno; critical revision and final approval of the version to be published.

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