

Study on the Effect of Early Ambulation on Recovery Time After Abdominal Surgery

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Abstract:

Background: Postoperative immobilization contributes to numerous complications following abdominal surgery, including venous thromboembolism, pulmonary complications, and delayed gastrointestinal recovery. Early ambulation has emerged as a key component of enhanced recovery protocols, yet implementation varies widely across institutions.

Methods: A prospective randomized controlled trial enrolling 240 patients undergoing elective open abdominal surgery. Participants were randomly assigned to either an early ambulation group (n=120), mobilizing within 6 hours postoperatively with scheduled ambulation protocols, or a standard care group (n=120), mobilizing at surgeon discretion typically after 24 hours. Primary outcomes included time to first bowel movement, length of hospital stay, and overall recovery time. Secondary outcomes comprised postoperative complications, pain scores, patient satisfaction, and functional recovery markers.

Results: The early ambulation group demonstrated significantly shorter time to first bowel movement (2.8 ± 0.9 days vs. 3.9 ± 1.2 days, $p < 0.001$), reduced hospital stay (5.2 ± 1.6 days vs. 7.1 ± 2.3 days, $p < 0.001$), and faster overall recovery time (14.3 ± 4.2 days vs. 19.8 ± 5.7 days, $p < 0.001$) compared to standard care. Early mobilization significantly reduced postoperative complications (15.0% vs. 30.8%, $p = 0.003$), including pulmonary complications (5.8% vs. 15.0%, $p = 0.020$) and ileus (6.7% vs. 16.7%, $p = 0.019$). Pain scores were comparable between groups. Patient satisfaction was significantly higher in the early ambulation group (8.7 ± 1.3 vs. 7.4 ± 1.8 , $p < 0.001$).

Conclusion: Early ambulation within 6 hours after abdominal surgery significantly accelerates recovery, reduces postoperative complications, and shortens hospital stay without increasing pain or adverse events. Implementation of structured early mobilization protocols should be standard practice in postoperative abdominal surgery care.

Keywords: Early Ambulation; Abdominal Surgery; Postoperative Recovery; Enhanced Recovery; Mobilization; Surgical Outcomes.

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Introduction

Abdominal surgery represents one of the most common surgical procedures performed worldwide, with millions of operations conducted annually across various subspecialties including general surgery, gynecology, and urology [1]. Despite advances in surgical techniques, anesthesia, and perioperative care, postoperative recovery remains a significant challenge, with patients experiencing variable recovery trajectories and complication rates [2]. Traditional postoperative care often emphasized bed rest and limited mobility until patients demonstrated clinical stability, a practice rooted in historical surgical doctrine rather than evidence-based medicine [3].

The pathophysiological consequences of postoperative immobilization are now well-documented and include increased risk of venous thromboembolism, pulmonary complications such as atelectasis and pneumonia, delayed gastrointestinal recovery with prolonged ileus, muscle weakness, and impaired cardiovascular function [4]. Prolonged bed rest activates catabolic pathways, promotes insulin resistance, and contributes to postoperative fatigue and deconditioning [5]. These complications not only compromise patient outcomes but also increase healthcare costs through extended hospital stays and additional interventions.

Early ambulation, defined as mobilization of patients within hours to one day following surgery, has emerged as a cornerstone of Enhanced Recovery After Surgery (ERAS) protocols [6]. These evidence-based, multimodal perioperative care pathways aim to reduce surgical stress, maintain physiological function, and accelerate recovery while minimizing complications [7]. ERAS protocols have demonstrated remarkable success across various surgical specialties, reducing hospital stays by 30-50% and lowering complication rates without compromising patient safety [8].

The physiological rationale supporting early ambulation is compelling. Mobilization promotes venous return and reduces stasis, thereby decreasing thromboembolism risk [9]. It enhances respiratory mechanics by improving lung expansion, facilitating secretion clearance, and preventing atelectasis [10]. Early ambulation stimulates gastrointestinal motility through mechanical stimulation and hormonal regulation, accelerating the return of bowel function [4]. Additionally, mobilization preserves muscle mass, maintains functional capacity, and promotes psychological well-being by restoring patient autonomy and normalcy [11].

Despite theoretical benefits and growing evidence, implementation of early ambulation protocols remains inconsistent across institutions. Barriers include traditional clinical practices, concerns about patient safety, inadequate staffing, lack of standardized protocols, and variable adherence by healthcare teams [12]. Furthermore, optimal timing and intensity of early mobilization specific to abdominal surgery populations require clarification. While some studies demonstrate benefits of mobilization within 24 hours, recent data suggest even earlier intervention may yield superior outcomes [13].

Existing literature on early ambulation in abdominal surgery shows heterogeneity in study designs, mobilization protocols, patient populations, and outcome measures, limiting conclusive recommendations [14]. Many studies combine early ambulation with other ERAS components, making it difficult to isolate its independent effect. Additionally, patient-centered outcomes such as quality of life, functional recovery, and satisfaction remain underexplored in the context of early mobilization strategies [15].

Materials and Methods

Sample size was calculated based on the primary outcome of time to first bowel movement. Assuming a mean difference of 1.0 day between groups (standard deviation of 1.5 days), with 90% statistical power and two-sided alpha of 0.05, the required sample size was 48 patients per group. To account for potential dropouts (20%) and enable robust

subgroup analyses, we planned to enroll 120 patients per group, totaling 240 participants.

Participant Selection

Inclusion Criteria: Adult patients aged 18-75 years; scheduled for elective open abdominal surgery (midline or paramedian laparotomy) including procedures for colorectal pathology, small bowel resection, gastric surgery, or exploratory laparotomy; American Society of Anesthesiologists (ASA) physical status I-III; ability to ambulate independently preoperatively; adequate cognitive function to understand and comply with mobilization protocols; provision of written informed consent.

Exclusion Criteria: Emergency surgery; laparoscopic or robotic procedures; extensive peritoneal carcinomatosis requiring palliative care; preoperative mobility limitations (wheelchair dependence, severe arthritis, neurological disorders); severe cardiovascular disease (NYHA Class IV, recent myocardial infarction); significant pulmonary disease requiring supplemental oxygen; postoperative mechanical ventilation beyond 6 hours; hemodynamic instability requiring vasopressor support; intraoperative complications necessitating ICU admission; pregnancy; inability to provide informed consent or comply with follow-up.

Randomization and Allocation: Eligible patients were randomly allocated in a 1:1 ratio to either the early ambulation group or standard care group using computer-generated random numbers in permuted blocks of 10. Allocation concealment was maintained through sequentially numbered, opaque, sealed envelopes opened by research coordinators after patient recruitment. Due to the nature of the intervention, blinding of participants and clinical staff was not feasible. However, outcome assessors and data analysts remained blinded to group allocation throughout the study.

Interventions

Early Ambulation Group (n=120): Patients received structured early mobilization initiated within 6 hours postoperatively. The protocol consisted of:

- Initial mobilization: Sitting at bedside for 15-30 minutes within 6 hours post-surgery
- Progressive ambulation: Walking 10-20 meters with assistance at 8-12 hours postoperatively
- Scheduled mobilization: Ambulating at least 50-100 meters four times daily from postoperative day 1
- Gradual progression based on individual tolerance and surgical complexity
- Physical therapy consultation and supervision for the first 48 hours

- Patient education materials and mobilization diaries

Standard Care Group (n=120): Patients received conventional postoperative care with mobilization at surgeon discretion, typically beginning 24-48 hours postoperatively. Mobilization frequency and intensity were not protocolized and varied based on clinical judgment and patient request.

All patients received standardized perioperative care including prophylactic antibiotics, venous thromboembolism prophylaxis (sequential compression devices and pharmacological prophylaxis unless contraindicated), multimodal analgesia (patient-controlled analgesia or epidural analgesia), early oral intake as tolerated, and standard wound care.

Outcome Measures

Primary Outcomes:

- Time to first bowel movement (passage of flatus or stool)
- Length of hospital stay (days from surgery to discharge)
- Overall recovery time (days to return to baseline functional status)

Secondary Outcomes:

- Postoperative complications (pneumonia, atelectasis, venous thromboembolism, ileus, surgical site infection, urinary retention) assessed using Clavien-Dindo classification
- Pain intensity measured using Visual Analog Scale (VAS, 0-10) at 24, 48, and 72 hours
- Analgesic consumption (morphine equivalent doses)
- Time to independent ambulation (walking 100 meters without assistance)
- Time to oral intake tolerance
- Readmission within 30 days
- Patient satisfaction score (0-10 scale)
- Quality of recovery assessed using QoR-15 questionnaire at postoperative day 3

Data Collection

Baseline demographic data, medical history, surgical details, and perioperative variables were

collected using standardized case report forms. Daily assessments were conducted during hospitalization by trained research nurses blinded to group allocation. Patients were followed up at 7, 14, and 30 days postoperatively through outpatient visits or telephone interviews to assess recovery milestones, complications, and patient-reported outcomes.

Statistical Analysis: Data were analyzed according to intention-to-treat principles using SPSS version 28.0 (IBM Corp., Armonk, NY). Normality of continuous variables was assessed using Shapiro-Wilk test and Q-Q plots. Normally distributed continuous variables were expressed as mean $\pm$ standard deviation and compared using independent t-tests. Non-normally distributed variables were presented as median (interquartile range) and analyzed using Mann-Whitney U test. Categorical variables were reported as frequencies and percentages, compared using chi-square test or Fisher's exact test as appropriate.

Multivariate linear regression was performed to adjust for potential confounders including age, gender, BMI, ASA status, surgical procedure type, and operative duration. Relative risk (RR) with 95% confidence intervals (CI) was calculated for dichotomous outcomes. Time-to-event outcomes were analyzed using Kaplan-Meier curves and log-rank tests. A two-sided p-value <0.05 was considered statistically significant. No interim analyses were planned or conducted.

Results

Patient Characteristics and Flow: Of 287 patients assessed for eligibility, 47 were excluded (31 did not meet inclusion criteria, 11 declined participations, 5 had surgery canceled). A total of 240 patients were randomized (120 to early ambulation, 120 to standard care). Three patients in the early ambulation group (2.5%) and five in the standard care group (4.2%) were lost to follow-up after hospital discharge. All randomized patients were included in intention-to-treat analysis. Baseline characteristics were well-balanced between groups (Table 1).

Table 1: Baseline Characteristics and Surgical Parameters

Variable	Early Ambulation (n=120)	Standard Care (n=120)	p-value
Demographics			
Age (years), mean $\pm$ SD	54.8 $\pm$ 14.3	56.2 $\pm$ 15.1	0.451
Male gender, n (%)	67 (55.8)	64 (53.3)	0.697
BMI (kg/m ²), mean $\pm$ SD	27.3 $\pm$ 4.6	27.9 $\pm$ 4.9	0.325
Comorbidities			
Diabetes mellitus, n (%)	28 (23.3)	31 (25.8)	0.652
Hypertension, n (%)	42 (35.0)	46 (38.3)	0.590
Cardiovascular disease, n (%)	15 (12.5)	18 (15.0)	0.575

Smoking, n (%)	32 (26.7)	29 (24.2)	0.660
COPD, n (%)	11 (9.2)	13 (10.8)	0.672
ASA Classification			0.738
ASA I, n (%)	38 (31.7)	35 (29.2)	
ASA II, n (%)	61 (50.8)	64 (53.3)	
ASA III, n (%)	21 (17.5)	21 (17.5)	
Surgical Procedure			0.812
Colorectal resection, n (%)	54 (45.0)	57 (47.5)	
Small bowel resection, n (%)	28 (23.3)	26 (21.7)	
Gastric surgery, n (%)	22 (18.3)	19 (15.8)	
Exploratory laparotomy, n (%)	16 (13.3)	18 (15.0)	
Operative Parameters			
Operative time (min), mean $\pm$ SD	162.4 $\pm$ 48.7	158.9 $\pm$ 51.3	0.585
Estimated blood loss (mL), mean $\pm$ SD	284.6 $\pm$ 142.3	296.8 $\pm$ 158.4	0.523
Epidural analgesia, n (%)	72 (60.0)	68 (56.7)	0.596
Incision length (cm), mean $\pm$ SD	18.6 $\pm$ 5.4	19.2 $\pm$ 5.8	0.410

BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; ASA: American Society of Anesthesiologists; SD: Standard Deviation

Primary Outcomes: The early ambulation group demonstrated significant improvements in all primary outcomes compared to standard care (Table

2). Time to first bowel movement was reduced by 1.1 days (2.8 ± 0.9 vs. 3.9 ± 1.2 days, $p < 0.001$). Hospital length of stay was significantly shorter in the early ambulation group (5.2 ± 1.6 vs. 7.1 ± 2.3 days, $p < 0.001$), representing a 27% reduction. Overall recovery time, defined as return to baseline functional status, was substantially faster with early mobilization (14.3 ± 4.2 vs. 19.8 ± 5.7 days, $p < 0.001$).

Table 2: Primary and Secondary Outcomes

Outcome	Early Ambulation (n=120)	Standard Care (n=120)	Mean Difference (95% CI)	p-value
Primary Outcomes				
Time to first bowel movement (days), mean $\pm$ SD	2.8 ± 0.9	3.9 ± 1.2	-1.1 (-1.4 to -0.8)	<0.001
Length of hospital stay (days), mean $\pm$ SD	5.2 ± 1.6	7.1 ± 2.3	-1.9 (-2.4 to -1.4)	<0.001
Overall recovery time (days), mean $\pm$ SD	14.3 ± 4.2	19.8 ± 5.7	-5.5 (-6.8 to -4.2)	<0.001
Secondary Outcomes				
Time to independent ambulation (days), mean $\pm$ SD	2.1 ± 0.8	3.6 ± 1.4	-1.5 (-1.8 to -1.2)	<0.001
Time to oral intake tolerance (days), mean $\pm$ SD	2.3 ± 0.7	3.1 ± 1.1	-0.8 (-1.0 to -0.6)	<0.001
Pain Scores (VAS 0-10)				
24 hours, mean $\pm$ SD	4.8 ± 1.6	4.6 ± 1.8	0.2 (-0.2 to 0.6)	0.358
48 hours, mean $\pm$ SD	3.7 ± 1.4	3.9 ± 1.5	-0.2 (-0.6 to 0.2)	0.284
72 hours, mean $\pm$ SD	2.8 ± 1.2	3.1 ± 1.3	-0.3 (-0.6 to 0.1)	0.167
Total opioid consumption (mg morphine equivalent), mean $\pm$ SD	84.6 ± 38.4	92.3 ± 42.7	-7.7 (-17.3 to 1.9)	0.118
QoR-15 score (POD 3), mean $\pm$ SD	118.4 ± 16.8	104.7 ± 19.3	13.7 (9.2 to 18.2)	<0.001
Patient satisfaction (0-10), mean $\pm$ SD	8.7 ± 1.3	7.4 ± 1.8	1.3 (0.9 to 1.7)	<0.001
30-day readmission, n (%)	8 (6.7)	15 (12.5)	-	0.128

CI: Confidence Interval; VAS: Visual Analog Scale; POD: Postoperative Day; QoR-15: Quality of Recovery-15; SD: Standard Deviation

Postoperative Complications: Overall complication rates were significantly lower in the early ambulation group (15.0% vs. 30.8%, $p = 0.003$, RR=0.49, 95% CI: 0.30-0.79) (Table 3). Pulmonary

complications, including pneumonia and atelectasis, occurred less frequently with early mobilization (5.8% vs. 15.0%, $p = 0.020$). Postoperative ileus was significantly reduced (6.7% vs. 16.7%, $p = 0.019$). No significant differences were observed in surgical site infections, urinary tract infections, or venous thromboembolism, though all trended toward lower rates in the early ambulation group.

Table 3: Postoperative Complications and Adverse Events

Complication	Early Ambulation (n=120)	Standard Care (n=120)	RR (95% CI)	p-value
Overall Complications				
Any complication, n (%)	18 (15.0)	37 (30.8)	0.49 (0.30-0.79)	0.003
Specific Complications				
Pulmonary complications, n (%)	7 (5.8)	18 (15.0)	0.39 (0.17-0.89)	0.020
- Pneumonia	3 (2.5)	9 (7.5)	0.33 (0.09-1.19)	0.082
- Atelectasis	4 (3.3)	9 (7.5)	0.44 (0.14-1.38)	0.154
Ileus, n (%)	8 (6.7)	20 (16.7)	0.40 (0.18-0.87)	0.019
Surgical site infection, n (%)	5 (4.2)	11 (9.2)	0.45 (0.16-1.27)	0.125
Urinary tract infection, n (%)	4 (3.3)	8 (6.7)	0.50 (0.15-1.63)	0.245
Venous thromboembolism, n (%)	1 (0.8)	4 (3.3)	0.25 (0.03-2.20)	0.213
Anastomotic leak, n (%)	2 (1.7)	3 (2.5)	0.67 (0.11-3.92)	0.652
Wound dehiscence, n (%)	1 (0.8)	2 (1.7)	0.50 (0.05-5.43)	0.562
Severity (Clavien-Dindo)				0.006
Grade I-II, n (%)	14 (11.7)	28 (23.3)		
Grade III-IV, n (%)	4 (3.3)	9 (7.5)		
Grade V (mortality), n (%)	0 (0.0)	0 (0.0)		
Mobilization-related Events				
Falls, n (%)	2 (1.7)	1 (0.8)	2.00 (0.18-21.69)	0.562
Dizziness requiring intervention, n (%)	6 (5.0)	3 (2.5)	2.00 (0.51-7.83)	0.315
Incision discomfort limiting mobility, n (%)	12 (10.0)	8 (6.7)	1.50 (0.64-3.52)	0.354

RR: Relative Risk; CI: Confidence Interval

Mobilization-related adverse events were rare and did not differ significantly between groups. Two falls occurred in the early ambulation group (both without injury), compared to one in the standard care group. No serious adverse events were attributed to early mobilization.

Discussion

This randomized controlled trial demonstrates that early ambulation initiated within 6 hours following abdominal surgery significantly accelerates postoperative recovery, reduces complications, and enhances patient-reported outcomes compared to standard mobilization practices. The clinically meaningful improvements observed across multiple endpoints provide compelling evidence supporting early mobilization as a safe, effective, and feasible intervention that should be incorporated into routine postoperative care protocols.

The 1.1-day reduction in time to first bowel movement represents a substantial acceleration of gastrointestinal recovery, one of the most important milestones after abdominal surgery. This finding aligns with mechanistic understanding of how physical activity stimulates intestinal motility through multiple pathways, including vagal nerve activation, catecholamine modulation, and mechanical effects of body position changes [4]. A meta-analysis by Vlug et al. examining ERAS protocols in colorectal surgery reported similar reductions in time to bowel function recovery,

attributing significant benefit to early mobilization components [6].

The 27% reduction in hospital length of stay (1.9 days shorter) has substantial clinical and economic implications. Prolonged hospitalization increases healthcare costs, risk of nosocomial infections, and patient dissatisfaction while consuming limited hospital resources [1]. Our findings correspond with systematic reviews demonstrating that ERAS pathways incorporating early ambulation reduce hospital stays by 2-3 days across various abdominal procedures [7], [8]. The accelerated discharge readiness reflects not only faster physiological recovery but also improved patient confidence and functional independence.

The 5.5-day reduction in overall recovery time to baseline functional status represents a patient-centered outcome of paramount importance. Return to normal activities, work, and social roles fundamentally defines successful surgical recovery from the patient perspective [15]. This finding suggests that early mobilization effects extend beyond the immediate postoperative period, potentially through preservation of muscle mass, maintenance of cardiovascular fitness, and prevention of deconditioning that typically accompanies prolonged bed rest [11].

The significant reduction in overall complications (15.0% vs. 30.8%) provides robust evidence for the safety and efficacy of early mobilization. The 49% relative risk reduction surpasses many

pharmacological interventions in surgical care. Specific reductions in pulmonary complications and postoperative ileus align with the physiological rationale for early ambulation. Mobilization enhances respiratory mechanics, improves ventilation-perfusion matching, and facilitates secretion clearance, thereby preventing atelectasis and pneumonia [10]. The protective effect against ileus likely reflects combined mechanical, neurohormonal, and anti-inflammatory mechanisms activated by physical activity [4].

Importantly, pain scores remained comparable between groups across all time points, contradicting concerns that early mobilization might exacerbate postoperative pain. This finding likely reflects adequate multimodal analgesia protocols and suggests that appropriately managed early ambulation does not compromise patient comfort [2]. The trend toward reduced opioid consumption in the early ambulation group, though not statistically significant, may indicate improved pain control through alternative mechanisms including endogenous endorphin release and reduced complications [13].

The significantly higher quality of recovery scores (QoR-15) and patient satisfaction in the early ambulation group underscore the importance of patient-centered outcome assessment. These findings suggest that early mobilization not only improves objective clinical parameters but also enhances subjective well-being, autonomy, and overall recovery experience [15]. The psychological benefits of early activity, including reduced anxiety, improved mood, and restored sense of normalcy, likely contribute to these positive patient-reported outcomes.

The minimal mobilization-related adverse events observed in our study challenge traditional concerns about safety of early postoperative ambulation. The two falls in the early ambulation group (both without injury) represent a low incidence given 120 patients mobilized early with scheduled protocols. Appropriate patient selection, adequate supervision, gradual progression, and effective analgesia appear sufficient to mitigate safety risks [12].

Our study possesses several methodological strengths, including randomized controlled design, adequate sample size with statistical power for primary outcomes, standardized intervention protocols, blinded outcome assessment, comprehensive outcome measurement including patient-centered endpoints, and minimal loss to follow-up. The pragmatic nature of our intervention enhances external validity and facilitates implementation in routine clinical practice.

However, limitations warrant acknowledgment. Single-center design may limit generalizability to

institutions with different patient populations, staffing models, or resources. The inability to blind participants and caregivers introduces potential performance and detection bias, though objective outcomes like hospital stay partially mitigate this concern. We included only elective open abdominal surgery patients; results may not apply to emergency cases or laparoscopic procedures, which have different recovery trajectories. The 30-day follow-up period, while capturing acute recovery, does not assess long-term outcomes such as quality of life or functional capacity at 3-6 months [14].

Cost-effectiveness analysis would strengthen evidence for widespread implementation but was beyond our study scope. Future research should evaluate economic outcomes, optimal mobilization intensity and frequency, patient subgroups most likely to benefit, integration with other ERAS components, and long-term functional outcomes [6].

Conclusion

This randomized controlled trial provides compelling evidence that early ambulation initiated within 6 hours after elective abdominal surgery significantly accelerates postoperative recovery, reduces complications, and enhances patient satisfaction without increasing pain or adverse events. The intervention resulted in meaningful improvements across multiple clinical endpoints: 1.1 days faster return of bowel function, 1.9 days shorter hospital stay, 5.5 days faster overall recovery, and 51% reduction in overall complications. The safety profile was favorable, with minimal mobilization-related adverse events and no serious safety concerns. These findings strongly support implementation of structured early mobilization protocols as standard practice in postoperative care following abdominal surgery. Early ambulation represents a simple, low-cost, evidence-based intervention that aligns with contemporary enhanced recovery principles and patient-centered care models. Healthcare institutions should develop and implement standardized early ambulation pathways, provide adequate staff training and resources, educate patients about mobilization benefits, and establish monitoring systems to ensure protocol adherence and safety. By systematically incorporating early ambulation into routine postoperative care, we can substantially improve surgical outcomes, enhance patient experiences, reduce healthcare costs, and advance the quality of perioperative medicine.

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