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Original Article

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Effect of Enhanced Recovery After Surgery *vs*. Traditional Postoperative Care in Patients with Endometriosis: A Retrospective Cohort Study

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Abstract

Background: Enhanced Recovery After Surgery (ERAS) may improve recovery after bowel surgery for deep endometriosis, but disease-specific evidence remains limited. In this study, ERAS was compared with traditional care.

Methods: This retrospective cohort included 150 women undergoing laparoscopic discoid excision or segmental resection at Avicenna Fertility Clinic, Tehran, from December 2020 to December 2021 (75 per group). Outcomes were hospital stay, return to activities, fever, and 30-day rehospitalization. Groups were compared with t-tests, chi-square tests, or Fisher exact tests. Crude odds ratios (ORs), risk differences (RDs), and 95% confidence intervals (CIs) were calculated.

Results: Chief complaints differed between groups (p<0.001). ERAS was associated with discharge within 1-3 days (85.3% *vs*. 17.3%; RD, 68.0 percentage points; OR, 27.75; 95%CI, 11.56-66.61) and complete return to activities within 2 weeks (94.7% *vs*. 62.7%; RD, 32.0 points; OR, 10.57; 95%CI, 3.48-32.11). Fever (8.0% *vs*. 1.3%; OR, 6.43; 95%CI, 0.76-54.82) and rehospitalization (4.0% *vs*. 1.3%; OR, 3.08; 95%CI, 0.31-30.34) were not significantly different.

Conclusion: These findings are suggestive rather than causal and require confirmation in prospective multicenter studies with verified adjusted analyses and longer follow-up.

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Introduction

Endometriosis is a chronic inflammatory disease affecting an estimated 2-10% of women of reproductive age. Deep endometriosis may involve the gastrointestinal tract, most often the rectosigmoid colon, and can cause pain, dyschezia, bleeding, impaired quality of life, and infertility (1-3). When bowel surgery is indicated, treatment ranges from rectal shaving and discoid excision to segmental resection; the choice should be individualized according to lesion size, depth, location, multifocality, symptoms, fertility goals, and the expertise of a multidisciplinary team (4-7).

Although minimally invasive surgery has improved perioperative recovery, bowel procedures for deep endometriosis remain complex and may be complicated by anastomotic leakage, rectovaginal fistula, infection, pain, delayed gastrointestinal recovery, and prolonged hospitalization (4, 5).

Therefore, perioperative pathways that accelerate functional recovery without increasing complications or readmission are particularly relevant in this population.

ERAS is a multimodal, multidisciplinary path

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way that combines patient education, avoidance of prolonged fasting, appropriate nutrition, opioid-sparing multimodal analgesia, maintenance of normothermia and euvolemia, early oral intake, early mobilization, standardized discharge criteria, and continuous audit of adherence (8-10). The current ERAS Society recommendations for elective colorectal surgery and gynecologic surgery support structured, evidence-based perioperative care, while emphasizing that protocol implementation and compliance should be measured rather than inferred from a pathway label alone (9, 10).

Disease-specific evidence has expanded. A 2025 systematic review and meta-analysis of four comparative studies including 1,662 patients undergoing surgery for deep endometriosis found that ERAS was associated with a shorter hospital stay (mean difference, -2.88 days; 95%CI, -5.34 to -0.41) without a clear increase in readmission or Clavien-Dindo complications (11). National and single-center studies, as well as a randomized fast-track trial, have reported broadly concordant findings (12-16). Nevertheless, the evidence remains limited by heterogeneous ERAS components, predominantly retrospective designs, incomplete reporting of protocol adherence and operative complexity, and insufficient control of temporal and clinical confounding. Data from Middle Eastern referral settings are also scarce.

The present study therefore aimed to compare short-term recovery outcomes between ERAS and traditional care among women undergoing laparoscopic discoid excision or segmental bowel resection for deep endometriosis at a single referral center. It was hypothesized that ERAS care would be associated with a higher probability of discharge within 1-3 days and complete return to daily activities within 2 weeks, without higher rates of postoperative fever or 30-day rehospitalization.

Methods

Study design and setting: This single-center retrospective cohort study was conducted at the Avicenna Fertility Clinic, affiliated with Avicenna Research Institute, ACECR, Tehran, Iran. It included women who underwent laparoscopic bowel surgery for deep endometriosis between December 2020 and December 2021. The reporting was revised in accordance with the STROBE statement for observational studies (19).

Participants and record selection: Eligible participants were women aged 18-45 years with bowel-involved deep endometriosis who were candidates for laparoscopic surgery and had provided written informed consent for use of their clinical data in research. Exclusion criteria were postmenopausal status, a history of breast, gastrointestinal, or genitourinary malignancy, and clinical or sonographic suspicion of malignancy. Eligible medical records were selected using computerized random-number generation, and 75 women were included in each care group (total n=150).

The sample size was calculated based on data from a previous prospective cohort study of ERAS in colorectal surgery (17). Assuming a 20-percentage-point difference in the proportion of patients with short hospitalization between the two groups, 80% power, and a two-sided significance level of 5%, 75 participants per group were required. The assumed event rate in the control group and the specific software used for the calculation were not documented in the available study records.

Surgical procedures and perioperative context: Endometriosis was staged according to the revised American Society for Reproductive Medicine (ASRM) classification. All operations were laparoscopic and included discoid excision or segmental bowel resection, together with excision of deep peritoneal or ovarian lesions, adhesiolysis for pelvic adhesions or cul-de-sac obliteration, and appendiceal resection when clinically indicated. At the time of surgery, care was delivered in accordance with the institution's contemporaneous endometriosis and perioperative protocols. For this revision, terminology and contextual discussion were checked against the current ESHRE guideline (1), NICE guidance endometriosis: diagnosis and management (NG73; updated in November 2024) (18), the 2025 ERAS Society colorectal guideline (9), and the 2026 ERAS Society gynecologic guideline (10); these later publications were not used to retrospectively redefine exposure or outcomes.

Intervention and group allocation: Group allocation was nonrandom. Patients were classified according to the perioperative pathway documented in their charts. Because the ERAS pathway was introduced later during the study period, group membership largely reflected the protocol in use at the time of surgery rather than an individual treatment decision. This before-and-after structure creates the risk of temporal confounding from concurrent changes in surgical experience, anes-

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thesia, discharge practice, documentation, and staffing.

The ERAS pathway comprised preoperative education, carbohydrate loading, and avoidance of prolonged fasting; laparoscopic minimally invasive surgery, optimized anesthesia, and multimodal analgesia using acetaminophen and nonsteroidal anti-inflammatory drugs, with opioid minimization; and oral intake within 6 *hr* after surgery and mobilization within 12 *hr*.

Traditional care comprised preoperative fasting for 8-12 *hr*, conventional anesthesia and opioid-based postoperative analgesia, oral intake after 12-48 *hr*, and mobilization after 24-48 *hr*.

The available records identified the assigned pathway but did not provide an element-by-element adherence score. Accordingly, this study evaluated care pathways as documented rather than the dose-response effect of ERAS compliance. The recover checklist recommends reporting individual ERAS elements, adherence, and outcome definitions in detail (20).

Outcomes and follow-up: Data were extracted from electronic medical records with a structured checklist. Baseline variables included age, chief complaint (pain, cyst, abnormal bleeding, or infertility), and preoperative imaging findings (left and right ovarian endometrioma, kissing ovaries, pouch of Douglas obliteration, uterosacral ligament nodule, and rectovaginal nodule). All participants had 30 days of postoperative follow-up for the outcomes recorded in the source dataset.

Primary outcomes were length of hospitalization, categorized as 1-3 days or 4-6 days and return to daily activities, categorized as complete when usual activities were resumed within 2 weeks, or partial.

Secondary outcomes were postoperative fever, defined as a temperature above 38°*C* within 72 *hr* and rehospitalization within 30 days after discharge.

Missing data: For the variables displayed in tables 1 and 2, all denominators were 75 per group and no missing observations were evident; no imputation was performed. The absence of missing values in the reported tables does not establish completeness for surgical variables that were not included in the source dataset.

Statistical analysis: Age was compared between groups using an independent-samples t-test, and categorical variables were compared using Pearson's chi-square tests, with Fisher exact tests applied to sparse 2×2 tables. Two-sided p-values below 0.05 were considered statistically significant. In addition to p-values, crude odds ratios (ORs) with logit-based 95% confidence intervals and absolute risk differences (RDs) with Newcombe hybrid-score 95% confidence intervals were calculated for binary outcomes. Although multivariable logistic regression adjusting for

Table 1. Baseline characteristics of women receiving ERAS or traditional care after surgery

Variables		ERAS (n=75)	Traditional care (n=75)	p-value
Age, mean±SD, yr	-	36.00±4.85	36.56±5.60	0.514*
Chief complaint	Abnormal bleeding	44 (58.7)	8 (10.7)	<0.001†
	Cyst	0 (0.0)	4 (5.3)	
	Infertility	8 (10.7)	8 (10.7)	
	Pain	23 (30.7)	55 (73.3)	
Left ovarian endometrioma	Yes	64 (85.3)	59 (78.7)	0.287†
	No	11 (14.7)	16 (21.3)	
Right ovarian endometrioma	Yes	58 (77.3)	61 (81.3)	0.545†
	No	17 (22.7)	14 (18.7)	
Kissing ovaries	Yes	62 (82.7)	60 (80.0)	0.675†
	No	13 (17.3)	15 (20.0)	
Pouch of Douglas obliteration	Yes	57 (76.0)	59 (78.7)	0.696†
	No	18 (24.0)	16 (21.3)	
Uterosacral ligament nodule	Yes	53 (70.7)	55 (73.3)	0.716†
	No	22 (29.3)	20 (26.7)	
Rectovaginal nodule	Yes	47 (62.7)	51 (68.0)	0.492†
	No	28 (37.3)	24 (32.0)	

* Independent-samples t-test. †Pearson's chi-square test. Values are n (%) unless otherwise stated.

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Table 2. Postoperative outcomes with crude effect estimates

Outcome (event)	ERAS n/N (%)	Traditional n/N (%)	RD, percentage points (95%CI)	Crude OR (95%CI)	p-value
Discharge within 1-3 days	64/75 (85.3)	13/75 (17.3)	68.0 (54.0 to 77.3)	27.75 (11.56 to 66.61)	<0.001*
Complete return to activities within 2 weeks	71/75 (94.7)	47/75 (62.7)	32.0 (19.4 to 43.8)	10.57 (3.48 to 32.11)	<0.001*
Postoperative fever	6/75 (8.0)	1/75 (1.3)	6.7 (-0.6 to 15.1)	6.43 (0.76 to 54.82)	0.116†
30-day rehospitalization	3/75 (4.0)	1/75 (1.3)	2.7 (-3.7 to 9.9)	3.08 (0.31 to 30.34)	0.620†

RD is ERAS minus traditional care. OR >1 favors ERAS for the three beneficial primary outcomes; OR >1 indicates more events for fever and rehospitalization. *Pearson's chi-square test. †Two-sided Fisher exact test. CIs are unadjusted.

baseline differences in chief complaint was originally planned, the patient-level dataset required to perform and verify the adjusted analysis was not available. Therefore, only crude effect estimates are presented.

The study was approved by the Ethics Committee of Avicenna Research Institute (IR.ACECR.AVICENNA.REC.1401.001) and was conducted in accordance with the Declaration of Helsinki. Because written informed consent for research use of clinical data was an eligibility criterion, consent was not waived.

Results

The cohort included 150 women; 75 received ERAS care and 75 received traditional care. Mean age was 36.00±4.85 years in the ERAS group and 36.56±5.60 years in the traditional-care group (mean difference, -0.56 years; 95%CI, -2.25 to 1.13; p=0.514). The distribution of chief complaints was markedly imbalanced between groups (p<0.001). Abnormal bleeding was reported by 58.7% of the ERAS group and 10.7% of the traditional-care group (absolute difference, 48.0 percentage points); pain was reported by 30.7% and 73.3%, respectively (absolute difference, −42.7 percentage points). Imaging findings did not differ significantly in the available comparisons (Table 1). This imbalance raises the possibility of selection and residual confounding.

ERAS care was associated with large crude differences in all three primary outcomes (Table 2). Discharge within 1-3 days occurred in 64 of 75 women (85.3%) receiving ERAS and 13 of 75 (17.3%) receiving traditional care (RD, 68.0 percentage points; 95%CI, 54.0-77.3; crude OR, 27.75; 95%CI, 11.56-66.61). Complete return to daily activities within 2 weeks occurred in 71 (94.7%) and 47 (62.7%) women, respectively (RD, 32.0 points; 95%CI, 19.4-43.8; crude OR, 10.57; 95%CI, 3.48-32.11).

Postoperative fever occurred in 6 women (8.0%) in the ERAS group and 1 (1.3%) in the traditional-care group (crude OR, 6.43; 95%CI, 0.76-54.82; Fisher exact p=0.116). Rehospitalization occurred in 3 women (4.0%) in the ERAS group and 1 woman (1.3%) in the traditional-care group (crude OR, 3.08; 95%CI, 0.31–30.34; Fisher exact p=0.620). The wide CIs include clinically important benefit and harm and reflect the small number of events.

Data on time to first flatus or bowel movement, actual time to oral intake, postoperative pain scores, opioid consumption, Clavien–Dindo complication grades, operative time, estimated blood loss, intraoperative complications, and conversion rates were not available and are therefore not reported.

Discussion

In this retrospective cohort, ERAS care was associated with substantially higher crude probabilities of discharge within 1-3 days and complete return to daily activities within 2 weeks. Fever and 30-day rehospitalization were uncommon and did not differ significantly, but their CIs were wide. Because exposure was not randomized, baseline symptoms were imbalanced, and verified adjusted estimates were unavailable, these findings describe associations and should not be interpreted as proof that ERAS caused the observed differences.

The direction of the primary findings is consistent with recent evidence focused specifically on deep endometriosis. The 2025 meta-analysis by Douligeris et al. included four comparative studies and 1,662 participants and found a mean reduction in hospital stay of 2.88 days, with no

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clear difference in readmission (RR, 1.13; 95%CI, 0.75-1.73), Clavien-Dindo grade I-II complications (RR, 0.75; 95%CI, 0.49-1.16), or grade III or higher complications (RR, 0.60; 95%CI, 0.27-1.33) (11). Pivano et al. reported shorter stay and reduced abdominal or pelvic pain after posterior deep-endometriosis surgery without increased 30-day complications or readmission (12). Studies of rectosigmoid and deep pelvic endometriosis from Arena et al. and Djemouai et al., along with earlier fast-track studies, similarly support the feasibility of structured recovery pathways (13-16).

The most important baseline concern is the distribution of chief complaints. Abnormal bleeding was 48.0 percentage points more common in the ERAS group, whereas pain was 42.7 points more common in the traditional-care group. Presenting symptoms may reflect different disease phenotypes, pain burden, analgesic requirements, prior treatment, patient expectations, or surgical complexity, each of which could influence hospitalization and return to activity.

Temporal bias is also plausible because ERAS was introduced later in the study period. Improvements attributed to the pathway could partly reflect increasing surgeon and team experience, changes in case selection, anesthesia, nursing practice, discharge criteria, documentation, hospital capacity, or billing over time. The lack of surgeon-level experience, team consistency, procedure-specific counts, lesion characteristics, operative time, estimated blood loss, conversion, and intraoperative complications prevents separation of the ERAS effect from these co-occurring changes. Future evaluations of a staged implementation should use prospectively defined data collection and consider interrupted time-series, contemporaneous control, propensity-score, or other causal-inference approaches.

The apparent similarity in short-term safety outcomes must be interpreted cautiously. Only seven fevers and four rehospitalizations occurred, producing unstable ORs with wide CIs; the study was therefore underpowered for rare events. In addition, fever and rehospitalization do not capture the full postoperative safety profile. Standard reporting should include anastomotic leakage, rectovaginal fistula, ileus, urinary and infectious complications, reoperation, and Clavien-Dindo grade, as well as recovery measures such as time to flatus, oral intake, pain, and opioid consumption. Larger ERAS studies have also shown that outcome improvement depends on protocol compliance and audit, particularly for postoperative elements, and that recovery pathways may improve patient-centered and resource-use outcomes (20-26).

Other limitations include the retrospective single-center design, potential inaccuracies in medical records, and only 30 days of follow-up. The study cannot address recurrence, long-term pain, quality of life, fertility, or reproductive outcomes. Element-level ERAS adherence was not measured, and the unavailable patient-level dataset prevented verification of the reported multivariable analysis. Strengths include a clinically relevant endometriosis-specific cohort, complete denominators for the reported variables, and reporting of absolute and relative crude effect estimates with CIs rather than p-values alone.

Clinically, these results add supportive real-world evidence that a structured ERAS pathway may facilitate recovery after complex laparoscopic bowel surgery for endometriosis. They do not justify labeling ERAS as superior or as a mandatory standard on the basis of this cohort alone. Prospective multicenter studies should predefine core surgical and recovery outcomes, record compliance with each ERAS component, report continuous length-of-stay data, ensure adequate power for complications, and provide transparent adjusted estimates. Randomized trials or robust quasi-experimental designs would offer stronger evidence.

Conclusion

In this single-center retrospective cohort, ERAS care was associated with shorter hospitalization, earlier return to daily activities, without a detected difference in fever or 30-day rehospitalization. Because of baseline imbalance, possible temporal and learning-curve bias, incomplete operative and adherence data, rare safety events, and unavailable verified adjusted estimates, the findings should be considered promising but not definitive. Prospective multicenter studies and adequately designed randomized or quasi-experimental evaluations with longer follow-up are needed before concluding that ERAS is superior or should be regarded as the standard approach for this population.

Conflict of Interest

The authors declare no conflict of interest.

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