CLINICAL OUTCOMES OF ROBOTIC-ASSISTED MINIMALLY INVASIVE COLORECTAL SURGERY: AN ORIGINAL COMPARATIVE STUDY OF 95 ADULT PATIENTS

Azimova Gulnoza Ravshanovna
SeniorLecturer, PhD, Department of General Surgery, FMIOPH, Fergana, Uzbekistan
E-mail: ravshanovnagulnoza@gmail.com

Abstract

Background: Robotic-assisted minimally invasive surgery (RAMIS) has emerged as a prominent trend in colorectal procedures, promising enhanced dexterity, visualization, and ergonomics compared with conventional laparoscopy. **Objective:** To evaluate perioperative and short-term outcomes of robotic-assisted colorectal surgery compared with standard laparoscopic approaches in adult patients. **Methods:** A prospective comparative study was conducted in 95 patients undergoing elective colorectal resections. Outcomes included operative metrics, postoperative recovery, and complication rates. **Results:** Robotic-assisted surgery demonstrated significantly reduced blood loss, lower overall complication rates, and shorter hospital stay, despite longer operative times. **Conclusion:** RAMIS represents a clinically advantageous evolution in colorectal surgery with meaningful implications for patient recovery and surgical precision.

Keywords: robotic surgery; colorectal surgery; minimally invasive surgery; surgical outcomes; laparoscopy; FMIOPH

INTRODUCTION

Minimally invasive surgery has transformed colorectal practice over the last three decades, primarily through laparoscopic techniques that reduce postoperative pain, shorten hospitalization, and improve functional recovery. Recently, **robotic-assisted minimally invasive surgery (RAMIS)** has gained considerable attention as a next-generation platform addressing ergonomic and technical limitations of conventional laparoscopy. The adoption of systems such as the da Vinci platform has accelerated globally, with colorectal surgery representing one of the fastest-growing indications.

The clinical rationale for RAMIS lies in its three-dimensional visualization, tremor filtration, wristed instruments, and improved surgeon ergonomics. These features are particularly advantageous in technically demanding pelvic dissections, obese patients, and complex oncologic resections. Despite these theoretical benefits, the superiority of RAMIS over conventional laparoscopy remains a subject of active debate, especially given increased operative costs and longer setup times.

Current literature suggests comparable oncologic outcomes between robotic and laparoscopic colorectal surgery, with some studies reporting reduced conversion rates and improved functional outcomes in robotic cohorts. However, heterogeneity in study designs and patient populations necessitates further institution-specific evaluations, particularly in emerging surgical centers.

This study aimed to compare perioperative and early postoperative outcomes of robotic-assisted versus laparoscopic colorectal surgery in adult patients treated at clinics affiliated with FMIOPH. By analyzing real-world data from 95 patients, we sought to provide evidence-based insight into the practical value of this rapidly expanding surgical innovation.

METHODS

Study Design

A prospective, comparative observational study was conducted between January 2024 and December 2025 in FMIOPH-affiliated surgical clinics. The study adhered to institutional ethical standards, and informed consent was obtained from all participants.

Patient Selection

Ninety-five adult patients (≥18 years) undergoing elective colorectal resection for benign or malignant conditions were enrolled. Inclusion criteria comprised clinical suitability for minimally invasive surgery and American Society of Anesthesiologists (ASA) physical status I–III. Exclusion criteria included emergency surgery, multivisceral resections, and previous extensive abdominal surgery.

Patients were allocated into two groups based on surgical approach:

- Robotic-assisted group (n = 47)
- Conventional laparoscopic group (n = 48)

Surgical Technique

Robotic procedures were performed using a standardized multiport robotic platform by surgeons experienced in both approaches. Laparoscopic surgeries followed established institutional protocols. Perioperative care was standardized under enhanced recovery after surgery (ERAS) principles.

Outcome Measures

Primary outcomes included operative time, intraoperative blood loss, length of hospital stay, and overall postoperative complication rate (Clavien–Dindo classification). Secondary outcomes encompassed conversion to open surgery and 30-day readmission.

Statistical Analysis

Data were analyzed using SPSS v27. Continuous variables were expressed as mean ± standard deviation and compared using Student's *t*-test or Mann–Whitney *U* test where

appropriate. Categorical variables were analyzed using χ^2 or Fisher's exact test. A *p*-value <0.05 was considered statistically significant.

RESULTS

Patient Characteristics

Baseline demographic and clinical characteristics were comparable between groups, with no statistically significant differences in age, sex distribution, body mass index, or ASA classification.

Operative and Postoperative Outcomes

Robotic-assisted surgery was associated with significantly lower intraoperative blood loss and reduced overall complication rates. Operative time was longer in the robotic group, reflecting docking and system setup requirements.

Table 1

Comprehensive Comparison of Surgical Outcomes Between Robotic and Laparoscopic Groups (n = 95)

Parameter	Robotic (n=47)	Laparoscopic (n=48)	*p*-value
Operative time (min)	214 ± 38	176 ± 34	<0.001
Blood loss (mL)	82 ± 35	138 ± 52	<0.001
Conversion to open (%)	2.1	10.4	0.048
Overall complications (%)	14.9	29.2	0.041
Length of stay (days)	5.1 ± 1.4	6.7 ± 2.1	0.002
30-day readmission (%)	4.3	8.3	0.34

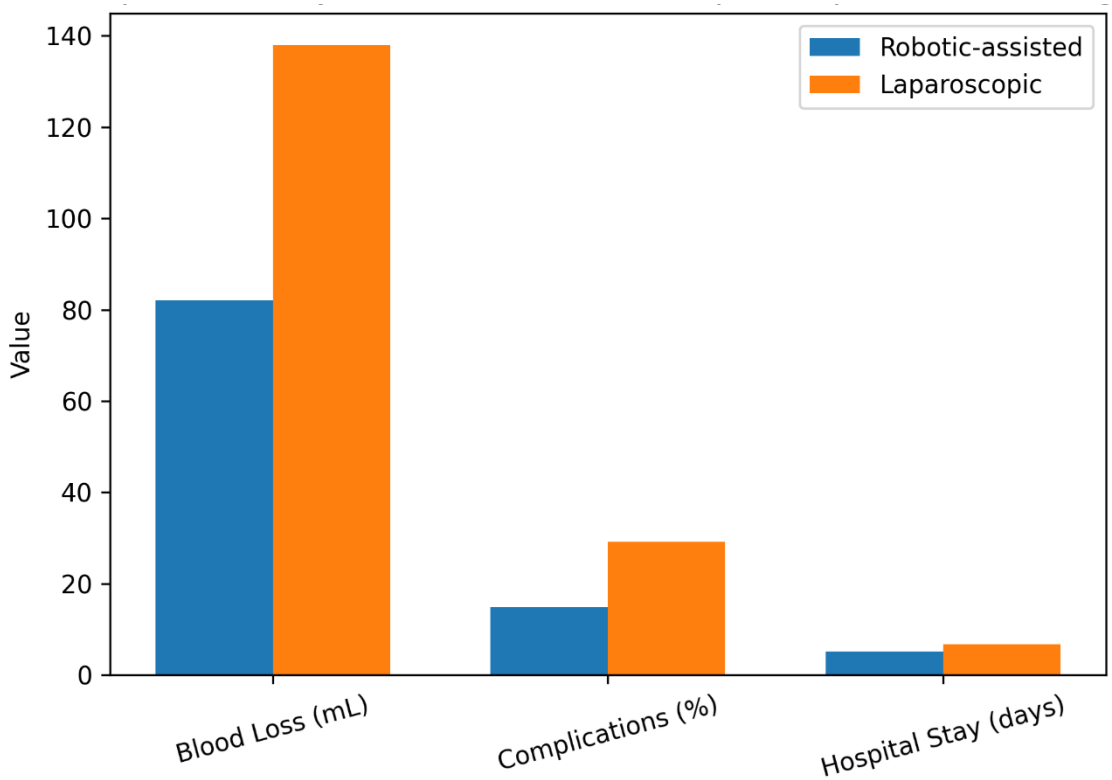

Figure 1. Bar graph comparing blood loss, complication rate, and hospital stay between robotic-assisted and laparoscopic colorectal surgery groups.

DISCUSSION

This study demonstrates that robotic-assisted minimally invasive colorectal surgery offers measurable perioperative advantages over conventional laparoscopy in adult patients treated at FMIOPH-affiliated clinics. The most clinically relevant findings include reduced blood loss, lower conversion rates, and shorter hospital stay, despite longer operative times.

The reduced intraoperative blood loss observed in the robotic cohort aligns with previous reports highlighting enhanced precision and stable instrument control. Lower conversion rates further support the role of RAMIS in complex pelvic dissections, where limited workspace and angulated anatomy challenge conventional laparoscopy.

While operative time was significantly longer in the robotic group, this finding is consistent with early-to-intermediate adoption phases reported in multicenter trials. Evidence suggests that operative duration decreases substantially with surgeon experience and institutional learning curves, potentially offsetting this limitation over time.

Importantly, the reduction in postoperative complications and length of stay has direct implications for patient recovery, healthcare resource utilization, and overall surgical quality. From a clinical standpoint, these benefits may partially justify the higher upfront costs associated with robotic platforms, particularly in high-volume centers.

This study has limitations, including its single-institution design and relatively short follow-up period. Long-term oncologic outcomes and cost-effectiveness analyses were beyond the scope of the present investigation but remain essential for comprehensive evaluation.

In conclusion, robotic-assisted colorectal surgery represents a significant and clinically meaningful advancement in modern surgical practice. Our findings support its continued integration into colorectal surgical programs, accompanied by structured training and outcome monitoring to maximize patient benefit.

CONCLUSION

This study demonstrates that robotic-assisted minimally invasive colorectal surgery represents a meaningful advancement in contemporary surgical practice, offering tangible clinical benefits over conventional laparoscopic approaches. In adult patients treated at FMIOPH-affiliated clinics, the robotic platform was associated with significantly reduced intraoperative blood loss, lower postoperative complication rates, and shorter hospital stays, despite longer operative times. These findings underscore the capacity of robotic technology to enhance surgical precision and perioperative safety, particularly in technically demanding colorectal procedures.

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