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Minimally invasive versus open surgery among colorectal cancer patients

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Abstract:
Minimally Invasive Surgery has become an acceptable substitute for Open Surgery in the management of colorectal cancer, with the claimed benefits of reduced morbidity and quicker recovery. Therefore it is of interest to compare the clinical and oncological results of MIS and OS among 200 patients with colorectal cancer over five years. The patients were evaluated for operative time, complications, hospital stay and disease-free survival. MIS has been demonstrated to be linked to markedly reduced stays in hospital (6 vs. 10 days) and decreased complication rates (15% vs. 25%) versus Open Surgery with similar oncologic outcomes: clearance of margins, as well as five-year disease- free survival, $p > 0.05$. Thus, data support MIS as an effective and safe method within suitably chosen patients with cancer of the colon and rectum, with advantage at recovery duration and complications.

Keywords: Minimally invasive surgery (MIS), open surgery (OS), colorectal cancer, surgical outcomes, disease-free survival, postoperative recovery

Background:
Colorectal cancer is one of the leading causes of cancer morbidity and mortality world over, the treatment of which in localized disease is the cornerstone of surgery **[1]**. Open surgery is the classic method with outstanding oncologic outcomes **[2]**. Minimally invasive surgery like laparoscopic and robotic surgery gained favor as technology and knowledge improved **[3]**. The rest of the answer remains the same. MIS has certain advantages, such as minimal postoperative pain, reduced hospital stay, faster recovery and improved cosmetic outcome, at the cost of oncologic safety **[4]**. Despite all these advantages, its use in such complex cases-advanced stage tumor or comorbidity-is doubtful and its impact on long-term oncologic outcomes needs to be studied **[5]**. These comparative studies where MIS has been contrasted with OS have produced promising outcomes, but operative time, rate of complications and disease-free survival data diverge among studies **[6]**. Therefore, it is of interest to compare MIS and OS outcomes in clinical and oncologic results, operative factors, postoperative course and survival at long term in patients with colorectal cancer.

Materials and Methods:
This was a comparative study over five years done in a tertiary care center with the enrollment of 200 patients with colorectal cancer who underwent open surgery (OS) or minimally invasive surgery (MIS). The patients were divided into two groups randomly: 100 underwent MIS and 100 underwent OS. Ethical approval was requested and informed consent was taken from all the participants. Inclusion criteria were patients 18 years and older with histologically proven colorectal cancer and no distant metastasis at presentation. Excluded was recurrent disease, prior abdominal surgery, or contraindication to MIS. Patient demographics, tumor size, location and stage and intraoperative variables like blood loss and operating time were recorded. Postoperative outcomes were complications, hospital stay and 30-day readmission. Oncologic outcomes recorded were clearance of surgical margins and five-year disease-free survival. Statistical testing on SPSS version 25 through chi-square tests and Kaplan-Meier analysis was performed to assess differences in outcomes between the groups. The p-value was set at <0.05.

Results:
200 patients were enrolled in the study, of whom 100 received minimally invasive surgery (MIS) and 100 received open surgery (OS). The demographic and tumor profile were similar in both groups without any difference in mean age, gender ratio, or tumor stage. **Table 1** presents a comparison of patients' demographic and tumor profile in MIS and OS groups based on similar baseline parameters in both groups. **Table 2** highlights intraoperative outcomes, indicating that MIS was associated with significantly lower blood loss, but a slightly longer

operative time compared to OS. **Table 3** compares postoperative outcomes, demonstrating significantly shorter hospital stays and lower complication rates in the MIS group. **Table 4** presents the oncological outcomes, showing comparable margin clearance and five-year disease-free survival rates between the two groups. **Table 5** illustrates the distribution of postoperative complications, showing that MIS was associated with fewer wound infections and respiratory complications compared to OS. **Table 6** compares the quality of life (QoL) scores between the two groups, with MIS patients reporting higher scores across physical, emotional and social domains at six months postoperatively. **Table 7** presents the recurrence rates at five years, showing no significant difference between the MIS and OS groups, indicating comparable oncological safety. **Table 8** highlights patient satisfaction scores, with MIS patients reporting higher satisfaction due to shorter recovery times and reduced pain levels. **Table 9** compares the economic impact of the two surgical approaches, showing that MIS was associated with lower overall costs due to shorter hospital stays and fewer complications. **Table 10** examines the return-to-work time among patients, with MIS patients resuming normal activities significantly earlier than those in the OS group.

The findings give detailed insights on comparative outcomes for minimally invasive surgery and open surgery for colorectal cancer patients. **Table 1** provides demographic and tumor characteristics showing equal baseline parameters. Intraoperative outcome results show significantly low blood loss, however, the MIS group experienced operative times a bit longer than those with OS as in **Table 2**. **Table 3** compares postoperative outcomes, showing that the MIS group had shorter hospital stays and fewer complications. **Table 4** presents oncological outcomes, which are similar in terms of margin clearance and five-year disease-free survival rates between the two groups. **Table 5** presents the distribution of postoperative complications, with fewer wound infections and respiratory complications in the MIS group. **Table 6** compares QoL scores at six months postoperatively, with higher physical, emotional and social domain scores in the MIS group. **Table 7** indicates no difference in the rates of recurrence at five years between the two groups and hence affirms the oncological safety of MIS. **Table 8** presents better scores of patient satisfaction with MIS on account of short recovery periods and good pain control. **Table 9** describes the economic analysis; the results suggest that overall, MIS is cheaper, having been associated with a shorter period of hospital stay and reduced complications. **Table 10** shows a much earlier return-to-work time for the MIS patients, indicating faster recovery and better postoperative functionality. This summary shows all benefits of MIS: recovery, complications and economic impact, maintaining equal oncological outcomes with OS.

Table 1: Demographic and tumor characteristics

Parameter	MIS Group (n=100)	OS Group (n=100)	*p*-value
Mean age (years)	58.6 ± 10.2	59.3 ± 9.8	0.68
Gender (Male:Female)	60:40	62:38	0.75
Tumor stage (I:II:III)	25:45:30	22:48:30	0.82
Tumor location (Colon:Rectum)	70:30	72:28	0.67

Table 2: Intraoperative outcomes

Parameter	MIS Group (n=100)	OS Group (n=100)	*p*-value
Mean operative time (minutes)	175 ± 30	160 ± 25	<0.05
Mean blood loss (mL)	150 ± 50	250 ± 60	<0.01

Table 3: Postoperative outcomes

Parameter	MIS Group (n=100)	OS Group (n=100)	*p*-value
Length of hospital stay (days)	6 ± 2	10 ± 3	<0.01
Complication rate (%)	15.0	25.0	<0.05
30-day readmission rate (%)	5.0	10.0	0.08

Table 4: Oncological outcomes

Parameter	MIS Group (n=100)	OS Group (n=100)	*p*-value
Margin clearance (%)	97.0	95.0	0.72
Five-year disease-free survival (%)	85.0	82.0	0.68

Table 5: Distribution of postoperative complications

Complication Type	MIS Group (n=100)	OS Group (n=100)	*p*-value
Wound infection (%)	5.0	12.0	<0.05
Respiratory complications (%)	4.0	10.0	<0.05
Anastomotic leak (%)	3.0	5.0	0.42
Ileus (%)	3.0	6.0	0.29

Table 6: Quality of life scores at six months postoperatively

Domain	MIS Group (Mean ± SD)	OS Group (Mean ± SD)	*p*-value
Physical health	85.2 ± 5.8	75.6 ± 6.4	<0.01
Emotional health	82.4 ± 6.2	72.8 ± 7.1	<0.01
Social functioning	84.6 ± 5.5	76.2 ± 6.7	<0.01

Table 7: Recurrence rates at five years

Recurrence Status	MIS Group (n=100)	OS Group (n=100)	*p*-value
No recurrence (%)	87.0	85.0	0.74
Recurrence (%)	13.0	15.0	0.74

Table 8: Patient satisfaction scores

Satisfaction Metric	MIS Group (Mean ± SD)	OS Group (Mean ± SD)	*p*-value
Recovery time	90.2 ± 4.8	78.6 ± 6.3	<0.01
Pain management	88.5 ± 5.1	80.2 ± 5.9	<0.01

Table 9: Economic impact of MIS vs. OS

Parameter	MIS Group (Mean ± SD)	OS Group (Mean ± SD)	*p*-value
Total hospital costs ($)	6,800 ± 500	9,200 ± 700	<0.01
Postoperative care costs ($)	1,200 ± 100	2,000 ± 150	<0.01

Table 10: Return-to-work time

Time to Return to Work (Days)	MIS Group (%)	OS Group (%)	*p*-value
≤ 30 Days	70 (70.0)	40 (40.0)	<0.01
> 30 Days	30 (30.0)	60 (60.0)	<0.01

Discussion:

This research presents the comparative outcomes of MIS and OS in colorectal cancer patients and highlights the clinical and cost advantages of MIS **[7]**. Results have determined that MIS had significantly decreased length of hospital stay, decreased postoperative complication rate and shorter recovery time compared to OS **[7, 8]**. For example, MIS patients had a mean hospital stay of 6 days versus 10 days in the OS group and a significantly reduced rate of complications at 15% versus 25% in OS ($p < 0.05$) **[9, 10]**. Oncological outcomes like surgical margin clearance and rates of five-year disease-free survival were comparable across the two groups, validating MIS oncological safety **[11]**. The rates of recurrence and rates of long-term survival were also not shown to have any statistically significant difference and further supported MIS as a proven alternative to OS **[12]**.

Interestingly, patients in the MIS group had higher quality of life and satisfaction ratings, signifying the better recovery process and reduced postoperative morbidity **[13]**. Economic evaluation determined that MIS is associated with lower overall healthcare costs due to reduced hospital stays and complications. The shorter return-to-work periods of MIS patients, where 70% returned to activity within 30 days, also highlight the functional benefits of this approach **[14]**. The results validate the overall application of MIS in colorectal cancer surgery from the literature. The study however indicates patient selection and surgical skill to guarantee optimal results. Long-term oncological outcomes, MIS technology innovation and measures to increase access to minimally invasive procedures are topics that require priority in research.

Conclusion:

Minimally invasive surgery (MIS) has clear clinical and economic advantages over open surgery (OS) in patients with colorectal cancer. MIS has lower postoperative complications, faster recovery, shorter hospital stay, and higher patient satisfaction without detrimental oncologic safety on the basis of equivalent surgical margins and five-year disease-free survival. The findings recommend expanded utilization of MIS in combination with advances in surgical technology and residency training to optimize colorectal cancer therapy.

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