Conversion in Laparoscopic Colectomy: Preventive or Reactive — Are There Differences?

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ABSTRACT

Background: Conversion to open surgery during laparoscopic colectomy may be required in certain intraoperative scenarios. Conversion can be preventive, when performed early in the presence of adverse findings that preclude continuation of the laparoscopic approach, or reactive, in response to intraoperative events. Assessing the impact of conversion type on postoperative outcomes is essential to optimize surgical decision-making.
Objective: To compare postopera tive outcomes between preventive and reactive conversion in laparoscopic colectomy.
Design: Retrospective comparative observational study using a prospectively maintained database.
Material and Methods: Patients who required conversion to open surgery during laparoscopic colectomy between January 2019 and May 2025 were included. The cohort was divided into two groups: preventive conversion (PC) and reactive conversion (RC). Demographic, intraoperative, and postoperative variables were analyzed. The primary outcome was the rate of major complications (Clavien–Dindo grade III–IV). Multivariable logistic regression was performed to identify independent risk factors for major complications.
Results: A total of 63 patients were included: 46 (73%) in the PC group and 17 (27%) in the RC group. No significant differences in baseline characteristics were observed. RC was associated with a higher rate of major complications (8.7% vs. 52.9%; p = 0.01), reoperation (10.8% vs 41.1%; p = 0.01), longer intensive care unit stay (1.9 vs 8.4 days; p = 0.001), and higher mortality (2.1% vs 23.5%; p = 0.01). On multivariable analysis, RC was an independent risk factor for major complications (OR 16.3; 95% CI 2.14–125.17; p = 0.007).
Conclusions: Reactive conversion during laparoscopic colectomy is associated with worse postoperative outcomes, including higher morbidity, increased need for reoperation, longer intensive care unit stay, and higher mortality.

Keywords: *Laparoscopic colectomy; Conversion to open surgery; Reactive conversion; Preventive conversion; Postoperative complications*

INTRODUCTION

Laparoscopic surgery has become the standard approach for the surgical management of a wide range of colorectal diseases, both benign and malignant, owing to its well-established benefits, including faster postoperative recovery, reduced pain, and lower rates of wound-related complications compared with open surgery.[1–3] However, the need for conversion remains an inherent challenge of the procedure, with a reported incidence ranging from 10% to 25%.[4,5] Conversion is a clinically relevant event, as it is associated with increased morbidity, longer operative time and hospital stay, and even a potential decrease in survival among patients undergoing surgery for oncologic disease.[6,7]

Two types of conversion have been described: preventive conversion, in which the surgeon makes an early decision in the presence of adverse conditions that may compromise safety or oncologic radicality, and reactive conversion, which occurs when laparotomy becomes necessary due to an intraoperative complication or unforeseen circumstance.[8,9]

The decision to convert is often influenced by multiple intraoperative and preoperative factors

In general surgery, several risk factors for conversion have been identified, including obesity, prior abdominal surgery, tumor extent, and anatomical difficulty.[10] However, the literature provides limited information regarding the impact of the type of conversion (reactive vs preventive) on postoperative outcomes in colorectal surgery.

The aim of this study was to compare postoperative morbidity and mortality between patients undergoing preventive versus reactive conversion during laparoscopic colectomy.

MATERIALS AND METHODS

Design and Population

A retrospective study was conducted using a prospectively maintained database of adult patients (≥18 years) who underwent laparoscopic colectomy for benign or malignant colorectal disease between January 2019 and May 2025 at Sanatorio Güemes (Buenos Aires, Argentina). All patients requiring conversion to open surgery were included in the analysis. The cohort was divided into two groups according to the reason for conversion: preventive conversion (PC) and reactive conversion (RC).

PC: when the surgeon opted for early conversion in the presence of intraoperative conditions that could compromise patient safety or oncologic radicality.

CR: when conversion was required due to an unexpected complication or difficulty during surgery (bleeding, injury, or inability to proceed laparoscopically).[8,9] Patients with a personal history of inflammatory bowel disease were excluded.

This study was conducted in accordance with the STROBE guidelines for observational studies (Supplementary Material 1). Institutional Review Board approval was obtained given the retrospective design of the study.

Variables Analyzed

Demographic variables included age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, prior abdominal surgery, and comorbidities such as hypertension, diabetes mellitus, dyslipidemia, smoking, chronic obstructive pulmonary disease (COPD), and chronic kidney disease. Intraoperative variables included the type of colectomy, the surgeon's level of specialization, years of experience in general surgery, timing of surgery (daytime vs nighttime), operative time, anastomosis rate, and stoma creation

Postoperative variables included overall complications (classified according to the Clavien-Dindo classification), need for blood transfusion, length of hospital stay, reoperation, and 30-day mortality.

A colorectal surgeon was defined as a physician who completed a general surgery residency followed by subspecialty training in colorectal surgery. Surgeons were considered experienced if they had at least 5 years of independent practice in general surgery.

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The primary endpoint of the study was to campare major complication rates (Clavien-Dindo III-IV) between PC and RC. Secondary endpoints included comparisons of minor complications (Clavien-Dindo grade I–II), surgical site infection, reoperation, mortality, readmission, and length of stay in the intensive care unit.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics® (version 26.0). Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were reported as frequencies and percentages and compared using the Chi-square test. A *p-value* <0.05 was considered statistically significant.

A multivariable logistic regression model was constructed to identify factors associated with major morbidity. Given the low number of events (grade III/IV complications), Firth's penalized logistic regression was used to reduce small-sample bias. Variables were selected based on clinical relevance and prior evidence to minimize overfitting. Results were expressed as odds ratios (ORs) with 95% confidence intervals (95% CIs).

RESULTS

A total of 511 laparoscopic colectomies were performed, of which 63 (12.3%) required conversion to open surgery; 46 patients (73%) underwent PC and 17 (27%) RC (Fig. 1). The most frequent reasons for PC were adhesions (60.8%) and inadequate exposure (26%), whereas in RC the predominant causes were hemorrhage (35.2%) and bowel perforation (29.4%) (Table 1).

No statistically significant differences were observed between groups in demographic variables (Table 2).

The type of surgery was similar between groups. No differences were found regarding nighttime surgery (PC: 9 [19.5%] vs RC: 6 [35.2%]; $p = 0.19$), participation of a colorectal surgeon (PC: 8 [17.4%] vs RC: 4 [23.5%]; $p = 0.58$), surgeon experience >5 years (PC: 14 [30.4%] vs RC: 3 [17.6%]; $p = 0.31$), or urgency of the procedure (PC: 24 [52.1%] vs RC: 11 [64.7%]; $p = 0.37$). Operative time was also comparable (PC: 169 minutes vs RC: 173 minutes; $p = 0.78$) (Table 3).

Table 1. Causes of conversion in both groups

Conversion type	n (%)
Preventive	
Extensive adhesions	28 (60.8)
Poor exposure	12 (26.0)
Technical difficulties	6 (13.0)
Reactive	
Uncontrollable bleeding	6 (35.2)
Intestinal perforation	5 (29.4)
Medical causes	6 (35.2)

Regarding postoperative outcomes, no differences were observed in surgical site infection (PC: 3 [6.5%] vs RC: 3 [17.3%]; $p = 0.21$) or overall morbidity (PC: 18 [39.1%] vs RC: 11 [64.7%]; $p = 0.12$). However, RC was associated with significantly higher rates of Clavien-Dindo grade III/IV complications (PC: 4 [8.7%] vs RC: 9 [52.9%]; $p = 0.001$), reoperation (PC: 5 [10.8%] vs RC: 7 [41.1%]; $p = 0.01$), and mortality (PC: 1 [2.1%] vs RC: 4 [23.5%]; $p = 0.01$).

Patients in the RC group had longer ICU stays (PC: 1.9 days vs RC: 8.4 days; $p = 0.001$), while overall length of stay was similar (PC: 11 days vs RC: 12 days; $p = 0.91$). Readmission rates were also comparable (PC: 5 [10.8%] vs RC: 2 [11.8%]; $p = 0.89$) (Table 4).

In multivariable analysis, RC was the only independent factor associated with an increased risk of major complications (OR 16.3; 95% CI 2.14–125.17; $p = 0.007$) (Table 5).

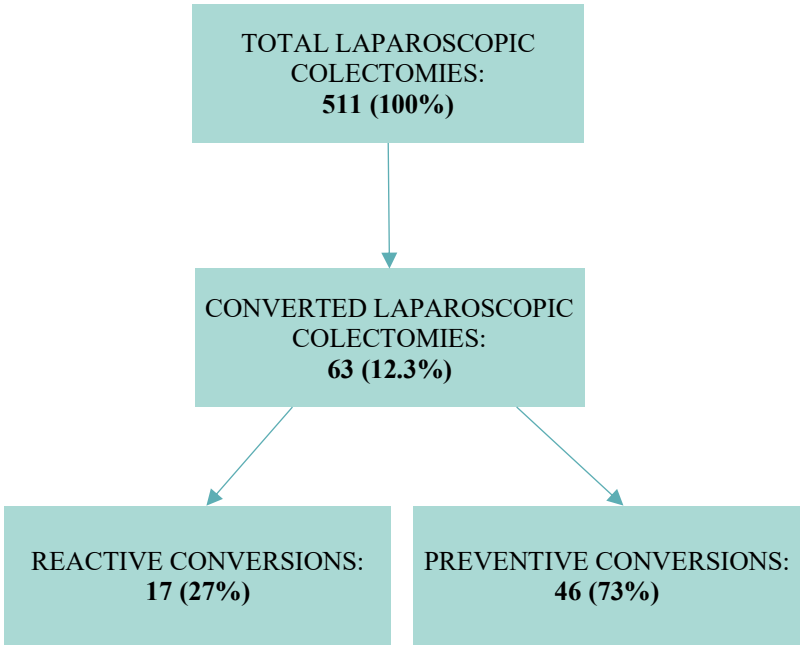

Figure 1. Flowchart of patient selection.

Table 2. Demographic and preoperative variables

	PC n = 46	RC n = 17	*p*
Age, years, mean (range)	63 (19–92)	61 (35–91)	0.80
Female sex, n (%)	22 (47.8)	4 (23.5)	0.08
ASA I/II, n (%)	22 (47.8)	7 (41.1)	0.72
Obesity (BMI >30) , n (%)	25 (54.3)	7 (41.1)	0.64
Hypertension, n (%)	25 (54.3)	12 (70.5)	0.24
Dyslipidemia, n (%)	9 (19.5)	3 (17.6)	0.75
Diabetes mellitus, n (%)	8 (17.3)	1 (5.8)	0.24
Prior myocardial infarction, n (%)	4 (8.6)	1 (5.8)	0.71
Smoking, n (%)	18 (39.1)	8 (47.0)	0.57
Chronic obstructive pulmonary disease, n (%)	1 (2.1)	1 (5.8)	0.50
Chronic kidney disease, n (%)	2 (4.3)	0 (0)	0.38
Immunosuppression, n (%)	4 (8.6)	1 (5.8)	0.71
Prior abdominal surgery, n (%)	19 (41.3)	8 (47.0)	0.93
Hypoalbuminemia <3.5 g/dL, n (%)	14 (30.4)	4 (23.5)	0.65
Anemia, n (%)	28 (60.8)	11 (64.7)	0.85
Indication for surgery Benign disease, n (%) Malignant disease, n (%)	 26 (56.5) 20 (43.5)	 6 (35.2) 11 (64.8)	0.11

PC = preventive conversion. RC = reactive conversion. ASA = American Society of Anesthesiologists classification. BMI = body mass index.
A *p-value* <0.05 was considered statistically significant.

Table 3. Intraoperative variables

	PC n = 46	RC n = 17	*p*
Type of surgery Right colectomy, n (%) Sigmoidectomy, n (%) Hartmann's procedure, n (%) Transverse colectomy, n (%) Total colectomy, n (%)	 18 (39.1) 11 (23.9) 11 (23.9) 4 (8.6) 2 (4.3)	 10 (58.8) 5 (29.4) 2 (11.7) 0 (0) 0 (0)	0.41
Emergency surgery, n (%)	24 (52.1)	11 (64.7)	0.37
Night-time surgery, n (%)	9 (19.5)	6 (35.2)	0.19
Colorectal surgeon, n (%)	8 (17.4)	4 (23.5)	0.58
Experienced surgeon, n (%)	14 (30.4)	3 (17.6)	0.31
Anastomosis, n (%)	19 (41.3)	10 (58.8)	0.21
Ostomy, n (%)	29 (56.5)	6 (29.4)	0.06
Operative time, minutes, mean ± SD	169 ± 52	173 ± 40	0.78

PC = preventive conversion. RC = reactive conversion.
SD = standard deviation. A *p-value* <0.05 was considered statistically significant.

Table 4. Variables postoperatorias.

	PC n = 46	RC n = 17	*p*
Overall morbidity, n (%)	18 (39.1)	11 (64.7)	0.12
Major morbidity (Clavien–Dindo III–IV), n (%)	4 (8.7)	9 (52.9)	0.001
Surgical site infection, n (%)	3 (6.5)	3 (17.6)	0.21
Postoperative ileus, n (%)	9 (19.5)	3 (17.6)	0.82
Blood transfusions, n (%)	10 (21.7)	7 (41.2)	0.09
Anastomotic leak, n (%)	1 (5.2)	3 (30)	0.06
Reoperation, n (%)	5 (10.8)	7 (41.1)	0.01
ICU length of stay, days, mean ± SD	1.9 ± 3.9	8.4 ± 11.9	0.001
Hospital length of stay, days, mean ± SD	11 ± 10.9	8.4 ± 35.8	0.55
Readmission, n (%)	5 (10.8)	2 (11.8)	0.89
Mortality, n (%)	1 (2.1)	4 (23.5)	0.01

PC = preventive conversion. RC = reactive conversion. ICU = Intensive care unit.
SD = standard deviation. A *p-value* <0.05 was considered statistically significant.

Table 5. Multivariable analysis of factors associated with major complications (Clavien–Dindo grade III–IV)

	OR	95% CI	*p*
Obesity	0.343	0.03–3.36	0.35
Age	0.958	0.89–1.02	0.235
ASA III/IV	0.819	0.10–6.17	0.847
Previous abdominal surgery	2.67	0.42–17.05	0.298
Emergency surgery	0.736	0.09–5.55	0.766
Nighttime surgery	0.536	0.27–10.76	0.684
Colorectal surgeon	3.47	0.314–38.4	0.310
Reactive conversion	16.369	2.14–125.17	0.007

A *p-value* <0.05 was considered statistically significant.

DISCUSSION

This study aimed to evaluate the impact of conversion type (PC vs RC) on postoperative outcomes in colorectal surgery. Patients undergoing RC experienced higher rates of major complications (Clavien-Dindo grade III/IV), reoperations, longer ICU stays, and higher readmission rates. In multivariable analysis, RC emerged as the only independent predictor of major complications.

Over recent decades, advances in minimally invasive techniques, technological innovation, and increasing surgical expertise have established laparoscopy as the standard approach for many colorectal conditions.[1] Multiple randomized controlled trials and meta-analyses have demonstrated that laparoscopic surgery provides multiple benefits, including reduced postoperative pain, lower rates of ileus, improved cosmetic outcomes, shorter hospital stay, and faster recovery.[11–14]

Despite these advances, conversion to open surgery remains a persistent challenge in colorectal practice. In our series, the conversion rate was 12.3%, consistent with prior reports.[15] However, the differential impact of preventive versus reactive conversion has been poorly studied. Yang et al.[8] reported worse outcomes among patients undergoing RC due to intraoperative complications compared with PC, including higher postoperative complication rates (50% vs 27%; $p = 0.02$), longer time to oral intake (6 vs 5 days; $p = 0.03$), and a trend toward longer hospital stay (8.1 vs 7.1 days; $p = 0.08$). Similarly, in our cohort, RC was associated with significantly worse outcomes, including higher rates of grade III/IV complications (52.9% vs 8.7%; $p = 0.001$),

increased reoperation rates (41.1% vs 10.8%; p = 0.01), and prolonged ICU stay (8.4 vs 1.9 days; p = 0.001). RC was the only independent factor associated with postoperative complications in our analysis.

Rather than representing technical failure, conversion should be viewed as a safety strategy aimed at avoiding or preventing major complications. Belizon et al.[4] reported that postoperative morbidity decreases significantly when conversion is performed within the first 30 minutes of surgery. Another study found that early conversion (<105 minutes) was associated with reduced blood loss and fewer transfusions compared with later conversion (p = 0.04), although no differences were observed in overall morbidity, reoperation rate, or hospital stay.[16]

A recent study evaluating the impact of time to conversion on 3-year oncologic outcomes demonstrated that although delayed conversion (>60 minutes) was associated with increased postoperative morbidity and longer hospital stay, it did not adversely affect cancer-specific or disease-free survival.[17]

Although the optimal timing of conversion remains uncertain due to limited evidence, early conversion may reduce postoperative morbidity and, in oncologic patients, avoid unnecessary tumor manipulation, potentially reducing the risk of tumor cell dissemination and adverse oncologic outcomes.[4-6]

From a technical standpoint, PC reflects the surgeon's ability to anticipate adverse scenarios and prioritize patient safety over persistence with a laparoscopic approach. This decision may be influenced by factors such as obesity, dense adhesions, bleeding, or inadequate exposure. Additionally, several studies have identified surgeon-related factors—including experience, institutional volume, learning curve, and technical skill—as risk factors for conversion.[18,19]

In our study, however, no differences in conversion type were observed according to surgeon subspecialty (PC: 8 [17.4%] vs RC: 4 [23.5%]; p = 0.58) or surgical experience >5 years (PC 14 [30.4%] vs RC 3 [17.6%]; p = 0.31).

The main limitation of this study is its retrospective design. Selection bias is present, as the decision to perform PC or RC was at the discretion of the operating surgeon. It is important to note that the classification of PC versus RC was subjective and depended on the authors' interpretation of the operative report. In addition, oncologic variables were not analyzed; therefore, no information is available regarding the potential impact of conversion type on recurrence or long-term survival in patients undergoing surgery for oncologic indications.

Surgeon-specific factors, such as individual experience and learning curve, were also not evaluated and may have influenced the decision to convert. Finally, time to conversion was not analyzed and may represent an area for future research.

Despite these limitations, this study is among the first to evaluate the impact of conversion type on postoperative outcomes in Argentina.

CONCLUSION

Reactive conversion during laparoscopic colectomy is independently associated with worse postoperative outcomes, including higher rates of major complications, reoperation, ICU stay, and mortality. These findings suggest that timely preventive conversion, in the setting of adverse intraoperative conditions, may represent a safer strategy. In this context, conversion should not be interpreted as a technical failure but rather as a decision aimed at optimizing patient outcomes. Prospective studies with larger sample sizes are warranted to confirm these findings and to better define the optimal timing for conversion.

Author Contributions
M.T.: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing
A.I.L.: Conceptualization, Investigation, Writing – review & editing
M.A.C.: Conceptualization, Methodology, Formal analysis, Investigation, Writing – review & editing, Supervision
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