Short-term outcomes of reactive versus preemptive conversion in laparoscopic colorectal resection

Amir Fawzy Abdelhamid[a], Tarek Youssef Ahmed[b], Hossam Ramadan Moussa[a]

[a]Department of General Surgery, Faculty of Medicine, Tanta University, Tanta, [b]Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Amir Fawzy Abdelhamid, MD, Gastrointestinal and Laparoscopic Surgery Unit,General Surgery Department, Faculty of Medicine, Tanta University, Tanta, 31527, Egypt. Tel: +20403337544; fax: +20403337544; e-mail: amirfawzyshaban@gmail.com

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Background
Multiple studies have reported that conversion during laparoscopic surgery is associated with poor surgical outcomes. Two types of conversions have been reported: preemptive and reactive conversion. This study aims to compare the short-term outcomes after preemptive versus reactive conversion during laparoscopic colorectal surgeries.
Patients and methods
A total of 67 cases underwent conversion during the period between January 2017 till December 2019. They were classified based on the type of conversion into two groups: reactive group (45 cases) and preemptive group (22 cases). The collected data included preoperative (age, sex, BMI, and American Society of Anesthesiologists score), operative (operative time, pathology, cause of conversion, and blood transfusion), and postoperative data (hospital stay, in hospital mortality, complications, and short-term recurrence).
Results
No significant difference was detected between the study groups regarding demographic data, pathology, or cause of conversion. However, longer operative time and more need for blood transfusion were noticed in the reactive group. Moreover, postoperative complications were more commonly encountered in the same group, apart from anastomotic leakage. Accordingly, longer hospitalization was present in that group.
Conclusion
Reactive conversion appears to be associated with worse postoperative outcomes compared with preemptive conversion.

Keywords:
laparoscopic surgery, preemptive conversion, reactive conversion

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Introduction

The popularity of laparoscopic colorectal resections has markedly increased [1] since it was first reported in the last decade of 20th century [2]. Most colorectal surgeons prefer to use that approach because of its advantages. It is associated with faster patient recovery, less postoperative pain, and shorter hospital stay, with the same oncological outcomes reported after open resections [3–5].

In spite of the great advances achieved in medical technology and medical training, conversion rates are reported to reach up to 30% [6]. Others reported higher conversion rates, reaching 42% [7].

Several risk factors for conversion to open surgery in laparoscopic colorectal surgery have been identified. These include patient-related factors (e.g. sex, obesity, and previous abdominal operations), surgeon-related factors (e.g. experience, technical ability, and learning curve), procedural factors (e.g. resection site), and intraoperative complications, like poor visualization, equipment malfunction, and bleeding. In general, adequate training and experience can control surgeon and procedural-related reasons for conversion. Patient-related factors remain largely outside the control of the surgeon [8].

Conversion to open surgery has been associated with more blood loss, more postoperative morbidity, and prolonged hospital stay [9]. Probably, longer operative time and more blood loss may have a negative effect on the immune system, leading to an increased risk of major complications [10].

Surgeon should always keep in mind that conversion may be required during minimally invasive technically demanding colorectal surgery. Conversion depends on many factors including patient-related, disease-related, and surgeon-related factors. Surgeon experience plays a crucial role in the decision and timing of conversion [11].

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Two types of conversions have been reported: reactive and preemptive (strategic) conversion. Reactive conversion occurs secondary to operative complication, whereas preemptive conversion is performed to avoid complications. It was reported that reactive conversion is significantly associated with more postoperative complications compared with the preemptive one [12,13].

Nevertheless, the existing literature is poor in handling that comparison. Therefore, this study aims to compare the short-term outcomes after preemptive versus reactive conversion.

Patients and methods

This retrospective study was conducted at the General Surgery Departments of both Tanta and Ain Shams University Hospitals. It included cases that underwent laparoscopic colorectal resections in both hospitals during the period between January 2017 and December 2019. We retrospectively reviewed the data of such cases, and a total of 313 cases had planned to undergo the laparoscopic operation (based on intention to treat), from whom 67 cases were converted to the open approach.

An informed written consent was taken from all cases before operation after the explanation of the possible complications of the procedure. Furthermore, the study was approved by the local ethical committee of both universities.

Conversion was defined by the need to perform a surgical incision rather than the laparoscopic ports, and the incision needed for specimen extraction (usually suprapubic) [11].

The included 67 cases were divided into two groups: reactive conversion group, which included 45 cases that were subjected to reactive conversion, and preemptive group, which included the remaining 22 cases that were subjected to preemptive conversion.

Preemptive conversion was established when a standard laparotomy was directly performed after assessment of the feasibility of completing the procedure laparoscopically and because of anticipated operative difficulty or logistic considerations. Reactive conversion was defined as the need for laparotomy owing to a complication or because of operative difficulty after a considerable dissection time (>15 min) [14]. All the surgeries were performed by a team led by a consultant surgeon who is well experienced in both laparoscopic and open colorectal surgeries, and the decision to perform either preemptive or reactive conversion was based only on the operator opinion and experience, supported by two other surgeons, the other assistant, and the cameraman.

Before admission, all cases were subjected to history taking, full clinical examination, and routine laboratory investigations, including tumor markers. Moreover, radiological evaluation included abdominal ultrasonography, triphasic pelviabdominal computed tomography, barium study, and/or pelvic MRI. Additionally, cases were evaluated by the anesthesia team and were classified according to the American Society of Anesthesiologists (ASA) status.

The collected data included preoperative (age, sex, BMI, and ASA score), operative (operative time, pathology, cause of conversion, and blood transfusion), and postoperative data (hospital stay, in hospital mortality, complications, and short-term recurrence over 6-month follow-up period). The rate of postoperative complications was the primary outcome, whereas operative time, operative complications, and hospital stay were the secondary outcomes.

Statistical analysis

Data were analyzed using IBM SPSS software package, version 22.0 (Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp). Qualitative data were described using number and percent. Quantitative data were presented as mean and SD or media (range) according to normality by using Kolmogrov–Smirnov test. χ^2 test was used for comparison of two groups of qualitative data (Monte Carlo test as correction for χ^2 test when more than 25% of cells have count <5 in tables). Student *t* test was used to compare two independent groups of parametric data. Univariate and multivariate logistic regression analyses were used to determine the dependent and independent risk factors for the categorical outcome variable (postoperative complications). *P* value less than 0.05 was considered statistically significant.

Results

The median age of the included cases was 55 and 54 years in the reactive and preemptive conversion groups, respectively. Males represented 53.33 and 50% of cases in the reactive and preemptive conversion groups, respectively. BMI had mean values of 30.66 and 29.45 kg/m^2 in the reactive and preemptive conversion groups, respectively. Regarding ASA

status, score I was present in 68.89 and 54.54% of cases in the reactive and preemptive conversion groups, respectively, whereas the remaining cases had score II. Neither of the previous demographics was significantly different between the two groups (Table 1).

Adenocarcinoma was the commonest encountered pathology (86.67 and 90.91% of cases in the reactive and preemptive groups, respectively). Other pathologies included diverticulosis, ischemic colitis, and squamous cell carcinoma. No significant difference was detected between the two groups regarding the operation performed (P=0.682). Infiltration of surrounding organs was the commonest cause of conversion in both groups (31.11 and 40.9% in the reactive and preemptive conversion groups, respectively). Other causes included adhesions, large mass making it difficult for manipulation, thick-walled edematous colon making it very difficult to grasp (like in diverticulosis and ischemic colitis), perforation together with abscess formation (cancer and diverticulosis), bleeding, and other organ injuries (ureter, spleen, and urinary bladder, one case for each complication).

Operative time was significantly increased in the reactive group (245 vs. 190 min in the preemptive group – P=0.001). In addition, blood transfusion was significantly more needed in the reactive group (31.11 vs. 13.36% of cases – P=0.015). Table 2 illustrates these data.

Table 1 Preoperative demographic data

Variables	Groups		*P* value
	Reactive conversion (*N*=45)	Preemptive conversion (*N*=22)	
Age (years)	55 (46–62)	54 (43–60)	0.416
Sex [*n* (%)]			
Male	24 (53.33)	11 (50)	0.684
Female	21 (46.67)	11 (50)	
BMI (kg/m^2)	30.66 (27.36–42.5)	29.45 (28.2–41.4)	0.752
ASA [*n* (%)]			
I	31 (68.89)	12 (54.54)	0.225
II	14 (31.11)	10 (45.45)	

ASA, American Society of Anesthesiologists.

Table 2 Operative data of the study cases

Variables	Groups		*P* value
	Reactive conversion (*N*=45)	Preemptive conversion (*N*=22)	
Disease nature [*n* (%)]			
Adenocarcinoma	39 (86.67)	20 (90.91)	0.537
Squamous cell carcinoma	1 (2.2)	0	
Diverticulosis	4 (8.89)	2 (4.44)	
Ischemic colitis	1 (2.2)	0	
Type of surgery [*n* (%)]			
Right colectomy	17 (37.78)	9 (40.91)	0.682
Left colectomy	19 (42.22)	9 (40.91)	
Ant resection	8 (17.77)	4 (18.18)	
Abdominoperineal resection	1 (2.2)	0	
Cause of conversion [*n* (%)]			
Patient related			
Abdominal adhesions	6 (13.33)	4 (18.18)	
Disease related			
Large mass	10 (22.22)	5 (22.73)	0.309
Infiltration of surrounding organ	14 (31.11)	9 (40.9)	
Perforation and abscess	3 (6.67)	3 (13.63)	
Technique related			
Difficulty grasping colon	5 (11.11)	1 (4.54)	
Bleeding	4 (8.89)	0	
Organ injury	3 (6.67)	0	
Operation time (min)	245 (210–320)	190 (160–280)	0.001*
Blood transfusion	14 (31.11)	3 (13.36)	0.015*

*It denotes that this factor has statistically significant impact or effect as relation to *P* value result.

When it comes to the postoperative parameters, oral intake was significantly delayed in the reactive group (fifth vs. fourth postoperative day in the preemptive group – P=0.039). Moreover, the duration of hospital stay was much longer in the same group (10 vs. 6 days – P=0.003). The rate of postoperative complications was significantly higher in the reactive group compared with the preemptive one (51.11 vs. 27.27%, respectively – P<0.001). Wound infection, paralytic ileus, and chest infections were significantly more encountered in the reactive group compared with the other group (P<0.05). However, the incidence of anastomotic leakage did not significantly differ between the study groups. No cases with in-hospital mortality or recurrence were detected in the current study. These data are illustrated at Table 3.

Regarding the risk factors for postoperative complications, both reactive conversion and the presence of abscess/perforation increased the risk of postoperative complications. Table 4 illustrates these data.

Discussion

Surgeons should realize the time point at which continuation of operation using the laparoscopic approach is not appropriate [15,16].

This retrospective study was conducted at the General Surgery Departments of both Tanta and Ain Shams University Hospitals. We included a total of 67 cases who underwent conversion during laparoscopic surgery, of

Table 3 Postoperative data of the study patients

Variables	Groups		*P* value
	Reactive conversion (*N*=45)	Preemptive conversion (*N*=22)	
Start oral (day)	5 (1–8)	4 (1–5)	0.039*
Hospital stay	10 (7–12)	6 (5–9)	0.003*
Complication rate	23 (51.11)	6 (27.27)	<0.001*
Wound infection	15 (33.33)	3 (13.63)	0.009*
Anastomotic leakage	5 (11.11)	1 (4.5)	0.368
Ileus	11 (24.44)	3 (13.6)	0.048*
Chest infection	10 (22.22)	1 (4.5)	0.015*
In-hospital mortality	0	0	1
Recurrence	0	0	1

*It denotes that this factor has statistically significant impact or effect as relation to *P* value result.

Table 4 Univariate and multivariate analysis of predictors of postoperative complications

Variables	Univariate analysis	Multivariate analysis		
		B	95% CI	*P* value
Age	0.28			
Male sex	0.832			
BMI	0.582			
ASA I	0.763			
Adenocarcinoma	0.858			
Squamous cell carcinoma	0.231			
Diverticulosis	0.843			
Ischemic colitis	0.656			
Colonic lesion	0.208			
Rectal lesion	0.22			
Abdominal adhesions	0.423			
Large mass	0.38			
Difficult grasping colon	0.758			
Surrounding organ infiltration	0.299			
Perforation and abscess	<0.001*	3.26	2.93–3.72	0.013*
Bleeding	0.47			
Organ injury	0.251			
Operation time	0.988			
Blood transfusion	0.314			
Reactive conversion	0.001*	1.517	1.241–2.28	0.045*
Preemptive conversion	0.214			

ASA, American Society of Anesthesiologists; CI, confidence interval. *It denotes that this factor has statistically significant impact or effect as relation to *P* value result.

which 45 had reactive conversion, whereas the remaining 22 cases had preemptive conversion.

Conversion rate was 21.4% in our study, which is consistent with the conversion rates ranging between 15 and 38% reported in the literature [12,17].

There is a paucity of trials comparing preemptive with reactive conversion of laparoscopic surgery.

In our study, no significant difference was detected between the two groups regarding demographic characteristics ($P>0.05$).

Another study also reported that there was no significant difference between the reactive and preemptive groups regarding patient demographics including age, sex, BMI, and ASA score ($P>0.05$) [18]. This comes in line with our findings.

In the current study, the performed operation and disease type did not significantly differ between the two groups ($P=0.682$ and 0.537, respectively).

Moreover, another study reported that neither of the operation performed nor pathology detected had an effect on conversion [18].

In our study, operative time showed a significant prolongation in the reactive group (245 min) compared with the preemptive group (190 min) ($P=0.001$). The prolongation could be owing to the long time elapsed either in harmful laparoscopic dissection or in the repair of complications occurred during laparoscopic dissection.

Aytac *et al.* [18] reported that operative time had mean values of 211 and 187 min in the reactive and preemptive groups, respectively. However, that difference was not statistically significant ($P=0.136$).

In the current study, intraoperative blood transfusion was required in 31.11 and 13.36% of cases in the reactive and preemptive groups, respectively. There was a significant increase in blood transfusion in the reactive group ($P=0.015$). This perspective should be handled with caution, as it has some subjective components. Anesthetists had low threshold in intraoperative blood transfusion in cases with borderline hemoglobin levels (8–9 g/dl).

Caputo *et al.* [11] reported that cases requiring blood transfusion significantly increased in the late conversion group (69.2 vs. 25% of cases in the early conversion group – $P=0.04$). This coincides with our findings.

Furthermore, Aytac *et al.* [18] reported that intraoperative blood loss was significantly increased in the reactive group (mean=632 vs. 375 ml in preemptive group – $P=0.045$). Such significant blood loss will eventually increase the need for blood transfusion in that group.

Regarding postoperative outcomes, the reactive group showed significant increase in hospital stay and postoperative complications, apart from leakage, compared with the preemptive group.

The increased rates of postoperative morbidity after reactive conversion could be owing to the intraoperative complication causing conversion in the first place [6]. Therefore, we recommend low threshold for conversion in challenging cases to avoid unsafe dissection.

Nevertheless, the optimum time for conversion has not been determined yet. Although Belizon *et al.* [19] has reported that postoperative morbidity significantly decreased if conversion was performed within the first 30 min during surgery, Aytac *et al.* [18] denied any significant effect of conversion timing on the postoperative outcomes.

Yang *et al.* [12] retrospectively reviewed that data of 122 cases that had been converted to the open approach. They reported that postoperative complications were significantly more encountered in the reactive group versus preemptive group. In-hospital complications were encountered in 50 and 26.7% of cases in the reactive and preemptive groups, respectively ($P=0.028$). This agrees with our findings.

Conversely, Caputo *et al.* [11] denied the presence of any significant difference between early and late conversion groups regarding all complications ($P>0.05$), except for blood transfusion requirement ($P=0.04$).

In our study, postoperative ileus was encountered in 24.44 and 13.6% of cases in the reactive and preemptive groups, respectively. It was significantly more encountered in the reactive group ($P=0.048$). This could be owing to excessive tissue handling, intraoperative complication, prolonged operative time, and increased postoperative complications in the same group.

Within the same context, Yang *et al.* [12] reported that cases in the reactive group needed significantly longer time to tolerate oral diet (6 vs. 5 days in the preemptive group – P=0.033).

In the study conducted by Aytac *et al.* [18], time needed for bowel function did not significantly differ between the two groups (P=0.265). However, the study did not comment on the number of cases that developed postoperative ileus like ours.

In our study, wound infection was more significantly encountered in the reactive group compared with the preemptive one (33.33 vs. 13.63%, respectively – P<0.001).

However, another study reported no significant difference between the two groups regarding the same parameter (33.3 vs. 30.8% of cases in the reactive and preemptive conversion groups, respectively – P=1.0) [11].

Chest infections were more commonly encountered in the reactive group (22.22%) compared with the preemptive group (4.5%) in the current study. There was a significant difference between the two groups regarding that perspective (P=0.015).

In another study, pneumonia was reported in 7% of cases in the reactive group, whereas it was not encountered in the preemptive group. The incidence of postoperative pneumonia was significantly higher in the reactive group (P=0.012) [18], and this supports our findings.

Other studies reported that postoperative bleeding was significantly more encountered in the reactive compared with the preemptive group (P<0.05) [18]. However, we did not encounter any case with postoperative bleeding in the current study.

In the current study, no significant difference was detected between the two groups regarding the incidence of anastomotic leakage (P=0.368). It was encountered in 11.11 and 4.5% of cases in both groups, respectively. Caputo *et al.* [11] confirmed our findings, as there was no significant difference between the two groups regarding the same complication (P=1). The incidence of anastomotic leakage was reported in 25 and 23.1% of cases in the reactive and preemptive conversion groups, respectively.Our results revealed significantly longer hospital stay in the reactive group (10 vs. 6 days in the preemptive group). Certainly, the increased postoperative morbidities in that group could explain that finding.

Yang *et al.* [12] reported that the duration of hospitalization was significantly prolonged in the reactive group (8.1 vs. 7.1 in the preemptive group).

Conversely, Caputo *et al.* [11] reported that there was no significant difference between the early and late conversion groups regarding the duration of hospital stay (median=11 days – P=1.00). This disagreed with our findings.

Our study revealed that the presence of abscess/perforation is a risk factor for postoperative complications. It was previously reported that reconstruction of colonic or rectal anastomoses in the presence peritonitis increases the incidence of postoperative anastomotic complications [20]. However, multiple studies have negated that association [21,22].

Our study has multiple limitations: it is a retrospective one; therefore, there is no randomization. The included sample size was relatively small. Finally, it was a short-term one, so long-term recurrence and survival data are missing. Hence, more studies should be conducted to reach global guidelines that defines the timing of conversion during laparoscopy.

Conclusion

Based on our findings, reactive conversion appears to be associated with worse postoperative outcomes compared with preemptive conversion. Once conversion is necessary, surgeon should not waste time performing laparoscopy. Therefore, more studies including more cases should be conducted to specify the indications for conversion to avoid the complications of delayed conversion.

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Conflicts of interest

There are no conflicts of interest.

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