Original research

Conversion in mini-invasive colorectal surgery: The effect of timing on short term outcome

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HIGHLIGHTS

- Conversion in MI colorectal surgery can always occur.
- We focused on effect of timing of conversion on early postoperative outcome.
- Earlier conversion has better outcomes.
- Surgeons should identify any critical aspects avoiding late conversion.

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ABSTRACT

Introduction: Different results have been reported about postoperative outcomes of conversion during laparoscopic colorectal surgery. We aimed to detect the effect of conversion on postoperative outcome and to identify features associated to better outcome after conversion.

Methods: Two hundred-fourteen mini-invasive left colonic and rectal resections were retrospectively analysed.

Two groups were identified: mini-invasive colorectal surgery (MI) that includes both laparoscopic and robotic resections, and conversion to open surgery.

Results: Among 214 colorectal procedures, 189 were MI. Conversion rate was 11.7%. Operating time was shorter for MI at overall analysis (p = 0.003) and sub-analysis of left colectomies (p = 0.001). MI procedures had shorter hospital stay (p = 0.000) both in left colectomy and rectal resection (p = 0.008 and p = 0.001 respectively).

A shorter time to first flatus emission was detected in MI group in both overall analysis (p = 0.003) and procedure's sub-analysis (left colectomy p = 0.032; anterior rectal resection p = 0.040). Oral feeding was resumed earlier after mini-invasive rectal resections (p = 0.014).

Conversion procedures required more blood transfusions (p = 0.000) and grade II complication rate was lower after MI procedures (p = 0.013).

Conversion presented higher anastomotic leakage and reoperation rates (p = 0.035 and p = 0.006 respectively). Conversion before 105 min (early conversion) had a significant lower number of blood transfusions (p = 0.047).

Conclusions: Conversion is associated to higher rate of blood transfusions, grade II complication and slower recovery. Earlier conversion has better outcomes. Colorectal surgeons should identify any critical aspects that could avoid late conversion allowing reducing negative effects of conversion.

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1. Introduction

More than two decades have passed since the first laparoscopic colonic resection was performed. To date, laparoscopic colorectal surgery is widely adopted; it is defined as challenging and
technically demanding and better results are reported in high volume centres [1].

Despite advances in technology and surgical techniques, rates of conversion to open surgery are described as up to 42% [2].

Different odds ratios for factors associated with higher risk of conversion have been reported in relation to the type of disease (inflammatory or neoplastic) and procedure (right colectomy, left colectomy, anterior rectal resection) [3].

Conversion has been related to increased length of stay, blood loss, postoperative complications and later return to a normal diet and common activities; however, some Authors denied this association and different results and conclusions have been described on this topic [4].

To our knowledge, some of the reported experiences come from multicentre trials, others from low volume colorectal surgery institutions and most series were collected over a large time span; thus, several Authors also considered hand-assisted procedures in the laparoscopic group; most of them didn’t analyse the effect of timing of conversion and lack of evidence is reported in the field of robotic-assisted laparoscopic colorectal resections.

The aim of our study is to analyse the perioperative outcome of conversion in a selected cohort of patients who underwent mini-invasive colorectal surgery (both laparoscopic and robotic assisted) over a short and recent period, in a high volume colorectal surgery centre.

2. Methods

A retrospective analysis was conducted on patients who underwent mini-invasive colorectal surgery between January 2010 and December 2012 at University Campus Bio-Medico di Roma.

Among these patients, only those who underwent left colonic and rectal resection for both malignant and benign disease have been considered eligible for the analysis.

Diverting stoma creations without resection were excluded as well as right and total colectomies in order to obtain a homogenous series.

Patients were divided into two groups: mini-invasive colorectal surgery (MI) that includes both laparoscopic (LPS) and robotic (R) resections, and conversion to open surgery (C).

In our institution no hand-assisted surgery is usually performed.

Conversion was considered as the need to perform any kind of laparotomy different from the incision necessary for the specimen removal, which was generally sovrapubic.

In the MI group, all colorectal anastomoses have been double stapled laparoscopically performed.

Retrospective analysis allowed to collect demographic data, previous medical history including previous abdominal surgery for all the series as well as perioperative data regarding duration of the surgical procedure, blood transfusion, time from the incision to conversion, postoperative complications (according to Clavien–Dindo grading system) [5], length of hospital stay and readmission.

Data regarding time for the first flatus, stool emission and time for recovering to oral feeding were available only in 171, 197 and 196 patients respectively.

Data were analysed in all the series. Sub analysis for type of procedure and for early and late conversion has been also performed.

3. Statistical analysis

Data were expressed as medians (with range) and frequency measures for continuous and categorical variables respectively. Groups were compared with the Mann–Whitney test, Pearson Chi square test and a two-sided Fisher’s exact test, as applicable. p values <0.05 were considered statistically significant. Statistical analyses were performed using SPSS 17.0 (SPSS Inc, Chicago, Illinois, USA).

4. Results

Among 214 colorectal procedures in the considered time span, 189 were MI (164 laparoscopic and 25 robotic-assisted) and conversion rate was 11.7% (25/214) (Fig. 1). Patients who underwent MI surgery were significantly younger than those in C groups. Clinical—demographic characteristics of all the series are showed in Table 1.

4.1. Duration of surgical procedure

Operating time was shorter for mini-invasive group (p 0.003). These data were confirmed at the sub-analysis of left colectomies (p 0.001) but no differences have been detected for anterior rectal resections (p 0.112).

4.2. Length of stay

Patients submitted to mini-invasive procedures had a shorter hospital stay than those in C group (p 0.000). These data have been confirmed at the sub-analysis for both left colectomy and rectal resection (p 0.008 and p 0.001 respectively).

4.3. First flatus (171 patients) and stool (197 patients) emission

A shorter time to first flatus emission was detected in MI group when compared to C group in both overall analysis (p 0.003) and procedure’s sub-analysis (left colectomy p 0.032; anterior rectal resection p 0.040).

No differences have been found at the analysis of first stool emission.

4.4. Oral feeding (196 patients)

Oral feeding was resumed earlier only after mini-invasive rectal resections (p 0.014). No difference was detected at the overall analysis and for left colectomy’s group.

All the above mentioned results are summarized in Tables 2 and 3.
4.5. Blood transfusion and postoperative complications

In our series a significant difference in blood transfusion and grade II complication between the two groups have been observed (see Table 4). Particularly, converted procedures required more blood transfusions than mini-invasive ones (p 0.000) and grade II complication’s rate was lower after MI procedures (p 0.013).

No differences were found in terms of Grade I and III complications, early re-admission, wound infections and need of re-operation.

Anastomotic leakage was more common in converted group (p 0.035) as well as the need of re-operation (p 0.006).

In our series the median time from incision to conversion was 105 min; patients who underwent conversion before 105 min (early conversion) had a significant lower number of blood transfusions than those in which conversion occurred later (late conversion) (p 0.047). No differences have been observed in terms of other complications between these two groups as showed in Table 5.

Causes that lead to conversion in our series are summarized in Table 6.

5. Discussion

In our experience conversion is significantly related to longer surgical time and implies longer hospital stay than mini-invasive surgery. Converted procedures had also significantly higher anastomotic leakage and reoperation rates.

First flatus emission happened earlier in mini-invasive group, first stool emission time was similar between the two groups, but, the return to oral feeding started significantly earlier only in patients submitted to laparoscopic rectal resection compared to converted cases.

Table 2
Overall analysis.

<table>
<thead>
<tr>
<th></th>
<th>MIa</th>
<th>Cb</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of surgery</td>
<td>220 (100–450)</td>
<td>240 (180–510)</td>
<td>0.003c</td>
</tr>
<tr>
<td>Time to first flatus</td>
<td>2 (1–7)</td>
<td>3 (1–5)</td>
<td>0.003c</td>
</tr>
<tr>
<td>Stool emission</td>
<td>4 (1–12)</td>
<td>5 (2–14)</td>
<td>0.252</td>
</tr>
<tr>
<td>Length of stay</td>
<td>7 (4–75)</td>
<td>11 (1–58)</td>
<td>0.000c</td>
</tr>
<tr>
<td>Oral feeding</td>
<td>3 (1–10)</td>
<td>3 (2–7)</td>
<td>0.059c</td>
</tr>
</tbody>
</table>

Values are expressed as median minutes (range) for duration of surgery and as postoperative days (range) for others parameters.

In our experience, conversion procedures had higher rate of required blood transfusions and grade II complications. Nevertheless, late conversion was associated to higher rate of blood transfusions when compared to both early conversion and MI surgery (p 0.047 and p < 0.001 respectively); whereas, compared to MI surgery, early conversion showed no significant differences in terms of blood transfusions (11.6% vs. 25% respectively; p 0.173).

Our results are consistent with those reported in literature. White, in 2011 published his findings on 25 cases of conversion demonstrating that this event was significantly associated with longer hospital stay (14.4 ± 10.0 vs. 8.3 ± 7.1; p 0.0064) and higher rate of major surgical complications (20% vs. 6%, p 0.035). Probably, longer surgical time and greater blood loss, associated to conversion, negatively affect the immune system leading to an increase in susceptibility to major complications [6].

The conversion appears associated with longer operative time and hospital stay in a meta-analysis of 28 non-randomized trials too [3].

Chan reported his experience on 41 converted patients among a series of 470; compared to laparoscopy, conversion had greater blood loss (461.9 vs. 191.2 ml, p < 0.001), higher postoperative complications rates (56.1% vs. 16.7%, p 0.001) and longer hospital stay (10 vs. 6 days, p < 0.001) [7].

Agha analysed 26 conversions among 300 laparoscopic rectal resections. In his experience conversion was associated with longer operative time (258.2 ± 80.3 vs. 215.9 ± 57.2 min, p < 0.001) and higher rate of blood transfusions (11.5% vs. 1.9%, p 0.001) when compared to laparoscopic procedures [8].

Higher rates of blood transfusions (19.4% vs. 0.7%; p 0.001) have been reported on 31 patients by Franko too [9].
Table 5
Analysis of perioperative course between patients who underwent early and late conversion.

<table>
<thead>
<tr>
<th></th>
<th>Early conversion</th>
<th>Late conversion</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required blood transfusion</td>
<td>3 (25)</td>
<td>9 (69.2)</td>
<td>0.047</td>
</tr>
<tr>
<td>Grade I complication</td>
<td>2 (16.7)</td>
<td>1 (7.7)</td>
<td>0.593</td>
</tr>
<tr>
<td>Grade II complication</td>
<td>4 (33.3)</td>
<td>8 (61.5)</td>
<td>0.238</td>
</tr>
<tr>
<td>Grade III complication</td>
<td>2 (16.7)</td>
<td>3 (23.1)</td>
<td>1.000</td>
</tr>
<tr>
<td>Grade V complication</td>
<td>1 (8.3)</td>
<td>1 (7.7)</td>
<td>1.000</td>
</tr>
<tr>
<td>Early re-admission</td>
<td>0</td>
<td>3 (23.1)</td>
<td>0.220</td>
</tr>
<tr>
<td>Wound infection</td>
<td>4 (33.3)</td>
<td>4 (30.8)</td>
<td>1.000</td>
</tr>
<tr>
<td>Anastomotic leakage</td>
<td>3 (25)</td>
<td>3 (23.1)</td>
<td>1.000</td>
</tr>
<tr>
<td>Re-operation</td>
<td>2 (16.7)</td>
<td>4 (30.8)</td>
<td>0.645</td>
</tr>
<tr>
<td>Time to first flatus</td>
<td>3.5 (2–5)</td>
<td>3 (1–3)</td>
<td>0.094</td>
</tr>
<tr>
<td>Stool emission</td>
<td>4.5 (3–9)</td>
<td>5 (2–14)</td>
<td>0.468</td>
</tr>
<tr>
<td>Length of stay</td>
<td>11 (1–38)</td>
<td>11 (6–58)</td>
<td>1.000</td>
</tr>
<tr>
<td>Oral feeding</td>
<td>3 (2–5)</td>
<td>3 (2–7)</td>
<td>0.882</td>
</tr>
</tbody>
</table>

Values are expressed as number of cases (%) or median (range).

a Fisher test.
b Mann–Whitney test.

discouraged the Authors to draw any conclusions tied to the details of the study.[10]

Our data on this topic confirm the results of the multicentre study of Japanese Society of Laparoscopic Colorectal Surgery [4]; 78 converted of 1073 laparoscopic rectal procedures have been collected detecting a significant increase in median postoperative hospital stay (20 vs. 14 days, p = 0.010), median operative time (295 vs. 270 min, p = 0.007), blood loss (265 vs. 80 ml, p < 0.001) and a slower re-feeding for both liquids and solids (p = 0.002 and <0.001 respectively). The Authors stated that analysis of the timing of conversion would have been helpful and an early conversion is however required before critical complications occur.

Gonzalez conducted a retrospective analysis on converted (56 cases), laparoscopic (182 cases including 22 hand assisted) and open (260 cases) colorectal procedures. Conversions were significantly associated with greater blood loss (200 vs. 100 ml), longer time to first bowel movement (82 vs. 72 h) and longer length of stay (6 vs. 5 days) than the laparoscopic colorectal resections group. There was no difference in operative time, transfusion requirements, intraoperative and postoperative complications or mortality between conversions and laparoscopic colorectal resections. Conversions resulted in fewer patients requiring transfusions (4% vs. 14%), shorter time to first bowel movement (82 vs. 93 h) and shorter length of stay (6 vs. 7 days) than in the open resections group. The Author stated that the main bias of its research was the impossibility to assess the length of laparoscopic time before conversion [10].

Small population of most studies and the lack of prospective design account for the differences in reported results.

Even our study is limited by the retrospective design and small number of patients in the conversion group. However, a prospective study on this topic would be difficult to be drawn and accepted.

A further limitation is due to the heterogeneity in MI group, which includes both laparoscopic and robotic procedures. Nevertheless, the small number of robotic procedures accounts for this inclusion, which is justified by the similar safety and effectiveness of robotic surgery compared to laparoscopic one. A growing number of papers can be found that support such statement [11].

In studies from single and high volume colorectal surgery centres with low conversion rates, the converted patients group is always small sized, ranging from 17 to 56 [12,13]. To the best of our knowledge, the bigger series of converted procedures has been recently reported by Allaix [13] who compared 122 converted to 992 laparoscopic colorectal resections performed in a single centre. His findings in terms of duration of surgery, blood transfusions, wound infection and overall 30-day postoperative morbidity rate were similar to ours even if we report higher rates of wound infections. Unlike what we have highlighted, he did not report any difference in hospital stay (9 and 7 days for conversion and laparoscopic groups respectively). Allaix also pointed out the benefit of an early conversion in avoiding excessive tumour handling and incorrect dissection.

Yang, on a series of 222 converted procedures retrospectively collected between 2000 and 2007, already suggested that those who receive a reactive conversion due to an intraoperative complication (such as bleeding or organ injury) had more postoperative complications than those who receive a pre-emptive conversion (undertaken to avoid complications) [14].

Mini-invasive colorectal surgery is technically demanding and conversion can always occur. Conversion is a significant event and should be critically considered. It can be related to patient and disease’s factors, but, also surgeon experience and specific procedural issues can play a role in the need and timing of conversion. Thus, even the importance of institutional system factors has been advocated.

Single-institution-based mathematical predictive models of conversion have been proposed; unfortunately they failed when used on patients referred to other institutions [15].

Predictors of conversion have been identified in well-known series [16] therefore, it is important to underline the necessity of conversion predictors in each colorectal surgery unit; thus, perhaps the most important issue is to make surgeons able to identify the “right” moment of conversion avoiding unnecessary and harmful extensions of the procedure’s length.

We would underline that our study takes into account only patients treated in the last three years and that right and total colectomies have been excluded from the analysis aiming to reduce the procedure-related variability. According to other Authors who suggest an early conversion, we considered data regarding the “time to conversion”.

Table 6
Analysis of causes of conversions.

<table>
<thead>
<tr>
<th>Causes</th>
<th>LC%</th>
<th>ARR%</th>
<th>Miles</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Difficult managing of left colon angle</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Adhesions</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Dolicocolon</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Large tumour size</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Visceral injury</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Narrow pelvis</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Short colon stump</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Intestinal dilatation</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ureteral identification impossibility</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Values are expressed as number of cases.

a LC: left colectomy.
b ARR: anterior rectal resection.

Conclusions

Our retrospective analysis allows us to focus on the operative time to conversion more than on its effects; earlier conversion is associated to a significantly lower blood transfusion rate. A trend towards lower incidence of other complications has been identified too. Probably, larger sample size would lead to significant results even for these last outcomes and to a ROC curve analysis detecting the best threshold value.

Disclosures

Damiano Caputo, Marco Caricato, Vincenzo La Vaccara, Gabriella Teresa Capolupo and Roberto Coppola have no conflicts of interest or financial ties to disclose.
Ethical approval

University Campus Bio-Medico di Roma Ethical Committee approved the present study (30.13 OSS).

Author contribution

Study design: Damiano Caputo and Marco Caricato.
Data collection: Damiano Caputo and Vincenzo La Vaccara.
Data analysis: Vincenzo La Vaccara.
Writing: Damiano Caputo and Gabriella Teresa Capolupo.
Critical revision: Roberto Coppola.

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References