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Reduced duration of stay after elective colorectal surgery during the peak phase of COVID-19 pandemic: A positive effect of infection risk awareness?

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ABSTRACT

Background: While elective surgery was shut down in most settings during the 2019 novel coronavirus pandemic, some referral centers were designated as surgery hubs. We sought to investigate how the pandemic scenario impacted the quality of a long-established enhanced recovery protocol colorectal surgery program in 2 referral centers, designated as colorectal surgery hubs, located in the epicentral Italian regions hardest hit by the pandemic.

Methods: We compared short-term outcomes of patients undergoing major colorectal surgery with a long-established enhanced recovery protocol during the coronavirus disease 2019 outbreak occurred in 2020 (group A) with the correspondent timeframe of 2019 (group B). Primary outcomes were morbidity and mortality, duration of stay, and readmission rate.

Results: One hundred and thirty-six patients underwent major colorectal surgery in group A and 173 in group B. Postoperative complications and readmission rate were comparable between the 2 groups. Oncologic case-log was predominant in group A compared with group B (73.5 vs 61%; $P = .01$). A significantly shorter overall duration of stay was found in group A ($P < .001$). Uncomplicated patients of group A had a shorter duration of stay when compared with uncomplicated patients of group B ($P = .008$).

Conclusion: Under special precautionary measures, major colorectal surgery can be undertaken on elective basis even during coronavirus disease 2019 pandemic with reasonable results. A reduction of duration of stay within a long-established enhanced recovery protocol colorectal surgery program was observed during the coronavirus disease 2019 pandemic occurred in 2020 in comparison with the correspondent timeframe of the previous year without compromising short-term outcomes. The pandemic uncovered the positive impact of patients' commitment to reducing duration of stay as the empowered risk awareness likely promoted their compliance to the enhanced recovery protocol.

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Introduction

Elective surgery was discontinued in many hospitals during the 2019 novel coronavirus (COVID-19) pandemic. At the same time, some colorectal surgery programs were designated by local governments as referral hubs to ensure treatment for patients affected by major surgical conditions (colorectal cancers and complicated inflammatory bowel diseases [IBD]).^{1,2} Enhanced precautionary measures such as screening for SARS-CoV-2 infection before hospital admission, as well as strict adherence to already established

enhanced recovery protocols (ERP), have been pursued to safely maintain the workload of colorectal surgery (CRS) programs.³

Delayed discharge after surgery correlates with increased rates of complications, elevated health care costs,^{4–6} and has been recently linked to an increased risk of mortality, especially in acute patients.⁷ The introduction of ERPs led to a shorter duration of stay without increasing the readmission rate after CRS.^{8,9} However, it is a common experience that patients fulfilling ERP recovery criteria who are deemed fit-for-discharge might often be unable to leave hospital for several nonmedical reasons,^{10–12} ie, limited access to a caregiver, reluctance of patients to go home, and poor logistics.

The objective of the study is to investigate how the pandemic impacted the quality of care in 2 ERP-CRS programs by comparing short-term outcomes achieved during the COVID-19 pandemic with those from the equivalent timeframe in 2019, with a special focus on duration of stay and readmission rate.

Design and methods

Two tertiary academic hospitals of Lombardy and Emilia Romagna (epicenter regions of the SARS-CoV-2 outbreak in Italy)¹³ were appointed by their respective regional government as hubs for oncologic/IBD surgery during the COVID-19 pandemic. The 2 centers were designated to continue with their major elective colorectal surgery activity prioritizing patients with cancer or severe benign conditions (ie, severe IBD-related complications). Patients were referred from the catch-area where the 2 hospitals are located and from neighborhood areas where other hospitals/services were focusing on patients affected by COVID-19 infection. Both CRS units continued their elective programs along with their long-established ERPs. The routine in both centers, in order to limit the chances of operating electively patients also affected by COVID-19, included that every surgical candidate was first questioned for high-risk contacts/early warning symptoms/symptoms and tested for SARS-CoV-2 72 to 48 hours before hospital admission. Routine testing for SARS-CoV-2 was performed since April 20, 2020 in one center and the first of March in the other and consisted of a nasopharyngeal swab and a chest computed tomography. SARS-CoV-2 positive and patients with computed tomography scan consistent with COVID-19 infection (although asymptomatic and with a negative swab) were rescheduled. Additional measures at hospital level included access restriction for visitors and nonessential personnel, universal use of the appropriate personal protective equipment, and temperature screening checkpoints for patients and staff. According to the ERP, discharge criteria were respected without exceptional measure. According to both teams' ERPs, the expected duration of hospital stay was postoperative day 3. In the absence of complications, patients were deemed fit-for-discharge once all the discharging criteria were met: (1) tolerating oral intake, (2) presence of gastrointestinal function, (3) adequate pain control with oral analgesia, (4) ability to mobilize and self-care, and (5) availability of a caregiver/social support in case of necessity. After hospital discharge, a close follow-up was obtained over the phone. No follow-up visit was planned during the COVID-19 pandemic.

Results from all consecutive patients undergoing colorectal surgery during the peak phase of the COVID-19 pandemic (group A) (Feb 23, 2020–May 4, 2020) were compared with results from all consecutive colorectal patients operated during the same timeframe in 2019 (group B). Data were collected from prospectively maintained electronic datasets. Informed consent was obtained from the patients.

The main outcomes measured were duration of stay, readmission rate, and 90-days morbidity and mortality. Ethical approval

has been obtained by the ethical committee of the participating Institutions respectively.

Statistical analysis

Statistical analysis was performed using χ^2 tests for categorical variables, variance analysis, and Student's *t* test to compare the means of quantitative variables following a normal distribution, and the Mann-Whitney and Kruskal-Wallis tests for continuous variables that followed a non-normal distribution. A multivariate linear regression model including year of surgery (2019 versus 2020), age, sex, body mass index, indication, approach, and complications was used to control for potential confounding factors and to assess the duration of stay between the study cohorts. Results were considered statistically significant when alpha levels were lower than 0.05. Data were analyzed using SPSS, version 25 (IBM Corporation, Armonk, NY).

Results

A total of 136 patients underwent major elective CRS from February 23 to May 4, 2020 (group A), and 173 patients were operated during the equivalent timeframe in 2019 (group B) (Table I). All patients completed a 90-day postoperative follow-up. Four patients from group A were found affected by COVID-19 at preoperative screening. Their operation was rescheduled outside the study period, therefore excluded from this analysis. No difference was found in the type of surgeries performed ($P = .32$). A significantly higher proportion of oncologic patients were registered in group A (73.5%) compared to group B (61%) ($P = .01$). However, no significant difference with regards to tumor stage for oncologic patients were registered for group A in comparison with group B (Table II). Laparoscopy was the preferred approach in most of the cases, including 125 (92%) patients in group A and 161 (93%) in group B, with no difference between groups ($P = .70$). Postoperative complications (Clavien-Dindo I–V) occurred in 33 out of 136 patients in group A (24%) and 53 out of 173 (30%) in group B ($P = .21$). The reoperation rate was higher in group B (4%) compared to group A (1.4%), although no significant difference was found (7 vs 2; $P = .09$). The readmission rate was similar between groups (group A: 4.4% vs group B: 2.8%; $P = .95$). A significantly shorter overall duration of stay was found for group A compared to group B, mean 4.3 vs 6.2 days, respectively ($P < .001$). Uncomplicated patients from group A also had a shorter duration of stay when compared to uncomplicated patients from group B. Mean duration of stay was 3.3 vs 4.1 ($P = .008$), respectively (Table III). In the subgroup analysis of patients operated for oncologic or benign conditions, duration of stay was shorter for group A than group B (Table II).

Postoperative complications occurred in 33 patients in group A (23%). One patient developed bilateral atelectasis, and 2 patients had a fever of unknown origin, resolved after antibiotic therapy (Clavien-Dindo II); 1 patient developed a postoperative hematoma that required percutaneous drainage (Clavien-Dindo IIIa). Fifty-nine patients had a postoperative complication in group B (31%); 2 presented with ileus and 1 with urinary retention that resolved spontaneously (Clavien-Dindo I), 2 patients had nausea and vomiting treated with antiemetic drugs (Clavien-Dindo II), 1 patient experienced rectal bleeding and anemia not requiring blood transfusion (Clavien-Dindo II), 1 patient developed an abdominal collection that required percutaneous drainage (Clavien-Dindo IIIa), and 1 underwent reoperation for an anastomotic leak (Clavien-Dindo IIIb). Perioperative mortality was nil in both groups. Three SARS-CoV-2 infections occurred in group A during the postoperative period and resolved with medical therapy in 2 cases

Table I
Patients characteristics and surgical specifics, mean \pm standard deviation, n (%)

| Characteristic | Group A | Group B | P value |
|----------------------------------|-------------------|-------------------|---------|
| N | 136 | 173 | |
| Sex | | | .41 |
| Male | 73 (54%) | 102 (60%) | |
| Female | 63 (46%) | 70 (40%) | |
| Age (y) | 63.20 \pm 17.67 | 63.26 \pm 15.62 | .68 |
| BMI (Kg/m ²) | 25.1 \pm 3.6 | 25 \pm 4.2 | .96 |
| Type of surgery | | | .32 |
| Abdominoperineal resection | 2 | 1 | |
| Hartmann reversal | 1 | 4 | |
| TAMIS | 4 | 3 | |
| Right colectomy | 37 | 41 | |
| Left colectomy | 29 | 37 | |
| Subtotal colectomy | 11 | 15 | |
| Rectal resection | 37 | 42 | |
| Ileocolic resection | 14 | 24 | |
| Completion proctectomy and IPAA | - | 4 | |
| Proctocolectomy | 1 | 2 | |
| Disease | | | .01* |
| Oncologic | 100 (73.5%) | 105 (61%) | |
| Benign | 36 (26.5%) | 68 (39%) | |
| Tumor staging (AJCC 8th edition) | | | .29 |
| N | 100 | 105 | |
| Stage 0 | 18 (18%) | 15 (14%) | |
| Stage I | 26 (26%) | 30 (29%) | |
| Stage IIa | 26 (26%) | 22 (21%) | |
| Stage IIb | 3 (3%) | 8 (8%) | |
| Stage IIIa | 15 (15%) | 14 (13%) | |
| Stage IIIb | 9 (9%) | 6 (6%) | |
| Stage IV | 3 (3%) | 10 (9%) | |
| Surgical approach | | | .70 |
| Laparoscopy | 125 (92%) | 161 (93%) | |
| Open | 11 (8%) | 12 (7%) | |

AJCC, American Joint Committee on Cancer; BMI, body mass index; IPAA, ileal pouch-anal anastomosis; TAMIS, transanal minimally invasive surgery.

* P value < .05 statistically significant.

(Clavien-Dindo II), while 1 patient required intensive treatment in the critical care unit (Clavien-Dindo IVa). Postoperative outcomes are depicted in Table III.

The multivariate linear regression model showed that cohort group (group A versus group B; coefficient = -1.41; 95% confidence interval [CI] = -2.5 to -0.29; $P = .014$) and occurrence of complications (complicated versus uncomplicated; coefficient = 5.62; 95% CI = 4.39 to 6.86; $P < .001$) were significant factors influencing the difference in duration of stay.

Discussion

This study compared the short-term outcomes of elective ERP-CRS programs during the COVID-19 pandemic with results achieved during an equivalent timeframe of the year before. A

reduction of duration of stay was found during the COVID-19 pandemic, while short-term outcomes, including complication and readmission rate, were similar. Our results indicate that, with adequate screening and development of COVID-free environments, it is possible to maintain steady volumes of colorectal surgery while guaranteeing patients' safety. Furthermore, as the patients were likely more motivated to leave the hospital as soon as discharge criteria were met, a reduction in duration of stay compared to the year before was observed.

As the peak of the COVID-19 pandemic has faded out in many countries, while others are already experiencing new outbreaks, it

Table II
Postoperative duration of stay: subgroup analysis on oncologic versus benign patients, mean \pm standard deviation

| Duration of stay: Oncologic (d) | Group A | Group B | P value |
|------------------------------------|---------------|---------------|---------|
| N | 100 | 105 | |
| Overall duration of stay | 4.2 \pm 2.7 | 5.3 \pm 4.2 | .02* |
| Length of duration (uncomplicated) | 3.3 \pm 1.2 | 4 \pm 2 | .04* |
| Length of duration (complicated) | 7.3 \pm 4.3 | 9 \pm 5.7 | .29 |
| Duration of stay: Benign (d) | Group A | Group B | |
| N | 36 | 68 | |
| Overall duration of stay | 4.5 \pm 2.8 | 6.5 \pm 4.8 | .02* |
| Duration of stay (uncomplicated) | 3.6 \pm 1.6 | 4.3 \pm 2 | .015* |
| Duration of stay (complicated) | 6.4 \pm 3.7 | 11 \pm 5.8 | .024* |

* P value < .05 statistically significant.

Table III
Overall postoperative outcomes, mean \pm standard deviation, n (%)

| Outcome | Group A | Group B | P value |
|------------------------------------|---------------|---------------|---------|
| N | 136 | 173 | |
| Postoperative complication | 33 (24%) | 53 (30%) | .21 |
| Clavien-Dindo | | | |
| I | 10 | 15 | |
| II | 18 | 22 | |
| IIIa | 2 | 6 | |
| IIIb | 1 | 6 | |
| IVa | 1 | 3 | |
| IVb | - | 1 | |
| Reoperation | 2 (1.4%) | 7 (4%) | .09 |
| Readmission | 6 (4.4%) | 5 (2.8%) | .95 |
| Duration of stay (d) | | | |
| Overall duration of stay | 4.3 \pm 2.9 | 6.2 \pm 6.6 | < .001* |
| Length of duration (uncomplicated) | 3.3 \pm 1.2 | 4.1 \pm 2.1 | .008* |
| Length of duration (complicated) | 7 \pm 4.1 | 10 \pm 5.7 | .01* |

* P value < .05 statistically significant.

is important to investigate the risks and benefits of continuing elective colorectal surgery during pandemic outbreaks. An unprecedented number of surgical procedures have been cancelled or postponed due to COVID-19 worldwide. Recovery plans from national governments and contingency strategies have been advocated to restore surgical activities as safely as possible.¹⁴ Although elective surgery was interrupted in many institutions, the local governments designated hubs to continue their surgical activity with case-specific prioritization.^{15,16} Furthermore, universal personal protective equipment and behavioral precautions have been well established to reduce the chances of bilateral transmission between health care workers and patients.¹⁷

In our experience, continuing elective colorectal surgery during the outbreak did not compromise short-term outcomes in elective CRS. Furthermore, long-established ERPs proved feasible and effective, also allowing a reduction in hospital stay with the side benefit of decreasing the risk of acquiring SARS-CoV-2 during hospital stay.

Feasibility and safety of laparoscopy during the pandemic was called into question and even discouraged in earliest reports^{18,19} due to the potential risk for viral spread through aerosolization. In our experience, the adoption of a minimally invasive approach did not add morbidity for our patients or risks for surgeons. In both institutions, measures to minimize surgical smoke leaks were routinely followed.^{20,21} During the pandemic outbreak, 94% of patients in our case series were operated by laparoscopy without affecting any health care worker or other patients, while promoting the well-known benefits of a minimally invasive approach.

Interestingly, a significant reduction in overall duration of stay was observed during the pandemic compared to the year before. Moreover, duration of stay was found to be shorter in the subgroup analysis including uncomplicated patients. Additionally, the risk adjustment by multivariate analysis confirmed that the year of surgery and the occurrence of complication were the only independent variables affecting duration of stay. This difference might be justified by specific contingency-related reasons. Even within an ERP-CRS program, patients deemed fit to leave the hospital sometimes experience a delay in discharge, often because of nonmedical reasons, for example, limited access to a caregiver, reluctance of patients to go home, poor logistics, or even excessive precaution by health care providers.^{10,11}

During the pandemic, none of those factors seemed to have any influence. In fact, as the lockdown forced people to stay home, a higher presence of family caregivers was available for patients, and the motivation to leave a potentially infective environment was strong.

The reluctance of patients to go home and clinician extra-precautionary behavior was replaced by the fear of patients for longer hospital stays, with prolonged contacts with health care workers who were at higher risk of infection.²² Similarly, clinicians were keen to release their patients as soon as the discharge criteria were met to reduce the risk of infection. ERPs have been proven already to reduce postoperative nosocomial infection.²³ The high risk of adverse postoperative outcomes in case of COVID-19 superinfection has been clearly reported by the COVIDSurg Collaborative group.²⁴

The further reduction we experienced in the duration of stay might have been related to an increased patients' awareness about the risks of COVID-19 infection. In Italy, this was also achieved by several informative governmental campaigns carried throughout various media platforms.

Our results could underline the possibility to further empower patients on postoperative ERP discharge criteria and maximize ERP

results by encouraging patients' engagement. Indeed, this task has been easier during the pandemic, as patients were already informed on the risks of nosocomial infections.

On the other hand, special efforts have been made to implement telemedicine for preoperative screening and postoperative follow-up.²⁵

Interestingly, a significantly higher number of oncologic surgeries was performed during the pandemic. The difference in the oncologic case-log compared to the previous year could be explained because both centers were designated as colorectal cancer hubs by local authorities. However, a significant difference in terms of duration of stay was maintained when subgroup analysis for benign or cancer surgery was performed.

The strength of our study relies on the inclusion of a considerable cohort of patients in a limited timeframe from 2 high-volume centers during the peak phase of the COVID-19 pandemic. Furthermore, despite our study's focus on colorectal surgery, the concept of postoperative duration of stay reduction may be generalized and applied to other surgical subspecialties. It seems once again that patients' engagement in ERP protocols is specifically relevant to improve results.

Our study has some limitations: resource allocation strategies to maintain COVID-free units/hospitals may not apply to every health care system due to individual peculiarities or national regulations. However, other reports have shown the feasibility and safety of continuing elective minimally invasive surgery during the pandemic.^{26–29} The other limitation is the lack of a cost-analysis between the 2 timeframes. However, we could argue that the special precautionary measures undertaken during the peak of the pandemic (additional preadmission COVID-19 testing and personal protective equipment) might justify an increased overall cost for the COVID-19 cohort of patients.

In conclusion, considering the possible evolution of this pandemic with recurrent outbreaks of SARS-CoV-2 infections,³⁰ our data show that continuing elective colorectal surgery in dedicated environments does not compromise short-term outcomes, while possibly improving long-term results just by not delaying necessary cancer/IBD surgery. The results of the present study also highlight the advantages of a centralization policy for major elective colorectal surgery during the pandemic, potentially diminishing the impact of the future backlog and providing reliable and reproducible short-term outcomes. Additionally, our study showed a reduced duration of stay during the pandemic, possibly due to higher patient compliance to the ERPs. These results should be read in consideration of the continuously increasing number of COVID-19 cases and new waves of the pandemic currently reported by the World Health Organization.

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Conflict of interest/Disclosure

AS has acted as speaker/consultant for Johnson & Johnson and Takeda; MC has acted as speaker for Pfizer; the other authors have nothing to disclose.

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