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Emergency robotic colorectal surgery during the COVID-19 pandemic: A retrospective case series study

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ABSTRACT

Objective: While interest in elective robotic surgery is growing, use in emergency setting remains limited due to challenges posed by sicker patients, advanced pathology and logistical issues. During the COVID-19 pandemic, robotic surgery could provide the benefit of having the surgeon away from the bedside and reducing the number of directly exposed medical staff. The objective of this study was to report patient outcomes and initial learning experience of emergency robotic colorectal surgery during the COVID-19 pandemic.

Methods: A case series study was conducted, including patients undergoing emergency robotic colorectal surgery between February 2020 and February 2021 at Queen Alexandra Hospital in Portsmouth, UK. Patient data were collected from an ethics approved prospective database. Patient demographics, operative time, conversions and postoperative complications were recorded. In addition, readmissions, length of stay and short-term oncological outcomes were analyzed.

Results: Ten patients with median age 64 y (range, 36–83 y) were included. Four patients had robotic complete mesocolic resection for obstructing cancers. Six had colorectal resections for benign disease in emergency setting. All were R0 with a mean lymph node harvest of 54 ± 13. Mean operative time was 249 ± 117 min, the median length of stay was 9.4 d (range, 5–22 d). Only one patient was given a temporary diverting ileostomy. There were no grade III/V complications and no 30-day mortality.

Conclusions: Provided an experienced team and peri-operative planning, emergency robotic colorectal surgery can achieve favorable outcomes with benefits of radical lymph node dissection in oncological cases and avoidance of diverting stoma.

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1. Introduction

The robotic platform addresses many of the technical and ergonomic limitations of laparoscopic surgery,1 and results in reduced conversions, faster recovery and shortened hospital stay.2 Difficult operative access and the technically demanding procedures with the need for enhanced dexterity, precision and stability are the key areas where the robotic approach is particularly beneficial. Rectal cancer surgery, complete mesocolic excision (CME) surgery for colon cancer and complex diverticular resections remain the popular indications for robotic surgery in the elective colorectal setting.

Over 25% of patients with colorectal cancer present as an emergency,3 and are associated with higher rates of morbidity, mortality and stoma formation compared to elective surgery.4 Emergency cases are challenging due to inflamed fragile tissues and less obvious anatomical planes. Furthermore, distended small bowel, risk of contamination and hemodynamic instability can add...
further complexity for the surgeon in such situations. Robotic surgery can provide the enhanced 3D view, fully wristed dexterity instruments and four operating arms for the surgeon, and stability of the platform that can address some of these issues. However, the logistical challenges of out of hours operating, stability of the patient, and availability of trained theatre staff remains a significant barrier to the wider adoption of robotic assisted surgery techniques in the emergency setting.

During the COVID-19 pandemic, the emphasis on reducing the number of theater personal and scrubbed members of surgical team has been clear. The need for full personal protective equipment in performing emergency surgery and the use of CO2 insufflation has caused concerns for many. Although the presence or absence of COVID-19 viral particles has not been clearly established and guidelines are based on weak evidence, measures to mitigate CO2 release into the operating room should be performed.6 And there is an added benefit in robotic surgery of having the surgeon away from the bedside and reducing the number of directly exposed medical staff.

Queen Alexandra Hospital in Portsmouth is a recognized training center for robotic colorectal surgery at UK and has been performing regular elective robotic colorectal resections since 2012 with an experience of over 600 major resections. With increasing experience and staff training, patients having emergency colorectal surgery were selectively offered robotic emergency surgery when a robotic colorectal surgeon was on call and experience theatre team was available. The aim of this study was to report patient outcomes and initial learning experience of emergency robotic colorectal surgery during the COVID-19 pandemic.

2. Materials and methods

2.1. Patient’s selection

Patients were enrolled, who had emergency robotic colorectal surgery from February 2020 to February 2021 at Queen Alexandra Hospital in Portsmouth, UK. All patients were admitted to the surgical admissions unit with acute abdomen and investigated with a diagnostic CT scan of the abdomen and pelvis.

2.2. Data collection

Data pertaining to patient demographics, such as age, body mass index (BMI) and the American Society of Anesthesiologists (ASA) classification were collected. Operative time and conversions were captured, and 30-day postoperative complications, readmissions, length of stay and short-term oncological outcomes were evaluated.

2.3. Surgical procedure

All procedures were carried out using the da Vinci X® (Intuitive Surgical, USA) fourth generation system. In case of right sided cancers, a CME and central vascular ligation was performed, as this is the standard of care in our unit. In all cases involving colorectal resection, an intracorporeal isoperistaltic stapled anastomosis was made and the specimen was extracted with a Pfannenstiel incision. Vascularization was evaluated in all robotic procedures using indocyanine green. For left sided resections, the standardized single docking technique for anterior resection was used.

To achieve an adequate operative view of the dissection plane, two robotic instruments should be lifting the mesocolon and the assistant applying traction to the floor during the dissection (Fig. 1A). If needed, a Hem-o-Lok® clip can be used to fix a loop of bowel to the side wall (Fig. 1B) to help lift the bowel. A stapled colorectal anastomosis was fashioned and reinforced with Vicryl 3/0 sutures in an attempt to avoid a diverting stoma. No bowel preparation was used in these cases. A single dose of prophylactic antibiotics was given at induction and further doses prescribed based on the clinical course.

2.4. Statistical analysis

Statistical analysis was carried out using the software package IBM SPSS v26. Normally distributed data was presented as mean ± SD. Nonnormally distributed data was in median with range.

3. Results

3.1. Patient demographics

Patient demographics are listed in Table 1. Totally, 10 patients were enrolled, including 7 males and 3 females, with a median age of 64 y (range, 36–83 y). The median BMI was 27 kg/m² (range, 19–41 kg/m²). Four patients had emergency robotic resection (CME right colectomy) for an obstructing colon cancer. Six patients had emergency robotic surgery for benign disease, including 3 complicated diverticulitis with perforation and abscess, 2 inflammatory bowel diseases with fistulation and 1 parastomal hernia with strangulated small bowel.

3.2. Clinical and oncological outcomes

Clinical and oncological outcomes are presented in Table 2. The mean operative time was 249 ± 117 min. All cancer resections were R0 with mean lymph node harvest of 54 ± 13. Median length of stay

![Illustration of the operative view from medial to lateral towards the splenic flexure with 2 robotic instruments lifting the mesocolon and the assistant applying traction to the floor (A). Use of a Hem-o-Lok® clip to fix a loop of bowel to the side wall (B).](image-url)
occurred within the no 30-day mortality. There were 4 cases with complications, which
omy. There were no Clavien-Dindo grade III/IV complications and
colon in 2 patients, cecum in 1 and transverse colon in 1. They were
patient who was given a temporary colostomy for diverticulitis
otics. There were no cases of surgical site infections.
acute kidney injury managed with
51 Male 22 II Obstructed parastomal hernia with strangulated small bowel
5 74 Male 24 II Perforated diverticular disease (Hinchey3)
6 51 Male 22 II Perforated diverticular disease (Hinchey3)
7 74 Male 27 II Perforated right colon cancer
8 75 Male 26 III Intussusception right colon cancer
9 71 Male 33 III Obstruction and perforated transverse colon cancer
10 37 Male 25 I Locally advanced right colon cancer

Table 2
Clinical and oncological outcomes

| No. | Age, y | Gender | BMI, kg/m² | ASA grade | Diagnosis | Surgery |
|-----|--------|--------|------------|-----------|-----------|---------|
| 1   | 83     | Female | 22         | II        | Diverticulitis + colovesical fistula | AR      |
| 2   | 76     | Female | 19         | III       | Complicated Crohn’s disease with obstruction | Right hemicolectomy and repair of bladder fistula |
| 3   | 36     | Female | 41         | II        | Ulcerative colitis with fulminant colitis | Subtotal colecction + definitive ileostomy |
| 4   | 74     | Male   | 24         | II        | Perforated diverticular disease (Hinchey3) | AR      |
| 5   | 59     | Male   | 24         | II        | Perforated diverticular disease (Hinchey3) | CME (right hemicolectomy) |
| 6   | 51     | Male   | 22         | II        | Obstructed parastomal hernia with strangulated small bowel | CME (right hemicolectomy) |
| 7   | 74     | Male   | 27         | II        | Perforated right colon cancer | CME (right hemicolectomy) |
| 8   | 75     | Male   | 26         | III       | Intussusception right colon cancer | CME (extended right hemicolectomy) |
| 9   | 71     | Male   | 33         | III       | Obstruction and perforated transverse colon cancer | CME |
| 10  | 37     | Male   | 25         | I         | Locally advanced right colon cancer | CME |

AR, anterior resection; ASA, the American Society of Anesthesiologists; CME, complete mesocolic excision.

was 9.4 d (range, 5–22 d). The cancers were located in ascending
colon in 2 patients, cecum in 1 and transverse colon in 1. They were
T4 tumors presenting with colonic obstruction.
There were no conversions to laparoscopic surgery or laparotomy.
There were no Clavien-Dindo grade III/IV complications and
no 30-day mortality. There were 4 cases with complications, which
occurred within the first 10 days after surgery. Two patients had an
acute kidney injury managed with fluid resuscitation, 1 had an
ileus, and 1 had an intra-abdominal abscess treated with antibiotics.
There were no cases of surgical site infections.

3.3. Complicated diverticulitis

All left sided resections had primary anastomosis, except one
patient who was given a temporary colostomy for diverticulitis
with colovesical and colovaginal fistulae, due to frailty and medical
comorbidities. Fig. 2 shows the abdominal CT scan image of the 59-
year-old patient with diverticulitis and a 45.4 mm abscess, who was
able to be treated without the need for a temporary stoma and did
not have any major postoperative complications.

4. Discussion

The robotic approach has been used for a variety of clinical in-
dications with good postoperative outcomes. Literature review
reports some case series of emergency robotic operations, such as
upper gastrointestinal,7–9 and colorectal procedures.10–12 These
studies underlined the feasibility of robotic approach in emergency
abdominal surgery, with the benefits of fewer complications,
quickier postoperative recovery and shorter length of stay in
emergency setting. This is the first case series study with the novel
use of a robotic platform in emergency colorectal surgery.
In this study, the mean operative time was 249 ± 117 min, which
is acceptable for major colorectal resections. A recent study by
Anderson et al, comparing urgent robotic subtotal colecotomy with
laparoscopic procedures, found that robotic procedures took
29 min longer than laparoscopic with an average of 323 min.
However, the difference was not significant.15 The median length of
stay was 9.4 d (range, 5–22 d), which favorably compares with
literature stating a mean length of stay of 10 d (range, 3–23 d) after
laparoscopic emergency colonic resection.13
It has been shown that in emergency surgery, the principles of
oncologic resection can be respected when considering and analyzing
the extent of the resection, the surgical margins and the number of
harvested lymph nodes.14 However, especially in locally advanced
tumors that warrant multivisceral en bloc resection and radical lymph
node dissection, which has prognostic and therapeutic implications,
the robotic platform can offer previously mentioned technical ad-

dvantages to facilitate oncological resection and to provide a high
lymph node harvest, as seen in our series. In colorectal cancer surgery,
over 25% of the patients present in emergency setting. This number is
likely to increase due to the stage migration effect of the COVID-19
pandemic. This delayed presentation may increase the rates of long-
term complications and overall mortality.15 Currently, during the
COVID-19 pandemic, we have observed patients presenting in the
emergency setting in a more advanced stage of disease. All the cancers
operated in this series were T4 tumors.
Patients admitted for colorectal surgery in the emergency
setting present several challenges, including fluid shifts, hemody-
namic instability, obstruction and poor nutritional state. All of these
are known risk factors for postoperative complications.15 Literature
analyzing outcomes after open emergency colorectal surgery re-
ports that the overall in-hospital mortality rate can be as high as
14.4%, secondary to peritonitis, bowel ischemia, intraoperative
bleeding and multiorgan failure.17 In our study there were no
Clavien-Dindo grade III/IV complications and no 30-day mortality.
There were no cases of surgical site infections, which is a cause of
major morbidity after open emergency surgery. The reduction of

Fig. 2 Imaging of complicated diverticulitis
Transverse section CT scan image showing complicated diverticulitis with a 45.4 mm abscess.
surgical site infections may be partly responsible for reduced morbidity in our study.

Anastomotic complications are major contributors to morbidity and mortality in bowel surgery and are prevented by proper vascularization and tissue integrity. To assess quality of the anastomosis, indocyanine green can be used to evaluate perfusion of the anastomosis. In addition, suture reinforcement can be performed, even in a low pelvic anastomosis, resulting in avoiding a temporary stoma in most patients. A study concerning emergency surgery of the colon reported the most common operations were Hartmann’s procedures (23.8%) and 59.4% of patients needed to have a temporary stoma. In our case series, only one patient was given a temporary stoma for diverticulitis with colovesical fistula, due to frailty and medical comorbidities.

Additionally, obstructed bowel with reduced intra-abdominal space can pose technical challenges for minimal access surgery. Inflammatory conditions are associated with fragile tissue with risk of bleeding and distortion of the anatomical planes. This can lead to a higher conversion rate from minimally invasive surgery to open surgery in the emergency setting. These conditions and advanced stage T4 cancers with bowel obstruction and/or perforation can be relative contraindications for laparoscopic surgery. One might argue it is not suitable to perform emergency robotic colorectal surgery taking in account that emergency laparoscopic procedures often have to be converted to open surgery. However, the robotic platform has some technical advantages in comparison to laparoscopic technique as previously described. Robotic surgery is associated with a lower conversion rate compared to laparoscopic technique in the elective setting. In our study, there was no need for conversion, possibly aided by the technical advantages of the robotic platform.

What needed to change moving from scheduled surgery to emergency setting, especially in the COVID-19 era with staff shortage, was the general mindset to get the surgery performed as fast as possible. Although robotic emergency surgery takes 30 minutes longer than laparoscopic emergency surgery, it can be reduced by team training and experience. Additionally, it must be taken into account that there is a higher conversion rate in laparoscopic surgery and length of stay after open and laparoscopic surgery is significantly longer, keeping patients in-hospital with associated risk of COVID-19 contact and adding to the burden of bed capacity. The reduced length of stay and surgeon’s distance from the bedside during surgery results in a risk reduction for the patient as well as the surgeon. Careful planning, team training and a change in mindset are essential prerequisites to achieve a successful emergency robotic program.

The limitations of this study are small numbers, clinical diversity of cases, the retrospective nature of the case series and possible selection bias. An experienced team was not always available, therefore limiting the cases that were robotically performed in emergency setting.

5. Conclusions

Emergency robotic colorectal surgery can achieve favorable outcomes with an experienced team and peri-operative planning. Oncological resections can be carried out respecting the principles of oncologic resection with radical lymph node dissection, and technical advantages of the robotic platform are considerable, including suture reinforcement of the anastomosis avoiding a temporary stoma.

Conflict of interest

The authors declare no conflicts of interest.

Ethics approval

This research data was obtained from an ethics approved prospective database by the Portsmouth Hospitals University.

Patient consent for publication

Consent for publication was obtained from all participants included in the study.

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