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Systematic review of emergent laparoscopic colorectal surgery for benign and malignant disease

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Abstract

Laparoscopic surgery has become well established in the management of both benign and malignant colorectal disease. The last decade has seen increasing numbers of surgeons trained to a high standard in minimally-invasive surgery. However there has not been the same enthusiasm for the use of laparoscopy in emergency colorectal surgery. There is a perception that emergent surgery is technically more difficult and may lead to worse outcomes. The present review aims to provide a comprehensive and critical appraisal of the available literature on the use of laparoscopic colorectal surgery (LCS) in the emergency setting. The literature is broadly divided by the underlying pathology; that is, inflammatory bowel disease, diverticulitis and malig-

nant obstruction. There were no randomized trials and the majority of the studies were case-matched series or comparative studies. The overall trend was that LCS is associated with shorter hospital stay, par or fewer complications but an increased operating time. Emergency LCS can be safely undertaken for both benign and malignant disease providing there is appropriate patient selection, the surgeon is adequately experienced and there are sufficient resources to allow for a potentially more complex operation.

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Key words: Laparoscopic surgery; Colorectal disease; Colorectal cancer; Inflammatory bowel disease; Emergency surgery

Core tip: Laparoscopic surgery is increasingly used in the emergency setting. This has been perceived to be a challenging surgical approach for such cases. However with appropriate expertise and training, laparoscopy can be used for colorectal emergencies with good short- and medium term outcomes.

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INTRODUCTION

Laparoscopic surgery has become a well-established part of elective gastrointestinal operative practice. The last decade has witnessed the evidence-based validation of

laparoscopic colorectal surgery (LCS) for both benign and malignant disease, with indisputable advantages including shorter hospital stay, faster recovery, and less morbidity^[1-3]. Increasingly, patients with uncomplicated colorectal disease are routinely offered laparoscopic surgery, and in many centres this is now the default position for elective cases, with national guidance recommending laparoscopic surgery performed by appropriately trained colorectal surgeons for patients with colorectal cancer^[4].

Nonetheless, while LCS is universally regarded as appropriate in suitably selected elective cases, its role in emergent colorectal pathology remains uncertain^[5]. Despite advances in technology and a more structured approach to training, which has allowed for a greater number of surgeons to become competent in laparoscopy, there is a perception that laparoscopic surgery should remain in the elective setting. At the present time, the most common use of laparoscopy in emergency surgery is for appendicectomy or the diagnosis of non-resolving, uncomplicated, right iliac fossa pain. Although some institutions routinely perform emergency laparoscopic cholecystectomies, repair of perforated peptic ulcers, and assessment of penetrating abdominal trauma by laparoscopic approaches, laparoscopy in colorectal emergencies is uncommonly performed.

In theory, emergency LCS is likely to be more challenging for several reasons. The procedures are technically more complex with significantly greater distortion to normal anatomy from infective or inflammatory processes. Indeed, the finding of dilated and vulnerable bowel in colonic obstruction was often considered a contraindication for minimally invasive surgery in the past^[6]. Furthermore, the patient cohort is more likely to be physiologically compromised due to the presence of acute pathology. Laparoscopic colonic resections typically take more time, and in the setting of a high-risk patient profile, a swift open approach may lead to better outcomes. Yet the established advantages of elective laparoscopic colorectal surgery in reducing post-operative pain, the stress response to surgery, wound complications, respiratory complications, in-patient hospital stay, short term health-related quality of life, and health care costs^[1,2,7-13], support the notion that emergency laparoscopic surgery may lead to similar benefits if performed by experienced laparoscopic surgeons in appropriately selected patients. For example, in a study comparing 42 patients undergoing emergency laparoscopic colonic resections *vs* 25 patients undergoing open emergency colon resections, observed benefits included a shorter hospital stay, less blood loss, reduced duration of ileus and intensive care unit stay, with equivalent mortality^[14]. Ballian *et al*^[15] evaluated the role of laparoscopy for emergent restorative colectomy using the American College of Surgeons National Surgical Quality Improvement Program (ACS NS-QIP) database and found that although less than 10% of patients that underwent emergency colon resection with primary anastomosis, they had at minimum comparable rates of morbidity and mortality but decreased total and

post-operative length of stay.

These findings suggest that some of the documented advantages of laparoscopic surgery may be translatable to the emergency arena. Given the large volumes of patients who undergo emergency surgery for colorectal pathology, determining the precise role of LCS in this setting is of significant clinical importance. However a recent study comparing laparoscopic and open surgery for the emergency treatment of diverticulitis reported no decrease in morbidity or mortality and no overall benefit over open surgery^[16]. As there is still some conflicting evidence, the present review aims to provide a comprehensive and critical appraisal of the available literature on the use of LCS in the emergency setting. We describe the role of laparoscopy in the emergency treatment of benign and malignant colorectal disease.

LITERATURE SEARCH

Identification of studies

An electronic search was carried out using MEDLINE (1965-2013), EMBASE (1980-2013), CINAHL (1982-2013) and the Cochrane library databases. The following medical subject heading (MeSH) terms and keywords were used: “emergency”; “laparoscopic”; and “colorectal”. The “related articles” function was used to broaden the search and all abstracts, studies, and citations retrieved were scanned for subject relevance. The latest date of this search was 1st June 2013. Complete articles of all potentially relevant manuscripts were retrieved and evaluated for inclusion. Additional references from the collective libraries of the senior authors were identified. Reference lists of all relevant publications were hand-searched for additional studies missed by this search strategy, and cross referencing continued until no further relevant publications were identified.

Study inclusion criteria and data extraction

Study methodology was carried out in accordance with the “Preferred Reporting for Systematic Reviews and Meta-Analyses” (PRISMA) recommendations for improving the standard of systematic reviews^[17]. Studies that met the following pre-defined criteria were included in the review process: (1) language: English language publications were included; (2) patient population: Studies had to report outcomes on the use of LCS in the emergency setting. Adult patients over the age of 18 were included. Where multiple studies describing the same patient population were identified, the most recent publication was used unless additional information was imparted by earlier work. Case reports were excluded. Studies describing partial right colonic mobilization as part of an appendicectomy were excluded. Studies evaluating the use of Single Incision Laparoscopic Surgery and robot-assisted surgery were excluded; and (3) outcome measures: Studies were only included if they reported outcome information including post-operative morbidity and mortality in addition to length of stay. Series describing the use of a technique

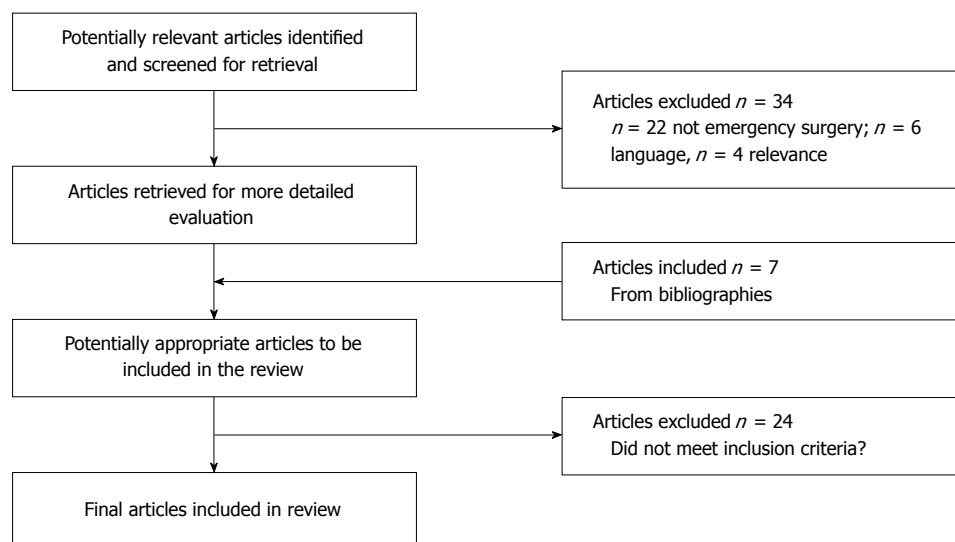


Figure 1 Flowchart of search strategy.

alone in the absence of outcome data were excluded. The search strategy is shown in Figure 1.

LITERATURE SEARCH AND DESCRIPTION OF STUDIES

The outlined search strategy identified 98 publications of potential relevance. Following screening of titles and abstracts, 34 studies were excluded (22 articles were not related to emergency surgery, 6 articles were not in English, 4 articles were not considered relevant to the scope of this article, 2 articles were not related to colorectal surgery) leaving 64 articles that were retrieved in full text. A further 7 articles were identified from a bibliographic search of these articles, providing a total of 71 articles for evaluation. Of these 24 did not meet the inclusion criteria, and were withdrawn from evaluation, leaving a total of 47 studies published between 1965 and 2013 that were entered into the review process. For ease of description, results are presented separately for benign and malignant pathology.

EMERGENCY LCS FOR BENIGN DISEASE

Inflammatory bowel disease

Laparoscopic surgery has been shown to be a safe alternative to open surgery in the elective surgical management for Ulcerative Colitis and Crohn's disease of the colon. It is associated with faster recovery of bowel function, shorter time to oral intake and reduced hospital stay although may lead to increased operating times^[18-23]. However in the emergency setting, the advantages are not so apparent and there is a paucity of data on long-term outcomes. 10 studies, of which 8 were comparative, reported on 286 cases of LCS in the emergency setting. The majority of reports undertaken are case-matched studies with fewer than 40 laparoscopic cases in the analyses^[6,14,24-31]. Overall, the general trend is one of shorter

hospital stay and increased operating time but morbidity which is either on par or better than open surgery. Table 1 shows the details of the studies and the main reported outcomes.

Nash *et al*^[27] compared the peri-operative outcomes of 32 patients who underwent laparoscopic surgery with 36 patients that had open surgery for acute colitis. The majority of patients in the laparoscopic group had toxic colitis ($n = 22$) whereas in the open group there were more patients with obstruction and perforation, limiting direct comparisons. They found no difference in morbidity but longer operating times in the laparoscopic cases (mean difference of 59 min). Similar findings were also noted by Watanabe *et al*^[29] in a comparison of 30 patients undergoing laparoscopic surgery and 30 patients having an open procedure. In addition, they reported a shortened recovery time for gut function (4.8 d in the laparoscopic group *vs* 5.9 d in the open group) - although in this series, the laparoscopic group comprised of a hand-assisted procedure. Earlier oral intake was a benefit also seen by Marcello *et al*^[6] in their case-matched study of acute colitic patients. Whilst most reports found complication rates and morbidity to be similar between open and laparoscopic surgery, Seshadri *et al*^[28] found fewer peri-operative complications in the laparoscopic group (9 patients in LCS *vs* 24 in open group), in their series of 37 patients despite longer operating times (270 min *vs* 178 min). The perceived increased risk of peri-operative complications in patients that are often immunocompromised from steroids or immunosuppressants is similar in open surgery and only Qazi *et al*^[24] and Bell *et al*^[31] showed significant operation-related morbidity (up to 35%). However both these reports did not include a case-matched open group.

Acute diverticulitis

Acute diverticulitis poses a significant challenge even in open surgery due to the variable degrees of inflam-

Table 1 Table of studies involving emergent laparoscopic colorectal surgery and inflammatory bowel disease

Ref.	Type of study	Number of LCS patients	Institution	Main outcome
Nash <i>et al</i> ^[27]	Comparative	36	Single	No difference in morbidity; Longer operating time in LCS; Shorter hospital stay
Stulberg <i>et al</i> ^[14]	Comparative	42	Single-centre	Less blood loss, shorter stay, less morbidity
Marceau <i>et al</i> ^[26]	Comparative	40	Single-centre	Similar operating time; Hospital stay similar; Morbidity similar
Fowkes <i>et al</i> ^[21]	Comparative	22	Single centre	Shorter hospital stay; Similar morbidity
Seshadri <i>et al</i> ^[28]	Comparative	37	Single-centre	Longer operating time in LCS; No differences in complications; Less post-op morbidity; Shorter hospital stay
Watanabe <i>et al</i> ^[29]	Comparative	30	Single-centre	Longer operating time in LCS; Fewer post-op complications in LCS; Faster gut recovery in LCS
Qazi <i>et al</i> ^[24]	Comparative	17	Single-centre	Increased complications in LCS; Conversion rate of 32%
Marcello <i>et al</i> ^[6]	Comparative	16	Single-centre	Early oral intake in LCS; No difference in morbidity
Ouaïssi <i>et al</i> ^[25]	Single cohort	18	Single-centre	Safe; feasible; Morbidity 33%
Bell and Seymour ^[31]	Single cohort	18	Single-centre	High morbidity; Shorter hospital stay

LCS: Laparoscopic colorectal surgery.

Table 2 Studies involving the role of laparoscopic lavage in diverticular disease

Ref.	No. of patients	LOS (d)	Morbidity	Mortality	Further resection
Lam <i>et al</i> ^[36]	6	11	33%	0%	50%
O'Sullivan <i>et al</i> ^[45]	8	10	25%	0%	0%
Myers <i>et al</i> ^[38]	100	8	5%	3%	0%
Bretagnol <i>et al</i> ^[39]	24	12	8%	0%	100%
Karoui <i>et al</i> ^[43]	35	8	28%	0%	71%
White <i>et al</i> ^[44]	35	14	12%	0%	64%
Da Rold <i>et al</i> ^[37]	7	8	28%	0%	0%
Favuzza <i>et al</i> ^[42]	7	6	14%	0%	57%
Mutter <i>et al</i> ^[40]	10	9	0%	0%	67%
Franklin <i>et al</i> ^[41]	40	3	20%	0%	60%

LOS: Length of stay.

mation, and distortion of anatomical planes. However, the surgical management of diverticulitis has evolved in recent years and there has been a shift away from traditional Hartmann's operation to percutaneous and laparoscopic drainage procedures^[32]. There is accumulating evidence, albeit from case series and cohort observational studies, that laparoscopic lavage and drainage is not only a safe and efficient method of treating non-feculent complicated diverticulitis but does not always necessitate a future elective colonic resection^[33-35].

All but one study had less than 40 patients - Table 2^[36-42]. Complication rate/morbidity ranges from 0%-54% with mortality of < 3%. Only 3 studies had patients which required conversion to open operation^[43-45]. The majority of patients included in these studies had ad-

vanced complicated disease as measured by the Hinchey classification (Hinchey Grade III or more)^[46]. The rate of stoma formation was low; only Mutter *et al*^[40] and Taylor *et al*^[47] reported the need for stoma in 2 of 14 and 1 of 10 patients, respectively. The largest series was reported by Myers *et al*^[38] of 100 patients. 92 patients underwent laparoscopic lavage with 8 requiring conversion to open Hartmann's operation. 87 patients had complete resolution of acute disease however one patient also required a delayed Hartmann's operation and a further patient undergoing percutaneous drainage under image guidance. There is 3% reported mortality in this series although this was not directly attributed to the surgical approach.

Although laparoscopic resection is routinely practiced with for patients requiring surgery due to previous episodes of recurrent diverticulitis in an elective setting^[48-50], there is scarce data in the emergent setting. Five retrospective studies have reported on laparoscopic resection in acute diverticulitis including fewer complications, no deaths and more than 90% stoma reversal rates^[51-55]. For example, Titu *et al*^[54] included 66 patients who underwent emergency laparoscopic surgery for complicated diverticulitis. These authors reported only one conversion to laparotomy and a median operating time of 110 min. They performed a majority of anterior resections in patients who were mostly classified with Hinchey grade I or II (56 of 66 patients).

A large scale analysis by Rea *et al*^[56] of network data in the US examined the emerging role of laparoscopic resections in acute diverticulitis using the National Inpatient Sample (NIS) database. Laparoscopic surgery was performed in 2664 patients in 4 years. There was

no difference in mortality or morbidity although the conversion rate was 55%. Multivariate analysis showed laparoscopic approach to be a predictor of routine discharge - OR = 1.31; and a decreased length of stay - (-).78. However cost analysis revealed no overall savings in financial terms.

EMERGENCY LCS FOR MALIGNANT DISEASE

Emergency laparoscopic right colectomy

The highest quality studies in this section were comparative studies. In a small scale retrospective study, Ng *et al.*^[57] noted favourable short-term clinical outcomes and an acceptable lymph node yield when they studied seven consecutive patients. However these are retrospective results and a prospective randomized controlled trial will be needed to strengthen the evidence in favour of emergency laparoscopic surgery in obstructed patients. A further study by Ng *et al.*^[58] compared 43 consecutive patients with right-sided obstruction from colonic cancer and found less morbidity and faster recovery in the laparoscopic group in addition to the intra-operative benefit of reduced blood loss. Operating time was longer in the laparoscopic group. Li *et al.*^[59] compared emergency and elective laparoscopically-assisted right hemi-colectomy in 181 patients and found no difference in intra- and post-operative complications although procedure time was significantly longer in the 33 patients in the laparoscopic group.

Emergency laparoscopic surgery for left colonic obstruction

The traditional approach to left-sided colonic obstruction has been a Hartmann's operation with the formation of an end-colostomy although in some cases primary anastomosis with or without a defunctioning stoma can be performed. However, the endo-laparoscopic approach consisting of endoscopic stenting followed by planned laparoscopic resection has become an important alternative to immediate open emergency surgery^[60,61]. Endoluminal stenting can be a valuable "bridge" to elective surgery as a more definitive procedure. Stipa *et al.*^[60] investigated the effectiveness of colonic stenting to determine whether it could be used in advance of a single-stage operation. Of the 31 patients managed with stenting, 6 underwent subsequent laparoscopic resection and 16 had an open colectomy. The laparoscopic group had no associated morbidity and shorter hospital stay. In a further study, colonic stenting as a bridge to elective laparoscopic surgery has shown to be more cost-effective and reduces the need for a stoma by 83%^[62]. The Colorectal Stent Trial (CReST) is a multi-centre phase III, randomized controlled trial, currently investigating the role of endoluminal stenting in the acute management of obstructing colorectal cancer^[63]. The future results would be interesting regarding association with subsequent laparoscopic surgery.

Emergency colonic surgery in iatrogenic perforations during colonoscopy

In this group of patients, the lower peritoneal contamination as a consequence of bowel preparation can often result in less peritonitis and a conservative approach with antibiotics may be successful. For those who require surgery, less contamination not only provides a more suitable environment for laparoscopy but also generally results in a better outcome as the patient is less systemically unwell. The options include a laparoscopic lavage and insertion of drains with or without a defunctioning stoma, or a segmental resection with or without primary anastomosis. If a perforation occurs at a tumour site, the management options must be considered in light of the potential upstaging of disease to that of T4 status. In a study of 11 patients with iatrogenic perforation operated on laparoscopically compared to 7 patients operated by open surgery^[64], results favoured the laparoscopic group in terms of less morbidity and less hospital stay. Further, none of the 11 patients who underwent laparoscopic treatment required colonic resection.

DISCUSSION

As laparoscopy has become a more accepted practice for colorectal surgeons, there has been a natural interest in the use of laparoscopy in emergency settings. The literature is broadly divided by the underlying pathology; that is, inflammatory bowel disease (IBD), diverticulitis and malignant obstruction. Interestingly, despite the technical difficulties that inflammation causes in terms of disruption of tissue planes, there are a greater number of reports regarding the role of laparoscopy in IBD rather than cancer.

There are no randomized trials in the IBD setting but the trend is that of shorter time to gut function which is important in nutritionally deplete patients. As many patients are on steroids, there are issues with wound healing and post-operative complications however the majority of studies have reported improved morbidity. A shorter hospital stay is associated with most laparoscopic operations and this is also the case with colitic patients. Operating times were increased but this may be expected with technically more challenging operations. As briefly mentioned, the inflammatory process makes the surgical anatomy more challenging and although laparoscopy gives enviable views at high magnification, there is not the same tactile feedback one gets during open surgery. This is most applicable in the cases of inflammation when the surgeon must be confident they are in the correct plane. This is a possible reason behind the increased operating time. Furthermore, whilst there are standard port positions due to the relatively consistent nature of cancer surgery, there may have to be more flexibility with IBD.

The reports on diverticulitis concentrate on lavage and drainage and no resection. However it is important to note that for many patients, this can be a definitive procedure. There is not sufficient medium or long-term data

to know whether laparoscopic lavage will reduce the need for an elective resection in the future but in the short term the results do seem promising. There is a paucity of literature regarding emergent colonic resection for diverticular disease but those which have reported have shown equivocal results to open surgery whether this be primary anastomosis or Hartmann's procedure. The contrast with IBD surgery is that there is no universal consensus on treatment for the surgical options in acute diverticulitis. A Hartmann's procedure, primary anastomosis or lavage and drainage may all be suitable for specific cases and it is the judgment of the surgeon which is key.

Emergency cancer surgery is commonly associated with obstruction or perforation of the tumour. This has an impact on the oncological outcome of the disease whereby systemic control is important and surgery to the primary may only be part of the overall treatment. Most reports favour a combined approach with endoscopy for stenting but reports are emerging of resectional cases. Our single-centre study has analyzed short and long term outcomes for colonic cancer patients undergoing laparoscopy and open surgery. We found that laparoscopic resections of colon cancers presenting as emergency were not only feasible and safe, but also provided long- and short-term outcomes similar to open surgery^[65].

With rapidly advancing technology and a greater number of trained surgeons, use of laparoscopy is emerging as the gold standard in the elective setting. More recently, surgeons are now attempting to take on the challenge of more complex interventions including emergency laparoscopic colorectal surgery. Selection of an appropriate case is important especially in the early part of the learning curve. In addition to increase technical ability of surgeon, improvement and availability of suitably trained theatre staff is also required to achieve better results. Barriers to adopting a minimally-invasive approach for colonic emergencies include surgeon-, patient- and resource-factors. The surgeon must be appropriately experienced and confident to recognize the potential pitfalls which may occur. Early conversion is preferable where technical problems are anticipated. In some cases, patients are not suitable to undergo pneumoperitoneum due to cardiopulmonary compromise or from previous procedures, although the latter is not an absolute contraindication. Finally, a significant proportion of the cases are undertaken outside normal working hours and there may not be adequate resources available - for example, some institutions lack sufficient time on their emergency theatre schedule to allow a potentially lengthy laparoscopic emergency operation.

LIMITATIONS

The present review is limited by the heterogeneity of the studies. This lack of universal definitions to key features of the study is the main limitation. The search strategy focused on studies either reporting on or comparing laparoscopic emergency surgery to open surgery. Laparoscopy or laparoscopic surgery is not defined in all the studies included in the review. Some surgeons accept

laparoscopically assisted or hand-assisted procedures to be included under the term laparoscopy, however this makes comparison difficult. The term "straight laparoscopy" is occasionally used to denote procedures in which only laparoscopic instruments were used and an open incision made to retrieve the specimen. A further term which was not universally defined was "conversion". Other limitations included description of the surgeons' experience and that of the institution. This has a bearing on the outcomes as we have mentioned the learning curve which is central to successful laparoscopic surgery.

CONCLUSION

There is comparatively little outcomes data for the medium and long-term to fully evaluate the role of laparoscopy in the emergency setting. Clearly, in selected patients there will be benefit and possibly cost-savings as well from shorter hospital stay and fewer complications. However, the heterogeneity of the studies causes difficulty in making direct comparison. There appears to be favourable short-term outcomes but sufficient equipoise to consider a randomized trial in the future.

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