Laparoscopic colorectal surgery for diverticular disease is not suitable for the early part of the learning curve. A retrospective cohort study

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1. Introduction

In the western society, 60% of the population acquire diverticular disease by the age of 80, a quarter of which will develop diverticulitis at one point of their life.1 Although most of the initial episodes respond to conservative treatment, a third of the patients will develop recurrent attacks and a third will require an operation.2

The management of diverticular disease has evolved rapidly since the introduction of laparoscopy in the early 1990s. The benefits of laparoscopy with regard to morbidity, pain, cosmesis and its cost-effectiveness have been well documented. The role for laparoscopy in managing diverticular disease continues to develop.3

Most of the studies in the literature compare the results of laparoscopic vs open colorectal procedures for the management of diverticular disease. Our aim is to study the laparoscopic management of diverticular disease in a district general hospital. To our knowledge, this is the first study to compare the results of LCP for diverticular disease with other LCP.

2. Methods

This is a retrospective study of consecutive elective laparoscopic colorectal procedures (LCP) for patients with diverticular disease performed between June 2001 and September 2011.

The first part of the study compares LCP for diverticular disease (study group: S) with LCP for benign and/or malignant pathology (first control group: C1). Groups are compared according to demographic characteristics (age, gender, body mass index “BMI” and co-morbidities demonstrated by the American Society of Anaesthesiologists “ASA” status), conversion to open procedure, operative time (stratified by procedure type), length of hospital stay, morbidity and mortality. The total operative time in both groups is compared with similar procedures only, to eliminate the bias that may arise from longer procedures in the control group e.g. multi-segmental procedures for multiple lesions or deep pelvic dissection for rectal pathology.

Operative timing was recorded from a computerised theatre system (TOMS theatre system).

The second part of the study compares LCP for diverticular disease (study group: S) with open colorectal procedures (OCP) for diverticular disease (second control group: C2) during the same period. Groups are compared according to demographic characteristics, complexity of the diverticular disease (simple or complicated diverticular disease as reported in the postoperative specimen pathology), operative time (comparing only similar procedures), length of hospital stay, morbidity and mortality.

This study is a single surgeon experience including all laparoscopic and open colorectal procedures. Data is collected prospectively. Exclusion criteria include all emergency and stoma-only procedures. Patients with incidental finding of
diverticular disease in the post-operative histo-pathology report are considered among the C1 group. LCP and OCP for diverticular disease include the procedures aimed for treatment of diverticular disease only. Converted laparoscopic procedures are analysed on intention-to-treat basis.

Statistical analysis is performed using Chi-square test and Fisher’s exact test for non-parametric data. Student ‘t’ test and Mann Whitney U test are used for analysis of parametric data. p Value <0.05 is considered statistically significant.

3. Results

The study involves 414 colorectal procedures; 194 (46.9%) LCP & 220 (53.1%) OCP. Fig. 1 shows the total number of LCP and OCP undertaken during the period of study. Within the 194 LCP, 22 (11.3%) were for treatment of diverticular disease; 19 were left-side resections, 2 were right-side resection and one total colectomy.

The first part of the study compares laparoscopic procedures for diverticular disease (S group) with other LCP (C1 group). Both groups were comparable in their demographic characteristics (age, gender, BMI & co-morbidities) as shown in Table 1.

The overall conversion rate in the LCP is 23/194 (11.9%). Conversion rate is significantly higher in S group. There are 6/22 conversions in S group (27.3%) vs 17/172 in C1 group (9.9%), p = 0.017 (C.I. 1.1804 - 9.9039).

The mean total operating time in all LCP is 226.5 min (Range: 60 – 544). The mean operating time is stratified for procedure type for groups S and C1 (n = 22 and 103, respectively) i.e. 69 LCP are excluded as they have no corresponding procedure in S group e.g. LCP for rectal pathology or LCP involving an additional procedure (gynaecological procedure, pouch, etc.). Mean operating time is significantly higher in S group (250 min) (SD = 57.7), compared with 196 min (SD = 58.6) in C1 group, p = 0.0004.

The median length of hospital stay in all LCP is 4 days (Range: 1 – 52, Mean: 6.8). This is not statistically different between patients in S group (6 days [Range: 2 – 52, Mean: 8.9]) and those in C1 group (4 days [Range: 1 – 44, Mean: 6.5]), p = 0.12.

The overall surgical morbidity is significantly higher in S group (12/22 [55%]) than in C1 group (43/172 [25%]), p = 0.0099. The incidence of enterotomy in S group (2/22 [9.1%]) is significantly higher than in C1 group 1/172 (0.6%), p = 0.034. There is one incident of right ureteric injury and another of superficial urinary bladder injury in S group, but not in C1 group (p = 0.113). Intra-operative bleeding from an inflamed friable mesentery occurred in 1/22 in the S group, whereas no significant bleeding occurred in C1 group, p = 0.0113. No anastomotic leak occurred in S group while 2/154 (1.3%) (Excluding No-anastomosis procedures) developed post-operative leak in the C1 group, p = 1. Other surgical morbidities were comparable. Mortality rate is not statistically different between the two groups, being 0/22 and 4/172 in S and C1, respectively, p = 0.38.

In S group, 12 patients have complicated diverticular disease (associated with abscess, perforation, peritonitis, stricture or fistula) and 10 patients have uncomplicated pathology (diverticular disease only ± chronic inflammation). There is no statistical difference between the sub-groups in conversion rates, mean operative time, post-operative hospital stay, wound infection or morbidity, Table 2.

In the second part of the study we compare LCP (S group, n = 22/194; 11.3%) with OCP (C2 group, n = 32/220; 14.5%) performed for diverticular disease. The S group comprises 19 left side resections (including 3 Hartmann reversals), 2 right side resections and 1 total colectomy while the C2 group comprises 22 left side resections, 3 Hartmann procedures, 6 Hartmann reversals and 1 total colectomy. Both groups are homogeneous in the demographic characteristics. Male: female = 12:10 vs 14:18, p = 0.4. Mean age is 64.9 (48 – 84) vs 66.6 (33 – 81), p = 0.5. ASA ≥ 3 in 4/22 vs 14/32 patients, p = 0.08 for groups S and C2 respectively.

The mean operative time is significantly higher in S group; 250 (169 – 391) minutes compared with that in C2 group; 155.8 (100 – 285) minutes, p < 0.0001.

The median length of hospital stay in S group is significantly lower than in C2 group; 6 (2 – 52, mean = 6.75) days Vs 11 (5.86, mean = 17.9) days respectively, p = 0.0002.

Wound infection is comparable in either group being 4/22 (18.2%) in S group and 12/32 (37.5%) in C2 group, p = 0.15. Similarly, other surgical morbidity rates are not significantly different in either group. There is one mortality in C2 group only, p = 1.

Post-operative histo-pathology results show that both groups are also homogeneous in the complexity of the diverticular disease. 10/22 (45.5%) patients in S group and 7/32 (21.9%) patients in C2 have non complicated diverticular disease. 12/22 patients in S and 25/32 patients in C2 had complicated diverticular disease (histo-pathology reporting diverticular disease with abscess, perforation, peritonitis, stricture and/or fistula), p = 0.07.

4. Discussion

The introduction of laparoscopic colectomy in the 1990s provided a new tool for the management of diverticular disease. After the initial learning curve, many studies were undertaken to evaluate the safety, efficacy, and potential benefits of laparoscopy over the traditional open approach. In 2000, the NICE guidelines suggested that laparoscopic colorectal surgery should be offered for treatment of colorectal cancer only as a part of clinical trial.
Following publication of several landmark trials confirming the safety and effectiveness of the laparoscopic approach for both benign and malignant colorectal pathology, 1–7 the NICE guidelines in 2006, suggested laparoscopic colorectal surgery as an alternative for colo-rectal cancer, provided that the surgeon has been trained in laparoscopic surgery for colorectal cancer and performs the operation often enough to keep his or her skills up to date. 8 In 2007, Leong et al. recommended prioritising benign cases in the initial experience. This was based on The American Society of Colon and Rectal Surgeons recommendation that oncological resection with curative intent should not be performed until reasonable confidence is gained through experience on patients with either benign disease or metastatic malignancy. 9 We conducted this study based on our observation that LCP for diverticular disease can be technically more challenging than other LCP.

Laparoscopic resection for inflammatory colon pathology is technically more demanding due to the inflammatory reaction and distortion of the normal surgical planes. Complication rates can be high and so, too, the rate of consequent conversions. 10 The consequences of this inflammation such as thick mesentery, fibrosis and fistulas can lead to time consuming operations, high conversion rates and post-operative complications. 11 In a survey including 35 worldwide experienced laparoscopic colorectal surgeons, sigmoid colectomy appears to be the simplest procedure to perform. The Hartmann procedure is associated with a higher overall difficulty rating (3.0) than sigmoid colectomy (2.0), despite the fact that no anastomosis is performed, mostly due to the acute inflammatory process often present in complicated diverticular disease. The Hartmann reversal was felt to be the most difficult procedure, with an overall score of 4.5. 12 The difficulty of the Hartmann reversal is also supported in other trials. 13, 14 Our study includes 3 Hartmann reversals in group S.

Various techniques were developed to improve the outcome of this widely prevalent disease. A meta-analysis published in 2008 reported comparable results between hand-assisted laparoscopic surgery (HALS) and laparoscopic-assisted (LAC) techniques. 15 Data comparing total intra-corporeal and laparoscopic-assisted techniques is conflicting. 16, 17 In our series; following intra-corporeal pedicle division and specimen delivery, the bowel anastomosis is performed intra-corporeally with the exception of right-side colectomy.

In sigmoid diverticular disease, Eijsbouts et al., advised excision of the sigmoid colon and anastomosis in the proximal rectum as a high anterior resection in order to avoid an anastomosis with the distal sigmoid where intra-luminal high pressure can induce the recurrence of diverticulitis. 11 We adopt this technique; we perform high anterior resection for all cases with sigmoid diverticular disease. Titu et al. suggested individually-approached dissections in a pragmatic manner using both medial and lateral approaches as dictated by fibrosis, abscess, site of fistulisation and degree of obstruction/peritonitis. 18 We find this pragmatic approach helpful in the management of diverticular disease in our series.

The timing of surgery has been the subject of controversy. 19 The traditional practice entails waiting 4–6 weeks after a diverticulitis attack before an elective operation to lower morbidity and conversion rates. 20 Other studies indicated that the preferred timing of elective surgery should be after the third or fourth attack of uncomplicated diverticulitis. Alternatively, some studies advised early intervention for complicated diverticulitis to avoid prolonged and recurrent hospitalization. 19, 21 Natarajan et al. showed no direct relationship between surgical timing after acute diverticulitis and complications or conversion rates after elective laparoscopic sigmoid colectomy. 22

Surgical indications for elective procedures in diverticular disease used to be (1) two attacks of diverticulitis or a single attack in patients younger than 50 years; (2) diverticulitis associated with fistulas in which the existence of a carcinoma has to be excluded; (3) elective resection after a previously drained peri- colic abscess; and (4) one attack in a patient requiring chronic immunosuppressive therapy. 22 Recent data suggests a rather more individualised approach, taking into account frequency, severity of the attacks and their impact on quality of life, as a guide to the indication for surgery in uncomplicated diverticular disease. 23 The indications for surgery in our study are (1) Symptomatic diverticular disease in the presence of a mass/stricture; (2) Colo-vesical/vaginal fistula; (3) Radiological suspicion of malignancy with failed endoscopy; (4) Reversal of Hartmann.

In LCP for uncomplicated diverticular disease, reported conversion rate was 2–19.7% 12, 26 while in complicated diverticular disease; it was 8–61%. 22, 23 In a multi-centre study which recruited 1118 patients, the overall conversion rate for laparoscopic sigmoidectomy was 7.2% (4.8% for uncomplicated and 18.2% for complicated cases). 27 Single-institutional series included 500 patients operated upon by experienced surgeons have reported conversion rates of as low as 2.8% (2.1% for uncomplicated and 5.3% for complicated diverticulitis). 23 The overall conversion rate in our study, including the learning curve, is 11.5%. It is significantly higher in S group (27.3%) than in C1 group (9.9%), p = 0.017.

Conversion to open operation is usually associated with longer operative time, longer hospital stay and increased post-operative complications. 28, 31, 32 It is generally accepted that when necessary, an early conversion can minimize major complications. 33 The reported operative time varies depending on the experience of the surgeon, the learning curve and the complexity of the disease. Jones et al. reported a median operating time of 120 min whereas the mean operating time was 195 min in another study. 11 In this study, the overall mean total operating time is 226.5 min. It is significantly higher in S group (250 min) compared with C1 group (196 min), p = 0.0004.

The median postoperative hospital stay reported by Jones et al. is 4 days (2–33). 30 The median postoperative hospital stay in all LCP in this study is 4 days. This is not statistically significant between both S group (6 days) & C1 group (4 days), p = 0.12. This insignificance reflects the benefits of laparoscopic colorectal surgery in both groups.

Several studies claim that LCP for diverticular disease is associated with less postoperative complications. These include short-term complications related to wound infection and ileus, as well as long-term complications, e.g. hernia and adhesive small bowel obstruction. 23, 34–36 Körkeling et al., in 1999 reported morbidity rates of 14–31.8% depending on the complexity of the diverticular disease with mortality rate of 1.1%. 29 Jones et al. reported major morbidity and mortality rates of 11% and 0.2%, respectively. 30 In the SIGMA trial, the overall morbidity was 42.3% (36.5% minor complications and 9.6% major complications). 14 In our study group, the overall morbidity is 12/22 (55%) which is higher than in C1 group (43/172 [25%]), p = 0.0099. Major surgical complications which altered or required further surgical management are comparable in the two groups, being 2/22 and 9/172 respectively, p = 0.36. Le Moine et al. mentioned that the mesentery can be friable and vascular with obliteration of the normal retroperitoneal planes and fistulisation that could be more than expected. 23 We have no mortality in S group. Mortality rate in C1 group is 2.3% (4/172), p = 0.38.

Uncomplicated diverticulitis is defined as the presence of peri-diverticulitis or a limited inflammatory process. Complicated diverticulitis entails the presence of obstruction, a free perforation in the abdominal cavity, the presence of a peri-colic abscess or the development of a fistula. 25 The intraoperative course of complicated diverticular patients undergoing laparoscopic resection
would be expected to be challenging. Reports of LCP to treat complicated diverticulitis are surprisingly few, with only small patient populations however several reports have demonstrated no increase in the operative time, conversion rate, length of stay or postoperative complications among these patients. The SIGMA Trial compared short term and long term outcomes of LCP and OCP. The short term results showed significantly (15.4%) decreased major postoperative complication rates in LCP compared with OCP. There was no significant difference in minor complications. Laparoscopic surgery resulted in longer operative time, significant reduction of pain, decreased hospital stay and improved quality of life. In the 30-day to 6-month follow-up period the clinical outcomes were comparable in both groups. The total postoperative morbidity showed a 27% reduction in major morbidity for patients undergoing LCP for diverticular disease.

Operative time tends to be longer in LCP for diverticular disease when compared with open surgery. Despite the increased operative time, the overall cost for LCP is lower than that of OCP, likely due to the shorter length of stay. The results in this study are comparable with those in the literature. We demonstrated a significantly higher mean operative time (mean difference of 99.2 min, including the learning curve, p < 0.0001) and lower post-operative hospital stay (Median – 6 vs 11, p = 0.0002) in favour of OCP. LCP. Morbidity and mortality rates were not significantly different in S and C2 groups.

This study is a single surgeon experience which eliminates individual variation in the learning curve. The limitation in the study is the small number of procedures performed for diverticular disease (Type II error) which is due to the selective criteria in the indications of surgery for diverticular disease.

5. Conclusion
Laparoscopic colorectal surgery for diverticular disease is safe and effective. It can be challenging and requires advanced laparoscopic skills. We recommend a pragmatic approach in laparoscopic colorectal surgery for diverticular disease early in the learning curve.

Ethical approval
Not required.

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Author contribution
Nader Naguib: study design, data collections, data analysis and writing.
Ashraf G. Masoud: study design, data collections, and writing.

Conflict of interest
None declared.

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