From small acorns – developing a laparoscopic colorectal surgical service

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ABSTRACT

INTRODUCTION Randomised controlled trials have shown that laparoscopic colorectal surgery is equal in terms of safety to open surgery. Benefits have been seen for length of stay, blood loss, immune suppression and analgesia requirements. The aim of this study was to assess the safety and feasibility of introducing laparoscopic colorectal surgery to our unit.

PATIENTS AND METHODS Prospectively collected cases of all patients undergoing laparoscopic colorectal surgery between July 2003 and July 2007 were reviewed.

RESULTS A total of 143 patients (75 males and 68 females) with a mean age of 65.8 years (range, 21–95 years) underwent surgery. Laparoscopic resection for colorectal malignancy was performed in 93 patients (65%). The conversion rate for all cases was 14.7%. Mean operative time was 203 min (range, 100–400 min), with a mean blood loss of 180 ml. The mean number of lymph nodes in malignant cases was 13.8 with clear resection margin in all but one case. The mean postoperative stay was 5.6 days (median, 4 days; range, 2–35 days). UKCCR standard for lymph node retrieval was achieved in 62.6% of cases. There were four postoperative deaths. The overall 30-day morbidity rate was 21.7%. The service is consultant-led with 9.8% of cases performed by senior trainees and 37% of procedures performed by two consultants.

CONCLUSIONS Laparoscopic colorectal surgery is technically feasible and safe in our hands. Although operative time is longer, this is counterbalanced by shorter hospital stay. The results from this series support the findings of others and continuing development of this service.

KEYWORDS

Colorectal surgery – Colorectal neoplasms – Laparoscopic surgery – Surgical service – Hospital

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Laparoscopic colorectal cancer surgery was first described in 1991.¹ Since this time, initial concerns regarding port sites metastases and overall safety have been allayed by the results of a number of randomised controlled trials.^{2–5} The COST study has reported no deleterious effect on overall survival.⁶ In addition, this type of surgery has been shown to shorten hospital stay and reduce postoperative analgesia requirements, somewhat at the expense of longer operating times. In view of these findings, we made the decision to adopt this approach in selected patients with benign and malignant colorectal disease in our unit. This paper reports the results from a prospectively collected database established in July 2003. We report how two consultant operating, and careful case selection allowed introduction of this service with minimal mortality and morbidity.

Patients and Methods

Between July 2003 and July 2007, data from all patients

undergoing elective laparoscopic colorectal surgery at a large teaching hospital were collected prospectively. On-going patient data collection was incorporated as part of the business plan when setting up the laparoscopic service and was with the approval of the local Audit Office. Patients were admitted under the care of one of four consultant surgeons, two of whom had undergone training in laparoscopic colorectal surgery as specialist registrars/fellows.

Patients with colorectal cancer underwent initial diagnosis with either endoscopy and biopsy or double-contrast barium enema (DCBE). All cancer patients were staged with CT scanning, in addition to MRI scanning in those with rectal lesions. Tattooing to aid localisation was performed in 60% of cases. All neoplastic cases were discussed at a multidisciplinary team meeting (MDT).

Surgery was performed under general anaesthesia, with or without an epidural. A second-generation cephalosporin and metronidazole were given parenterally on induction. All patients received low molecular weight

heparin, as well as pneumatic boot compression and TED stockings, unless contra-indicated.

Right hemicolectomy was performed with the patient supine, in 30° of reverse Trendelenburg initially. Port position and the procedure are illustrated in Figure 1. Sigmoid colectomy and high anterior resections were performed in a modified Lloyd–Davies position with minimal hip flexion. Port position and the procedure are shown in Figure 2.

Telephone follow-up was undertaken in the week following discharge by a colorectal nurse practitioner using a standard proforma. Patients were referred for postoperative adjuvant therapy as determined by the MDT, and seen routinely in surgical out-patients according to individual surgeon preferences.

Results

Demographics and operative procedure

A total of 143 laparoscopic colorectal procedures were performed between July 2003 and July 2007. There were 75 males and 68 females with a mean age of 65.8 years (range,

21–95 years). The median ASA grades and body mass indices were 2 (range, 1–4) and 26 kg/m² (range, 16–46 kg/m²). The mean P-POSSUM for all patients in the series predicted a mortality of 2.9% and morbidity of 34.7%, which would equate to four deaths and 50 complications overall. P-POSSUM increased year on year suggesting that, as confidence and numbers grew, patients with more co-morbidity had their procedures performed laparoscopically (Table 1).

Of the 143 cases, 108 were performed for neoplastic lesions of which 95 (86.1%) were malignant and 15 benign adenomas. Overall, there were 58 right hemicolectomies, 31 sigmoid colectomies (1 de-functionalised), 25 anterior resections (8 de-functionalised), 2 suture/resection rectopexies for full thickness rectal prolapse, 24 restorations of intestinal continuity (Hartmann's procedures or ileorectal anastomoses), 1 abdominoperineal excision of rectum (APER), 1 completion proctectomy and 1 subtotal colectomy in our series.

Conversion rates and causes

The overall conversion rate was 14.7% (2003–2004, 0%; 2004–2005, 24%; 2005–2006, 12%, 2006–2007, 16%).

Table 1 Summary of laparoscopic results

		July 2003– July 2004	July 2004– July 2005	July 2005– July 2006	July 2006– July 2007
Number of procedures (number performed by 2 consultants)		7 (7)	17 (11)	42 (19)	77 (16)
Median operating time (min)		145	180	240	170
Median blood loss (ml)		175	112.5	150	107.5
Median lymph node retrieval for cancer cases		N/A	14	13.5	13
Relative proportions*		3:0:0:4:0	6:0:2:6:3	16:12:10:3:1	34:13:18:9:3
Overall P-POSSUM	Morbidity	15.9%	30.3%	36.8%	36.2%
	Mortality	0.7%	1.7%	3.4%	3.0%
Average specimen length (cm)	Mean	12	19.8	16.2	19.5
	Median	12	18.0	16.0	19.0

*Right hemicolectomy:anterior resection:sigmoid colectomy:reversal of Hartmann's procedure:other.

Conversion in our hands is defined as an incision that one did not intend to make (excluding the insertion of further ports), and invariably meant abandoning the laparoscopic procedure in favour of a midline incision. Conversion was most likely for reversal of Hartmann's procedure (27.3%) compared to other procedures (Table 2). Dense adhesions were the most common cause for conversion (11 patients [52.4%]). Other causes included difficult anatomy (*e.g.* redundant bowel, infiltrating tumours) and equipment failure (*e.g.* miss-fire of bowel or vascular stapler).

Operation data

Mean operative time was 203 min (range, 100–400 min). This varied considerably between years and procedures.

In operations where blood loss was recorded, the mean loss was 180 ml. The accuracy of this value is difficult to quantify, as 'minimal blood loss' was recorded in 83 patients and the exact volume not stated (Table 1). Forty-two patients had an epidural inserted, while the remainder were managed with patient-controlled analgesia (PCA). Mean postoperative stay was 5.6 days (median, 4 days; range, 2–35 days) for all patients, though the figure in the unconverted laparoscopic group was 4.8 days (median, 4 days; range, 2–35 days). This compared with 10.4 days (median, 8 days; range, 4–34 days) in patients who were converted. The mean number of lymph nodes retrieved in the cancer cases was 13.8. Thus, the UKCCR standard for lymph node retrieval was achieved in 62.6%. All but one patient had clear resection margins.

Table 2 Conversion rates for procedure and year

	July 2003– July 2004	July 2004– July 2005	July 2005– July 2006	July 2006– July 2007	Total
Right hemicolectomy	0%	0%	6.3%	5.9%	5.2% (<i>n</i> = 3/58)
Sigmoid colectomy	N/A	50% ^a	0%	16.7%	12.9% (<i>n</i> = 4/31)
Anterior resection	N/A	N/A	8.3%	23.1%	16% (<i>n</i> = 4/25)
Reversal of Hartmann's procedure	0%	0%	66.7% ^b	44.4%	27.3% (<i>n</i> = 6/22)
Others (<i>e.g.</i> APER)	0%	100%	100%	0%	57.1% (<i>n</i> = 4/7)

^aTwo procedures; ^bthree procedures.

APER, abdominoperineal excision of rectum.

Mortality and morbidity

There were four deaths (2.8%) within 30 days of the original surgery. Three deaths occurred in patients who had undergone a right hemicolectomy and one in a laparoscopically assisted sigmoid colectomy. The first death was due to an anastomotic leak. Two further deaths were due to postoperative myocardial infarctions. One patient, who made an uneventful recovery and was discharged after 4 days, died suddenly at home 20 days following the procedure with a pulmonary embolus.

The overall 30-day morbidity event rate was 31 of 143 cases (21.7%). These included 9 microbiologically confirmed wound infections, 1 anastomotic leak, 2 intra-abdominal collections, 5 microbiologically confirmed urinary tract infections (UTIs), 5 radiological or microbiologically confirmed chest infections, 1 early port-site hernia, 1 with small bowel evisceration via ileostomy site, 1 myocardial infarction, 4 new onset fast atrial fibrillations, 1 pleural effusion requiring drainage and 1 wound seroma.

In converted patients, the overall 30-day morbidity rate was 8 of 21 (38.1%). These included 2 collections, 3 microbiologically confirmed wound infections, 2 chest infections and 1 UTI. Overall, 25.8% (8 of 31) of all complications occurred in the 14.7% of patients whose laparoscopic procedure was converted.

Consultant learning curve

As the service evolved, the number of cases increased. The numbers performed in the four 12-month periods were 7, 17, 42 and 77 (Table 1). The early procedures were performed by a colorectal surgeon and minimal access surgeon combined. Subsequently, either two colorectal consultants or one colorectal consultant and a trainee have been involved. Three of the last 25 cases (12%) have been performed by a supervised trainee. Over the total series, 14 of 143 (9.8%) have been undertaken by a supervised trainee. This suggests that, now the service has become established, opportunities for more training exist. However, overall two consultants operating together have performed 53 of 143 (37.1%) cases (Table 1).

Re-admissions and follow-up

A nurse practitioner instituted telephone follow-up was also developed alongside our laparoscopic service. Out of the first 124 patients in the series, 37 patients were phoned. Each patient was contacted a median of 2 times (range, 1–3 times), at a median of 10 days following discharge (range, 2–14 days). Nine patients (24%) had reason to visit their general practitioner or attend the accident and emergency department during this time. Twelve required planned visits from the district nurses, and one was an unplanned visit.

Of the 143 patients, 4 (2.8%) were re-admitted within 30 days of surgery. Two patients were re-admitted at 6 and 17

days after discharge to commence intravenous antibiotics for wound infections, which had failed to settle with oral medication. A further patient was re-admitted at 20 days with sub-acute small bowel obstruction, which settled conservatively. One patient was re-admitted twice: on day 7 post discharge, for *Clostridium difficile* infection and evisceration of small bowel through the ileostomy site, for which he returned to theatre. The patient returned again on day 24 with recurrent *C. difficile* infection, which was successfully treated with vancomycin.

Long-term complications and recurrence

This series extends over 4 years; as such, a number of medium/long-term complications declared themselves. These occurred in 15 patients (10.4%). They included 7 incisional hernias (4 at stoma site, 1 port site and 2 where the exact site was not documented), 1 parastomal hernia, 1 port site metastasis, 1 asymptomatic radiologically demonstrated anastomotic leak (treated conservatively), and 3 anastomotic strictures. The long-term complication rate was 16 of 143 (11.2%).

Local recurrence at the site of the anastomosis and in the absence of other disease has been detected in three patients. One patient has a positive resection margin after a right hemicolectomy for a Dukes' C1 tumour. Currently, the patient is well and undergoing chemotherapy with no evidence of recurrence.

Discussion

As current evidence increases regarding the safety of laparoscopic colorectal surgery and with the continued dissemination of laparoscopic skills, surgical departments throughout the UK are developing their own services. Nottingham University Hospitals began its laparoscopic colorectal service in 2003, following appointment of a new consultant, who had undertaken training in laparoscopic colorectal surgery. The continued success of the enterprise has been based on consultant-to-consultant tutoring, structured reviews of outcomes and meticulous prospective audit of all aspects of the service.

Initially, within the first year, collaboration occurred between colorectal consultants and a specialist minimal-access surgeon in an effort to reduce the learning curve for this new service. At this stage, the current preceptor programme, supported by the Association of Laparoscopic Surgeons (ALS), was not as widely established as at present. As the service developed, colorectal consultants operated together, until finally a stage was reached where trainees were being taught individual procedures (currently 12%). As demonstrated in Table 1, 100% of operations were performed with two or more consultants in the first year, compared to 20.8% over the last 12 months. This is clearly a

model for how a service involving complex, high-risk procedures should evolve.

Operation time has been demonstrated to be a poor marker for experience and does not correlate with better clinical outcomes.⁷ Conversion rates are also not related to experience as more experienced surgeons attempt increasingly complex cases.⁷ The increasing P-POSSUM predicted morbidity (first year, 15.9% versus fourth year, 36.2%) and mortality (0.7% versus 3%) of patients in this series (Table 1) supports the growing complexity of cases performed. The staggered introduction of less experienced consultant surgeons to laparoscopic surgery may have also resulted in prolonged operation duration of less complex procedures during later years. Over future years, as more surgeons gain experience, it is expected that operation time will improve for simple cases.

There has been no compromise in oncological clearance despite increasingly complex cases. Median lymph node retrieval and specimen size was maintained despite increasing incidence of malignant resections and complexity of cases (Table 1). Only one of the laparoscopic resections had R1 resection margin involvement.

The overall conversion rate was 14.7%; this is comparable with Veldkamp *et al.*⁵ (17%), Senagore *et al.*⁸ (12.1%) and Belizon *et al.*⁹ (19.6%). Conversion rates also vary for different procedures (Table 2), with right hemicolectomies (5.2%) being less than for anterior resections (16%) and sigmoid colectomies (12.9%). This may be related to the fact that more right hemicolectomies were performed and that this was the first procedure on which consultants develop their skills in the presence of a consultant colleague. In addition, the learning curve is less for right- compared with left-sided colectomies.^{9,10} The conversion rates as reported by Tekkis *et al.*¹⁰ (right 8.1%; left 15.3%) also compared favourably with this series (right 5.2%; left 14.3%; Table 2).

Converted patients in this series had a greater length of stay (10.4 days versus 4.8 days) and increased morbidity (38.1% versus 21.7%) compared to laparoscopic patients. Two out of 5 cases, who returned to theatre were also converted patients. Belizon *et al.*⁹ and Marusch *et al.*¹¹ have previously demonstrated the poorer outcome for converted patients.

The mortality (2.8%) and morbidity (21.7%) were comparable with a recent meta-analysis¹² of non-randomised laparoscopic colorectal studies (24%). Wound infections were the most commonly occurring complication (9 of 143 [6.3%]) in unconverted patients. The incidence of wound infections was doubled in converted patients (3 of 21 [14.3%]).

All patients in this series received low molecular weight heparin (LMWH) while in-patient and pneumatic intermittent calf compression during theatre. Compression stockings were prescribed unless contra-indicated, and patients were discharged with them. Despite concerns that prolonged laparoscopic surgery might increase the risk of thrombosis

due to raised intra-abdominal pressures, and that faster discharge reducing the number of doses of LMWH, only one pulmonary embolism was seen. This occurred 20 days after surgery and was fatal. This compares with a figure of 13 of 2040 (0.64%) for clinically detectable pulmonary embolus in Swiss patients undergoing laparoscopic colonic surgery.¹⁵

Major complications (excluding, for example, wound infections and UTIs) occurred in 9.7% (14 of 143). There was good correlation between the actual and predicted P-POSSUM mortality (2.8% versus 2.9%). This was not seen with actual and predicted morbidity (21.7% versus 34.7%), which corresponds with previous reports.^{14,15}

One criticism of this series is that supervised trainees performed only a small percentage of cases. This is consistent with the findings of others,^{16,17} and can be explained by the fact that the service was being established. Interestingly, increasing numbers of cases were performed by year 4, 5 and 6 specialist registrars as the service developed. It is to be hoped that this evolves further. In addition, recent evidence suggests that laparoscopic sigmoid colectomy may be safely introduced even earlier in surgical training.¹⁸

As with the development of any new service there was considerable interest in short-term outcomes, especially as a number of patients were discharged much quicker than would have been convention. As such, a nurse-led telephone follow-up of patients was instituted. This confirmed that the short length of stay after laparoscopic surgery has not resulted in a greater workload for primary care services, with only 9 of 38 patients having to see their general practitioner within the first 2 weeks of discharge.

Conclusions

As specialist registrars and junior-grade doctors become confident in laparoscopic surgery and continue to progress to consultant level, it seems likely that enthusiasm for laparoscopic colorectal surgery throughout the UK will continue. It remains to be seen whether they will be trained sufficiently to carry out such complex procedures within the current training framework. While a preceptor programme is available through the Association of Laparoscopic Surgeons, this only involves the direct supervision of individual consultants for a small number of cases. We would suggest that the model we have established of two-consultant operating, prospective data collection and meticulous audit are mandatory if a laparoscopic colorectal service is to be safely established.

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