Morbidity and Mortality Following Laparoscopic-Assisted Right Hemicolectomy for Cancer

E. L. Bokey, M.S., F.R.A.C.S., J. W. E. Moore, M.B.B.S., F.R.A.C.S., P. H. Chapuis, D.S., F.R.A.C.S., R. C. Newland, F.R.C.P.A.

From the Department of Colon and Rectal Surgery, The University of Sydney, Concord Hospital, Concord, Australia

PURPOSE: This study was undertaken to compare morbidity, mortality, and pathology after laparoscopically assisted right hemicolectomy (LARHC) or open right hemicolectomy (ORHC) for cancer of the right colon. METHODS: Patients undergoing either LARHC or ORHC for invasive carcinoma of the right colon during a 30-month period were studied. Data were collected from two sources. All morbidity, mortality, and pathology data were collected prospectively in a form suitable for computer storage and analysis as part of the ongoing Concord Hospital Colorectal Cancer Registry. Data concerning in hospital course were obtained by casenote review. RESULTS: Twenty-eight patients underwent LARHC, and 33 had an ORHC during the study period. The two groups were well matched with respect to age, sex, weight, associated comorbidities, and tumor stage. Mean operating room use time was significantly higher for LARHC (LARHC = 261 minutes; ORHC = 203 minutes; $P < 0.001$). Mean hospital stay from date of resection was the same in both groups (LARHC = 12 days; ORHC = 12.2 days). There was no significant difference between procedures with respect to postoperative complications, return of gastrointestinal function, or narcotic analgesic requirements. There was a significant shorter distal margin of resection in the LARHC group (ORHC = 13.4 cm; LARHC = 10 cm; $P = 0.03$.). Total cost was significantly greater for LARHC ($9,064 *vs.* $7,881 (Australian); $P < 0.001$). Median follow-up was 23.4 months for the LARHC group and 23.9 months for the ORHC group. To date, there have been no local or port site recurrences. CONCLUSION: Although there is no difference in morbidity and mortality following LARHC or ORHC, there is no apparent benefit for LARHC. [Key words: Laparoscopy; Laparoscopic colon resection; Colon carcinoma]

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In 1987, Mouret[1] performed the first laparoscopic cholecystectomy. Since then, laparoscopic techniques have been described for many abdominal operations including several colorectal procedures. Some reports have now suggested that recovery is quicker and hospital stay shortened.[2,3] following colorectal resections performed laparoscopically or assisted laparoscopically. Many of these reports are highly selected in terms of patient age and general health[4] and may not reflect the outcome in an older group undergoing resection for malignancy. In June 1990, we developed in a laboratory the necessary skills to perform laparoscopic colorectal procedures, and between May 1991 and August 1994, we performed 127 laparoscopically assisted colorectal operations. This study describes our experience with a group of patients who had a laparoscopically assisted right hemicolectomy (LARHC) for carcinoma. We compared morbidity, mortality, postoperative course, and histopathology of this group with a group of patients who had an open right hemicolectomy (ORHC) during the same period of time, by the same surgeons.

PATIENTS AND METHODS

This is a nonrandomized design study comparing a consecutive group of patients undergoing LARHC for invasive carcinoma between January 1992 and August 1994 with a group of patients who had an ORHC performed by the same surgeons during the same period. Data were collected from two sources. Since 1971, all morbidity, mortality, and pathology data in patients who have had a resection for colorectal cancer at our institution have been collected prospectively in a form suitable for computer storage.[5] Data concerning clinical in-hospital course after a laparoscopic-assisted operation were collected by casenote review. Significant comorbidities were assessed by well defined organ system criteria (Table 1) and the American Society of Anesthesiology status.[6]

Clinical endpoints examined included operating room use time (defined as time from induction of anesthesia to time of leaving the operating room),

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Address reprint requests to Professor Bokey: Department of Colon and Rectal Surgery, University of Sydney, Clinical Sciences Building, Concord Hospital, Concord, 2139 Australia.

Table 1.
Premorbid Status

	LARHC (n = 28)	ORHC (n = 33)
Weight (mean, SD)	67 (13.54)	70.2 (12.32)
Cardiovascular status		
NYHA* grade		
1	16	24
2	9	7
3	3	2
4	0	0
Respiratory status		
Normal	24	29
Impaired, nonsteroid-dependent	2	4
Steroid-dependent	2	0
Renal function		
Normal	26	31
Impaired	2	1
Dialysis-dependent	0	1
Diabetes		
None	27	29
Noninsulin-dependent	1	4
Insulin-dependent	0	0
ASA Status		
I	5	10
II	15	16
III	7	6
IV	1	1

NYHA = New York Heart Association[18]; SD = standard deviation; LARHC = laparoscopically assisted right hemicolectomy; ORHC = open right hemicolectomy; ASA = American Society of Anesthesiology.

hospital length of stay (from day of surgery to discharge), analgesic requirements (number of postoperative days during which parenteral narcotic was required), return of bowel function, and postoperative complications. Wound infection was assessed by an independent observer and defined as a purulent discharge or serous discharge with a positive culture.

All patients who had an ORHC had a standard mobilization of the colon, and all lymphovascular pedicles were ligated and divided close to their origin. Ileocolic anastomoses were performed using a handsewn end-to-end, interrupted single-layer technique. For LARHC, the patient is placed in a modified Trendelenberg position using Allen (Allen Surgical, Cleveland OH) stirrups, with the hips only slightly flexed. Pneumoperitoneum is achieved *via* a 10-mm Hasson port that is introduced under direct vision in the midline just above the umbilicus. Three 5-mm ports and a 10/12-mm port are inserted under direct vision well to the left of the lateral side of the rectus sheath. The patient is tilted to the left, and the cecum and ascending colon are triangulated and mobilized from the posterior abdominal wall using scissors. Dissection is continued toward the hepatic flexure, which is left undisturbed at this stage. Attention is then directed toward the proximal transverse colon. The head of the table is tilted upward, and the greater omentum is retracted superiorly. The transverse colon and greater omentum are triangulated, and the plane between omentum and transverse mesocolon is developed. Dissection then proceeds in this plane toward the hepatic flexure. The flexure can now be retracted downward and mobilized off the duodenum. Attention is then directed to the terminal ileum. The peritoneal reflection between the ileal mesentery and the posterior abdominal wall is carefully divided. The cecum is then held up and to the right toward the anterior abdominal wall to demonstrate the ileocolic vessels. A 5-mm grasping forcep is placed under the vessels to create a window on either side. The pedicle is divided using a vascular linear cutting instrument. The right colic and right branch of the middle colic vessels are similarly dealt with or are ligated extra corporeally after the specimen is exteriorized. A small (3–5 cm) vertical incision is made centered on the umbilicus and incorporating the umbilical port site. After exteriorizing the specimen, the ileal mesentery is ligated and divided, and the specimen is resected. An ileotransverse anastomosis is performed using either a modified functional end-to-end stapling or a single-layer handsewn technique.

One pathologist (RCN) examined and reported on all specimens without knowledge as to how the operation had been performed. Handling of pathology specimens was previously described elsewhere.[7] Proximal and distal margins of resection were measured in the fresh, unfixed state, and specimen lymph node numbers were assessed by a standardized technique of lymphovascular pedicle dissection without use of fat-clearing techniques. Tumors were staged according to the Concord Hospital Clinicopathological Staging System.[8] Operative and postoperative costs were estimated using the methodology described by Hardy *et al.*[9] Three cost periods were identified and specific cost events attributed therein, based on data made available by the hospital finance department, the hospital Patient Administrative Information System, and State Industrial Awards. All costs are given in Australian monetary figures. Statistical analysis was performed using S.P.S.S. computer software. Categoric variables were compared using Pearson's and Fisher's exact test as appropriate. Compar-

ison of means was by Student's *t*-test, and significance was taken at the 5 percent level.

RESULTS

Thirty-four patients had an attempted LARHC, which was completed in 28 patients (15 males, 13 females). Reasons for conversion were accidental port injury to the cecum (n = 1), tumor adherence to the duodenum (n = 1), dense adhesions (n = 1), development of hypercapnia (n = 1), and lack of progress after trial dissection (n = 2). During the same period, 33 patients underwent ORHC (17 males, 16 females). Average age of both groups was similar (LARHC = 73.9 (standard deviation, 10.3) years; ORHC 71.9 (standard deviation, 10.2) years; $P = 0.46$).

Table 1 summarizes the premorbid state of both groups. Significantly more ORHC patients had a previous cholecystectomy (LARHC, 0; ORHC, 5; $P = 0.04$). A similar trend was seen with respect to previous appendicectomy (LARHC, 3; ORHC, 10; $P = 0.06$), and overall ORHC patients were more likely to have had prior abdominal surgery (LARHC, 8; ORHC, 21; $P = 0.006$).

Mean operating room use time was significantly higher for LARHC (LARHC, 261 minutes; ORHC, 203 minutes; $P < 0.001$). Mean hospital stay from date of resection was the same in both groups (LARHC, 12 days; ORHC, 12.2 days).

One patient died in the hospital. He was an eighty-year-old man (New York Heart Association Grade 3 with steroid-dependent airways disease) who had an uneventful LARHC and suffered a cardiac arrest on day 25 while convalescing in a geriatric medical ward. Apart from the conversions listed above, there were no intraoperative complications. Table 2 lists the postoperative complications. There were no differences between the two groups. There were no anastomotic complications, intra-abdominal sepsis, or hemorrhage in either group. Table 3 summarizes patients' postoperative course. The only significant benefit for the LARHC group was an earlier return to full ambulation ($P = 0.04$).

Site distribution of tumors was similar between the two groups (LARHC: cecum = 6, ascending colon = 14, hepatic flexure = 3 transverse colon = 5; ORHC: cecum = 14, ascending colon = 13, hepatic flexure = 2, transverse colon = 5; $P = .0.41$). Table 4 lists stages of the tumors. There were no patients with histologic evidence of incomplete local tumor excision in the LARHC group, but there was one such case in the ORHC group. Table 5 summarizes tumor size, margins of resection, and lymph node harvest. There was a significant reduction in the distal margin of resection in the LARHC group (ORHC = 13.4 cm; LARHC = 10 cm; $P = 0.03$). Median follow-up was 23.4 months for

Table 2.
Postoperative Complications

	LARHC (n = 28)	ORHC (n = 33)	*P* Value*
Wound infection	4	3	0.25
Septicemia	1	1	
Small-bowel obstruction	0	2	0.29
Urinary tract infection	1	2	0.56
Acute renal failure	1	2	0.56
Pneumonia/atelectasis	6	3	0.16
Cardiac	7	7	0.72
Deep vein thrombosis	1	1	0.71
Pulmonary embolus	0	2	0.29

LARHC = laparoscopically assisted right hemicolectomy; ORHC = open right hemicolectomy.
* One-tailed Fisher's exact test.

Table 3.
Postoperative Clinical Course

	LARHC (n = 28)	ORHC (n = 33)	*P* Value*
Mean days to/of			
Full ambulation	2.7	3.4	0.04
Passage of flatus	4.5	4.4	0.84
First bowel movement	4.9	5.5	0.37
Commenced oral fluids	4.3	4.2	0.86
Commenced full diet	6.9	7.6	0.35
Parenteral narcotic analgesia	4.4	4.9	0.22

LARHC = laparoscopically assisted right hemicolectomy; ORHC = open right hemicolectomy.
* Student's *t*-test.

Table 4.
Tumor Stage

	LARHC	ORHC
Tumor stage		
A	4	1
B	11	17
C	9	11
D	4	4
Total	28	33

LARHC = laparoscopically assisted right hemicolectomy; ORHC = open right hemicolectomy.

Table 5.
Macroscopic Tumor Data

	LARHC (n = 28)	ORHC (n = 33)	*P* Value*
Mean tumor size (cm)	4.4	6.0	0.054
Mean proximal resection margin (cm)	10.1	11.9	0.42
Mean distal resection margin (cm)	10.0	13.4	0.03
Mean lymph node harvest	17.0	16.0	0.65

* Student's *t*-test.
LARHC = laparoscopically assisted right hemicolectomy; ORHC = open right hemicolectomy.

the LARHC group and 23.9 months for the ORHC group. There have been no local or port site recurrences to date.

There was a significantly increased total cost associated with LARHC compared with ORHC (LARHC, $9,064; ORHC, $7,881; $P < 0.001$), attributable mainly to increased costs in the operating room cost period, both as increased direct costs (staff salaries, disposable instrumentation) and indirect costs (operating room overheads).

DISCUSSION

While there have been several reports of laparoscopically assisted colectomy for cancer, most have been anecdotal and focused on aspects of technique.[10] Although there have been no randomized controlled comparisons of laparoscopically assisted colectomy with open procedures, many authors have claimed a significant reduction in postoperative pain and a quicker return of gastrointestinal function following laparoscopically assisted colectomy.[2, 11-13] Furthermore, it has been suggested that laparoscopic techniques can significantly reduce length of hospital stay and thus offset the costs generated by longer operating room use and use of disposable instruments.[14] Other studies, however, have failed to demonstrate such benefits.[15, 16]

This study compared results of LARHC and ORHC using a nonrandomized methodology, and we acknowledge the attendant shortcomings. Nevertheless, we believe comparison between the two groups is instructive. The LARHC group consists of consecutive cases, and operations were performed after a significant period of training in endosurgical technique. We, therefore, believe they represent a realistic picture of the procedure in experienced hands. The two groups were well matched but we admit to a selection bias in choosing potential, technically easier patients for laparoscopic procedures. The longer operating room use time for the LARHC group reflects in part the natural concern we had to prevent surgical misadventure. This was borne out by the negligible incidence of operative complications.

This audit demonstrated that LARHC can be performed without apparent clinical disadvantage. What is equally important is that there is no apparent advantage either, especially with respect to postoperative pain, return of gastrointestinal function, and length of stay. It may be argued that we were too liberal in prescribing postoperative narcotic analgesia, and we were too slow in permitting patients to resume oral fluids postoperatively. There have been recent reports to suggest that the traditional view of postoperative care is too conservative,[17] and this may have implications for hospital stay in the future.[18]

It is noteworthy that the length of stay was the same in both groups. This study describes a predominantly elderly group of patients with significant comorbidities. Patient discharge was determined by clinical state, prevalence of comorbidities, and social circumstances. A more aggressive discharge policy may have resulted in a reduced hospital stay, but this would have affected both groups alike.

Previous studies reporting the histopathologic features of laparoscopically resected specimens have not described the method of specimen-handling,[2, 3, 13, 14] which will influence nodal harvest and tumor staging. In this study, a single experienced pathologist was responsible for dissecting all specimens and recording data prospectively using a method that has been standardized in our hospital since 1971. Histopathologic findings and, in particular, lymph node harvest of both groups was similar. The shorter distal margin seen in the LARHC group is not important when one considers that mean clearance for that group was 10 cm. To date there have been no instances of local recurrences or port site recurrences, but the postoperative follow-up is too short to draw meaningful conclusions on survival.

An increasing importance is now placed on containment of costs of surgical practice. The finding in this study of a significant cost disadvantage for LARHC compared with conventional ORHC does not support the view that laparoscopic techniques are currently cost-effective.[14]

Although results of this study are negative, we believe they are informative. Future advances may im-

prove outcome but, at present, these findings suggest that there is no apparent benefit for LARHC in patients with right-sided colon cancer.

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REFERENCES

1. Mouret P. La chirurgie des voies biliaires. In: Testas P, Delaitre B, eds. Chirurgie digestive par voie coelioscopique. Paris: Maloine, 1991:68–9.
2. Tate JJ, Kwok S, Dawson JW, Lau WY, Li AK. Prospective comparison of laparoscopic and conventional anterior resection. Br J Surg 1993;80:1396–8.
3. Falk PM, Beart RW Jr, Wexner SD, *et al.* Laparoscopic colectomy: a critical appraisal. Dis Colon Rectum 1993; 36:28–34.
4. Jacobs M, Verdja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). Surg Laparosc Endosc 1991;1:144–50.
5. Chapuis PH, Pheils MT. Report of a multi disciplinary research programme for colorectal cancer. Anticancer Res 1981;1:15–8.
6. Dripps RD, Lamont A, Eckenhoff JE. The role of anaesthesia in surgical mortality. JAMA 1961;178:261–6.
7. Davis NC, Newland RC. Terminology and classification of colorectal adenocarcinoma: the Australian clinicopathological staging system. Aust N Z J Surg 1983;53: 211–21.
8. Chapuis PH, Newland RC, Dent OF, Bokey EL, Hinder JM. Current perspectives in staging large bowel cancer. Aust N Z J Surg 1990;60:261–5.
9. Hardy KJ, Miller H, McNeil J, Shulkes A. Measurement of surgical costs: a clinical analysis. Aust N Z J Surg 1994;64:607–11.
10. Phillips EH. Laparoscopic colon surgery: who, what, where and when. Semin Colon Rectal Surg 1994;5:218–23.
11. Quattlebaum JK, Flanders HD, Usher CH: Laparoscopically assisted colectomy. Surg Laparosc Endosc 1993;3: 81–7.
12. Monson JR, Darzi A, Carey DP, Guillou PJ. Prospective evaluation of laparoscopic-assisted colectomy in an unselected group of patients. Lancet 1992;340:831–3.
13. Vara-Thorbeck C, Garcia-Caballero M, Salvi M, *et al.* Indications and advantages of laparoscopy-assisted colon resection for carcinoma in elderly patients. Surg Laparosc Endosc 1994;4:110–8.
14. Musser DJ, Boorse RC, Madera F, Reed JF. Laparoscopic colectomy: at what cost? Surg Laparosc Endosc 1994;4:1–5.
15. Wexner SD, Johansen OB, Nogueras JJ, Jagelman DG. Laparoscopic total abdominal colectomy: a prospective trial. Dis Colon Rectum 1992;35:651–5.
16. Wexner SD, Cohen SM, Johansen OB, Nogueras JJ, Jagelman DG. Laparoscopic colorectal surgery: a prospective assessment and current perspective. Br J Surg 1993;80:1602–5.
17. Wexner SD, Reissman P. Laparoscopic colorectal surgery: a provocative critique. Int Surg 1994;79:235–9.
18. Diseases of the heart and blood vessels: nomenclature and criteria for diagnosis. Criteria Committee of the New York Heart Association. 6th ed. Boston: Little, Brown, 1964.