Factors that influence lymph node retrieval in the surgical treatment of colorectal cancer: a comparison of the laparoscopic versus open approach

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Abstract
BACKGROUND: The purpose of this study was to determine whether surgical approach and patient demographics are important factors that influence lymph node retrieval.

METHODS: This was a retrospective review of patients receiving surgical treatment for colorectal cancer at a single institution.

RESULTS: Two hundred three patients underwent resection for colorectal cancer. The total number of lymph nodes recovered and the number of lymph nodes involved were similar in both the laparoscopic group and the open group. Patients who had right-sided colon resection had a higher total number of lymph nodes recovered. There was no effect of age, sex, race, or body mass index (BMI) on the total number of lymph nodes harvested or on the number of positive lymph nodes.

CONCLUSIONS: Adequate regional lymphadenectomy for colorectal cancer can be successfully performed using a laparoscopic approach. Patient demographics did not make a difference in the number of total or positive lymph nodes recovered.

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Background
Adenocarcinoma of the colon and rectum is the third most commonly diagnosed cancer and the third leading cause of cancer death in both men and women in the United States. It is estimated that in 2011 there were 141,210 new cases of colon cancer and 49,380 deaths related to colon cancer. The objective of surgery for colon adenocarcinoma is the removal of the primary cancer with adequate margins, regional lymphadenectomy, and restoration of gastrointestinal tract continuity. The extent of resection is determined by the location of the cancer, its blood supply, and the draining lymphatic system. Although the importance of an adequate lymphadenectomy for colorectal specimens is widely accepted, the absolute number of lymph nodes deemed necessary for an adequate lymphadenectomy has been debated. The College of American Pathologists released a consensus statement in 2000 advising a minimum harvest of 12 lymph nodes, which has subsequently been supported by the American College of Surgeons, the American Association...
of Clinical Oncology, and the National Comprehensive Cancer Network.

The first laparoscopic colon resection was described in 1991. Several randomized controlled trials comparing laparoscopic to open colorectal cancer resections provided evidence that the results of a laparoscopic approach were comparable to those of conventional open resection.1–6 Laparoscopic resection of colorectal cancer results in a shorter hospital stay and similar overall survival and recurrence rates compared with conventional open resection.

The aim of the study was to determine lymph node retrieval comparing laparoscopic to open resection and to assess if patient demographics are important in influencing lymph node retrieval.

Methods

We conducted a retrospective review of patients receiving surgical treatment for colorectal cancer at a single institution from January 2004 to December 2009. All patients who underwent resection for colorectal cancer by open or laparoscopic approaches were included. Data was obtained retrospectively from a prospectively maintained database. Approval from the institutional review board was obtained before data collection and review. Data points included age, sex, race, body mass index (BMI), tumor stage, total number of lymph nodes recovered, number of lymph nodes involved, type of surgical approach, and type of resection performed (right-sided, left-sided, or rectal). The choice of the surgical approach was at the discretion of the surgeon.

Ten surgeons were involved in the study. Two surgeons performed all the laparoscopic colorectal resections. Operative technique using the lateral to medial approach is standardized for open and laparoscopic surgery at our institution. The total number of pathologists involved in the study is unknown. There were no set criteria for performing an open or laparoscopic procedure. We did not compare specimen length or completeness of the mesocolic specimen. Frequency and descriptive statistics were calculated. Associations between the groups and categorical variables were assessed using chi-square analysis. Differences between groups on continuous variables were calculated using the Student t test for independent groups, with P values less than .05 being significant.

Results

During a 6-year period, 203 patients underwent resection for colorectal cancer with 147 open colon resections and 56 laparoscopic colon resections. There was no statistical difference in mean BMI, age, sex, tumor location, and tumor stage between the 2 groups. The total number of lymph nodes recovered in the laparoscopic group was similar to that in the open group (P = .52) (Table 1). The number of lymph nodes that were positive for cancer in the laparoscopic group was similar to that of the open group (P = .27) (Table 1). Patients who had right-sided colon resections had a higher total number of lymph nodes recovered compared with those who had left-sided colon resections (P = .03). The number of lymph nodes involved was not affected by tumor location (P = .43). There was no significant difference in the total number of lymph nodes retrieved (P = .76) or the number of lymph nodes positive for cancer (P = .10) in correlation to tumor stage. Additional subgroup analysis showed no statistical difference in the total number of lymph nodes retrieved and the number of lymph nodes involved between obese (BMI, ≥30 kg/m²) and nonobese (BMI, <30 kg/m²) groups (Table 2). There was no effect of sex or race on the total number of lymph nodes harvested or on the number of positive lymph nodes (Table 2). There was no correlation between age at the time of diagnosis and the total number of lymph nodes harvested (P = .18) or the number of positive lymph nodes (P = .36).

Comments

The number of lymph nodes analyzed for staging colorectal cancers is itself a prognostic variable on outcome.7

| Table 1 Number of lymph nodes by surgery type, tumor location, and tumor stage |
|-----------------|-----------------|-----------------|
| Variable        | Overall         | Total nodes     | Positive lymph nodes |
| Surgical approach: n (%) |                 |                 |                   |
| Laparoscopic    | 56 (27.6)       | 18.13 ± 7.49    | 3.63 ± 2.88       |
| Open            | 147 (72.4)      | 18.16 ± 10.13   | 4.18 ± 3.92       |
| P value         | .52             | .27             |                   |
| Tumor location: n (%) |                 |                 |                   |
| Right side      | 126 (62)        | 19.45 ± 10.33   | 5.74 ± 9.69       |
| Left side       | 57 (28.1)       | 15.60 ± 7.18    | 4.05 ± 3.97       |
| Rectum          | 20 (9.9)        | 17.20 ± 8.0     | 4.90 ± 5.45       |
| P value         | .03             | .43             |                   |
| Tumor stage     |                 |                 |                   |
| Stage 1 or 2    | 17 (10.0)       | 18.0 ± 9.57     | 1.94 ± 1.51       |
| Stage 3         | 122 (60.0)      | 18.54 ± 10.39   | 4.96 ± 9.29       |
| Stage 4         | 61 (30.0)       | 17.44 ± 7.60    | 6.62 ± 6.40       |
| P value         | .76             | .10             |                   |
The College of American Pathologists released a consensus statement in 2000 advising a minimum harvest of 12 lymph nodes. Factors such as age, BMI, tumor location, tumor stage, tumor differentiation, surgeon experience, and type of surgical resection have been shown to affect lymph node retrieval in colorectal cancer resection.8–12

Laparoscopic colorectal cancer resection has gradually gained acceptance since its introduction more than 2 decades ago. Multiple randomized controlled trials comparing laparoscopic to open colorectal cancer resections provided evidence that the results of the laparoscopic approach were comparable to those of the conventional open approach.1–6

Laparoscopic resection of colorectal cancer results in a shorter hospital stay and similar long-term oncologic outcome and quality of life compared with open resection.1–6

Major randomized controlled trials documented total number of lymph nodes retrieved and the number of positive lymph nodes identified.1–6 Galal et al11 reported that lymph node retrieval using the laparoscopic approach (26.1 ± 22.9 nodes) was similar to that of the open surgical approach (25.9 ± 24.6 nodes) \( (P = .88) \). In our study, the total number of lymph nodes retrieved was 18.13 ± 7.5 in the laparoscopic group and 18.16 ± 10.1 in the conventional open group. These results concur with previous recent studies. We also analyzed the number of positive lymph nodes in both the laparoscopic and the open groups and found them to be similar. Although fewer studies have evaluated the number of lymph nodes involved, our study also found no significant differences between involved lymph nodes retrieved through laparoscopic and open approaches.

One factor found to significantly affect lymph node retrieval was tumor location. Bilimoria et al.10 using the National Cancer Data Base, found that patients undergoing a left-sided colectomy for colorectal cancer were less likely to have adequate lymph node retrieval. Baxter et al12 reported a higher number of lymph node retrievals in patients with right-sided colon cancer. Jakub et al10 also reported that lymph node retrieval was affected by the site of the primary tumor. However, in their study they found fewer lymph nodes retrieved from proximal colon tumors than from distal colon primary tumors. In our study, the inferior mesenteric artery was taken in high ligation for all left-sided cases. Patients who underwent right-sided colon resection had a higher total number of lymph nodes recovered than those who underwent left-sided colon resection. However, the number of positive lymph nodes retrieved did not differ significantly with regard to tumor location.

Few studies have evaluated the effect of obesity on the adequacy of lymph node retrieval. These studies concluded that lymph node retrieval is equivalent between obese and non-obese patients. In our study, there was no statistical difference in the total number of lymph nodes retrieved and the number of lymph nodes involved between obese (BMI, \( \geq 30 \text{ kg/m}^2 \)) and nonobese (BMI, \( <30 \text{ kg/m}^2 \)) groups.

Previous studies found that age, sex, and race were factors that affected lymph node recovery in colorectal surgery. Baxter et al.12 through the use of data from the National Cancer Institute’s Surveillance, Epidemiology, and End Results program, found that patients older than 70 years were less likely to receive adequate lymph node evaluation. Some studies found that female sex was a significant independent predicting factor in decreased number of lymph nodes acquired. Our study did not find these factors to significantly influence the total number of lymph nodes recovered or the number of involved lymph nodes found. An adequate number of lymph nodes were recovered regardless of these patient factors. The explanation for this is not totally clear.

### Limitations

Our study did contain several limitations. It was a single-institution community-based study with 2 primary surgeons skilled in laparoscopic oncologic resections. Our findings may not apply to other centers with differing levels of laparoscopic experience. We were also unable to control for possible differing pathologic preparations of our specimen. The retrospective nature of this study also is a limiting factor.

### Conclusions

Adequate regional lymphadenectomy for colorectal cancer can be successfully performed using either a laparoscopic or open approach. Patients with right-sided tumors were found to yield a higher number of lymph nodes in the resected specimen; however, the number of positive lymph nodes did not significantly differ with regard to tumor location. Factors such as patient age, sex, race, BMI, and tumor stage did not make a difference in the number of total or positive lymph nodes recovered.

### References

Can you clarify how many surgeons and pathologists were involved? Were the surgical and pathologic evaluation techniques standardized? What were the criteria for open or laparoscopic surgery? Were factors like recurrent cancer, morbid obesity, and such controlled for in your analysis at all? We heard yesterday from Dr Kondylis’ group about radiation affecting rectal cancer node yields. Did any of your patients with left-sided disease have rectal cancers and had they had preoperative radiation? What about specimen length, and not even so much that the specimen length matters, but perhaps the length of the mesenteric specimen? Was the inferior mesenteric artery taken routinely with high ligation for all of your left-sided cases. Finally, when you’re looking at the mesocolon, which is really important and is now increasingly being realized to affect local recurrence rates after colon cancer surgery as well as rectal cancer surgery, were you able to look at completeness of the mesocolon between your laparoscopic and open groups?

Dr Chichester. To begin with your first question, we had 10 surgeons at our tertiary care institution who were involved in this, in which 2 were involved in the laparoscopic approach. We used the standardized operative approach of lateral to medial resection. As for the pathologists, we did not standardize the pathologic approach or the pathologists who were involved, so that would be something to look into in the future. The criteria for open versus laparoscopic procedures—it was the surgical training and surgical preference, so the 2 surgeons were involved in laparoscopic surgery, and they performed that and the others solely did the open approach. Demographics didn’t play a factor in the 2 approaches. In the question about the rectal resections, there were about 20 rectal resections, and they were all stage III or stage IV cancers, so they did have preoperative radiation before that. Lymph node retrieval actually did not change between that and the others solely did the open approach. About specimen length and mesocolon specimen, actually that wasn’t a factor that we looked at, but, again, it was something that we noticed—that right colon resection did yield a higher amount of tumor, or just lymph nodes in total, versus the ones that were involved. We think that most likely it has something to do with the specimen length that you can get from a right colectomy versus the other resections.

Discussion

Dr Conor P. Delaney (Cleveland, OH). Lymph node evaluation after colon cancer surgery has received a lot of attention, over the past decade particularly. Randomized and comparative studies have conclusively shown that laparoscopic and open surgery fare equally. The number of nodes found is really more dependent on the surgeon and pathologist than on the approach. I think what you bring is a modern update on the outcomes—particularly that it’s in a setting in which patients were offered laparoscopy in a nonrandomized fashion, so it gives an interesting look at the overall cohort in practice.