



Original research

Lymph node retrieval for colorectal cancer: Estimation of the minimum resection length to achieve at least 12 lymph nodes for the pathological analysis



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HIGHLIGHTS

- Adequate lymph node retrieval is important in colorectal cancer staging.
- APR and Hartmann's had significant lower adequate lymph nodes retrievals.
- Additional maneuvers are required to achieve the minimum length of bowel to resect and adequate sampling.

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ABSTRACT

Introduction: Adequate lymph node retrieval is important in colorectal cancer staging for the selection of patients that necessitate adjuvant treatments. The minimum number of 12 lymph nodes is one of the premises and is dependent, among the other factors, from the length of bowel resected. We have reviewed our specimens to identify the high-risk operations for inadequate nodal sampling and estimate the minimum length of bowel needed to resect to achieve this purpose.

Materials and methods: A retrospective review of colorectal specimens over 10 years of activity looking at data including location of the tumor, type of operation performed, length of bowel resected and number of lymph nodes retrieved.

Results: Abdominoperineal and Hartmann's resections produced significant lower adequate retrievals compared to other colorectal operations, corresponding to 45.4% and 59.1% of cases respectively. The measured average length of bowel was 30 cm and 25 cm respectively, increasing the length to 36 cm and 42 cm would increase the adequacy rate to 90%.

Conclusions: Abdominoperineal and Hartmann's resections are, in our series, high-risk operations that frequently do not produce the minimum number of lymph nodes necessary. These operations may require additional maneuvers such as mobilization of the splenic flexure to achieve the minimum length of bowel to resect.

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1. Introduction

Accurate nodal staging is important in colorectal cancer (CRC) for the selection of patients that necessitate adjuvant treatment to treat eventual disseminated microscopic disease. Accuracy increases, among the other factors, with the number of lymph nodes examined and according to the current guidelines a minimum of

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12 is necessary for a reliable estimation [1–3]. Inadequate retrievals have progressively decreased over the years (68% of cases in 1988, 56% in 2001) [4], however they are still present in 25% of patients [5]. Different factors influence the number of nodes retrieved and must be considered when analyzing the performance of a colorectal unit. These may be related to the surgeon's individual operative practice (i.e. a high ligation of vascular pedicles increases the mesenteric volume provided and improves the node clearance) [6–8], the pathologist's accuracy and experience [8–10], the techniques of retrieval used (i.e. chemical fat clearance of the mesentery) [11,12] or patient factors. Whilst the progressive diffusion of the colorectal subspecialty for general surgeons [3,10] and the development of national guidelines for pathologists [13] have progressively standardized practices, patient-related factors still remain an important variable for the adequacy of lymph node retrieval.

Various studies already examined patient factors which may influence nodal sampling. The age [4,8,14–16], sex [4], cancer stage [4,15–17] and tumor mass size [18,19] have sporadically been associated with the number of nodes retrieved; but the length of bowel resected and the type of the operation conducted (or indirectly the tumor location) had a constant association [8,14,17,19], even at multivariate analysis [14,19]. The length of the bowel resected has in fact a direct relationship with the amount of mesentery removed. We have therefore conducted a retrospective analysis of our specimens in order to identify the minimum length of bowel required during the most common colorectal operations and provide the operating surgeon with a simple but practical intraoperative guideline.

2. Materials and Methods

A retrospective study was performed on patients undergoing CRC surgery at the Kettering General Hospital between 2003 and 2012. Excluded were patients that had their colorectal operations conducted for benign diseases (i.e. ulcerative colitis, villous adenomas), and those operations in which the length of bowel resected was not dependent from the surgeon (subtotal colectomy – partial removal of the colon, total colectomy – entire removal of the colon, proctocolectomy – removal of the entire colon and rectum - and panproctocolectomy – removal of entire colon, rectum and anus).

The colorectal unit has a prospectively maintained database that includes basic demographics and clinical data such as age, sex, year of surgery, location of the tumor and type of operation performed. For patients that fit the inclusion criteria the hospital electronic database was searched for the histological reports with data such as the length of bowel resected and number of lymph nodes retrieved gathered. Primary outcome of the study was to evaluate which operations and tumor sites are more at risk of inadequate retrieval of sufficient number of lymph nodes for adequate staging. Secondary outcome was to evaluate the minimum length of bowel to resect for these operations in order to provide an adequate number of lymph nodes. Factors potentially influencing the adequacy of node retrieval were checked such as age, sex, year of operation, surgeon performing the operation, cancer stage and tumor mass size (evaluated using the tumor length, maximum diameter and depth - T parameter of staging). Patients received high ligation of the major vessels.

2.1. Statistical analysis

All data was inserted into an Excel database (Microsoft, Redmond, Washington–United States) and analyzed with the Statistical Package for the Social Sciences Windows version 13.0 (SPSS, Chicago, Illinois, USA). Descriptive statistics used for continuous

parametric variables were the mean, standard deviation and coefficient of variation (standard deviation/mean expressed as percentage) and for categorical variables were frequencies. Normality assumptions were demonstrated with histograms and the Kolmogorov-Smirnov test. Analysis of comparison between groups was conducted with the ANOVA one-way test for continuous parametric variables and Chi-Square test for categorical variables. Factors potentially influencing the adequacy of node retrieval were checked with the Chi-Square test immediately if these were categorical variables (i.e. sex, surgeon) or following transformation into classes if continuous (i.e. age, tumor length). The Receiver Operating Characteristic (ROC) curve was used to determine the best cut-off for the amount of bowel to resect in order to achieve an adequate number of lymph nodes (minimum 12) according to the type of operation performed. For this purpose, patients were divided into two groups according to the adequacy ($n \geq 12$) or inadequacy ($n < 12$) of node retrieval. *P* values less than 0.05 were considered statistically significant.

3. Results

A total of 892 adequate histological reports have been reviewed and included in the study. Excluded were 45 cases of resections conducted for benign diseases, 16 subtotal colectomies, 9 total colectomies and 8 panproctocolectomies. Mean age of included patients was 70 ± 11 years; with 493 (55.3%) males. A total of 622 (69.7%) patients had adequate node sampling with 270 (30.3%) patients found to have inadequate retrieval. The average number of lymph nodes retrieved in both groups were 19 ± 6 and 8 ± 3 respectively.

No significant associations were found between the adequacy of lymph node retrieval and age (Chi-Square test, $p = 0.482$), sex (Chi-Square test, $p = 0.673$), year of operation (Chi-Square test, $p = 0.453$), and surgeon performing the operation (Chi-Square test, $p = 0.416$). However, a significant difference was found with the cancer stage (Chi-Square test, $p = 0.0001$), tumor length (Chi-Square test, $p = 0.0001$) and T staging (Chi-Square test, $p = 0.0001$). In fact, Dukes A and pT1-2 tumors were associated with higher percentages of inadequate retrievals compared to Dukes B-C (48.5% vs. 24.1–27.7%) and T3-4 (46.7%–49.1% vs. 24.7–27.5%). When comparing the patients with adequate vs. inadequate retrievals a significant difference was found for the length of bowel resected (313 ± 187 vs. 274 ± 178 ; ANOVA one-way test $p = 0.004$).

3.1. Analysis according to cancer sites

The distribution of CRCs in the large bowel showed that the rectum was the most affected site followed by the sigmoid colon and cecum (Table 1). Operations conducted for sigmoid cancers produced the greatest variability in the length of bowel resected while those conducted on the hepatic flexure, transverse colon and splenic flexure had the most constant lengths (Table 1). Operations conducted for cancers on the left bowel (rectum, sigmoid and descending) produced higher variability in the number of lymph nodes retrieved than those in the rest of the colon (Table 1). The adequacy of lymph node retrieval was significantly lower for operations conducted for rectal and sigmoid cancers compared to other sites, while those for cancers of the hepatic flexure always produced adequate retrievals (Table 1).

3.2. Analysis according to operation types

The most common operations performed were right hemicolectomies followed by low anterior resections, sigmoid colectomies and abdominoperineal resections (APR) (Table 2). APRs

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