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Original research

Surgical quality in colorectal cancer

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HIGHLIGHTS

- This manuscript documents lymph node resection for colorectal cancer between hospitals in Jamaica.
- Left hemicolectomies and proctectomy specimens were not meeting acceptable standards.
- This has important treatment and prognostic implications.

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ABSTRACT

Objective: To determine the quality of surgical management offered to patients with colorectal cancer (CRC) as measured by adequacy of nodal resections and compare variations across the major hospitals in Jamaica.

Method: Data was obtained from the CRC Registry of patients diagnosed and treated surgically for CRC during the 3-year period commencing January 1, 2011. Variables analyzed included tumor site, stage and number of lymph nodes resected across hospitals.

Results: During the period under review 60% (349) of 586 patients had resections and formed the basis of this study. Of these 49% were treated at the UHWI, 27% from the KPH and STH, 15% from CRH and MRH and 8% from a private laboratory (DPS). Patient distribution was similar at UHWI compared to the others with mean age (61 vs 62) and with slightly more women having surgery (53% Vs 54%) (UHWI vs Others). For tumor grade, margin status, lymphovascular and depth of invasion (majority T3) there was no difference between UHWI and the other sites, although a smaller percentage of tumors treated at UHWI had Crohn's like reaction ($p = 0.01$). There was a larger proportion of sigmoid cancer at UHWI while the reverse trend was seen in cancers of the rectum ($p = 0.027$). The tumors treated at UHWI have a larger median number of regional nodes when compared to the other facilities (14 vs 10; $p < 0.001$) and also more likely to have positive nodes, as were women and younger patients. Comparison across facilities revealed that the proportion of tumors classed as well differentiated, circumferential margin involvement, and having lymphovascular invasion were higher for specimens processed at the private facility ($p = 0.021$, 0.035, 0.01 respectively). Histopathology reports of tumors treated at UHWI and DPS had median 14 and 18 nodes respectively while at NPH laboratory and CRH they were 9 and 10 respectively ($p < 0.001$), whilst those of the ascending, descending, sigmoid colon and rectum had median 15, 11, 13, 11 nodes respectively ($p < 0.001$).

Conclusions: This review demonstrates measurable differences in the surgery and histopathological reports for CRC patients treated across the island. Given adjuvant treatment and prognostic implications there is room for improvement.

1. Introduction

Colorectal cancer (CRC) is the second or third most common cause of cancer related deaths in the Jamaican population and in

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most western countries [1,2]. If presentation is at an early stage it can be cured with surgery only but at a more advanced stage surgery is one aspect of a multimodal approach to effect cure or at least prolong life. Even in metastatic cases there is a central role for surgery in selected cases in effecting cure or improving quality of life. Surgery therefore is essential in managing patients affected with this disease. Offering quality surgery is important in attempting to help CRC patients. The importance of quality surgery is well established with rectal cancer where the surgeon and the institution are important prognostic factors [3,4] and surgeons performing rectal cancer surgery benefit from formal training in total mesorectal excision, and in fact preferably this should be a specialist surgeon [5]. It is also now well established that though the operating surgeon for CRC may not have this specialist training, attention should be paid to ensure a certain quality. A proxy to quality surgery is adequacy of nodal resection [6,7]. Adequate lymph node evaluation is associated with reduced mortality among all patients treated for CRC [7,8]. There however is an important interplay between patient factors, quality of surgical resections and the quality of the pathology assessment.

Previous publication from the region looking at adequacy of resection looked only at the patients treated at University Hospital of the West Indies (UHWI) [9] and reported that patients with left sided cancers were receiving less than adequate surgery as less that 12 nodes being resected. It called for improvement of this quality indicator on both the part of the operating surgeon and the pathology team given the treatment and prognostic importance of nodal status. Several years have since passed since this call for action without the topic being re-evaluated.

The purpose of this study was to re-assess adequacy of nodal resection at the UHWI and to compare this CRC quality indicator to the other hospitals throughout the island including analysis of additional factors that may influence the number of nodes resected.

2. Patients and methods

Data was obtained from the Colon Cancer Registry maintained at the UHWI that uses CnEXT software to prospectively enter all cases of colorectal cancer diagnosed at the UHWI and from the major regional hospitals throughout Jamaica. The UHWI is a 500-bed teaching hospital based on the Mona campus of the University of the West Indies. It is at this site that the postgraduate training of the majority of surgeons currently practicing in Jamaica occurs. The other hospitals are the Kingston Public Hospital with its pathology service being provided by the National Public Health Laboratory (NPHL), Spanish Town Hospital (STH), the Cornwall Regional Hospital (CRH), the Mandeville Regional Hospital (MRH) and two small hospitals whose specimens are processed by the private Diagnostic Pathological Services (DPS). Health care is regionalized in Jamaica and all colorectal resections being undertaken by staff general surgeons. Since 2007 there is a government policy of free health care in Jamaica and all-together these institutions handle more than 90% of all pathological specimens processed and reported in Jamaica. It should be noted that the pathological services of STH are provided by the NPHL whilst that of the MRH is provided by a unit shared with and based at the CRH.

All cases entered during the three-year period January 2011–December 2013 were identified and evaluated for inclusion. Only patients subjected to operative treatment and their histopathology reports entered were included for this report. In addition to nodal status other treatment and prognostic indicators such as tumor margins and lymphovascular invasion were examined. Various characteristics of the tumors were compared across hospitals. Characteristics compared include patient demographics as well as characteristics of the tumor such as site, grade, differentiation and depth of invasion.

3. Statistics

Chi-square tests of association were conducted to compare the distribution of categorical variables across hospitals (see Table 2). Wilcoxon rank sum tests were conducted to compare numerical variables across hospitals (see Table 3). Crude and adjusted risk ratios were calculated as well as crude and adjusted odds ratios comparing indicators of patient care across hospitals (see Tables 4–6).

4. Results

During the three-year period a total of 580 cases were entered into the Registry, but of this 349 were resected specimens and formed the basis of this report. Approximately half (49%) of the tumors were treated at the UHWI while just over a quarter of the patients came from the NPHL but all regional hospitals were represented as was a single Kingston-based private pathology laboratory (see Table 1). The initial analysis compared UHWI and all other facilities as a group (Other) and this showed that distribution of patient sex treated was similar across facilities (UHWI vs. Other) with there being a slightly higher proportion of women treated at each facility 53% & 54 respectively. The distribution of the ages of patients treated was similar across facilities (UHWI vs. Other) with mean age of patients being 61.5 & 62.3 years old respectively. For margin status, degree of differentiation and lymphovascular invasion there was no association between facilities (UHWI vs. Other). A smaller percentage of tumors treated at UHWI had Crohn's like reactions when compared to other facilities ($p = 0.01$). With respect to tumor site there was a larger proportion of tumors located in the sigmoid that were treated at UHWI when compared to other facilities while the reverse trend was seen in tumors located in the rectum ($p = 0.027$) (Table 2a).

Other characteristics examined regional nodes positive and depth invasion did not display any association with facility. The tumors treated at UHWI have a greater median number of regional nodes when compared to the median number of regional nodes examined at other facilities ($p < 0.001$) (Table 2b). However when nodal resection was examined with respect to tumor site only tumors of the right and sigmoid colon had adequate nodal resection ($p < 0.001$) (Table 3).

Comparison was then made with individual facilities. Most tumors seen at the various facilities were moderately differentiated however, 31% of tumors treated at DPS were well differentiated compared to 11% at UHWI, 9% at KPH & STH and 14% at CRH & MRH; $p = 0.021$. The proportion of tumors having involved circumferential margins was higher at DPS when compared to other facilities $p = 0.035$. The proportion of tumors with lymph vascular invasion present was much higher in tumors treated at DPS when compared to other facilities ($p = 0.01$). Tumors treated at CRH & MRH had a much smaller proportion that had a Crohn's like reaction ($p < 0.001$).

Kruskall–Wallis tests were conducted on numeric tumor characteristics in order to compare them across facilities. Tumors treated at DPS had the largest median number of positive regional nodes as well as the largest median number of regional nodes examined. Tumors treated at CRH & MRH had the smallest median depth invasion ($p = 0.0159$).

It was found that patients treated at UHWI were more likely to have positive nodes found ($RR_A = 1.23$; $P < 0.05$), women were more likely than men to have positive nodes found ($RR_A = 1.30$; $P < 0.05$) and tumors located in the rectum were less likely to have positive nodes found when compared to tumors in the right/

Table 1a
Summary of facilities represented in the data for the 3-year period commencing January 2011.

Facility	Number of CRC resections (N)	%
Cornwall Regional Hospital	39	11.2%
Diagnostic Pathological Services	29	8.3%
Mandeville Regional Hospital	14	4.0%
Kingston Public Hospital (NPH)	93	26.5%
Spanish Town Hospital	3	0.9%
University Hospital of the West Indies	171	49.0%
Total	**349**	**100%**

The data for facility was reclassified into 4 groups (Table 1b) and characteristics were compared for this new grouping.

Table 1b
Summary of facility names & grouping of the data.

Facility	N	%
UHWI	171	49.0%
NPH & STH	96	27.5%
DPS	29	8.3%
CRH & MRH	53	15.2%
Total	**349**	**100%**

ascending colon ($RR_A = 0.58$; $P < 0.001$). Patients' odds of having at least 12 modes removed were 3 times higher at UHWI compared to other hospitals ($OR_A = 3.08$; $P < 0.001$). Older patients had slightly reduced odds of having at least 12 nodes removed when compared to younger patients ($OR_A = 0.98$; $P < 0.05$). All tumor sites (left/descending, sigmoid & rectum) had less than half the odds of having at least 12 nodes removed when compared to tumors located in the right/ascending colon ($OR_A = 0.44$, 0.58 & 0.39 resp.; $P < 0.05$).

Table 2a
Comparison of categorical characteristics across hospitals (University Hospital of the West Indies vs. other).

Characteristic	UHWI	Other
Sex (p = 0.748)		
Male	47%	46%
Female	53%	54%
N	171	178
Site* (p = 0.027)		
Right/ascending colon	38%	37%
Left/descending colon	12%	12%
Sigmoid	35%	24%
Rectum	15%	27%
N	165	169
Grade differentiation (p = 0.449)		
Well	11%	16%
Moderate	79%	77%
Poor	10%	7%
N	157	166
Lymph vascular invasion (p = 0.809)		
Present	46%	45%
N	125	85
Crohn's-like reaction* (p = 0.01)		
Present	26%	41%
N	139	114
Margins circumferential (p = 0.662)		
Involved	10%	9%
N	157	138
Margins distal (p = 0.601)		
Involved	0.60%	1.40%
N	162	142
Margins proximal (p = 0.667)		
Involved	1.20%	2.10%
N	162	141

Table 2b
Comparison of numerical characteristics across hospitals (UHWI vs. other).

Characteristic	UHWI	Other
Age (p = 0.548)		
N	167	175
Mean + sd	61.5 + 15.3	62.5 + 15.0
Min	17	13
Max	99	95
Regional nodes positive (p = 0.206)		
N	164	157
Median + iqr	1 + 3	0 + 2
Min	0	0
Max	25	13
Regional nodes examined*** (P < 0.001)		
N	162	156
Median + iqr	14 + 13	10 + 12
Min	2	0
Max	81	65
Depth invasion (P = 0.336)		
N	167	155
Median + iqr	3 + 1	3 + 1
Min	1	1
Max	4	4

Table 3
Summary of regional nodes examined by tumor site.

Characteristic	Right/Ascending	Left/Descending	Sigmoid	Rectum
Regional nodes examined*** (p < 0.001)				
N	116	37	89	63
Median + iqr	15 + 13	11 + 13	13 + 11	11 + 11
Min	0	1	0	0
Max	81	59	38	38

Table 4a
Comparison of select characteristics across facility.

Characteristic	UHWI	NPH & STH	DPS	CRH & MRH
Site (p = 0.164)				
Right/ascending colon	38%	33%	32%	47%
Left/descending colon	12%	13%	16%	8%
Sigmoid colon	35%	25%	28%	20%
Rectum	15%	29%	24%	25%
N	165	93	25	51
Grade differentiation* (p = 0.021)				
Well	11%	9%	31%	14%
Moderate	79%	82%	67%	78%
Poor	10%	9%	2%	8%
N	157	90	27	49
Margins circumferential* (p = 0.035)				
Involved	10%	3%	21%	12%
N	157	72	24	42
Lymph vascular invasion* (p = 0.01)				
Present	46%	50%	83%	30%
N	125	30	12	43
Crohn's-like reaction*** (p < 0.001)				
Yes	26%	68%	63%	8%
N	139	41	24	49

Table 4b
Distribution of select numerical characteristics across faculties.

Characteristic	UHWI	NPH & STH	DPS	CRH & MRH
Regional nodes positive (p = 0.0621)				
N	164	85	25	47
Mean + sd	1 + 3	0 + 1	2 + 5	1 + 4
Min	0	0	0	0
Max	25	13	12	13
Regional nodes examined*** (p < 0.001)				
N	162	84	25	47
Median + iqr	14 + 13	9 + 13	18 + 15	10 + 8
Min	2	0	3	0
Max	81	65	45	59
Depth invasion* (p = 0.0159)				
N	167	84	23	48
Median + iqr	3 + 1	3 + 1	3 + 0	2 + 1
Min	1	1	1	1
Max	4	4	4	4

Table 5
Zero − inflated Poisson regression models displaying crude risk ratios (RR_C) and adjusted risk ratios (RR_A) for the number of regional nodes positive.

Regional nodes positive	RR_C (95% conf. Int.)	RR_A (95% conf. Int.)
Facility		
Other	1.00 [reference]	1.00 [reference]
UHWI	1.23 (1.03–1.46)*	1.26 (1.04–1.49)*
Age	1.00 (0.99–1.00)	1.00 (0.99–1.00)
Sex		
Male	1.00 [reference]	1.00 [reference]
Female	1.15 (0.97–1.36)	1.30 (1.08–1.55)*
Site		
Right/ascending	1.00 [reference]	1.00 [reference]
Left/descending	1.21 (0.92–1.57)	1.20 (0.91–1.57)
Sigmoid	0.88 (0.72–1.09)	0.92 (0.74–1.14)
Rectum	0.59 (0.45–0.76)***	0.58 (0.45–0.74)***

*P < 0.05; ***P < 0.001.

Table 6
Logistic regression models displaying crude odds ratios (OR_C) and adjusted odds ratios (OR_A) for predicting the number of nodes removed (≥12).

Regional nodes examined (≥12)	OR_C (95% conf. Int.)	OR_A (95% conf. Int.)
Facility		
Other	1.00 [reference]	1.00 [reference]
UHWI	3.20 (2.03–4.88)***	3.08 (1.92–4.95)***
Age	0.98 (0.96–0.99)*	0.98 (0.96–0.99)*
Sex		
Male	1.00 [reference]	1.00 [reference]
Female	0.79 (0.52–1.21)	0.77 (0.48–1.24)
Site		
Right/ascending	1.00 [reference]	1.00 [reference]
Left/descending	0.44 (0.21–0.91)*	0.42 (0.19–0.92)*
Sigmoid	0.58 (0.34–0.99)*	0.45 (0.25–0.81)*
Rectum	0.39 (0.21–0.70)*	0.39 (0.21–0.74)*

*P < 0.05; ***P < 0.001.

5. Discussion

Colorectal cancer is an important cause of cancer related morbidity and mortality in our population and surgery has a central role in curing or alleviating the symptoms of those affected. While surgery is one aspect of a multimodal approach to the majority of patients with this disease, its performance is the only hope for cure or any long-term palliation of symptoms. Surgical quality therefore then must be scrutinized in any attempt to optimize affected patients. One marker of surgical quality is the adequacy of nodal resection [7]. The National Quality Forum has endorsed the examination of at least 12 regional nodes as a quality indicator and a means of improving survival from CRC. This is independent of stage of diagnosis, the most important determinant of outcome. Nodal status also helps to determine treatment. Other less reliable prognostic variables such as the degree of differentiation, lymphovascular invasion and Crohn's like reaction may also influence adjuvant treatment or surveillance in individual patients. It should be noted that hospitals with the highest proportion of patients meeting the 12 lymph nodes quality were more likely to have higher volumes of patients and tended to treat lower risk patients, thus limiting the overall value if emphasis is placed only on this intervention [8]. Lymph node status as a quality indicator remains is complex relationship and is not made better by ratios of number of nodes examined to number of positive nodes [9].

To our knowledge this report represents the largest collection of CRC patients and comes from a wide cross-section across the island. The important finding from this study speaks to the adequacy of nodal resection and this is being used as a proxy to the overall quality of care being given to these patients. It has been shown that this is a good marker along the CRC care continuum, that is, patients receiving appropriate nodal resection are also more likely to get adjuvant therapy and post cancer surveillance. They actually live longer [10].

The two important findings to be highlighted from this report are that overall nodal resection is adequate only at PDS and UHWI accounting for just over 50% of cases and even at the UHWI greater attention needs to be place in improving surgical quality for rectal resections. This finding is similar to the previous report by Graham et al. looking only at data from the UHWI [11]. While there is room for improvement it should be remembered that in 2008 although improving, the majority of US hospitals, especially the community hospitals were not meeting this minimum standard in order to improve staging and survival [12,13]. Cancers of the rectum and descending colon are not adequately resected as median number of nodes removed is less than 12 with these cancers. The finding of a minimum number of nodes of zero across all sites is also of concern. Median number of positive nodes, circumferential margin positivity and lymphovascular invasion were highest at DPS and all of statistical significance. It and speaks to the fact that it being a private facility most colectomy specimen received would have been done by staff surgeons and the pathologist there has a special interest and training in gastrointestinal pathology. So here we are seeing the benefits of the best of both worlds. The importance of not just the surgeon and pathologist, but also the treating hospital is also now well acknowledged and the evaluation of a minimum of 12 nodes after colon cancer resection has been adopted as a hospital quality measure [14].

This study has several limitations. Firstly it was retrospective and all the potential cases were not captured with only 60% of the potential cases included during this report. As this report only included patients having resections, it is possible that some of the patients some of the patients not included died prior to resection or had metastatic disease that precluded resections. Patient outcome as measured by survivorship was not analyzed and although this study was not intended to determine patient outcome its inclusion and correlation would enhance this paper. Other factors that may have affected our results such as hospital volume, surgeon and pathologist training and sub-specialization were not analyzed and contributes to the limitations of this study.

Across all facilities the majority of patients had a positive regional node and this highlights the locally advanced nature of CRC seen in our population at presentation. As the total number of nodes analyzed for stage 3 CRC is not a prognostic indicator of cancer-specific and disease-free survival [15], improving surgical quality in our population, albeit necessary, may not have the expected outcome of improving survival from this disease. This has

been the experience in the US [8]. Measures geared towards earlier presentation such as screening and public health campaigns to improve population awareness of the symptoms of the disease are necessary and likely to have a greater impact. Invited preceptorship by experts for rectal cancer resections may also be useful.

Conflict of interest

There are no conflicts of interest to be declared with any of the authors and this work.

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Ethical approval

Ethical approval was obtained from the Faculty of Medical Science Ethics Committee and the Advisory Panel on Ethics and Medico-Legal Affairs in the Ministry of Health: #193.

Consent

Informed consent was obtained from all patients included in this study.

Author contribution

Study concept and design: JM Plummer, PA Leake, J East.

Data Collection: D Feron-Boothe, N Meeks-Aitken.

Data analysis and paper writing: JM Plummer, NP Williams, ME McFarlane.

All authors contributed to and approve of the final version of this manuscript.

Guarantor

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