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ORIGINAL ARTICLE

Multidisciplinary management of colorectal cancer enhances access to multimodal therapy and compliance with National Comprehensive Cancer Network (NCCN) guidelines

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Abstract
Purpose Multidisciplinary teams have become increasingly desirable for managing complex disease but little objective data exist to support this approach. The aim of our study was to determine the impact of a multidisciplinary clinic on the management of colorectal cancer.
Methods Data were prospectively collected on all patients with newly diagnosed colorectal cancer referred to the multidisciplinary clinic at our institution in 2009 and compared to a control group of all patients managed outside the clinic from 2008 to 2009. Comprehensiveness of preoperative evaluation was determined by frequency of abdominal and chest CT, CEA testing, and transrectal ultrasound. Access to multimodal care was measured by frequency of oncology consultation and treatment, advanced pathology testing, genetics counseling, and trial enrollment.
Results Two hundred eighty-eight patients met inclusion criteria; 88 patients were referred to the clinic (40 preoperative, 48 postoperative) and 200 patients were managed outside. Complete preoperative evaluation was accomplished three times more frequently in clinic patients (85 vs. 23 %, $p<0.0001$) with significant improvements in all parameters. Enhanced access to multimodal therapy was demonstrated in clinic patients by increased frequency of oncology consultation (98.9 vs. 61.5 %, $p<0.0001$) and treatment (62.5 vs. 41.5 %, $p=0.02$), advanced pathology testing (29.6 vs. 10.6 %, $p=0.0001$), and genetics counseling (6.8 vs. 1.6 %, $p=0.28$). Clinic patients also received significantly higher rates of neoadjuvant therapy for stage II or greater rectal cancer (82.6 vs. 30.9 %, $p=0.0001$).
Conclusions Multidisciplinary clinic management of colorectal cancer is associated with a significantly more complete preoperative evaluation as well as improved access to multimodal therapy.

Keywords Multidisciplinary · Neoadjuvant · Colon cancer · Rectal cancer · Genetics · Microsatellite instability

Introduction

Colorectal cancer is the second leading cause of cancer-related mortality in USA with over 100,000 new cases diagnosed annually [1]. Numerous studies have demonstrated the importance of accurate staging and combination therapy in achieving an optimal outcome especially for advanced disease [2–5]. How these goals are accomplished, however, varies greatly across institutions and providers of care.

The establishment of a multidisciplinary team (MDT) has become an increasingly popular approach over the last two decades. In this model, patient care is coordinated in a synchronous fashion. Specialists from multiple disciplines are involved in a decision-making process structured around evidence-based treatment [6, 7]. Potential advantages include increased efficiency, improved patient satisfaction and compliance, and an enhanced educational experience for all participants.

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While this approach seems ideal in theory, there is little evidence to support actual benefit. Studies are limited, generally retrospective, and often compare MDT outcomes to historical data [8–13]. Thus it is difficult to differentiate the effects of multidisciplinary management from the numerous advances in diagnostics, surgical technique, and adjuvant therapy which have occurred over the last decade. In addition, most reports describe the recruitment of surgical subspecialists and the adoption of total mesorectal excision (TME) as integral parts of the MDT transition [8, 9, 12–15]. The well-documented benefits of these measures alone on colorectal cancer outcomes [16–21] may overshadow any contributions made by the multidisciplinary management itself. No study has addressed the true influence of the MDT model exclusive of surgeon-related factors and historical bias.

This study evaluates the impact of a newly formed multidisciplinary colorectal tumor clinic at our institution. This clinic was developed in the setting of a well-established colorectal surgery department with all related specialties and resources already in place. Initiation of the clinic did not involve any physician recruitment, change in surgical technique, or construction of new facilities but simply the reorganization of patient care delivery, the addition of a nurse coordinator, and the commitment of all involved to a common goal. We hypothesized that multidisciplinary clinic management would enhance preoperative evaluation and give patients increased access to specialists and multimodal therapy. In turn, these changes would hopefully translate into improved long-term outcomes. All results from the multidisciplinary clinic were compared to data from a historical control group of patients treated within the year prior to the clinic opening. Comparisons were also made to a contemporary control group managed by the same physicians within the hospital but outside the auspices of the clinic.

Materials and methods

Structure of the clinic

The multidisciplinary colorectal tumor clinic was established at William Beaumont Hospital in January 2009. Patients referred to the clinic are first contacted by a dedicated nurse navigator who documents relevant demographic and diagnostic data. Test results are collected and further studies performed if indicated. The patient is then scheduled for an appointment, typically within 1 week from the time of the original referral.

The clinic meets weekly at the hospital and begins with an hour-long tumor board where cases are discussed by the multidisciplinary team. This conference is attended by colorectal surgeons, radiation and medical oncologists, radiologists, pathologists, clinical trials coordinators, physicians-in-training, and a nurse navigator. The tumor board allows the group to review imaging studies, discuss treatment alternatives, and determine trial eligibility, focusing on evidence-based best practice guidelines and implementation strategies for therapy.

Each patient comes to the clinic following the tumor board discussion and has sequential appointments with each specialist. Evaluations are accomplished in one location where a treatment plan is presented and put into action. During the clinic session, the nurse navigator assists the physicians and the patient in scheduling additional consultations and arranging further diagnostic or therapeutic interventions, including surgery, as indicated. Radiologic studies are often performed on the same day as the clinic visit. In addition, patients have access to a social worker, a nutritionist, a clinical trials nurse, enterostomal therapy, and a genetics counselor as needed.

Patient selection

Patients referred to the clinic are entered into a prospectively maintained database which was retrospectively reviewed for cases of newly diagnosed colon, rectal, or anal cancer treated at the clinic during its first year of operation from January to December 2009. Data pertaining to demographics, pathology, preoperative evaluation, and access to multimodal therapy were collected.

For comparison, we conducted a retrospective review of all patients with newly diagnosed disease who were referred to our colorectal surgery department but were not treated at the clinic. These patients were cared for by the same seven colorectal surgeons who managed the clinic patients; however, they were seen in private offices rather than in the multidisciplinary clinic and their cases were not discussed in the tumor board (Fig. 1). This data were gathered 1 year prior to the initiation of the clinic, starting in January of 2008 and continued until December 2009 to include both historical and contemporary control groups.

Preoperative evaluation

The impact of the clinic on preoperative evaluation was determined by comparing data from patients referred to the clinic before surgery to that of patients managed preoperatively outside the clinic. Therefore, the control group in this part of the study included patients who were never referred to the clinic or who were only referred postoperatively.

Parameters were selected according to the 2008 and 2009 National Comprehensive Cancer Network (NCCN) guidelines for evaluating colorectal and anal cancer, which include a preoperative CT of the abdomen and chest, CEA

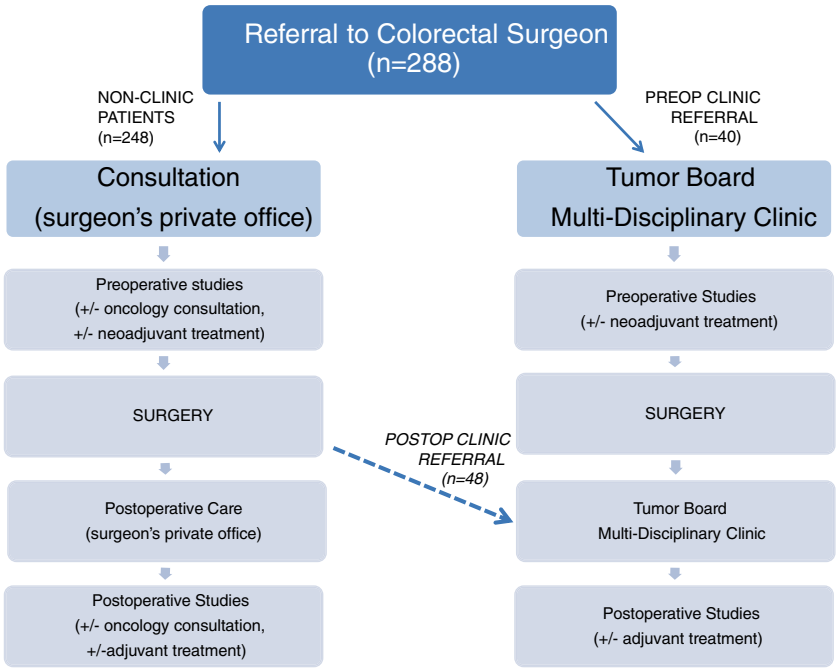

Fig. 1 Patient flow diagram during study period, 2008–2009

testing, and transrectal ultrasound (TRUS) for rectal cancer. The percentage of patients completing each diagnostic test was compared between the two populations.

Access to multimodal therapy

The second part of the study compared patients treated at the clinic either pre- or postoperatively to patients never seen in the clinic at all. Access to multimodal therapy was measured by the frequency of perioperative oncology consultation and treatment, genetic counseling, advanced pathology testing (microsatellite instability analysis), and clinical trials enrollment.

We also performed a subgroup analysis of neoadjuvant therapy rates in rectal cancer. For this comparison, we used the preoperative referral populations from part one of the study.

Statistical analysis

Differences in demographics and outcome data between the study populations were analyzed using the chi-square test or the Fisher's exact test for smaller numbers. Mean ages were compared using the Student t test. A p value of <0.05 was considered statistically significant. The study was approved by the institutional review board at William Beaumont Hospital.

Results

Preoperative evaluation

Forty patients were referred to the clinic preoperatively in 2009 and 248 patients were preoperatively managed outside the clinic from 2008 to 2009. Demographics for the two study populations are listed in Table 1. Overall the clinic group was significantly younger and the proportion of rectal to colon cases was significantly higher in this group. In addition, the number of stage I cancers was significantly lower in the clinic population. There was no significant difference in gender distribution, frequency of stage II–IV cancers, or the number of anal cases. These trends held constant when comparing the clinic patients to the full 2-year control group as well as to the historical (2008) and contemporary (2009) control groups individually.

Preoperative evaluation is summarized in Table 2. By all measures, preoperative testing, as dictated by NCCN guidelines, was completed in a significantly higher proportion of clinic patients compared to controls. These differences are most pronounced when comparing rates of chest CT (95 vs. 37.1 %, $p<0.0001$), CEA testing (100 vs. 63.8 %, $p<0.0001$), and TRUS for rectal cancer (88 vs. 37.7 %, $p<0.0001$). In addition, a complete preoperative work-up was performed in the clinic group over three times more frequently for colon cases and over five times more frequently for rectal cancers when compared to the 2008–2009 control group. All differences remained statistically significant on separate analysis of the 2008 and 2009 control groups as well.

Access to multimodal therapy

A total of 88 patients were pre- or postoperatively referred to the clinic in 2009 and 200 patients received all of their perioperative care outside the clinic from 2008 to 2009 (139 patients in 2008 and 61 patients in 2009). Demographics are

Table 1 Patient characteristics (preoperative evaluation)

	Clinic 2009 (n=40)	Non-clinic 2008–2009 (n=248)	p value	Non-clinic 2008 (n=142)	p value	Non-clinic 2009 (n=106)	p value
Age (years)	61.8±14.2	68.1±14.3	**0.01**	68.2±14.4	**0.01**	68±14.3	**0.02**
Gender (%)			0.44		0.25		0.88
Male	37.5	45.6		49.3		40.6	
Female	62.5	54.4		50.7		59.4	
Stage (%)							
I	10	31.1	**0.01**	28.2	**0.03**	34.9	**0.01**
II	30	23.8	0.51	26.1	0.77	20.8	0.34
III	20	23	0.83	23.2	0.83	22.6	0.9
IV	30	19	0.16	20.4	0.29	17	0.13
Unknown	10	3.2	0.12	2.1	**0.07**	4.7	0.43
Location (%)							
Colon	30	61.7	**0.0003**	62	**0.001**	61.3	**0.001**
Rectum	62.5	34.3	**0.001**	35.2	**0.004**	33	**0.002**
Anus	7.5	3.6	*0.48*	2.8	0.37	4.7	0.8

Bold indicates a statistically significant value

listed in Table 3. Clinic patients were younger than the controls, but there were no significant differences in terms of gender, stage of cancer, or tumor distribution.

Results are summarized in Table 4. Compared to the control groups, clinic patients were more likely to undergo oncology consultation and treatment during their perioperative course. Differences in consultation alone were significant not only when comparing total populations (98.9 vs. 61.5 %, $p<0.0001$), but also for the subgroups of stages I and II disease (100 vs. 25.4 %, $p<0.0001$ and 100 vs. 59.6 %, $p=0.001$, respectively) as well as when stage I cases were excluded from analysis (98.6 vs. 70.8 %, $p<0.0001$). Frequency of perioperative treatment was significantly increased in the total clinic population (62.5 vs. 41.5 %, $p=0.02$) and this remained true when stage I disease was excluded (77.1 vs. 59.1 %, $p=0.002$). Subgroup analysis demonstrated a trend towards increased treatment in clinic patients for each stage but numbers were too small to achieve statistical significance.

Other measures of access to multimodal care included trial enrollment, advanced pathology testing, and genetics consultation. Overall, enrollment in colorectal cancer trials was low during the study period and not significantly different between the clinic and non-clinic groups (3.4 vs. 3.5 %, $p=0.76$). A review of patient records suggested a trend towards increased trial referral in the clinic but this did not reach statistical significance and we were limited in our ability to track this data through the entire study period.

There was a significant difference in the rates of advanced pathology testing. Clinic patients who underwent resection of colorectal adenocarcinomas were more likely to have microsatellite instability (MSI) analysis performed than non-clinic patients (29.6 vs. 10.6 %, $p=0.0001$). This difference existed in comparisons with all three control groups.

Genetic counseling data were not available for 2008 and rates of consultation were low in 2009, but there was a non-

Table 2 Comparison of preoperative evaluation parameters in clinic and non-clinic patients

	Clinic 2009	Non-clinic 2008–2009	p value	Non-clinic 2008	p value	Non-clinic 2009	p value
CT abdomen (%)	97.5	83.1	**0.03**	83.1	**0.04**	83	**0.04**
CT chest (%)	95	37.1	**<0.0001**	28.9	**<0.0001**	48.1	**<0.0001**
CEA (%)	100	63.8	**<0.0001**	65.2	**0.0001**	61	**<0.0001**
TRUS (%) (rectal pts)	88	37.7	**<0.0001**	44	**0.001**	25.7	**<0.0001**
Complete work-up (%)							
Colon	91.7	27.5	**<0.0001**	19.3	**<0.0001**	38.5	**0.002**
Rectum	84	15.3	**<0.0001**	18	**<0.0001**	11.4	**<0.0001**
Anus	66.7	22.2	0.48	25	0.48	20	0.77
Total	85	23	**<0.0001**	19	**<0.0001**	28.3	**<0.0001**

Bold indicates a statistically significant value

Table 3 Patient characteristics (access to multimodal care)

	Clinic 2009 (n=88)	Non-clinic 2008–2009 (n=200)	p value	Non-clinic 2008 (n=139)	p value	Non-clinic 2009 (n=61)	p value
Age (years)	63.6±13.9	69.3±14.4	**0.004**	68.2±14.4	**0.02**	70.3±14.5	**0.03**
Gender (%)			0.24		0.14		0.91
Male	38.6	47		49.6		41	
Female	61.4	53		50.4		59	
Stage (%)							
I	20.5	31.5	0.08	28.1	0.26	39.3	**0.02**
II	26.1	23.5	0.74	26.6	0.94	16.4	0.23
III	25	22	0.68	22.3	0.76	21.3	0.75
IV	21.6	20	0.88	20.9	0.97	18	0.75
Unknown	6.8	3	0.24	2.2	0.16	4.9	0.89
Location (%)							
Colon	51.1	60.5	0.18	63.3	0.09	54.1	0.85
Rectum	43.2	36	0.63	33.8	0.44	41	0.98
Anus	5.7	3.5	0.52	2.9	0.48	4.9	0.87

Bold indicates a statistically significant value

significant trend towards increased access to this specialty in the clinic group (6.8 vs. 1.6 %, p=0.28)

Finally, the frequency of neoadjuvant therapy was evaluated in the subgroup of patients with rectal cancer. Because this parameter is a preoperative intervention, we used the previously defined preoperative referral populations from Table 1 for this analysis. Results are summarized in Table 5. Twenty-five patients with rectal cancer were referred to the clinic preoperatively in 2009 and 85 patients underwent preoperative management outside the clinic from 2008 to 2009. Overall, clinic patients were more than three times as likely to undergo neoadjuvant therapy (76 vs. 20 %, p<0.0001). Results were more pronounced when comparing the clinic patients to the contemporary control group where there was

Table 4 Comparison of access to multimodal care in clinic and non-clinic patients

	Clinic 2009	Non-clinic 2008–2009	p value	Non-clinic 2008	p value	Non-clinic 2009	p value
Oncology consultation (%)							
Stage I	100	25.4	**<0.0001**	28.2	**<0.0001**	20.8	**<0.0001**
Stage II	100	59.6	**0.001**	59.5	**0.001**	60	**0.01**
Stage III	95.5	90.9	0.87	90.3	0.87	92.3	0.71
Stage IV	100	95	0.82	96.6	0.83	90.9	0.78
Unknown	100	16.7	**0.02**	33.3	0.16	0	**0.02**
Total	98.9	61.5	**<0.0001**	64.8	**<0.0001**	54.1	**<0.0001**
Total (excluding stage I)	98.6	70.8	**<0.0001**	69	**<0.0001**	75.7	**<0.0001**
Oncology treatment (%)							
Stage I	5.6	3.2	0.81	5.1	0.57	0	0.06
Stage II	47.8	31.9	0.3	35.1	0.48	20	0.26
Stage III	86.4	77.3	0.58	83.9	0.89	61.5	0.2
Stage IV	100	80	0.09	86.2	0.25	63.6	**0.02**
Unknown	83.3	0	**0.02**	0	0.1	0	0.1
Total	62.5	41.5	**0.02**	47.5	**0.04**	27.9	**0.0001**
Total (excluding stage I)	77.1	59.1	**0.002**	64	0.1	46	**0.002**
Clinical trials enrollment (%)	3.4	3.5	0.76	2.8	0.87	4.9	0.97
Advanced pathology testing (%)	29.6	10.6	**0.0001**	9.8	**0.003**	12.5	**0.02**
Genetics consultation (%)	6.8	–	–	–	–	1.6	0.28

Bold indicates a statistically significant value

Table 5 Comparison of neoadjuvant therapy rates in rectal cancer patients

Stage (%)	Clinic 2009 (n=25)	Non-clinic 2008–2009 (n=85)	p value	Non-clinic 2008 (n=50)	p value	Non-clinic 2009 (n=35)	p value
I	0	0	NA	0	NA	0	NA
II	87.5	31.3	**0.03**	44.4	0.18	14.3	**0.03**
III	87.5	23.8	**0.003**	35.7	**0.05**	0	**0.001**
IV	60	50	1	50	0.99	50	1
Unknown	100	0	0.33	0	NS	0	0.33
Total	76	20	**<0.0001**	26	**0.0001**	11.4	**<0.0001**
Total (excluding stage I)	82.6	30.9	**0.0001**	39.4	**0.003**	18.2	**0.0001**

Bold indicates a statistically significant value

a sevenfold increase in treatment (76 vs. 11.4 %, $p<0.0001$). In addition, there was a significant difference for stage II or greater disease (82.6 vs. 30.9 %, $p=0.0001$) as well as for stage II and stage III subgroups (87.5 vs. 31.3 %, $p=0.03$ and 87.5 vs. 23.8 %, $p=0.003$).

Discussion

Multidisciplinary teams are gaining increased prominence in the management of complex diseases which require coordination of multiple specialists and treatment modalities. Advantages of this approach have been heralded in centers across the USA and abroad for a wide spectrum of illnesses ranging from pediatric nephropathy [22] to esophageal cancer [23]. Studies have reported greater patient satisfaction [7], changes in management [10, 11, 24], improved staging [23, 25], increased resident operative experience [26], and even enhanced survival [10, 11, 15, 23, 25–28].

Colorectal cancer is also increasingly managed in a multidisciplinary fashion as diagnostic technologies expand and the importance of carefully timed multimodality therapy is recognized. Preliminary literature has demonstrated some benefits to this approach but studies are mainly retrospective with varied quality and design. One of the largest reports found improved survival in 22 of 24 malignancies after establishing a multidisciplinary center [15]. Results for colorectal cancer reached statistical significance when analyzed against an external contemporary control group. In addition to specialist recruitment and expanded resources, the authors attributed these findings to earlier detection and increased application of multimodal therapy. Smedh et al. [12] and Khani et al. [9] demonstrated improved survival with reduced recurrence rates at a Swedish facility which centralized care to a few trained colorectal surgeons, adopting routine TME and employing an MDT approach. The Debakey VA Medical Center used a similar design to evaluate the impact of MDT care on surrogate markers of surgical quality and reported improvements in lymph node harvest, margin-negative resections, and use of neoadjuvant therapy [13]. As with the other studies, these changes coincided with specialist recruitment and the widespread use of TME.

It is well-established that surgery by a trained specialist results in improved outcomes, especially for rectal cancer [16, 19–21]. In addition, TME has become the standard for reducing recurrence and improving survival [17, 18]. Therefore, it is difficult to discern whether the benefits of a MDT cited in previous literature derive from the multidisciplinary model itself or from the known advantages of these two interventions alone. Our study reports the impact of a multidisciplinary clinic independent of surgeon-related factors or specialist recruitment. Patients from both clinic and non-clinic groups were managed by the same seven colorectal surgeons and exposed to the same oncology and ancillary resources available within the institution. The only difference was in the structure of clinical decision-making, care delivery, and follow-up.

We found that multidisciplinary management led to a more comprehensive preoperative evaluation and improved access to multimodality therapy. In the first part of the study, preoperative work-up was evaluated based on NCCN guidelines which recommend CT scanning, CEA testing, and TRUS for rectal cancer. By all measured parameters, a substantially higher level of compliance with this national protocol was seen with clinic management when comparing to both historical and contemporary controls. While differences between the clinic and non-clinic populations existed in terms of age, staging, and tumor distribution, the guidelines for preoperative testing were the same. In addition, when tumors were stratified by location, complete preoperative evaluation increased threefold for colon cancer and fivefold for rectal cancer.

Access to multimodality care was measured by frequency of oncology consultation and treatment, trial enrollment, advanced pathology testing, and genetic counseling. In this part of the study, clinic patients were younger than controls

but no other significant demographic or tumor disparities existed between the two groups. Overall clinic patients were more likely to undergo oncology consultation and treatment. This difference was statistically significant when the total populations were compared and persisted when stage I patients were excluded from analysis. In addition, consultation rates were significantly increased in stage I and stage II patients and trends towards increased treatment existed in all staging subgroups. While these differences might be a reflection of a younger clinic population, advanced age is not a contraindication to therapy nor a barrier to oncology consultation [3, 4]. Overall our results are similar to those of Forrest et al. [27], who also reported increased adjuvant therapy rates after the introduction of a MDT, and highlight the value of collaboration and centralized specialty care in affecting treatment decisions.

Efficient identification of patient eligibility for clinical trials is a key element of the multidisciplinary model [6]. Our clinic did not have any effect on trial enrollment despite a preliminary review indicating a trend towards increased referrals. Both measures will be important to track for future studies, as we strive to deliver the most current evidence-based treatment options.

Approximately 10–15 % of colorectal cancers have a familial origin. Lynch syndrome accounts for 2–4 %, making genetic risk stratification a vital component of disease management [29]. The Amsterdam criteria and revised Bethesda guidelines are useful clinical tools for identifying high-risk individuals [30], but many argue that sensitivities are too low and molecular tumor testing should substitute as the universal screening tool [29, 31–34]. To investigate the prevalence of familial risk stratification, we compared the frequency of MSI testing and genetic counseling in the clinic and non-clinic populations. A statistically significant increase in molecular testing was found in clinic patients compared to controls. A trend towards increased genetics consultation in 2009 was also identified in the clinic group. Again these findings may be partly related to a younger age population in the clinic, but we feel that these results also reflect a more comprehensive evaluation with improved specialist access provided by the multidisciplinary model.

Subgroup analysis of neoadjuvant therapy rates in rectal cancer found a substantial difference between groups. Over three times as many clinic patients underwent treatment compared to the total control population and over seven times compared to the contemporary control group. Neoadjuvant therapy has resulted in lower recurrence rates [35] and improved disease-free survival [36] in large randomized trials. We believe that these increased treatment rates are a direct result of the more frequently completed preoperative evaluations in the clinic, further highlighting the importance of multidisciplinary management in optimizing outcomes.

This study has a number of limitations including small cohort size and retrospective design. Although information on the clinic patients was collected prospectively, control data were dependent on the accuracy of medical records. The use of historical comparisons comes with inherent biases as current results may be affected by technological advances and new evidence-based protocols rather than the intervention itself. We attempted to decrease this bias found in most MDT studies by including a contemporary control group. Results were similar across both historical and contemporary controls. Confounding factors from previous studies, such as advances in surgical technique and differences in specialist involvement, were limited by restricting analysis to a single colorectal department with consistent resources throughout our study period.

Despite these measures, significant differences in patient and tumor characteristics persisted between the clinic and non-clinic populations. Selection bias was inevitable as patients were referred to the clinic through physician preference rather than by random allocation. In addition, increased comorbidities or prolonged hospital courses may have limited certain patients from presenting to the clinic or partaking in advantages of multimodal therapy. However, patients with all levels of disease severity were eligible for inclusion in the clinic population if a referral was made and information recorded by the nurse navigator. Moreover data were stratified by tumor location and stage prior to statistical comparison.

Overall, our results indicate that multidisciplinary management was associated with improved adherence to national guidelines, as well as increased resource utilization and specialist referral. Whether these trends were cost effective or beneficial was beyond the scope of our analysis. However we are hopeful that, with increased patient accrual and longer follow-up, we will be able to demonstrate superior outcomes. Comprehensive multidisciplinary care requires a significant commitment of human and monetary resources and, therefore, remains largely unpracticed outside of major urban and academic centers. Our findings contribute to the growing body of evidence suggesting that, despite such obstacles, this reality must change.

Conclusion

In summary, this study demonstrated that multidisciplinary management of colorectal cancer was associated with a more comprehensive, NCCN-compliant preoperative evaluation as well as improved access to multimodal therapy as evidenced by increased rates of specialist consultation, adjuvant and neoadjuvant therapies, and advanced pathology testing. Longer follow-up is necessary to determine whether these findings will translate into meaningful improvements in outcome.

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References

1. American Cancer Society Website. Available at http://www.cancer.org/cancer/ colonandrectumcancer/detailedguide/colorectal-cancer-key-statistics. Accessed 19 Nov 2010
2. Mitry E, Fields ALA, Bleiberg H et al (2008) Adjuvant chemotherapy after potentially curative resection of metastases from colorectal cancer: a pooled analysis of two randomized trials. J Clin Oncol 26:4906–4911
3. Sargent DJ, Goldberg RM, Jacobson SD et al (2001) A pooled analysis of adjuvant chemotherapy for resected colon cancer in elderly patients. N Engl J Med 345:1091–1097
4. Sargent D, Sobrero A, Grothey A et al (2009) Evidence for cure by adjuvant therapy in colon cancer: observations based on individual patient data from 20,898 patients on 18 randomized trials. J Clin Oncol 27:872–877
5. Wong RKS, Tandan V, De Silva S, Figueredo A (2007) Preoperative radiotherapy and curative surgery for the management of localized rectal carcinoma. Cochrane Database Syst Rev 2: CD002102
6. Fleissig A, Jenkins V, Catt S, Fallowfield L (2006) Multidisciplinary teams in cancer care: are they effective in the UK? Lancet Oncol 7:935–943
7. Valicenti RK, Gomella LG, El-Gabry EA et al (2000) The multidisciplinary clinic approach to prostate cancer counseling and treatment. Semin Urol Oncol 18:188–191
8. Garcia-Granero E, Marti-Obiol R, Gomez-Barbadillo J et al (2001) Impact of surgeon organization and specialization in rectal cancer outcome. Colorectal Dis 3:179–194
9. Khani MH, Smedh K (2010) Centralization of rectal cancer surgery improves long-term survival. Colorectal Dis 12:874–879
10. Morris E, Haward RA, Gilthorpe MS, Craigs C, Forman D (2008) The impact of the Calman–Hine report on the processes and outcomes of care for Yorkshire's breast cancer patients. Ann Oncol 19:284–291
11. Morris E, Haward RA, Gilthorpe MS, Craigs C, Forman D (2006) The impact of the Calman–Hine report on the processes and outcomes of care for Yorkshire's colorectal cancer patients. Br J Cancer 95:979–985
12. Smedh K, Olsson L, Johansson H, Aberg C, Andersson M (2001) Reduction of postoperative morbidity and mortality in patients with rectal cancer following the introduction of a colorectal unit. Br J Surg 88:273–277
13. Wilks JA, Liebig C, Tasleem SH et al (2009) Rectal cancer patients benefit from implementation of a dedicated colorectal cancer center in a Veterans affairs medical center. Am J Surg 198:100–104
14. Dahlberg M, Glimelius B, Pahlman L (1999) Changing strategy for rectal cancer is associated with improved outcome. Br J Surg 86:379–384
15. Dillman RO, Chico SD (2005) Cancer patient survival improvement is correlated with the opening of a community cancer center: comparisons with intramural and extramural benchmarks. J Oncol Pract 1:84–92
16. Bokey EL, Chapuis PH, Dent OF, Newland RC, Koorey SG, Zelas PJ, Stewart PJ (1997) Factors affecting survival after excision of the rectum for cancer: a multivariate analysis. Dis Colon Rectum 40:3–10
17. Aitken RJ (1996) Mesorectal excision for rectal cancer. Br J Surg 83:214–216
18. Enker WE, Thaler HT, Cranor ML, Polyak T (1995) Total mesorectal excision in the operative treatment of carcinoma of the rectum. J Am Coll Surg 181:335–346
19. Holm T, Johansson H, Cedermark B, Ekelund G, Rutqvist LE (1997) Influence of hospital- and surgeon-related factors on outcome after treatment of rectal cancer with or without preoperative radiotherapy. Br J Surg 84:657–663
20. Porter GA, Soskolne CL, Yakimets WW, Newman SC (1998) Surgeon-related factors and outcome in rectal cancer. Ann Surg 227:157–167
21. Read TE, Myerson RJ, Fleshman JW et al (2002) Surgeon specialty is associated with outcome in rectal cancer treatment. Dis Colon Rectum 45:904–914
22. Menon S, Valentini RP, Kapur G, Layfield S, Mattoo TK (2009) Effectiveness of a multidisciplinary clinic in managing children with chronic kidney disease. Clin J Am Soc Nephrol 4:1170–1175
23. Branagan G, Davies N (2004) Early impact of centralization of oesophageal cancer surgery services. Br J Surg 91:1630–1632
24. Newman EA, Guest AB, Helvie MA et al (2006) Changes in surgical management resulting from case review at a breast cancer multidisciplinary tumor board. Cancer 107:2346–2351
25. Stephens MR, Lewis WG, Brewster AE et al (2006) Multidisciplinary team management is associated with improved outcomes after surgery for esophageal cancer. Dis Esophagus 19:164–171
26. Granger SR, Glasgow RE, Battaglia J et al (2005) Development of a dedicated hepatopancreaticobiliary program in a university hospital system. J Gastrointest Surg 9:891–895
27. Forrest LM, McMillan DC, McArdle CS, Dunlop DJ (2005) An evaluation of the impact of a multidisciplinary team, in a single centre, on treatment and survival in patients with inoperable non-small-cell lung cancer. Br J Cancer 93:977–978
28. Junor EJ, Hole DJ, Gillis CR (1994) Management of ovarian cancer: referral to a multidisciplinary team matters. Br J Cancer 70:363–370
29. Vasen HF, Moslein G, Alonso A et al (2010) Recommendations to improve identification of hereditary and familial colorectal cancer in Europe. Fam Cancer 9:109–115
30. Rodriguez-Moranta F, Castells A, Andreu M et al (2006) Clinical performance of original and revised Bethesda guidelines for the identification of MSH2/MLH1 gene carriers in patients with newly diagnosed colorectal cancer: proposal of a new and simpler set of recommendations. Am J Gastroenterol 101:1104–1111
31. Julie C, Tresallet C, Brouquet A et al (2008) Identification in daily practice of patients with Lynch syndrome (hereditary non-polyposis colorectal cancer): revised Bethesda guidelines-based approach versus molecular screening. Am J Gastroenterol 103:2825–2835
32. Southey MC, Jenkins MA, Mead L et al (2005) Use of molecular tumor characteristics to prioritize mismatch repair gene testing in early-onset colorectal cancer. J Clin Oncol 23:6524–6532
33. Terdiman JP, Gum JR Jr, Conrad PG et al (2001) Efficient detection of hereditary nonpolyposis colorectal cancer gene carriers by screening for tumor microsatellite instability before germline genetic testing. Gastroenterology 120:21–30
34. Trano G, Sjursen W, Wasmuth HH, Hofsli E, Vatten LJ (2010) Performance of clinical guidelines compared with molecular tumour screening methods in identifying possible Lynch syndrome among colorectal cancer patients: a Norwegian population-based study. Br J Cancer 102:482–488
35. Sauer R, Becker H, Hohenberger W et al (2004) Preoperative versus postoperative chemoradiotherapy for rectal cancer. N Engl J Med 351:1731
36. Roh MS, Colangelo LH, O'Connell MJ et al (2009) Preoperative multimodality therapy improves disease-free survival in patients with carcinoma of the rectum: NSABP R-03. J Clin Oncol 27:5124–5130