

Preferential use of imaging modalities in staging newly diagnosed rectal cancer: a survey of US radiation oncologists

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Background: Accurate staging is crucial for management of patients with newly diagnosed rectal cancer. Endorectal ultrasound (EUS) has been the standard modality in the United States for decades, with magnetic resonance imaging (MRI) now preferred by national guidelines. Positron emission tomography (PET), conversely, is not recommended. The current utilization of imaging modalities by American radiation oncologists in staging newly diagnosed rectal cancer is unknown.

Methods: American radiation oncologists completed an anonymous institutional review board-approved online survey probing their imaging preferences for initial staging of rectal cancer patients.

Results: We received 220 responses from American radiation oncologists, with 39% in academic centers and with 45% seeing more than 10 rectal cancer patients per year. Most respondents utilize all three imaging modalities for rectal cancer staging—EUS, MRI and positron emission tomography/computed tomography (PET/CT). Fifty-two percent and 38% of respondents are high utilizers of EUS and MRI, respectively, defined as ordering these tests at least 75% of the time. Forty seven percent were high PET utilizers. The latter was associated with practice in a private setting ($P=0.015$) and being within 10 years from residency training completion ($P<0.01$).

Conclusions: Our analysis reveals a dramatic discordance among national guidelines and the practice patterns among American radiation oncologists. More rely on PET for initial staging of rectal cancer patients than on pelvic MRI. Further research needs to determine the most effective imaging work-up of patients with an initial diagnosis of rectal cancer.

Keywords: Rectal neoplasm; neoplasm staging; magnetic resonance imaging (MRI); positive emission topography computed topography (PET/CT); radiation oncologists

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Introduction

Colorectal cancer is the second leading cause of cancer death in the United States (1) and the fourth most frequently diagnosed cancer, with rectal cancer representing 40–50% of cases (2). Annually, approximately 39,910 patients are newly diagnosed with rectal cancer in the United States (3).

Death from colorectal cancer has decreased 35% from 1990 to 2007 due to earlier diagnoses through screening and better treatment modalities (4).

Up until 2003, endorectal ultrasound (EUS) was the only standard imaging modality recommended for staging rectal cancer (5), with sensitivity and specificity of 94%

and 86%, respectively. More recently, pelvic magnetic resonance imaging (MRI) became widely used, as it has similar sensitivity and specificity to EUS (at 94% and 69%, respectively), but has an important advantage in being able to evaluate iliac lymph nodes and can accurately assess the circumferential resection margin (CRM), which is key in planning surgery and in some countries informs the choice of neoadjuvant therapy (6). CRM status by MRI evaluation is also prognostic. Based on the results of the MERCURY trial patients with negative CRM by MRI had a 5-year OS of 62.2% compared with 42.2% in patients with positive CRM (7). The current National Comprehensive Cancer Network (NCCN) guidelines recommend pelvic MRI with contrast for rectal cancer staging at diagnosis. At the same time, these guidelines discourage providers from using positron emission tomography/computed tomography (PET/CT) scans in this clinical setting. Literature investigating the sensitivity and specificity of PET is scant, however van Cutsem *et al.* states specificity of PET is limited due to the recognized increased intake of FDG yielding false positives (8).

The current utilization of imaging modalities for staging of newly diagnosed rectal cancer in the US by radiation oncologists is not known.

Methods

Survey instrument development and data collection

We designed an online closed survey using REDCap software licensed by the Oregon Clinical and Translational Research Institute (OCTRI). The study was approved by the institutional IRB and was tested for functionality before launch. Participants were notified the length of time to complete the survey, that it was anonymous, and the purpose of the study. The survey consisted of 14 questions pertaining to respondents' demographics and use of imaging modalities. The online survey was sent anonymously with the internet-based REDCap data collecting software to 6,949 currently practicing potential participants. Email invitations were sent on November 16th and 17th of 2016 and a single reminder email was sent on November 30th, 2016.

Statistical analysis

Respondent characteristics (years in practice, practice setting, region of practice, number of rectal patients treated

per year) were tested for association with respondents' self-assessed utilization of imaging modalities—EUS, pelvic MRI and PET/CT—using Chi-squared test. A P value of less than 0.05 was defined as statistically significant. The reported percent of imaging utilized among all respondents using a specific modality for staging their rectal cancer patients is defined as median frequency. Staging 75% or more of rectal cancer patients with a given imaging modality was defined as high utilization.

Results

Respondent characteristics

Of the 6,949 potential participants, we received 337 failed/undelivered automatic responses, 7 non-applicable/ineligible responses and 220 completed responses. The characteristics of these 220 individuals are summarized in *Table 1*. Sixty one percent of respondents practice over 10 years since completion of residency program, and 61% work in private practice. Fifty five percent treat 10 or fewer patients with rectal cancer per year.

Use of imaging modalities

EUS was the most common imaging modality used by respondents, with the median utilization frequency of 75%. This was followed by PET/CT at 60% and pelvic MRI at 50% median utilization frequencies (*Table 2*). *Figure 1* shows the overlap of high utilizers, with 9.5% of respondents classified as high utilizers of all three modalities. Thirty eight percent of respondents are high utilizers of MRI, while 52% are high utilizers of EUS (*Table 2*). Forty seven percent are high PET utilizers (*Table 2*). Of those, 27% solely use PET/CT in staging newly diagnosed rectal cancer.

Table 3 shows association between respondent characteristics and their use of imaging modalities. Fifty two percent of respondents self-identified as high utilizers of EUS. These respondents were more likely to have 10 or more years of professional experience. In particular, 62% of those with 10 or more years of experience are high utilizers of EUS as compared with 37% of those with less than 10 years experience ($P < 0.0001$).

Forty seven percent of respondents were classified as high utilizers of PET/CT. Among these respondents, 31.0% of those who practiced 10 or fewer years self-identified as high utilizers, compared to 57% of those with more than

Table 1 Characteristics of radiation oncologists who completed the survey

Respondent characteristics	Number of respondents, n (%)
Number of years after completion of residency training	
Currently in residency training	9 [4]
1–5	42 [19]
6–10	36 [16]
>10	133 [61]
Number of rectal cancer patients evaluated over the past 12 months*	
0	3 [1]
1–5	45 [21]
6–10	73 [33]
>10	98 [45]
Practice setting	
Academic center	85 [39]
Private practice	135 [61]
Practice region*	
Northern	34 [16]
Pacific	49 [22]
Southern	42 [19]
Western	51 [23]
Central	40 [18]
Outside US	3 [1]

*, one respondent failed to answer demographic questions concerning number of patients seen annually and region of practice.

Table 2 The median frequency and interquartile range for utilization of all three imaging modalities

Imaging	Median frequency, [IQR]	Respondents classified as high utilizers
EUS	75% [30–90%]	52% (n=114)
Pelvic MRI	50% [18.75–80%]	38% (n=83)
PET/CT	60% [20–90%]	47% (n=103)

IQR, interquartile range; EUS, endorectal ultrasound; MRI, magnetic resonance imaging; PET/CT, positron emission tomography/computed tomography.

10 years' experience ($P < 0.0001$). Thirty seven percent of academics self-identified as high utilizers, compared with 53% of those in private practice ($P = 0.015$).

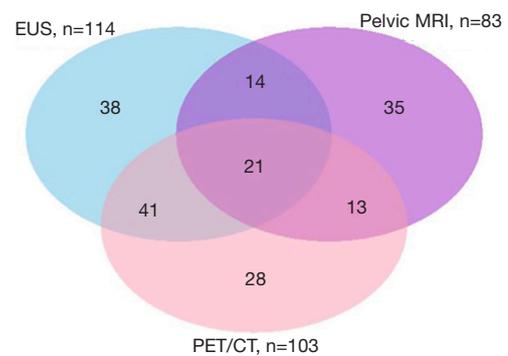


Figure 1 Venn diagram of imaging modalities for staging of newly diagnosed rectal cancer (n = # of respondents who utilize an imaging modality in at least 75% of patients). Light blue: EUS; purple: pelvic MRI; pink: PET/CT. EUS, endorectal ultrasound; MRI, magnetic resonance imaging; PET/CT, positron emission tomography/computed tomography.

Thirty eight percent of respondents are classified as high utilizers of pelvic MRI. Only 31.0% of those who practiced 10 or more years self-identified as high utilizers of pelvic MRI, compared to 47% of those with less than 10 years' experience ($P = 0.02$). Forty six percent of academics self-identified as high utilizers, compared with 33% of those in private practice ($P = 0.05$).

Five percent of respondents report zero EUS utilization. Another 5% of respondents do not use pelvic MRI and 7% report no utilization of PET/CT during patient evaluation.

Conclusions

Accurate staging of patients with newly diagnosed rectal cancer is essential for defining the treatment strategy and counseling patients regarding the expected outcomes. EUS and pelvic MRI have similar sensitivities (94%), yet EUS has higher specificity (86%) than MRI (69%) in assessing local tumor invasion (4). However, MRI can evaluate iliac, mesenteric or retroperitoneal nodes as well as the CRM involvement. At the present time, there is no indication for PET/CT use in evaluation of patients with rectal cancer (1).

Our results show EUS continues to be the most frequent imaging modality, despite current NCCN recommendations that support MRI over EUS. One possible explanation for this discordance is the prevalent difference in experiences among treating physicians. Whereas EUS has been used in rectal cancer staging for decades, MRI is still a relatively new imaging modality. This explanation is in part supported by our observation that respondents who have been

Table 3 Demographic characteristics among high and low utilizers of imaging modalities

Respondent characteristics	EUS			Pelvic MRI			PET/CT		
	Low utilizer, n [%]	High utilizer, n [%]	P value	Low utilizer, n [%]	High utilizer, n [%]	P value	Low utilizer, n [%]	High utilizer, n [%]	P value
Practice setting			0.631			0.048			0.015*
Academic	42 [50.0]	42 [50.0]		46 [54.1]	39 [45.9]		54 [63.5]	31 [36.5]	
Private practice	63 [46.7]	72 [53.3]		91 [67.4]	44 [32.6]		63 [46.7]	72 [53.3]	
Practice region			0.194			0.434			0.007*
Central	14 [35.0]	26 [65.0]		28 [70.0]	12 [30.0]		24 [60.0]	16 [40.0]	
Northern	16 [47.1]	18 [52.9]		19 [55.9]	15 [44.1]		12 [35.3]	22 [64.7]	
Pacific	26 [53.1]	23 [46.9]		35 [71.4]	14 [28.6]		25 [51.0]	24 [49.0]	
Southern	16 [39.0]	25 [61.0]		24 [57.1]	18 [42.9]		17 [40.5]	25 [59.5]	
Western	29 [56.9]	22 [43.1]		31 [60.8]	20 [39.2]		36 [70.6]	15 [29.4]	
Not US	3 [100.0]	0 [0]		0 [0.0]	3 [100.0]		2 [66.7]	1 [33.3]	
Years post residency			<0.0001			0.020			<0.0001*
10 or fewer years	54 [62.8]	32 [37.2]		46 [52.9]	41 [47.1]		60 [69.0]	27 [31.0]	
>10 years	51 [38.3]	82 [61.7]		91 [68.4]	42 [31.6]		57 [42.9]	76 [57.1]	
Number rectal cancer patients evaluated over a year			0.310			0.136			0.321
10 or fewer patients	62 [51.2]	59 [48.8]		81 [66.9]	40 [33.1]		61 [50.4]	60 [49.6]	
>10 patients	43 [44.3]	54 [55.7]		56 [57.1]	42 [42.9]		56 [57.1]	42 [42.9]	

*, P values indicate statistical significance. EUS, endorectal ultrasound; MRI, magnetic resonance imaging; PET/CT, positron emission tomography/computed tomography.

practicing for more than 10 years post-residency were more likely to rely on EUS than pelvic MRI. Of the respondents practicing more than 10 years post-residency, 61.7% were high EUS utilizers, compared with 31.6% high utilizers of pelvic MRI.

Future studies need to revisit how EUS over MRI utilization affect patient outcomes, and with time we anticipate that MRI utilization will continue to increase. This will become increasingly more important, given the emergence of new nodal contrast agents such as ultrasmall paramagnetic iron oxide (USPIO), which has been shown to increase sensitivity of detecting lymph nodes involved with malignant cells (9). As treatment personalization supplants standard one-size-fits-all guidelines, detailed information on CRM status, tumor vascularity, involvement of perirectal and lateral pelvic lymph nodes will become paramount to optimal treatment modality and sequence selection.

Of a greater concern is our finding PET/CT—the imaging modality not supported by clinical evidence—is used more frequently than pelvic MRI, especially by those further out from their residency training. PET/CT imaging is currently reimbursed by Medicare and most private insurances in the initial treatment planning and subsequent treatments for almost all solid cancers, including colorectal cancer (10). This financial incentive could be the potential culprit for inappropriate utilization of this imaging technology. Another explanation could be physicians are simply unaware of the NCCN guidelines. Comfort level of each physician could be an alternative explanation. It will be of interest to compare the rate of PET/CT utilization in other countries that do not cover PET imaging in management of rectal cancer. Further policy work and cost analysis need to shed light on the current US practice of over-utilization of PET imaging in rectal and other solid tumor malignancies, such as prostate, bladder and liver malignancies.

Finally, as evidenced from *Figure 1*, many clinicians order more than one imaging modality for an individual patient with a newly diagnosed rectal cancer. Whether or not ordering supplementary tests improves staging precision or treatment outcomes, and not simply escalating overall treatment costs, needs to be elucidated.

One of the greatest limitations of our study is the limited sample size of 220 completed responses. It is possible that the results were skewed by selection bias. A reimbursement-based national database analysis should be conducted to support or refute our survey findings. However, due to the delay in reporting captured clinical data, this analysis

could take several years to pilot in order to determine retrospectively the true rate of imaging modalities utilization in the US in the year corresponding to the timing of our survey of late 2016.

In conclusion, there is a dramatic divide between national guidelines and the utilization of imaging modalities for initial staging of patients with rectal cancer in the United States. The most cost effective modality needs to be determined through further studies and its use enforced by policy and reimbursement changes.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study was approved by institutional review board of Oregon Health and Science University (IRB protocol 11149), and the requirement to obtain informed consent from survey respondents was waived.

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