Preoperative localization of distal colorectal tumours

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Savas Bayrak*, Erdem Kinaci*, Abdulkerim Ozakay*, Ceyda Turan Bektas**, Aytul Hande Yardimci**, Esra Arslan***, Mert Mahsuni Sevinc*, Hasan Bektaş*.

Istanbul Training and Research Hospital, Turkey
**Department of General Surgery*
***Department of Radiology*
****Department of Nuclear Medicine*

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BACKGROUND: *The detection of true localization of the tumour are crucial to driving the proper treatment algorithm in distally-located colorectal cancers (CRCs). The performance of four methods; colonoscopy, computed tomography (CT), magnetic resonance imaging (MRI), and fluoro-deoxy-glucose-positron emission tomography scan (FDG/PET-CT), were evaluated to identify the localizations of distal colorectal malignancies according to the rectum, sigmoid colon and recto-sigmoid junction (RSJ).*
MATERIALS AND METHODS: *Medical records of patients who underwent colorectal surgery for tumours located on the sigmoid colon, RSJ, or rectum were reviewed retrospectively.*
METHODS: *In total, 156 patients were included in the study. In terms of overall accuracy, colonoscopy, CT, MRI and FDG/PET-CT had similar accuracy rates, with 74%, 67%, 75%, and 74%, respectively. Colonoscopy was relatively less sensitive for rectosigmoid tumours (33%), while CT was less sensitive for rectal tumours (26%). MRI was less specific for tumours located on the rectum (33%).*
CONCLUSIONS: *It is crucial to correctly identify the location of distal colorectal tumours in order to plan accurate treatment strategies. Preoperative modalities, including colonoscopy, CT, MRI, and FDG/PET-CT, do not provide excellent accuracy for tumours of the distal colorectal tumours. To increase the success of these modalities; combined use could be more successful.*

KEY WORDS: Colonoscopy, Computed tomography Distal colorectal cancer, Magnetic resonance imaging

Introduction

Treatment approaches in distal colon and rectal cancers significantly differ according to tumour location. The first choice of treatment for a tumour in the sigmoid colon is surgery, whereas neoadjuvant therapy is the first option for the treatment of advanced-stage rectal cancer [1]. Therefore, to select the best treatment option, it is important to determine the exact location of a tumour located in the distal part of the sigmoid colon and rectum. Most of the radiologic modalities currently available, including conventional endoscopy, computed tomography (CT), magnetic resonance imaging (MRI), CT colonography, and MRI colonography, have been used for this purpose [2-5]. However, the data related to determining the correct localizations of distal colorectal tumours are very limited.

Although the term "rectosigmoid" is a familiar term among endoscopist and ishistopathologically definable [2], it has not been used in previous studies as a separate part of localization [2-5]. Treatment options for a tumour located in the distal colon, including both the proximal

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Correspondence to: Savas Bayrak,Istanbul Training and Research Hospital Department of General Surgery, Istanbul, Turkey. Org Nafiz Gurman Cad. Istanbul Egitimve Arastirma Hastanesi, 34098, Istanbul, Turkey. (e-mail: savasbayrak74@gmail.com)

rectum and the distal sigmoid colon, are controversial. Therefore, the identification of the exact location of a tumour should be included when using the term "rectosigmoid". Based on this, we aim to evaluate the performance of four evaluation methods, including colonoscopy, CT, MRI, and FDG/PET-CT, to identify the localizations of distal colorectal malignancies according to three different areas on the distal colon: the rectum, the sigmoid colon, and the RSJ.

Materials and Methods

Medical records of patients who underwent colorectal surgery for tumours located on the sigmoid colon, RSJ, or rectum between January 2010 and December 2014 were reviewed retrospectively. We received permission from the Ethical Committee of Istanbul Training and Research Hospital. The patients for whom pathology reports were not available were excluded from the study, even if they had undergone surgery. Preoperative endoscopic and radiologic examinations, including CT, MRI, and FDG/PET-CT, were also reviewed. Although the primary targets of these preoperative examinations were the diagnosis and staging of the tumour, they were reviewed in this study in terms of tumour localization.

In all endoscopic examinations, the distance of the tumour from the anal verge was measured in colonoscopic examination. Generally, the first 12-cm segment after the anal canal (approximately 15 cm from anal verge) has been accepted as extraperitoneal rectum by endoscopists. Additionally, the other landmark that endoscopists use to describe the rectum is the presence of semilunar folds (valves of Houston). If a tumour was located on a defined segment, or it was palpable on digital examination, the tumour was defined as a tumour of the rectum. If a tumour was located ahead of the rectum, within the first 60 cm of the distal colon, it was defined as a tumour of the sigmoid colon. If a tumour was located to the proximal border of the defined rectum and invaded both the distal part of the sigmoid colon and the proximal part of the rectum, the tumour was defined as a tumour of the RSJ.

Although all of the patients underwent endoscopic evaluation, only patients with a clear definition of the tumour localization according to the aforementioned criteria were included in the further evaluation. Likewise, CT and MRI examinations were two standard preoperative evaluation methods, according to our clinical policy. However, despite the availability of the written reports, the records of CT and MRI sections were not available in all patients due to technical problems in our picture archiving and communication system (PACS). Therefore, patients with available recorded sections of CT and MRI examinations underwent re-reads by two radiologists. FDG/PET-CT examination, however, is not a standard preoperative evaluation method in our clinic; it was actually performed to detect the suspected distant metastases according to the preference of the clinician. CT sections of the FDG-PET/CT examination have not actually been used to identify the localization of the tumours due to the relatively low resolution and wide cross-section ranges. However, the CT sections of the FDG-PET/CT scans were also interpreted and re-evaluated in terms of tumour localization for this study.

Colonoscopy was done after standard colon cleansing using Fujinon or Olympus video-endoscopes. CT scans were taken by using 64-detector multi-slice Aquilion CT scanner (Toshiba Medical Systems Corporation, Japan). Imaging was performed with a gantry rotation time of 0.4 s and a slice thickness of 0.5 mm with an effective scan width of 32 mm (64 × 0.5 mm). Tube current and voltage were set to 50 mA and 120 kV and 128-detector multi-slice Ingenuity Core (Philips Healthcare, Eindhoven, The Netherlands). Scan parameters were fixed as follows; tube voltage: 120 kV, effective tube current-time products: 400 mAs/slice, resolution: high resolution (small focus), rotation time: 0.5sec/ rot, helical pitch: 0.3, slice thickness/slice increment: 0.67 mm/0.33mm. MR imaging was performed using a Signa 1.5-T imager (SignaHDxt, GE Medical Systems, Milwaukee, Wisconsin, USA). All patients were instructed to drink oral contrast.

All patients underwent 18F-FDG PET CT scan according to the protocol. Each patient fasted for 4–6 hours for glycaemic control, 300 MBq (0.21 mci/kg body weight). After one hour, whole body PET CT scan acquisition was performed by a dedicated PET scanner (Siemens Biograph mCT 20 ultra HG LSO PET CT scanner, IL, USA) with 1.5-3 min acquisition for each 8-9 bed positions. The CT scan was used for anatomical localization, and also for attenuation correction of PET emission data. The CT scan has been used for anatomical localization and also for attenuation correction of PET emission data.

In this study, histopathological examination was accepted as the gold standard to describe the tumour localizations. The tumours surrounded by serosa were considered tumours of the sigmoid colon. The tumours surrounded by perirectal fatty tissue without serosa were considered tumours of the rectum. If the anterior surface of the tumour was surrounded by serosa and the posterior surface by perirectal fatty tissue, the tumour was described as a tumour of the RSJ. Success of the other preoperative examination techniques was evaluated according to this gold-standard definition. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the overall accuracy were calculated for each modality.

Results

Of the 156 patients, 98 males and 58 females were diagnosed with sigmoid, rectosigmoid, or rectal cancer dur-

ing the study period. The mean age was 65±12 years. According to the histopathological examination as an accepted gold standard to identify tumour location, the tumour was located in the sigmoid colon in 31 patients, in the RSJ in 42 patients, and in the rectum in 83 patients. 110 patients who underwent endoscopic evaluation were included in this study. Recorded sections of the CT and MRI examinations were available for re-evaluation in only 58 and 35 patients, respectively. In addition, 83 patients with CT sections of FDG-PET/CT scan were re-evaluated. The defined localizations for each modality are detailed in tables I and II.

The values of the MRI scan for tumours located on the sigmoid colon could not be calculated due to an insufficient number of cases. Nevertheless, the present cases in this group were included in the calculation of overall performance of MRI scan.

Discussion

Although surgery remains the primary treatment method for colorectal cancer (CRC), management of advanced disease differs, especially for tumours located on the most distal part of the colon. In locally-advanced rectal cancers, in contrast to proximally-located tumours, neo-adjuvant chemoradiotherapy (CRT) is recommended [1,2,3,6,7]. Therefore, preoperative staging of the disease and the detection of true localization of the tumour is crucial to determine the proper treatment algorithm in distally-located CRCs. Preoperative assessment modalities, including colonoscopy, contrast studies, ultrasonography, CT, MRI, and FDG-PET/CT, have been used for these two purposes [2,3]. The reliability of these modalities is therefore very important and valuable. Thus, the performance of four main modalities – colonoscopy, CT, MRI, and FDG-PET/CT – were evaluated in this study to identify true localization of distal CRC.

Reliable baseline data should be present to evaluate the accuracy of the preoperative assessment techniques in comparison to them. The histopathological examination was accepted as the gold standard to define the exact localization of the tumours in this study. Although the term "rectosigmoid" was defined in previous studies, evaluation of the tests was performed according to the two main localizations, rectum and sigmoid colon [2-4]. To our

TABLE I - *The defined localizations in different modalities*

	Histopathology	Endoscopy	CT	MRI	PET-CT
Overall (n)	156	110	58	35	83
Sigmoid (n)	31 (20%)	22 (20%)	14 (24%)	1 (3%)	18 (22%)
Rectosigmoid (n)	42 (27%)	27 (25%)	33 (57%)	7 (20%)	26 (31%)
Rectum (n)	83 (53%)	61 (55%)	11 (19%)	27 (67%)	39 (47%)

CT: Computedtomography, MRI: Magneticresonanceimaging, PET: Positronemissiontomography

Table II –*The performance characteristics of the examination methods for each localization in compare to the histopatholological examinations*

		N	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Colonoscopy	Sigmoid	22	65	91	68	89	85
	Rectosigmoid	27	35	79	41	76	67
	Rectum	61	77	67	70	73	71
	Overall	110	63	80	62	80	74
CT	Sigmoid	14	60	83	43	91	79
	Rectosigmoid	33	71	51	52	71	60
	Rectum	11	26	85	55	63	61
	Overall	58	51	75	50	75	67
	Sigmoid*	1	-	-	-	-	-
MRI	Rectosigmoid	7	100	72	11	100	74
	Rectum	27	81	33	77	38	69
	Overall	35	82	37	63	81	75
PET-CT	Sigmoid	18	60	84	43	92	81
	Rectosigmoid	26	46	75	43	78	67
	Rectum	39	71	81	77	75	76
	Overall	83	61	81	58	81	74

* *Incomputableduetoinsufficientnumber of cases.*

CT: Computedtomography; MRI: Magneticresonanceimaging; PET: Positronemissiontomography; PPV: Positivepredictivevalue; NPV: Negativepredictivevalue

knowledge, this is the first study that evaluates the accuracy of the preoperative assessment modalities and reported the results for three different localizations of distal CRCs: rectum, sigmoid colon, and (RSJ).

According to the results of the current study, colonoscopy is not an excellent modality for identification of true localization of distal CRCs. The accuracy of colonoscopy decreased dramatically for tumours localized on the RSJ. The sensitivity of colonoscopy for the RSJ was 35%, while it was 77% for the rectum and 65% for the sigmoid colon. Overall accuracy of colonoscopy was 74%, although it was 85% for the sigmoid colon. In our view, endoscopic assessment had two disadvantages for the detection of the true tumour localization. Firstly, the endoscopy is a highly practitioner-dependent intervention. Secondly, disruption of the anatomic landmarks due to tumour involvement causes misinterpretation. In a study including 220 distal CRCs, the great success of colonoscopy regarding the correctly localized distal CRCs was revealed with very high sensitivity (>98%) and specificity (96%) [4]. In another study reported by Loffeld et al. [2], the results related to the colonoscopic evaluation was a little less, with sensitivity at 100% and 77%, and specificity at 77% and 100% for the sigmoid colon and the rectum, respectively. Lee et al. [5] also reported 100% accuracy of colonoscopy for tumours of the sigmoid colon. All of these results seem to be better than ours. However, none of the previously reported studies were acknowledged tumours of the RSJ as a separate group.

According to the CT scan, the rectum is generally defined as the colonic segment below the imaginary line drawn from the promontorium to the symphysis pubis [2]. It should be kept in mind that in certain cases the sigmoid colon can be longer and more curved than usual. Therefore, tumours of the lower sigmoid may be misidentified as rectal tumours [2]. In the current study, the sensitivity and specificity of CT in the localization of distal CRCs were 51% and 75%, respectively. However, when the segments were considered separately, the sensitivity was 71% for the rectosigmoid portion, 60% for the sigmoid colon, and 26% for the rectum. These results are interesting in that they demonstrate that CT is not efficient on its own in identifying the location of rectal tumours.

Thus, in our study, this also reduced the overall success rate of CT. In the literature, there is no consensus about the efficiency of CT in tumour localization. Feuerlein et al. [8] reported that CT was more successful and accurate than colonoscopy in identifying the location of tumours and can be used in surgery planning. In contrast, Lee et al. [5] suggested that CT was not sufficient alone and should be used with colonoscopy to obtain the best result. However, rectal tumours were excluded in both studies. The general approach in the literature has been to include in the study the accuracy of preoperative CT scan for the staging of the disease in comparison to MRI [9,10,17,18]. Therefore, the data regarding the accuracy of CT scan in the identification of the localization of the distal colorectal tumours is very limited. This study provides comprehensive data related to this issue.

The American Academy of Radiology recommends MRI for the T-staging of colon cancers, and it can also be used to diagnose advanced local colon cancers [11,12]. Compared to other imaging methods, MRI is more efficient in assessing the rectal wall, the surrounding mesorectal fat tissue, lymph nodes, and perirectal fascia [8]. Thus, it can also identify the circumferential margin in total mesorectal excision [13]. FDG/PET-CT is a useful tool for the diagnosis of recurrent diseases and occult metastatic disease, and preoperative staging. It has been reported to change the treatment modality in one-third of patients with rectal tumours [14]. It is clear from the literature that MRI and FDG/PET-CT cannot primarily identify the location of the tumour. Therefore, in the current study, MRI and FDG/PET-CT were only used to obtain and evaluate the existing data in terms of tumour localization. Of the 156 cases, MRI sections were obtained in only 35 of them. Therefore, the results related to MRI scan were a little bit less reliable. The number of rectal tumours was considerably high (n= 27) in this group. According to our results, MRI was the most sensitive test (82%) in comparison to the others, including colonoscopy, CT, and FDG/PET-CT, despite the very low specificity (37%). However, it is well known that an MRI scan is generally preferred for T and N staging in patients with known rectal tumours. The obtained success of MRI could therefore be related to this trick. A total of 83 tumour cases underwent FDG/PET-CT scans to detect distant metastasis. In terms of tumour localization, the accuracy of the FDG/PET-CT was close to colonoscopy, conventional CT, and MRI.

The misidentification of a distal sigmoid colon tumour as a rectal tumour could lead to unnecessary neoadjuvant treatment, whereas if the tumour in the upper rectum is incorrectly identified as being in the distal sigmoid, this would prevent the application of the required neoadjuvant treatment. Furthermore, incorrect preoperative tumour localization can change the preoperative strategy, resulting in unfavourable outcomes for the patient. Since the treatment modality for rectosigmoid cancer depends on the origin of the tumour, it is of crucial importance to perform a careful assessment and correctly localize the tumours. According to the results of present study and on-going data in the literature, the classic methods, including colonoscopy, CT, MRI, and FDG/PET-CT, are not perfect modalities to correctly localize distal colorectal tumours. Nevertheless, CT colonography has been a suggested modality in recent studies for this purpose [3,15,16].

The main limitation of this study was the retrospective nature and the relatively small number of cases for

CT and MRI scans. In addition, the currently proposed modality to correctly localize the distal CRCs, CT colonography, was not included in this study. Despite these limitations, this study provides the most comprehensive data regarding the accuracy of first-line evaluation modalities, particularly for distal CRCs, including tumours of the RSJ as a separate group of lesions.

Conclusions

In conclusion, it is crucial to correctly identify the location of distal colorectal tumours to plan accurate treatment strategies. None of the preoperative assessment modalities, including colonoscopy, CT, MRI, and FDG/PET-CT, provides excellent accuracy for tumours of the sigmoid colon, RSJ, or rectum. Therefore, special attention is needed to increase the success of these modalities, and also the combined use could be more successful than each of them individually. In addition, newer methods, like CT colonography, would be the leading examination method for this purpose.

Riassunto

L'identificazione della reale sede del tutmore è essenziale per la formulazione di un adatto algoritmo nei cancri localizzati distalmente nel colon-retto (CTC). In questo studio è stata indagata l'efficacia della localizzazione di tumori distali del colon-retto di quattro metodologia: la colonscopia, la TAC, l'imaging della RMN, e la PET con fluoro-18-desossi-glicosio tomografia computerizzata (CT), analizzando retrospettivamente le cartelle cliniche di 156 pazienti affetti, Fluorodeoxyglucose -positron emission tomography scan da tumore del colon-sigma, della giunzione retto sigmoidea e del retto sottoposti a trattamento chirurgico.
Per quanto riguarda l'accuratezza delle quattro metodologie essa è risultata simile: 74% per la clolonscopia, 67% per la TAC, 75% per la RMN e 74% con la PET. La colonscopia è risultata meno sensibile nei tumori retto-sigmoidei (33%) mentre la TAC è risultata meno sensibile (26%) e la RMN meno specifica (33%) per i tumori del retto.
In conclusione, confermando l'importanza di poter localizzare correttamente i tumori distali del colon retto al fine di determinare le strategia più accurate del trattamento, le indagini preoperatorie non forniscono dati di adeguata accuratezza per i tumori colon rettali distali, e solo l'uso combinato di esse può accrescere il risultato cercato.

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