Original Article

The Accuracy of Multi-Detector Row Computerized Tomography in Staging Rectal Cancer Compared to Endoscopic Ultrasound

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ABSTRACT

Background/Aim: Our aim was to evaluate the diagnostic accuracy of multi-detector row computerized tomography (MDCT) in staging of rectal cancer by comparing it to rectal endoscopic ultrasound (EUS). **Materials and Methods:** We prospectively included all patients with rectal cancer referred to our gastroenterology unit for staging of rectal cancer from December 2007 until February 2011, 53 patients whose biopsy had proven rectal cancer underwent both MDCT scan of the pelvis and rectal EUS. Both imaging modalities were compared and the agreement between T- and N-staging of the disease was assessed. **Results:** We staged 62 patients with rectal cancer during the study period. Of these, 53 patients met the inclusion criteria and were evaluated (25 women and 28 men). The mean age was 57.79 ± 14.99 years (range 21-87). MDCT had poor accuracy compared with EUS in T-staging with a low degree of agreement (kappa = 0.26), while for N-staging MDCT had a better accuracy and a moderate degree of agreement with EUS (kappa = 0.45). **Conclusions:** MDCT has a poor accuracy for predicting tumor invasion compared to EUS for T-staging while it has moderate accuracy for N-staging.

Key Words: Cancer staging, cancer, endoscopic ultrasound, multi-detector row computerized tomography, rectal

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Colorectal cancer (CRC) is the most common gastrointestinal malignancy and the second cause of cancer-related deaths in North America.[1] CRC is the second most common cancer in Saudi males (accounting for 8.8% of all male cancers, with an average annual age standardized rate (ASR) of 7.2/100,000 population) and the third most common cancer in Saudi females (accounting for 7.6% of all cancers, with an average annual ASR of 6.1/100,000 population).[2]

Accurate staging of rectal cancer is necessary to provide the optimal treatment strategy. The prognosis of rectal cancer is related to several factors, such as the depth of tumoral invasion, number of metastatic lymph nodes, and the percentage of the circumference of the rectum involved by the tumor.[3,4] Pre-operative staging is of great importance for adequate management. 6-10% of patients with primary rectal cancer still experience intra-pelvic local recurrence with or without pre-operative neoadjuvant therapy,[5,6] however, therapy improves survival and diminishes recurrence rates in patients with locally advanced cancer (T3-4, N0 or N1-2).[7-9]

Assessment of the depth of cancer invasion (T-stage) in rectal cancer and the presence of lymph node involvement (N-stage) remains an important part in management of patients with rectal cancer.

Rectal endoscopic ultrasound (EUS) is a safe diagnostic method that allows both tumor invasion and lymph node

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involvement to be staged and significantly contributes to the selection of the optimum management strategy in patients with rectal cancer.[10] Reported EUS accuracy in rectal cancer varies between 69% and 97% for T-staging[11] and is 70-75% accurate for N-staging.[12] However, the accuracy of EUS is related to many factors, such as the operator's experience, tumor stenosis, peritumoral inflammation, hemorrhage, and the shape of the tumor itself whether it is villous or pedunculated. Even with these limitations EUS remains one of the most accurate techniques available for rectal tumor staging, it is found to be superior to computerized tomography (CT) scan and equivalent to magnetic resonance imaging (MRI).[13]

The current role of CT in patients with known colon cancer is controversial. Accuracy rates for pre-operative staging of colon cancer with CT have been disappointing. For the T-staging it ranges between 48% and 77%,[14-18] while for N-staging accuracy has ranged from 54% to 70%.[19] The use of contrast enhanced multi-detector row computerized tomography (MDCT) colonography has improved the staging accuracy.[20] At present, only a few MDCT studies have been published on the subject of rectal cancer staging although there are studies comparing CT and EUS, but the impact of MDCT was not evaluated on such a comparison.

The application of chemoradiation has become the initial treatment modality for locally advanced rectal cancer. This has created a methodological problem for the evaluation of the staging accuracy of new imaging techniques, due to tumor down staging by neoadjuvant therapy,[21-24] therefore, the traditional gold standard of histology is no longer valid.

Thus, the aim of this study was to evaluate the accuracy of MDCT for the prediction of T and N in rectal cancer staging with EUS as reference standard.

MATERIALS AND METHODS

The study was conducted at the King Khalid University Hospital, Riyadh, Saudi Arabia, which is considered one of the major teaching hospitals in the country and a major tertiary care center in Riyadh. Prospective EUS examinations performed for rectal cancers are stored in an electronic database. All patients with biopsy proven rectal carcinoma were included. The study period was from December 2007 until February 2011. Two endoscopists performed the EUS examinations in our endoscopy unit. Informed consent was obtained from all of the patients prior to the examination.

Patients were included if the distal margin of the tumor was within 15 cm from the anal verge[25,26] and was proven to be adenocarcinoma on biopsy. The staging by EUS and CT occurred prior to chemoradiation therapy, both were done within the same week with no preferential sequence. Patients with obstructive lesions were excluded from the study.

Rectal EUS

All the exams were performed using an ALOKA ProSound α 10 machine (7.5-10 MHz) and a 360° electronic radial scanning echoendoscope (Olympus, GF-UE160-AL5e), filling the transducer balloon with degassed water to enable coupling with the tumor. A second endoscopist was present during the procedure and the final staging of the tumor was made after the agreement of both. Both endoscopists were blinded to the MDCT results.

Patients were prepared with two 250-cc cleansing enemas administered 2 hours before the procedure. No sedation was given. EUS was carried out with the patients in the left lateral position. The bowel wall is represented in five sonographic layers as a result of differences in acoustic impedance.

Beginning with the lumen, the five layers are: (1) Hyperechoic layer from the interface between mucosa and ultrasound probe; (2) hypoechoic layer produced from the mucosa and muscularis mucosae; (3) hyperechoic layer corresponding to the submucosa; (4) hypoechoic layer corresponding to the muscularis propria; and (5) hyperechoic layer being the interface between the muscularis propria and perirectal fat/serosa.

The EUS staging corresponds to the TNM classification: (1) T1 is when the tumor is confined to mucosa and submucosa; (2) T2, when the tumor infiltrates the muscularis propria; (3) T3 is when the tumor invades the perirectal fat; and (4) T4 is when the tumor infiltrates surrounding organs.[27]

The echoendoscope was advanced to 20-25 cm from the anus for the detection of iliac lymph nodes. All detected lymph nodes, more than 5 mm in size, hypoechoic, rounded were considered to be suspicious for malignancy.[28]

MDCT scan of the pelvis

All patients were examined by CT using 16-MDCT (LightSpeed 16, GE Medical Systems, and Milwaukee, USA). A detailed consent was discussed with and signed by the patients. The protocol study included the acquisition of unenhanced images of the entire liver followed by acquisition of triple-phase contrast-material-enhanced images during the hepatic arterial phase, portal venous phase and delayed phase.[29] All CT acquisitions were started at the top of the liver and preceded in a craniocaudal direction during a single breath-hold on deep inspiration. Patients were instructed to hold their breath with tidal inspiration during acquisition. With slice thickness = 0.625 mm, interval 0.625 mm, pitch 1.35, 1 mm section overlapping every

0.7 mm. Contrast-enhanced images were obtained with a dose of 1.8 ml/kg body weight of non-ionic iodinated contrast material. Oral contrast was given after fasting for 6 hours as 3% diluted water-soluble contrast as 1 L given over 2 hours, one cup was given on table at the time of examination while rectal contrast was given diluted water-soluble contrast (15 cc of gastrografin diluted in 500 cc of water).

Statistical analysis

Pre-operative EUS and MDCT findings were compared to assess the concordance between the two methods. Kappa-statistics were used to check how well EUS and MDCT classified subjects in the T- and N-stage groups. The degree of agreement was quantified by weighted kappa, which assumes the categories (Tl, T2, etc.) are ordered and accounts for how far apart EUS and MDCT are in classifying them.

RESULTS

A total of 53 patients with rectal cancer were staged in our unit (25 females and 28 males). The mean age was 57.79 ± 14.99 (range 21-87). The main presenting symptoms were bleeding per rectum in 42 patients (79.2%) and abdominal pain in 19 patients (35.8%). There was a positive family history for colon cancer in 7 (13.2%) and 6 patients (11, 3%) had a past history of adenomas [Table 1].

For T-staging, MDCT was found to under stage 14 patients (26%), while 6 patients (11%) were over staged. 30 patients (63%) were correctly staged compared with EUS. The agreement on T-staging between MDCT and EUS was found to be fair (kappa = 0.26).

Regarding N-staging, MDCT under staged 7 patients (12%), over staged 13 patients (24%), while 33 patients (64%) were correctly staged compared with EUS. The degree of agreement between EUS and MDCT was found to be moderate (kappa = 0.45).

Tables 2 and 3 show the comparison of both MDCT and EUS for both T- and N-staging.

DISCUSSION

The present study evaluated the accuracy of preoperative MDCT for determining the T- and N-stages for rectal cancer compared to EUS as a reference standard. We found a fair agreement between MDCT and EUS in T-staging of rectal cancer (kappa = 0.26), while there was moderate correlation for N-staging with kappa = 0.45.

Treatment options for rectal cancer depend on the stage at presentation.[30] Accurate preoperative staging is mandatory and mostly based on imaging.[31] CT, EUS, and MRI are the imaging modalities predominantly utilized for preoperative staging of rectal cancer.

EUS is one of the most accurate techniques for rectal cancer staging and has been in use since the early 1980s. EUSs overall accuracy was 81.8%.[32] Although, most of earlier studies had accuracies of 85-95% but in two large studies that included more than 400 patients the accuracy for nodal staging was 63.3% and 69%,[33,34] while for tumor staging it ranged from 70% to 75%.[35,36] EUS can distinguish the different anatomic layers of the bowel and thus, it appears to have advantages over both CT or MRI in assessing mural penetration and is invaluable in assessing patients considered for local resection. A meta-analysis by Bipat *et al.*,[37] also found that rectal EUS was the best technique for assessing local invasion. We do think that the role of these imaging modalities is complementary rather than competitive as there are studies that had found that EUS and MRI have similar accuracies in the staging of T2 and T3 tumors while MRI could not visualize T1 lesions, EUS under staged T4 lesions.[38]

Table 1: Demographic data of 53 patients with rectal cancer

	Frequency (%)
Abdominal pain	19 (35.8)
PR bleeding	42 (79.2)
Presentation	9 (17.0)
Constipation	15 (28.3)
Diarrhea	12 (22.6)
Weight loss	19 (35.8)
Anorexia	10 (18.9)
Altered bowel habit	8 (15.1)
Incontinence	13 (24.5)
Sensation of incomplete evacuation	2 (3.9)

Table 2: Comparing multi-detector row computerized tomography to endoscopic ultrasound for T-staging

	EUS			Total
	T2	T3	T4	
CT scan				
T1	0	1	1	2
T2	4	10	0	14
T3	4	27	2	33
T4	0	2	2	4
Total	8	40	5	53
Symmetric measures	**Value**	**Asymptotic standard error[a]**	**Approx. T[b]**	**Approx. sig.**
Measure of agreement kappa	0.219	0.121	2.230	0.026
Number of valid cases	53			

EUS: Endoscopic ultrasound, [a]Not assuming the null hypothesis, [b]Using the asymptotic standard error assuming the null hypothesis

Table 3: Comparing multi-detector row computerized tomography to endoscopic ultrasound for N-staging

	EUS			Total
	N0	N1	N2	
CT scan				
N0	10	5	0	15
N1	13	23	2	38
Total	23	28	2	53
Symmetric measures	**Value**	**Asymptotic standard error[a]**	**Approx. T[b]**	**Approx. sig.**
Measure of agreement kappa	0.243	0.121	2.003	0.045
Number of valid cases	53			

EUS: Endoscopic ultrasound, [a]Not assuming the null hypothesis, [b]Using the asymptotic standard error assuming the null hypothesis

New technological advances such as contrast-aided EUS and three-dimensional (3D) EUS may offer high accuracy for T- and N-staging in rectal cancer. 3D EUS consists of the traditional transverse scan as well as coronal and sagittal scans that allow for a multiplanar display, it also improves visualization of subtle protrusions of tumors infiltrating into adjacent tissues and organs, allowing for improved T- and N-staging. This procedure has been found to be superior to CT and two-dimensional EUS in accurately determining tumor margins.[39]

CT is unable to differentiate the different layers of the rectal wall and has lower overall predictive accuracy than EUS and MRI. Initial data showed CT T-staging accuracy of 79% to 94% in patients with primarily advanced T-stage disease,[40-42] while its accuracy fell to a range of 52-74% when a broader spectrum of tumor sizes were analyzed.[43-45] While nodal staging accuracy has ranged from 54% to 70%.[46,47]

The decrease in accuracy may have been due in part to the lack of detailed spatial and contrast resolution offered by standard CT imaging techniques, leading to diminished accuracy for early-stage lesions confined to the rectal wall. Although improvement in CT imaging (e.g., MDCT) has occurred, however, data are limited on whether such advances will result in improved locoregional staging accuracy.[20] In a study of 21 patients comparing MDCT with MRI an agreement of 95% was found between MDCT and histology,[48] while Kulinna, *et al*.,[49] reported an accuracy of 86% in a 92 patient study, A study by Taylor, *et al*., addressed the clinical important prediction of the tumor relationship to the MRI and reported a poor agreement between MDCT, MRI and histology (kappa 0.06-0.15) in 42 patients treated with a short course of radiotherapy (5 Gy × 5 Gy) or surgery only.[50] No study up to date compared the degree of agreement of MDCT and EUS in pre-operative staging of rectal cancer.

Although, the number of patients included in our study is not high, our aim was to know the utility and reliability of MDCT for pre-operative rectal cancer staging under usual daily conditions in our center with our experience, and we found that MDCT had a low diagnostic accuracy with poor agreement compared to EUS in T-staging.

Based on the current evidence, we feel that even with the advancement in imaging using MDCT, its accuracy is not optimal compared to EUS. Larger studies with different tumor invasion depths are needed.

CONCLUSION

MDCT has a poor accuracy for the identification of the tumor invasion of rectal cancer and moderate accuracy in nodal staging.

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