

CONTRAST ENHANCED HELICAL MULTIDETECTOR COMPUTERIZED TOMOGRAPHY (MDCT): IS IT STILL USEFUL FOR DIAGNOSIS AND STAGING OF COLORECTAL CARCINOMA?

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PJR April - June 2015; 25(2): 49-54

ABSTRACT

PURPOSE: To assess the capability of contrast enhanced multidetector computed tomography helical (MDCT) for the diagnosis, local spread, lymph nodal involvement and metastatic staging of colorectal carcinoma. **SUBJECT AND METHODS:** Over a period of 18 months, 72 patients who were referred for contrast enhanced MDCT with a clinical suspicion of colorectal Ca followed by optical colonoscopy with biopsy and/or surgery for the treatment of colorectal carcinoma were included in this study. **RESULTS:** MDCT showed sensitivity and specificity of 77.35% and 78.94% for the detection of tumor. For local spread MDCT displayed high specificity 84.61 % and sensitivity 75% when compared with operative findings. MDCT was equally sensitive and specific for the detection of lymphadenopathy i.e., 69.44% sensitive and 76.69% specific. For the diagnosis of hepatic metastasis MDCT has shown highest sensitivity of 90.90% and highest specificity of 96.77% when performed in arterial phase of CT scan. **CONCLUSION:** Although due to advancement in technology newer imaging modalities such as CT colonography, MRI and PET/CT are nowadays best modalities for the preoperative staging of colorectal carcinoma but due to its easy availability, cost-affordability and better diagnostic accuracy MDCT is still an investigation of choice for suggesting diagnosis and deciding the operability of Colorectal Carcinoma in our country.

Key words: MDCT scan, colorectal carcinoma, preoperative, staging

Introduction

Malignant gastrointestinal tumours are amongst the commonest tumours exhibiting an annual increase globally. Colorectal Carcinoma (CRC) is one of the most widespread malignancies worldwide. CRC ranks second to lung cancer as a cause of cancer death in the United States.¹ Its incidence is rising in Asian countries, including Pakistan.² In Pakistan it constitutes 25.4% and 20.1% of gastrointestinal malignancies in males and females respectively. Ashraf K et al shows 60% sensitivity and 83% specificity for assessment of local spread of disease, 66% sensitivity and 76% specificity for the evaluation of lymph nodal

metastases.³ Recent international literature reveals sensitivity and specificity of post contrast MDCT were 70.2% and 79.2%, respectively for the diagnosis of CRC.⁴ CT colonography (CTC), a recent advancement in CT scan imaging shows the sensitivity of 96.1% for colorectal cancer when compared with optical colonoscopy.⁵ Accurate preoperative staging is essential in determining the optimal therapeutic planning for individual patients. The CT in the preoperative evaluation of colorectal cancer is useful for planning surgery and/or neoadjuvant therapy, particularly when local tumor extension into adjacent organs and lymph nodes or distant metastases is detected.⁶

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Submitted 9 April 2015, Accepted 27 April 2015

The initial diagnosis is usually made with colonoscopy or air-barium enema examination; however, with the increased use of computed tomography (CT) as the initial imaging modality in patients with a variety of gastrointestinal symptoms, the radiologist may be the first to suggest the diagnosis of colon cancer on the basis of CT findings. Nevertheless, at this time, CT is not routinely performed for detection of colon cancer, although continued advancements in scanner and computer technology may allow CT to play a future role in detection of polyps and early-stage colon cancer. The current role of CT in patients with known colon cancer is controversial. Accuracy rates for preoperative staging of colon cancer with CT have been disappointing, ranging between 48% and 77%. Limitations of CT staging include an inability to definitively identify nodes that contain tumor or to determine the exact depth of tumor invasion through the wall. Despite these limitations, CT is valuable in the management of colon cancer. Preoperative CT is useful for planning surgery or radiation therapy, particularly when local extension of tumor into adjacent organs or distant metastases is detected. In addition, preoperative CT provides baseline findings for comparison during the postoperative period and is the modality of choice for detection of local recurrence after surgical resection.⁷ The advent of positron emission tomography (PET)/CT has provided an added dimension, taking into consideration both anatomical and functional aspects, but its strength lies primarily in the detection of distant metastases as opposed to local spread and staging. The use of magnetic resonance (MR) imaging on the other hand, is primarily confined to the staging of rectal carcinomas. Its use in other parts of the colon is unreliable due to motion artifact secondary to peristalsis. With the use of MR imaging, accuracy rates of 54%–87% for T-staging of rectal carcinomas have been reported.⁸

Currently, CT is the main modality of choice for the preoperative staging of colorectal carcinomas at our institution. Therefore, the purpose of this study was to determine the accuracy of standard protocol CT in the evaluation of local staging and regional lymphadenopathy in colorectal carcinomas.

Subject and Methods

Over a period of 18 months, 72 patients who were referred for contrast enhanced MDCT with a clinical suspicion (per rectal bleeding, altered bowel habits, weight loss, positive fecal occult blood and low grade fever for more than 2 months) of colorectal Ca followed by optical colonoscopy with biopsy and/or surgery for the treatment of colorectal carcinoma were included in this study. Already diagnosed cases, post surgical cases, patients who had received any prior treatment for the CRC or those who had any concurrent disease process, were excluded from this study. This was a prospective cross-sectional study carried out over 18 months period in which a total of 72 patients with biopsy proven CRC undergoing surgery were preoperatively evaluated by contrast enhanced MDCT within a one-month period before the surgery. The CT results were compared with surgical/pathological results (which are the gold standard reference) and measures of association and 95% confidence interval calculated based on the results.

All relevant features including patient's age, sex, CT findings and histopathological findings were recorded on proforma. Data was collected on proforma. Mean $\pm$ SD was calculated for age. Frequency and percentage was calculated for gender, clinical presentation, CT scan findings, histopathological examination findings, true positive cases, true negative cases, false positive cases & false negative cases. Sensitivity, specificity, positive and negative predictive values and accuracy of helical MDCT was determined by taking histopathology as gold standard. Chi square test was applied and p value <0.05 was taken as significant. Stratification was done with regards to age & gender to see the effect of these on outcomes. CT scans were performed on Toshiba Activion™ 16 Slice helical CT scanner after giving oral, I/V and rectal contrast. All patients received 1.5 liters of 2% Sodium diatrizoate/meglumine diatrizoate (Gastrograffin, Squibb) as positive oral contrast medium 1-2 hours before the scan. Injected intravenously was 3 mls / Kg of non-ionic water-soluble contrast medium (Omnipaque, Schering containing 300mg Iodine / ml) at the rate of 3-5 ml/sec. Examination was carried out using Toshiba Activion™ 16 Slice helical CT sca-

anner. The slice thickness was 5 mm and interslice gap was also 5 mm. Pitch was 1.0. Images were acquired from the dome of diaphragm to the pubic symphysis in craniocaudal fashion. Scanning was started in helical mode 30-35 seconds after the start of intravenous contrast injection. Images were acquired in arterial and venous phase of enhancement, which is ideal for detection of hepatic lesions. Imaging was done in two breath-holds in majority of patients. A few patients only, required three breath-holds. Total imaging time was less than 5 minutes in all patients. The patient time in the room was 15-20 minutes. Image interpretation was carried out by the senior (5 years of experience) radiologist.

The collected data was analysed using the Microsoft Windows based Statistical Package for the Social Sciences (SPSS. V-22.0, standard version), Measure of association and 95% confidence interval was then calculated based on the results.

DETECTION OF TUMOR AND ITS LOCAL SPREAD:

Images were interpreted with presence of tumor and knowledge of the site of the tumour as well as the biopsy findings, based on the parameters of local (extramural) invasion (hinted by irregular, serrated or spiculated outer contour, tumour mass or strands extending out and/or pericolic fat stranding. Direct extension into adjacent solid or hollow organs was included in this as well.

LYMPHADENOPATHY:

Lymph nodes (taken as a single adjacent node 1 cm or larger or a cluster of 3 or more nodes, even less than 1 cm. Lymph nodal size was taken in the largest dimension.

METASTASIS:

Metastases (suspicious lesions in the liver, adrenals, bones, abdominopelvic viscera, peritoneal or retroperitoneal deposits were all assumed to be metastases unless they were previously confirmed as benign lesions).

Results

Seventy two patients with clinical suspicion of colorectal carcinoma fulfilling the inclusion criteria were included in this study. There were 44 (61.11%) males and 28 (38.88%) females. The mean $\pm$ standard deviation age was 55.83 ± 10.73 years. 24 (33.33%) patients in 41-60 years of age groups followed by 22 (30.55%) patients in 61-80 years of age group, 14 (19.44%) patients in 81-100 years of age group, and 12 (16.66%) patients in 21-40 years of age group. 28 (38.88%) patients had history of per rectal bleeding, 28 (38.88%) had altered bowel habits, 25 (34.72%) had history of weight loss, 18 (25.0%) had positive fecal occult blood and 15 (20.83%) had low grade fever. Forty one out of the 53 primary malignant lesions were detected on the helical CT yielding a sensitivity of 77.35%. They were mostly localized in sigmoid colon and rectum. Twenty out of the 41 (48.78%) lesions were in the form of circumferential thickening of the bowel wall and 21 (51.21%) were discrete focal masses.

DETECTION:

CT detected tumor in 41 patients (true positive) out of 72 and failed to diagnose tumor in 12 patients (false negative). In 15 patients tumor was not found on CT as well as on biopsy (true negative) and 4 patients were falsely labeled as having tumor on CT scan (false positive). Therefore in this study we found sensitivity, specificity, PPV and NPV of 77.35%, 78.94%, 91.11% and 55.55% respectively.

LOCAL SPREAD:

Evidence of local (extramural) spread of the tumor was determined using the help of predefined parameters, mentioned above for image interpretation. These were compared with surgical/ histological results. Correct assessment for local spread was made in 41 out of 53 scans (77.35%) Incorrect assessment was made in 12 scans (22.64%). Of the 41 scans correctly evaluated, 30 had extramural tumour spread (true positive) and 11 did not (true negative). Of the 12 CT scans proven to be incorrectly evaluated, local spread was falsely interpreted as positive in 2 patients and as negative in 10 patients. The sensitivity and specificity of CT scan in detecting

local tumour spread in this study was 75% and 84.61% respectively. The positive and negative predictive values were 93.75% and 52.38% respectively.

LYMPHADENOPATHY:

The preoperative evaluation for lymph nodal status was also done according to the predefined criteria stated above. They were divided into two groups, 'metastatic lymphadenopathy' or 'no lymphadenopathy detected. Lymphadenopathy was correctly identified in 38 out of 53 (71.69%) cases and incorrectly in 15 out of 53 (28.30%). 25 out of these 38 scans correctly assessed had histologically proven metastatic lymphadenopathy (true positive). The remaining 13 of the 38 were accurately described as negative for lymphadenopathy (true negative). The sensitivity and specificity for detection of adenopathy was 69.44% and 76.47% respectively. The positive predictive value for metastatic lymphadenopathy was 86.20% and negative predictive value 54.16%.

METASTASIS:

Metastases to solid viscera or other sites and organs were diagnosed on CT on the basis of image interpretation criteria mentioned above. Ultrasound and CT guided fine needle aspiration and core biopsy, peroperative ultrasound, surgical excision and clinical follow-up were the methods deployed for the diagnosis of metastatic lesions. Of hepatic metastases CT scans were correct in evaluation in 50 out of 53 scans (94.33%) with 20 true positives and 30 true negatives. Of the remaining three, 1 scan was proven to be false positive and 2 false negative on surgery/biopsy. Perioperative surgical evaluation and peroperative ultrasonography were used for confirmation. Furthermore, all patients regardless of presence or absence of liver metastasis were followed for one year in which six monthly clinical assessments and ultrasonography was done. The sensitivity and specificity of preoperative CT for hepatic metastases was proven to be 90.90% and 96.77% respectively. Positive and negative predictive values were 95.23% and 93.75% respectively.

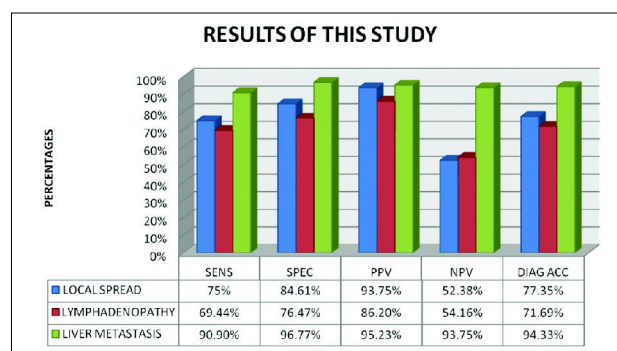


Figure 1: Bar chart showing Sensitivity (Sens), Specificity (Spec), Positive predictive value (PPV), Negative predictive value (NPV) and diagnostic accuracy (Diag Acc) of contrast enhanced MDCT scan for local spread, lymphadenopathy and liver metastasis.

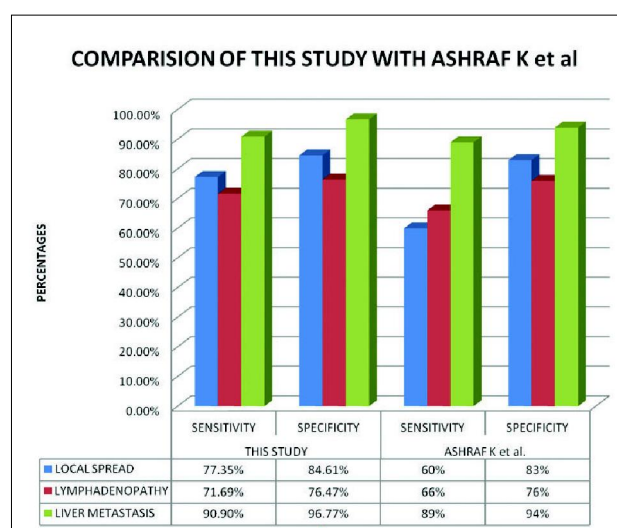


Figure 2: Bar chart showing comparison of result obtained in this study and results calculated by Ashraf K et al for contrast enhanced MDCT scan for local spread, lymphadenopathy and liver metastasis.

Disucssion

Colorectal carcinoma is a common malignancy associated with significant morbidity and mortality. It is the third commonest cancer in Western countries.⁸ To select the optimal treatment modality, accurate preoperative staging is necessary, which will benefit patients with colorectal cancer in terms of cure and quality of life. Therefore, the main purpose of this study was to evaluate the overall diagnostic accuracy of contrast-enhanced MDCT in staging of colorectal carcinoma to help choose the optimal treatment modality for each case.⁹ In this study CT detected tumor in 41 patients (true positive) out of 72 and failed to diagnose tumor in

12 patients (false negative). In 15 patients tumor was not found on CT as well as on biopsy (true negative) and 4 patients were falsely labeled as having tumor on CT scan (false positive). Therefore in this study we found sensitivity, specificity, PPV and NPV of 77.35%, 78.94%, 91.11% and 55.55% respectively. In a Study conducted by Balthazar et al¹⁰ CT detected the colonic tumor in 76 cases but failed to detect it in 14 cases, giving a sensitivity of 84%.

In this study the sensitivity and specificity of MDCT scan in detecting local tumour spread was 75% and 84.61% respectively. In 2006 Ashraf K et al³ performed the study on 52 patients for preoperative evaluation of colorectal carcinoma by spiral CT and found 60% and 83% sensitivity and specificity respectively for the assessment of local spread. Balthazar et al¹⁰ assessed 90 patients for the duration of 4 years and concluded that CT has a sensitivity of 55% and a specificity of 77% for the local staging of CRC.

For the detection of lymphadenopathy the sensitivity and specificity of MDCT scan was 69.44% and 76.47% respectively in our study and Ashraf K et al estimated 66% and 76% sensitivity and specificity for the detection of lymphadenopathy. Similarly Balthazar et al calculated a sensitivity of 73% and a specificity of 58% on the other side freeny el al¹² found specificity of 96%, at the cost of 26% sensitivity because authors labeled a node malignant if its size was a minimum 1.5 cm.

The sensitivity and specificity MDCT for hepatic metastases was proven to be 90.90% and 96.77% respectively in this study and Ashraf et al showed 89% and 94% sensitivity and specificity respectively. Kuszyk et al¹³ achieved a sensitivity of 91% for detection of liver lesions more than 1 cm in diameter and a sensitivity of more than 56 % for detection of lesions smaller than 1 cm.

Regarding tumor morphology Xiao B et al¹¹ demonstrated the sensitivity and specificity of CT were both 100% in the type of mass, were 77.8% and 100% in the type of infiltration, and were 100% and 85.7% in the type of ulceration. In all, 18 cases were consistent with the type of pathology, with a coincidence of 90%. (18/20).

Conclusion

Although due to advancement in technology newer imaging modalities such as CT colonography, MRI and PET/CT are nowadays best modalities for the preoperative staging of colorectal carcinoma but due to its easy availability, cost-affordability and better diagnostic accuracy MDCT is still an investigation of choice for suggesting diagnosis and deciding the operability of Colorectal Carcinoma in our country.

DISCLOSURE:

The authors declare no conflicts of interests in relation to this work.

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