DIAGNOSTIC ACCURACY OF CONTRAST ENHANCED COMPUTED TOMOGRAPHY IN STAGING OF COLORECTAL CARCINOMA

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ABSTRACT

Objective: To determine the diagnostic accuracy of CT scan in staging of colorectal carcinoma among biopsy proven patients of colorectal carcinoma by taking histopathological finding as gold standard.
Study Design: Cross-sectional validation study.
Place and Duration of Study: Combined Military Hospital Rawalpindi, Six months, from Jul 2015 to Dec 2015.
Material and Methods: A total of 176 cases of 15-70 years of age, diagnosed of colorectal carcinoma oncolonoscopic biopsy, were included in the study. Patients with previous malignancies other than colorectal carcinoma, allergy to the contrast agent and pregnant patients were excluded from the study. All the patients then underwent CT scan for detection of the stage of cancer. After surgery, histopathology of the resected specimen was compared with the findings on CT scan.
Results: Mean age was 50.27 ± 14.50 years. Out of these 176 patients, 113 (64.20%) were male and 63 (35.80%) were females with ratio of 1.8:1. Among CT positive, 80 were true positive while 11 were false positive. Among, CT negative patients, 12 were false negative while 73 were true negative. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT in staging colorectal carcinoma taking histopathology as gold standard was 87.91%, 85.88%, 86.96%, 86.90% and 86.93% respectively.
Conclusion: This study concluded that CT scan is a highly sensitive and accurate modality for pre-operative detection of stage of colorectal carcinoma.

Keywords: Colorectal cancer, Imaging modality, Sensitivity, Stage.

INTRODUCTION

Colorectal carcinoma is the most common malignant tumour of gastrointestinal tract. Globally it is third most common carcinoma. The worldwide incidence rates of colorectal carcinoma in young population are rising due to changing lifestyle patterns and westernization of diet[1]. In Pakistan, Age standardized rate (ASR) world per 100,000 is 5.3% and 3.2% in males and females respectively. Male, female ratio is almost equal for colon cancer (1:1). Men has more rectal cancers (2:1) and overall incidence of CRC is 1.7:1[1]. Incidence of colorectal cancer is more in 41-60 years age group. Fory-eight percent patients of CA colon belong to above 50 year age group but carcinoma rectum has interesting age distribution, majority of cases of carcinoma rectum belong to less than 30 year age group[2].

The symptoms and signs of colorectal cancer depend on the location of tumor and whether it has spread elsewhere in the body. Warning signs include: change in bowel habits, including diarrhea or constipation, blood in stool, change in consistency of stool, loss of appetite, unexplained weight loss or persistent abdominal discomfort[3-5]. Colorectal carcinoma can be diagnosed by screening even before the onset of symptoms. Screening decreases chance of dying from colorectal cancer and is recommended starting at age of 50 and continuing until a person is 75 years old[6].

The aim of preoperative staging is to individualize the treatment options and determine prognosis of the disease. Staging of colorectal carcinoma is based on the spread of tumour locally, to the regional lymph nodes and distant organs of the body. The stage of colorectal cancer

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Received: 14 May 2017; revised received: 13 Aug 2017; accepted: 24 Aug 2017

is based on the results of examination, biopsy and imaging studies. CT scan of abdomen and pelvis should be advised if locally advanced cancer i.e. stage B or even systemic metastases i.e. stage D are suspected[7,8]. Stage D is inoperable so by staging it is easily decided that surgery will not be of any help and chemotherapy is the treatment now required.

In 2010, study done by Dighe *et al*[7], it was found that the sensitivity and specificity of CT scan for tumour invasion i.e. stage B were 86% and 78% respectively and the sensitivity and specificity of CT in detecting lymph node metastases i.e. stage C were 70% and 78% respectively.

CT is the investigation of choice in assessment of abdomen and retro peritoneum in clinically advanced disease and it also evaluates characteristics of primary tumour i.e. Stage A and B. With advances in technology of CT scanning such as multidetector CT, CT with water enema or air insufflations and multiple planner reconstruction, its accuracy has been greatly increased in both preoperative staging and postoperative surveillance of colorectal cancers[9-11]. CT is more readily available, faster, quicker and cost effective than MRI. Nonetheless, no imaging modality is 100% accurate for preoperative staging of colorectal cancer, to date[10].

Based on the results of our study, we would be able to know that how much CT scan is accurate in staging colorectal cancers as it indi-cates the future outcome of disease. More importantly we would have local data on this issue which might help us to devise strategies to screen all the patients of colorectal carcinoma as postoperative survival rates are much encouraging if disease is detected at early stage.

PATIENTS AND METHODS

This cross-sectional validation study was conducted at Radiology department of Combined Military Hospital, Rawalpindi from July 2015 to December 2015 with permission from its Ethical Committee. Sample size was calculated through non-probability, consecutive sampling technique. By taking prevalence of colorectal cancer 18.5%, sensitivity 86%, specificity 78%[7], d=0.14 and the confidence level of 95% the number of patients calculated were n=176. Patients with colonoscopic biopsy proven colorectal carcinoma were included in the study. Brief history regarding duration of disease and verbal consent was taken from the patient. Patients with previous malignancies other than colorectal carcinoma, known allergy to contrast media and pregnant females were excluded from our study.

Contrast enhanced CT scan of all patients was performed on Philips Brillliance-16 CT scanner (S No 6115 nk-em-1589 Netherland) with 120 Kv and 150mA. Omnipaque (Iohexol 350mg I/ml) X-ray contrast agent was administered to all patients. The dose of intravenous contrast

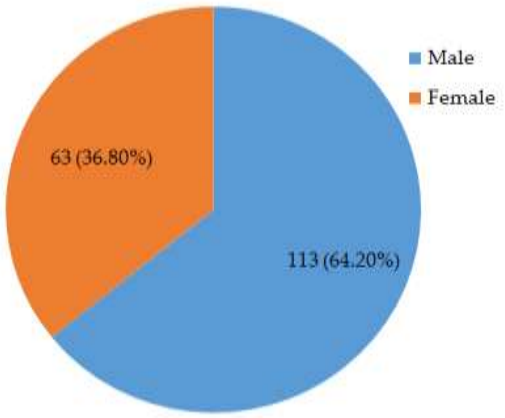

Figure-1: Percentage of patients according to gender (n=176).

agent was calculated according to the weight of patients (1-1.5ml/kg). Images (5mm thickness) were analyzed by experienced radiologist (who is working independently in the radiology department for the minimum period of five years) for staging of cancer. After CT imaging, patients were followed till surgery. After surgery, surgical specimen was reviewed by a competent histopathologist (who was working independently in the department of histopathology with experience of minimum period of five years) for histopathological findings. Involvement of muscularis propria as well as lymph nodes is definitively diagnosed by histopathological findings, which is used as a gold standard for this study. All the

information was documented on performas. After collection of data, it was analyzed using Statistical Package for Social Science (SPSS) version 16. Descriptive statistics were used to analyze demographic data which included gender, extent of tumour and lymph node involvement in terms of percentage while age in terms of mean and standard deviation.

Stratification was done with regards to age, gender and stage of colorectal cancer to see effect of these on outcome. Post stratification chi square test was applied. A *p*-value<0.05 was taken as significant.

RESULTS

Total number of 176 patients with age range was from 15-70 years were included. Mean age was 50.27 ± 14.50 years (table-I). Majority of the patients 59 (33.52%) were between 46 to 60 years of age. Out of these 176 patients, 113 (64.20%) were male and 63 (35.80%) were females, with ratio of 1.8:1 (fig-1). If CRC was limited to mucosa and muscularis propria, it was staged as Stage A and B respectively. Lymph nodal mets were staged as stage C distant mets were staged as stage D according to modified Duke's classification.

All the patients were subjected to computed tomography. Among CT positive, 80 were true positive while 11 were false positive. Among, CT negative patients, 12 were false negative while 73 were true negative as shown in table-II. Although CT poorly differentiated stage A from stage B disease, in our study, the sensitivity, specificity, PPV and NPV of CT scan for stage A were 82.14%, 90.91%, 92.0% and 80.0% respectively. CT scan had sensitivity, specificity, PPV and NPV for stage B were 93.33%, 94.12%, 93.33% and 94.12% respectively. Sensitivity, specificity, PPV and NPV of CT scan for stage C were 88.24%, 73.68%, 75.0% and 87.50% respectively. CT scan sensitivities, specificities, PPVs and NPVs were 100%, 98.33%, 83.3% and 100% for stage D respectively. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT in staging colorectal carcinoma taking histopathology as gold standard was 87.91%, 85.88%, 86.96%, 86.90% and 86.93% respectively (fig-2). Number

Table-I: Percentage of patients according to age distribution.

Age (years)	No. of Patients	Percentage
15-30	24	13.64
31-45	41	23.30
46-60	59	33.52
61-70	52	29.55
Total	176	100.0

Mean ± SD = 50.27 ± 14.50 years

Table-II: Summary of results.

	Positive result on CT Scan	Negative result on CT Scan	*p*-value
Positive result on Histopathology	80 (TP)*	12 (FN)***	0.0001
Negative result on Histopathology	11 (FP)**	73 (TN)****	

*TP=True positive **FP=False positive ***FN=False negative ****TN=True negative

Table-III: Percentage of patients according to stage of disease (n=176).

Stage of tumor	Frequency	Percentage
Stage A - Localized to bowel wall	33	18.75
Stage B - Spread through bowel wall	49	27.84
Stage C - Spread to lymph nodes	58	32.95
Stage D – Spread to distant organs	36	20.45

of patients presenting in different stages of disease is depicted in table-III.

DISCUSSION

Staging tests for CRC can be divided into noninvasive and invasive tests. Although certain aspects of staging (such as histopathological examination of sampled lymph node) require invasive tests, staging tests using noninvasive means are also important. For example, decisions about which patients should receive pre-surgical chemotherapy treatment require input from non-invasive imaging[12].

Imaging tests can be broadly divided into two categories, some provide anatomical information (e.g. CT), while others primarily provide functional information in terms of metabolic activity (e.g. positron emission tomography [PET])[13]. Conventional CT is not able to distinguish different layers of the rectal wall and has lower accuracy than EUS and MRI. The recent technical advancements however have revolutionized the capability of CT and its clinical applications. The introduction of MDCT allows faster scanning, thinner slice, increased spatial resolution and better image quality of both axial and MPR images. These advantages increase accuracy of MDCT in the local staging of rectal tumor by improving evaluation of the rectal wall and mesorectum[14]. CT is more accurate in assessing advanced stages; however, the spatial resolution of plain CT is too low to distinguish stage A from stage B lesions. CT without contrast has 50% sensitivity for local invasion, but it does not distinguish between direct tumor infiltration and an inflammatory reaction induced by the tumor. CT accuracy rates vary from 53% to 94% for depth of penetration and from 54% to 70% for lymph node metastases, but CT is unable to detect tumors in normal-sized nodes (<1 cm in diameter). Rectal lesions smaller than 2 cm may not be detected[15].

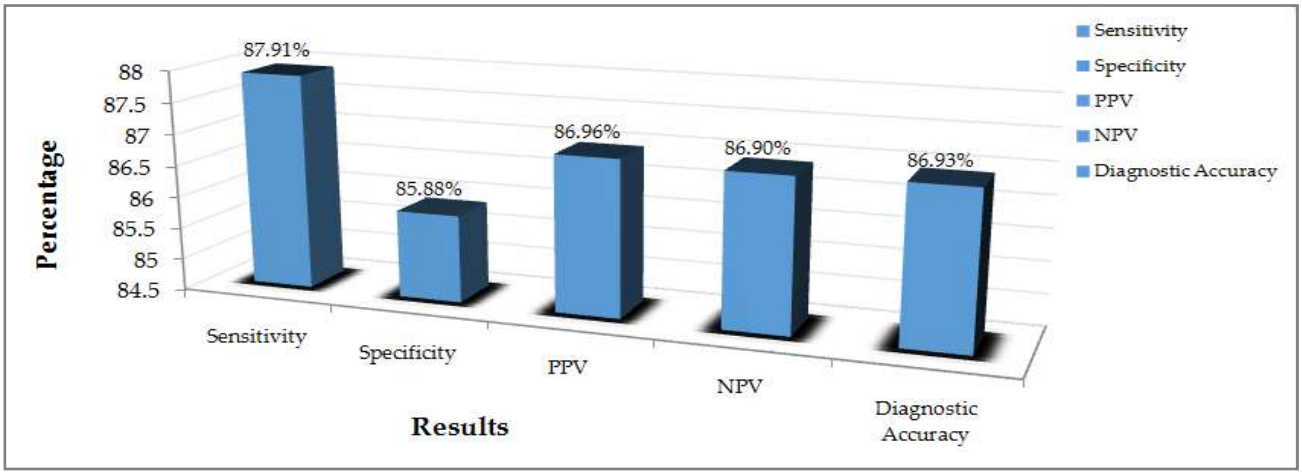

Figure-2: Diagnostic accuracy of CT scan in colorectal carcinoma, taking histopathology as gold standard.

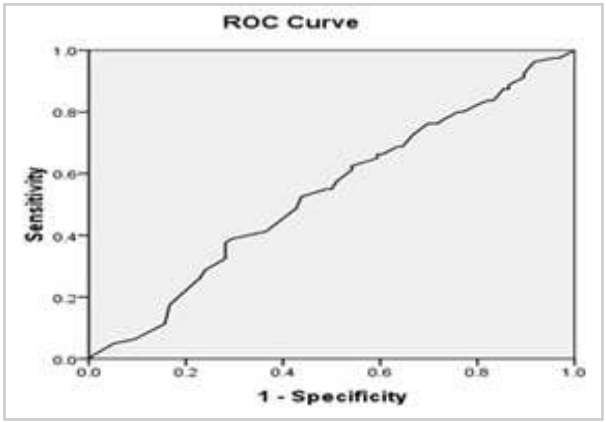

Figure-3: Diagonal Segments are produced by ties.

In this study, mean age was 50.27 ± 14.50 years which is much lower than the study of Pomerri *et al* who had observed mean age of 61 years. Many previous studies have shown a much larger mean age because they included patients with much larger age range in their studies as compared to this study[16]. On the other

hand, Dar *et al* in his study had found much comparable mean age i.e. 53 years compared to our study. In their studies, Pomerri *et al* and Ucar *et al*[17] observed that colorectal carcinoma was more frequent in males which is quite similar to results of our study. So, our study has shown that colorectal carcinoma was more common in males with increasing incidence with age. Age is a well-known risk factor for colorectal cancer, as it is for many other solid tumors.

In our study, all the patients were subjected to contrast enhanced computed tomography. Among CT positive, 80 were true positive while 11 were false positive. Among, CT negative patients, 12 were false negative while 73 were true negative. Majority of patients presented with stage C (32.9%), followed by stage B (27.84%), stage D (20.45%), and stage A (18.75%). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT in staging colorectal carcinoma taking histopathology as gold standard was 87.91%, 85.88%, 86.96%, 86.90% and 86.93% respectively.

Ashraf *et al*[18] concluded that spiral CT had 60% sensitivity and 83% specificity for assessment of local spread of disease, 66% sensitivity and 76% specificity for the evaluation of lymph nodal metastases and 89% sensitivity and 94% specificity for hepatic metastases. *Freeny et al*[19] examined 103 patients and reported sensitivity of 61% and a specificity of 81% for local tumor extension. Gazelle *et al*[20] correctly assessed 23 of 30 tumors using water as intraluminal contrast. The best-published results however, are for Hundt *et al*[21] with an accuracy of 81%.

In a study[22], the diagnostic accuracy of MDCT for T1/T2, T3 and T4 lesions was 77%, 86.5% and 100%, respectively. For perirectal lymph node metastasis (N+), the diagnostic accuracy of MDCT was 84.1%. The diagnostic accuracy of MDCT for MRF involvement was 91%.

Recently published studies with MDCT, which evaluated both axial and MPR images reported an accuracy rate between 78% and 96%. These studies concluded that MPR image increased accuracy of MDCT in the N staging by allowing more accurate measurement of lymph node and better differentiation of lymph nodes from small perirectal vessels.

Our study found that contrast enhanced computed tomography is a highly sensitive and accurate modality for staging colorectal carcinoma, however not a single technique is 100 percent accurate in detection of bowel carcinoma. Thus, further studies are required to compare the diagnostic accuracy of invasive procedures with the risks of complications and individual tolerance.

CONCLUSION

Computed tomography is a highly sensitive and accurate modality for staging colorectal carcinoma. So, it is recommended that CT scan should be used as a prime modality in every colorectal carcinoma patient for the early detection of stage which would help surgeons for preoperative planning and offer proper and timely management regarding neo-adjuvant therapy to these particular patients for better prognosis.

Author's Contributions

Nasira Sultana: Acquisition of data and drafting of article.

Sumayya Khan: Data analysis and interpretation of data.

Salahuddin: Concept and design.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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