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Colorectal carcinoma, preoperative evaluation by spiral computed tomography

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Original Article

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Abstract

Objectives: To assess the capability of spiral computed tomography (CT) scan in preoperative evaluation of colorectal carcinoma (CRC).

Methods: A cross sectional study on 52 patients with recent histopathologic diagnosis of CRC was conducted over a period of one year at the Aga Khan University Hospital, Karachi. All these patients underwent spiral CT with oral and intravenous contrast administration. Surgery was subsequently done in all cases and surgical specimens were sent for detailed pathologic analysis. The radiologic findings on the CT scans were compared with the pathological findings.

Results: The results proved 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. In all the cases, the visualized tumour growth with wide zone of resection and regional nodal chains were surgically removed. It was however, the distant metastases which made a difference to the type of curative or palliative surgery planned and in this study spiral CT had 92% accuracy for detection of hepatic metastases.

Conclusion: With technological advances and improvement in imaging protocols the results for local tumor spread are expected to improve, however based on the accuracy in detecting hepatic metastases in clinically unsuspected patients, this study proves that spiral CT has a significant role in preoperative evaluation and subsequent management of CRC (JPMA 56:149;2006).

Introduction

Carcinoma of the colon and rectum is one of the most prevalent malignancies worldwide. In the United States, CRC ranks second to lung cancer as a cause of cancer death. In Pakistan it constitutes 25.4% and 20.1% of gastrointestinal malignancies in males and females respectively.[1] Medical literature abounds with evidence that early detection and aggressive management of these lesions can significantly improve patient survival.

Colorectal cancer is usually diagnosed by barium studies and colonoscopy followed by biopsy. Although these techniques provide superb visualization of the mucosa, they cannot determine the depth of mural invasion by the tumor or the extent of metastatic disease. In patients with colorectal cancer, accurate assessment of tumour extent within and beyond the bowel wall, the presence or absence of lymphadenopathy and distant metastases is significantly important.

Preoperative imaging aims to accurately assess tumour extent to individualize patient therapy, facilitate evaluation of treatment results, assess risk of disease recurrence and determine prognosis. This study was done to prospectively evaluate the CT scans of these patients over a one year period and compare their findings with those seen at surgery and histopathology, which was taken as a gold standard. The results were then evaluated statistically. On the basis of the results conclusions were derived, about the future utility of spiral CT in preoperative evaluation of colorectal carcinoma.

Patients and Methods

This was a prospective cross-sectional study carried out over a one-year period in which a total of 52 patients with biopsy proven CRC undergoing surgery were preoperatively evaluated by spiral CT 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. Excluded from the study were all patients who had received any prior treatment for the CRC or those who had any concurrent disease process, which could result in a false interpretation of the CT scan.

All patients received 2 liters of 2% methylglucamine diatrizoate (Gastrografin, Squibb) as oral contrast medium 2 hours before the scan. Injected intravenously was 100ml of non-ionic water-soluble contrast medium (Omnipaque, Schering containing 300mg Iodine / ml). Examination was carried out using GE HiSpeed Pro Medical Systems (General Electric, USA) spiral CT scanner. The slice thickness was 7mm and interslice gap was also 7mm. Pitch

was 1-1.5. Images were acquired from the dome of diaphragm to the pubic symphysis in craniocaudal fashion. Scanning was started in spiral mode 45-50 seconds after the start of intravenous contrast injection. Images were acquired in venous phase of enhancement, which is ideal for detection of hepatic metastases, majority of which are hypovascular. 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 3 minutes in all patients. The patient time in the room was 15-20 minutes.

Image interpretation was carried out by the same (one only) radiologist. Images were interpreted with 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.); lymph nodes (taken as a single adjacent node 1cm or larger or a cluster of 3 or more nodes, even less than 1cm. Lymph nodal size was taken in the largest dimension.); 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). The collected data was analysed using the Microsoft Windows based Statistical Package for the Social Sciences (SPSS- released 10.1, standard version, copyright SPSS; 1989-1999). Measure of association and 95% confidence interval was then calculated based on the results.

Results

There were a total of 52 patients out of which 32 were male and 20 female. The mean age was 58 years with a range from 22 to 87 years. The clinical presentation in majority of cases was of abdominal pain (32%) and altered bowel habits (30%). The other symptoms include weight loss and bleeding per rectum in 22% patients each, a palpable mass in one and one patient had no symptoms.

Forty eight out of the 52 primary malignant lesions were detected on the spiral CT yielding a sensitivity of 92%. They were mostly localized in sigmoid colon and rectum. Twenty one of the 48 (44%) lesions were in the form of circumferential thickening of the bowel wall (Figure 1) and 27 (56%) were discrete focal masses.

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 34 of 52 scans (65%) (Figure 2). Incorrect assessment was made in 18

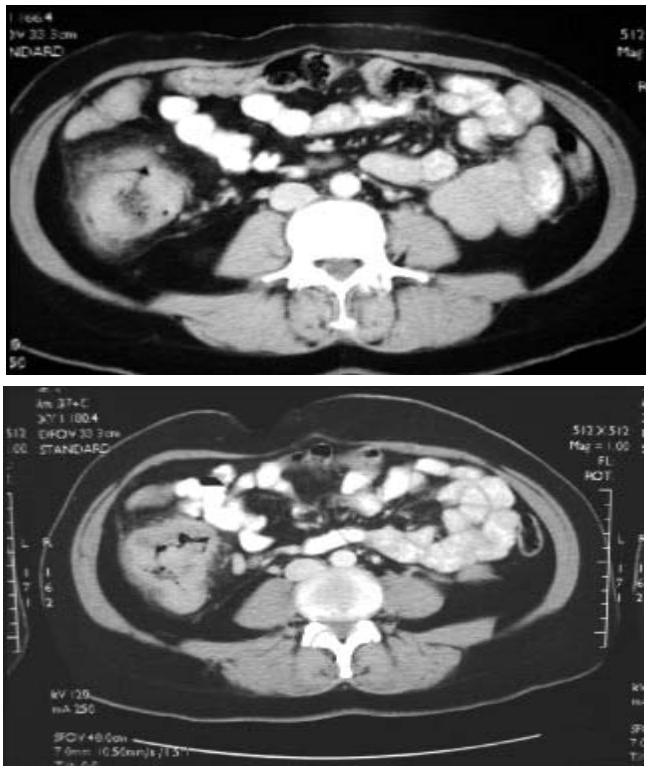

Figure 1. Malignant tumor of the ascending colon. Circumferential wall thickening with extramural spread (A) and paracolic lymphadenopathy (B), all correctly detected on the CT scan.

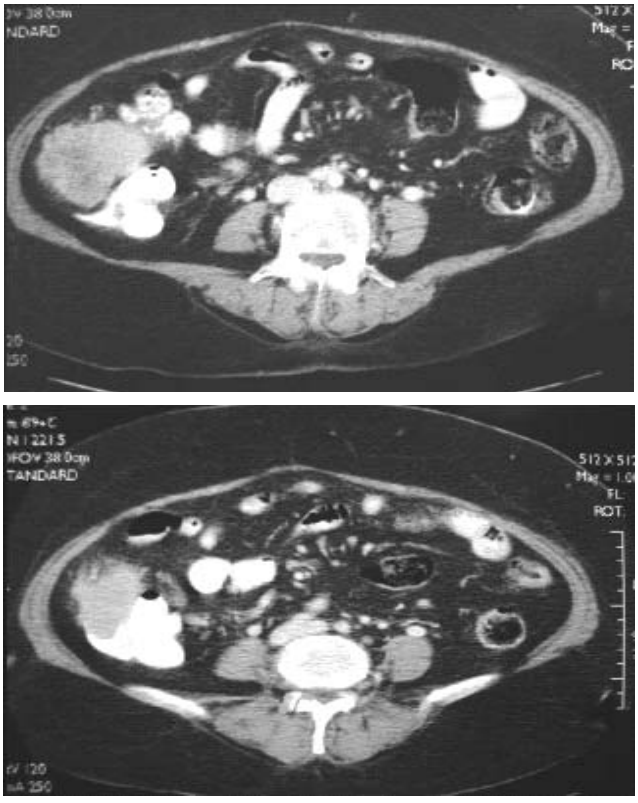

Figure 2. Carcinoma of the ascending colon (A). Tumor necrosis & extramural spread were correctly identified on the CT scan.

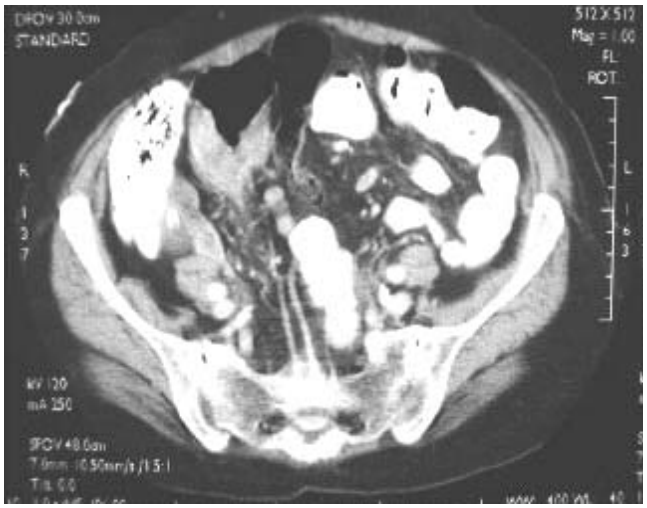

Figure 3. Tumor present in the sigmoid colon (A). CT was falsely positive for extramural spread (B). Vascular congestion with edematous changes in adjacent fat was seen on surgery. These were negative for any malignant cells on pathology.

scans (35%). Of the 34 scans correctly evaluated, 24 had extramural tumour spread (true positive) and 10 did not (true negative). Of the 18 CT scans proven to be incorrectly evaluated, local spread was falsely interpreted as positive in 2 patients and as negative in 16 patients (Figure 3). The sensitivity and specificity of CT scan in detecting local tumour spread in this study was 60% (95% confidence interval 43.4, 74.7) and 83% (95% confidence interval 50.9, 97.1) respectively. The positive and negative predictive values were 92% (95% confidence interval 73.4, 98.7) and 38% (95% confidence interval 20.9, 59.3) respectively.

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 36 out of 52 (70%) cases and incorrectly in 16 out of 52 (30%). Twenty three out of these 36 scans correctly assessed had histologically proven metastatic lymphadenopathy (true positive). The remaining 13 of the 36 were accurately described as negative for lymphadenopathy (true negative). The sensitivity and specificity for detection of adenopathy was 66% (95% confidence interval 47.7, 80.3) and 76% (95% confidence interval 49.8, 92.27) respectively. The positive predictive value for metastatic lymphadenopathy was 85% (95% confidence interval 65.4, 95.1) and negative predictive value 52% (95% confidence interval 31.8, 71.7).

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 48 out of 52 scans (92%) with 16 true positives and 32 true negatives. Of the remaining four, 2 scans were proven to be false positive and 2 false negative on surgery. 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 assessment and ultrasonography was done. Three patients could not be followed up since two expired and one was lost to follow up. The sensitivity and specificity of preoperative CT for hepatic metastases was proven to be 89% (95% confidence interval 63.9, 98.1) and 94% (95% confidence interval 78.9, 99.0) respectively. Positive and negative predictive values were 89% (95% confidence interval 63.9, 98.1) and 94% (95% confidence interval 78.9, 99.0) respectively.

Metastases to lungs were found in 5 patients. Located on lung bases, all of these were identified correctly.

Two patients had adrenal masses and were diagnosed as having unilateral metastatic deposits to the adrenals on CT scan. One of these was proven on CT guided biopsy. The lesion in the other patient was proven on histopathology to be a benign adrenal cortical adenoma. The accuracy therefore, for adrenal metastases was 50%.

CT scan also picked up skeletal metastases in two patients and peritoneal deposits in 4 out of 9 patients with metastatic disease to the peritoneum (accuracy of 44%). Liver resection was carried out in fifteen cases.

Discussion

Local spread of tumor

Accurate prediction of local spread was made in 65% of patients with a sensitivity and specificity of 60% and 83% respectively.

Balthazar et al[2] found an accuracy of 58% in 90 patients. Freeny et al[3] examined 103 patients and reported sensitivity of 61% and a specificity of 81% for local tumor extension. Gazelle et al[4] correctly assessed 23 of 30 tumors using water as intraluminal contrast. The best-published results however, are for Hundt et al[5] with an accuracy of 81%.

In the study done by Hundt et al[5], the arterial phase of contrast enhancement was used for evaluation of mural and extramural disease which was helpful in differentiating the mucosal membrane, the submucosa and the serosa as three differentially enhancing layers. Tap water enema (1.5 liter) was given as intraluminal contrast and 2ml Buscopan/ 0.5mg Glucagon were injected intravenously for colonic relaxation. Oral colon cleansing preparation was given to

each patient. Furthermore imaging was done with a sub second spiral scanner using collimation of 5mm. And the imaging time was 0.75 seconds totally eliminating motion artifacts.

As is evident the limitations in this study are, only the traditional venous phase of contrast enhancement was used for imaging which although optimal for detection of hepatic metastasis is not comparable to the much focused study briefly described above, in terms of evaluating local spread of tumor. This study as well as prospectively evaluating the accuracy of our existing CT protocols, also helped us to devise more accurate techniques of detection of local spread of colorectal cancer. Though literature supports the role of arterial phase of imaging for detection of local spread, but since our existing protocol was different and also as the currently employed venous phase was more accurate for detection of hepatic metastasis, we persisted with the existing protocol. At the conclusion of this study, upon review of the results, we did realize this potential weakness and have since adopted arterial phase imaging for detection of local spread of tumor. Similarly, no bowel preparation was given and above-mentioned gut paralytic agents were also not injected.

Lymphadenopathy

Lymph nodal assessment was accurate for 70% of the patients. The sensitivity and specificity being 66% and 76% respectively. These figures, though still not excellent compare favorably with most other studies. In patients with a primary tumor seen on CT, sensitivity up to 87% has been reported.[6] Balthazar et al[2] determined a sensitivity of 73% and a specificity of 46%. The disparity in the results of various authors is most likely related to the different diameter of nodes considered pathologic. If the criterion for nodal size, which is 1cm, is lowered, the sensitivity increases at the expense of specificity. Convention dictates that it is the specificity of CT for metastatic lymphadenopathy, which is its asset rather than sensitivity. The study by Freeny et al[3], although a slight overstatement of what is generally believed is worth mentioning. This study has an enviable specificity of 96%, at the cost of 26% sensitivity. It has to be mentioned that the sensitivity for lymphadenopathy in this study is unexpectedly low due to the fact that the authors labeled a node malignant if its size was a minimum 1.5cm.

Modern surgical opinion helps to solve this universal problem faced by radiologists concerning nodal assessment. It is now accepted that low sensitivity is not a significant clinical problem because regional lymph node sampling is routinely performed at surgery.[7] Pathways of nodal metastases can be reliably predicted based on the site of the primary tumor.[8]

Metastatic disease

CT has an established role in the detection of hepatic metastases. Currently spiral CT coupled with rapid injection of contrast material is the preferred technique for hepatic imaging and is more sensitive than conventional scanning for tumor detection and characterization. When imaging the liver for metastases, adequate hepatic enhancement is crucial. Using spiral CT, Kuszyk et al[9] achieved a sensitivity of more than 90% for detection of liver lesions more than 1cm in diameter and a sensitivity of more than 56 % for detection of lesions smaller than 1cm. These results represent an improvement over those achieved with traditional incremental CT.

The results of this study are equally good with 89% sensitivity (95% confidence interval 63.9, 98.1) and 94% specificity (95% confidence interval 78.9, 99.0) for liver metastases.

This study shows that spiral CT has an accuracy of 65% for local spread of colorectal carcinoma, 70% for evaluation of lymphadenopathy and 92% for hepatic metastases. We believe more studies are required in this regard. Apart from this study, no other study done in Pakistan using spiral CT for preoperative evaluation of colorectal carcinoma was found indexed in Index Medicus.

The limitations in local spread can be significantly improved using several modifications in technique mentioned above. The problems encountered in reliable assessment of nodal status are real and they are expected to decrease with effective surgical sampling of regional nodal chains.

The management and prognosis of a patient with a known malignancy significantly depends on the presence or absence of distant metastases. It is in the detection of metastatic disease, especially to the liver where rapid contrast enhanced spiral CT has its real role. In these patients, clinically unsuspected CT findings may lead to changes in either the preoperative management or the type of surgical intervention. Therefore the use of spiral CT for preoperative evaluation in all patients recently diagnosed with colorectal carcinoma is advocated.

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