A prospective study of colonic tumors and accuracy of CT pneumocolon in staging colonic carcinoma

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ABSTRACT

Background: Preoperatively, reliable diagnosis of the amount of dissemination of a colorectal cancer not only reveals the probable outcome but also aids care. There have been few studies on the use of spiral computed tomography (CT) pneumocolon for pre-operative staging of colorectal cancer. **Aims and Objectives:** Therefore, the present study was undertaken to evaluate colonic masses and determine the accuracy of spiral CT pneumocolon in staging colonic carcinomas. **Materials and Methods:** This prospective and hospital-based study was conducted for 2 years of period at the Department of Radiodiagnosis and comprised 75 patients who were sent for CT abdomen. All patients of all ages referred for CT examination with symptoms and/or clinical suspicion of colonic cancer, suspected colonic tumor, blockage, or stricture on barium studies or colonoscopies, or worrisome sonographic abnormalities, including colonic wall thickening and other features indicative of colon cancer were included in the study. **Results:** The predominated gender is male (63%) than female (37%). The observations reveal that, in malignant diseases, bleeding per rectum was the most prevalent symptom, while discomfort in the abdomen was the most common symptom in benign pathologies. CT pneumocolon correctly diagnosed cancer in all 57 patients, although three benign lesions were incorrectly categorized as malignant. The sensitivity and specificity for differentiating benign from malignant lesions were both 100% (57/57) and 83.3% (15/18). **Conclusion:** CT pneumocolon looks to be a non-invasive and quick inquiry that clearly displays the lumen of the colon, wall of the colon, surrounding structures, extraluminal component of colonic lesions, and metastases and gives useful information preoperatively.

Key words: CT pneumocolon; Colonic carcinoma; Staging; Modified dukes classification

INTRODUCTION

The function, indications, and accuracy of computed tomography (CT) of the colon have drastically expanded and improved with the introduction of high-resolution scanners, technological advances in getting better quality images, and cumulative clinical experience leading to better interpretation.[1,2] Colorectal carcinoma is one of the most common kinds of cancer globally.[3] Preoperatively, reliable diagnosis of the amount of dissemination of a colorectal cancer not only reveals the probable outcome but also aids care. Many studies have indicated that water enema spiral CT is an effective technique for pre-operative staging of colorectal cancer patients.[4,5] Water enema, on the other hand, can be difficult and painful in frail senior individuals and there is a danger of water incontinence. Air insufflation for the colon is simple and quick and patients tolerate it well. Air also serves as an effective CT contrast medium.[6]

Following rectal insufflation, the colon is always emptied, paralyzed, and spiral CT images of the abdomen and pelvis are conducted. Virtual colonoscopy is a 3D computer simulated endoscopic "fly through" of the colon that employs small collimation, no intravenous contrast, and three dimensional endoluminal computerized reconstruction and visualization, whereas

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CT pneumocolon uses thicker collimation and intravenous contrast. CT pneumocolon demonstrates the involvement of colon problems on both the mural and extramural levels. Virtual colonoscopy produces high-quality pictures of the intestinal lumen but provides inadequate evaluations of extracolonic disease, which might be a disadvantage of this approach. Furthermore, the enormous quantity of two-dimensional axial pictures increases the time necessary for data reconstruction and viewing, and three-dimensional reconstructions need the use of additional software. Spiral CT pneumocolon, a simple extension of traditional abdominal and pelvic CT, does not yield unnecessary pictures and does not require specialist software. Although intravenous contrast media is not utilized in virtual colonoscopy, it is a necessary component in CT pneumocolon. Intravenous contrast is critical because the lesion enhancement pattern helps distinguish benign from malignant diseases, feces from haustral folds, and increases lesion identification in collapsed and fluid-filled segments, rendering virtual colonoscopy uninterpretable.

The potential significance of CT pneumocolon in assessing colonic problems is demonstrated by both secondary symptoms of bowel illness and direct imaging of the gut wall. The two- and three-dimensional reconstructions of images for colonic luminal evaluation in CT pneumocolon not only aid the radiologist in establishing a diagnosis, but also communicate the information to physicians in a manner that they are more familiar with. Attenuation pattern of colonic wall thickening (Figure 1); degree of colonic wall thickening; circumferential symmetric thickening versus asymmetric thickening (Figure 2); length of involvement and associated perienteric abnormalities such as abnormal fat or hypervascularity; and metastasis to other organs are some of the criteria used to differentiate benign and malignant conditions. There have been few studies on the use of spiral CT pneumocolon for preoperative staging of colorectal cancer. Keeping these things in the mind, the present study was undertaken to evaluate and characterize colonic masses and determine the accuracy of spiral CT pneumocolon in staging colonic carcinomas using CT pneumocolon examination.

Aims and objectives
To evaluate colonic masses and determine the accuracy of spiral CT pneumocolon in staging colonic carcinomas.

MATERIALS AND METHODS

This prospective and hospital-based study was conducted for 2 years of period at the Department of Radiodiagnosis and comprised 75 patients who were sent to the department of Radiodiagnosis for CT Abdomen. The Institutional Ethical committee clearance was obtained before beginning of the study.

Selection criteria
Inclusion criteria
The following criteria were included in the study:
1. All patients of all ages referred for CT examination with symptoms and/or clinical suspicion of colonic cancer
2. All patients of all ages who had a suspected colonic tumor, blockage, or stricture on barium studies or colonoscopies, or worrisome sonographic abnormalities, including colonic wall thickening and other features indicative of colon cancer.

Exclusion criteria
The following criteria were excluded from the study:
1. Patients whose CT scans revealed no colonic pathology
2. Patients who are contraindicated for IV contrast delivery, such as those who have renal insufficiency or a known allergy to contrast material.

Data collection procedure
All patients had a thorough clinical history and physical examination. Patients who could handle it were given a bowel cleaning enema the night before. This was avoided in elderly, infirm individuals. Patients were also put on a reduced residue diet the day before the testing. In this investigation, the typical CT scanning protocol consists of scanning the abdomen after contrast material has been administered orally, rectally, and intravenously (Triple contrast).

The colon was gradually insufflated with room air (negative contrast) to the greatest level allowed by the patient following the insertion of a rectal tube, and colonic distention was monitored by the CT scout radiograph. In situations with poor intestinal distension, the rectal tube was left in place and more insufflation was performed. In disabled patients, rectal contrast delivery was avoided. Patients with no visible abnormalities on plain imaging were ruled out of the trial. In a few situations, the CT approach was precisely adapted to the suspected diagnosis ahead of time. Patients suspected of having an intestinal blockage were not administered oral contrast media. The remaining water and fluid in the dilated intestinal lumen served as negative contrast media.

Masses, strictures, and focal foci of gut thickening were identified in the images. The lesions were further classified based on their location, degree and duration of colonic involvement, symmetry/asymmetry of the affected intestine, pattern of attenuation, pericolonic fat stranding, pericolonic lymph nodes, and other bowel-related characteristics such as ileocecal junction involvement. Bowel attenuation was classified as homogeneous or

heterogeneous. The density of the neighboring pericolic fat was measured. The size and number of lymph nodes, as well as distant liver metastases, were also recorded. The short axis of lymph nodes was measured, and those with diameters more than 1 cm or displaying apparent increase on contrast were regarded relevant for tumor involvement. The lesion was classified as either malignant or benign. On CT, all patients with colonic cancer were staged using the modified Duke's classification:

Duke's staging[7]
- Stage A – Tumor limited to colonic wall
- Stage B – Extension through serosa into pericolic fat
- Stage C – As for stage B but with positive findings of local lymphadenopathy
- Stage D – Distant metastasis.

Patients who had CT pneumocolon had further histology evidence of diagnosis and pathologic Duke's stage if cancer was confirmed. Colonoscopy and barium enema observations are also recorded if they were performed prior to the CT pneumocolon.

Statistical analysis
Descriptive statistics such as mean, SD, and percentage were used to present the data. CT pneumocolon accuracy in staging was assessed by sensitivity and specificity. Data analysis was performed using statistical software SPSS v20.0.

RESULTS

In the present study, the predominated gender is male (63%) than female (37%). The onset of colonic diseases ranged from 18 to 81 years of age (mean age 57 years). The greatest incidence occurred between the ages of 41 and 70. In all age categories, males outnumbered female. There are 76% of malignant diseases and 24% of benign pathologies. However, the percentage of malignancy among all patients is about identical (58% for males and 61% for females). Few patients had more than one symptom. The observations above reveal that in malignant diseases, bleeding per rectum was the most prevalent symptom, while discomfort in the abdomen was the most common symptom in benign pathologies (Table 1).

The majority of benign diseases (77.8%) result in bowel thickening of 2 cm with a mean wall thickness of 1.2 cm, whereas the majority of malignancies (77.2%) result in bowel thickening of >2 cm with a mean wall thickness of 2.5 cm. The thicker gut wall is uniformly attenuated in the majority of benign inflammatory disorders (44.4%). Only benign cases (33.3%) had stratified gut wall attenuation, whereas 22.2% have mixed attenuation. The bulk of malignant lesions (78.9%) had thickened intestinal wall attenuation. The majority of malignant pathologies (68.4%)
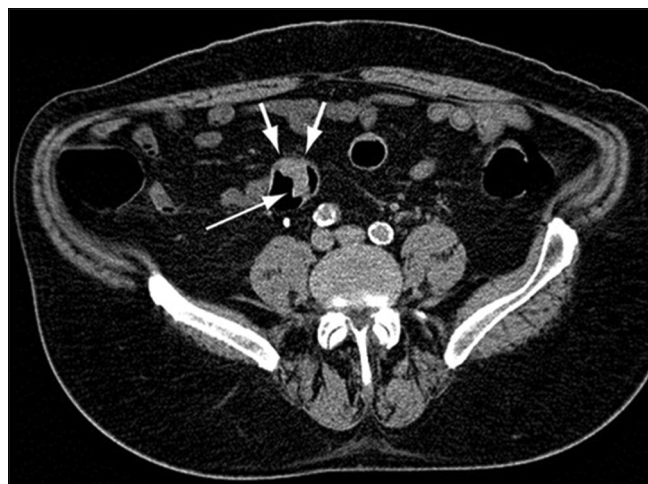

Figure 1: Mild homogeneously enhancing endoluminal focal lesion

Figure 2: Asymmetrical colonic wall thickening

involved small segments with a mean length of the bowel of 4.7 cm, whereas the majority of benign inflammatory pathologies (55.6%) involved large segments with a mean length of 7.9 cm. Minor stranding was shown to be associated with benign inflammatory diseases (66.7%), whereas major stranding was found to be associated with most malignant pathologies (78.9%). Asymmetric thickening of the intestinal wall is evident in all cancer cases and a few instances of tuberculosis. The majority of benign illnesses (72.2%) affected the gut wall symmetrically (Table 2).

Histology indicated that seven of the 57 carcinomas were Duke's Stage A, with three appropriately staged and four overly advanced. Histologically, 17 carcinomas were classified as Stage B, with 11 being correctly advanced, five being over staged because to significant regional lymphadenopathy that was shown to be reactive on histology, and one being under staged. There were 24 Dukes Stage C carcinomas found, 15 of which were correctly staged and nine of which were wrongly staged due

to false negative lymph node findings. All nine Dukes D stage carcinomas were correctly staged using CT (Table 3). CT pneumocolon correctly diagnosed cancer in all 57 patients, although three benign lesions were incorrectly categorized as malignant. The sensitivity and specificity for differentiating benign from malignant lesions were both 100% (57/57) and 83.3% (15/18) (Table 4).

An irregularly serrated or hypothesized outer contour, tumor mass or strands of soft tissue extending out, and/or continuously increasing density in pericolonic fat were all signs of local extra mural invasion. We correctly identified serosal invasion in 44 of 46 patients while incorrectly classifying five patients who did not have serosal invasion as positive. Invasion of lymph nodes was defined as a lymph node with a short axis diameter higher than 1 cm or a lymph node with a diameter <1 cm and visible enhancement. We correctly identified lymph node involvement in 24 of 33 patients while incorrectly labeling three patients as positive for lymph nodes. In 13 of 13 cases, we correctly diagnosed metastases (Table 4).

DISCUSSION

Colonic carcinomas are one of the most prevalent carcinomas in the western world and the prevalence of colonic carcinoma is growing in India as life expectancy rises. Colorectal cancer is diagnosed mostly by colonoscopy and barium enema. Guidelines support neoadjuvant chemoradiotherapy for the treatment of MRI-staged high-risk rectal cancers, defined as tumors involving the mesorectal fascia.[8]

In the present study, there were 28 (37%) females and 47 (63%) males. The peak age for benign pathologies ranged from 21 to 50 years, whereas the peak age for malignant pathologies ranged from 51 to 70 years. The malignant group had a mean age of 64 years, whereas the benign group had a mean age of 41 years. Xiong et al., had evaluated 111 male and 74 female patients, with a mean age of presentation of 59 years.[9] The study evaluated 92 individuals with pathologically verified colonic wall thickening (70 men and 22 females; mean age 57 years).[10]

Malignant neoplastic lesions (76%) were the most prevalent, followed by infective lesions, followed by various benign lesions such as polyps, Crohn's disease, and diverticulitis (two each), and two vascular lesions.

According to Balthazar et al., the most prevalent presenting symptoms in individuals with colorectal cancer were rectal bleeding (52.4%) and bloody diarrhea (16.2%).[10] In the present study, the most prevalent presenting symptom

Table 1: Basic characteristics

Characteristics	Number	Percentage
Sex		
Male	47	63
Female	28	37
Age		
11–20	3	4
21–30	10	13
31–40	11	15
41–50	13	17
51–60	18	24
61–70	15	20
>70	5	7
Etiology		
Malignant	57	76
Benign	18	24
Symptoms		
Bleeding per rectum	25	33
Change in bowel habits	28	37
Constipation	11	15
Anemia	20	27
Weight loss	20	27
Pain in abdomen	23	31
Fever	10	13
Abdominal lump	7	9
Malena	7	9

Table 2: Distribution malignant and benign pathologies – CT findings

CT finding	Benign (%)	Malignancy (%)
Pattern involvement		
Asymmetric	5 (27.8)	57 (100)
Symmetric	13 (72.2)	0
Length of colon involved		
<5 cm	6 (33.3)	39 (68.4)
5–10 cm	10 (55.6)	18 (31.6)
>10 cm	2 (11.1)	0
Attenuation of wall thickening		
Homogenous	8 (44.4)	12 (21.1)
Stratified attenuation	6 (33.3)	0
Mixed	4 (22.2)	45 (78.9)
Colonic wall thickening		
Mild <2 cm	14 (77.8)	13 (22.8)
Marked >2 cm	4 (22.2)	44 (77.2)
Pericolonic fat stranding		
None	0	4 (7.0)
Mild	6 (33.3)	41 (71.9)
Moderate	8 (44.4)	10 (17.5)
Severe	4 (22.2)	2 (3.5)

was change in bowel habit (37%), followed by rectum hemorrhage (33%) and abdominal discomfort (31%).

The rectum was the most prevalent location of malignancy (42.1%) in the present study, while it was 36% in the study by Xiong et al.[9] In the present study, two cases of diverticulitis were discovered in the sigmoid colon, extending to the descending colon, which is the most common location; however, Lee discovered that in Indians, diverticulitis is more commonly detected in the right colon.[11] Both polyps were discovered in the rectum,

Table 3: Staging of colonic carcinomas

Pathologic findings	CT pneumocolon findings					
	Stage A	Stage B	Stage C	Stage D	Benign	Total
Stage A	3	4	-	-	-	7
Stage B	1	11	5	-	-	17
Stage C	-	9	15	-	-	24
|Stage D	-	-	-	9	-	9
Benign	-	-	3	-	15	18
Total	4	24	23	9	15	75

*-Stage A-D refers to Modified Duke's classification

Table 4: CT pneumocolon accuracy in staging

Diagnostic accuracy parameters	Modality		
	Local serosal invasion	Metastasis	Lymph node involvement
Sensitivity	95.7 (44/46)	100 (13/13)	72.7 (24/33)
Specificity	45.5 (5/11)	100 (44/44)	87.5 (21/24)

which is the most prevalent location, as demonstrated by Chung et al.[12]

CT pneumocolon has been widely utilized to distinguish colon cancer from benign diseases utilizing a variety of criteria.

Degree of colonic wall thickening: According to Macari and Balthazar, modest (2 cm) bowel wall thickening was primarily found in benign pathologies, whereas most significant (>2 cm) thickening was mostly present in malignant pathologies.[13] Suwalee and Wannasopha stated that modest (1.2 cm) thickening implies benign illness (diverticulitis), whereas substantial thickening (>1.2 cm) indicates colon cancer.[14] In the present study, the majority of benign inflammatory diseases cause intestinal thickening of 2 cm (77.8%) with mean wall thickness 1.2 cm, while the majority of malignancies create wall thickness >2 cm (77.2%) with mean wall thickness 2.5 cm.

According to Macari and Balthazar, the stratified kind of attenuation is more prevalent in benign diseases than cancer.[13] In the present study, benign diseases showed stratified attenuation (33%). Such attenuation is not seen in any case of cancer. Mixed attenuation is more prevalent in carcinoma and indicates a high degree of malignancy. In the present study, 78.9% of the carcinomas showed mixed attenuation. Some benign instances have a mixed kind of attenuation (22.2%).

According to Macari and Balthazar, gastrointestinal neoplasms are usually focal short segment involvement, with diffuse long segment thickening of the intestine wall more common in benign situations than malignant neoplasms.[13] In the present study, most malignant pathologies had short segment involvement (68.4%), with a mean length of affected bowel 4.7 cm, whereas most benign inflammatory pathologies had long segment involvement (55.6%), with a mean length 7.9 cm.

According to Macari and Balthazar, when perienteric fat stranding occurs next to a thicker tract of intestine, an inflammatory condition should be recognized.[13] In a research conducted by Suwalee and Wannasopha, pericolonic severe fat stranding was more prevalent in patients with diverticulitis (89.5%) than in patients with colonic cancer, with the majority of cases showing mild fat stranding (73.9%).[14] In the present study, benign patients had more moderate-to-severe fat stranding (66.7%), while malignant patients had more mild stranding (71.9%).

According to Macari and Balthazar, the pattern of engagement is as follows: Symmetric thickening occurs when the affected segment has the same degree of thickening across the whole circle of the aberrant section. Different degrees of eccentric thickening around the perimeter of the affected segment are referred to as asymmetric thickening. Intestinal inflammatory diseases, infections, bowel edema, and ischemia all cause symmetric thickening. Asymmetric or eccentric intestinal thickening is most commonly associated with malignant diseases.[13] In the present study, all (100%) colon carcinomas were asymmetric, whereas benign disease has symmetric involvement more frequently (72.2%).

In the present study, we accurately identified all 57 colonic carcinomas and misdiagnosed three benign lesions as Stage C malignancy due to uneven outer colon wall opacification and significant lymphadenopathy. As a result, the sensitivity and specificity for distinguishing benign from malignant lesions were 100% (57/57) and 83.3% (15/18), respectively. Overall, the accuracy rate was 95%. In the study conducted by Sun et al., reported that, it correctly staged 6 (33.3%) of 18 patients with Dukes A lesion, 18 (78.3%) of 23 patients with Dukes B lesion, 10 (66.7%) of 15 patients with Dukes C tumor, and 7 (87.5%) of eight patients with Dukes D tumor.[15] In the study conducted by Harvey et al., all 37 carcinomas were accurately identified; however, two benign lesions were misinterpreted as Stage B colonic carcinoma. As a result, the sensitivity and specificity for distinguishing benign from malignant lesions were 100% (38/38) and 86%

(13/16), respectively. Overall, the accuracy rate was 96%.[6] Our results are corresponded similarly with previous studies.[15,16]

Sensitivity and specificity for local serosal invasion were determined to be 95.7% and 45.5%, respectively, and 72.7% and 87.5% for lymph nodal involvement.

Harvey et al., observed that the sensitivity and specificity for local serosal invasion were 100% (35/35) and 33% (1/3), respectively, and that the sensitivity and specificity for lymph node involvement were 56% (9/16) and 95% (21/22).[6]

Limitations of the study

The majour limitations in the present study are Frail, uncooperative patients, Known or impending colonic perforation, Very tight anal stricture, Profuse per rectal bleeding.

CONCLUSION

CT pneumocolon looks to be a non-invasive and quick inquiry that clearly displays the lumen of the colon, wall of the colon, surrounding structures, extra luminal component of colonic lesions, and metastases and gives useful information preoperatively. Furthermore, it is less operator reliant, patient-friendly, and technically simple.

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