

Accuracy of Multidetector Computer Tomography in Differentiating Benign and Malignant Colorectal Lesions with Histopathological Correlation

Anto J Richie¹, P Mellonie², H B Suresh³

¹Assistant Professor, Department of Radiodiagnosis, Father Muller Medical College, Kankanady, Mangaluru, Karnataka, India, ²Assistant Professor, Department of Pathology, Father Muller Medical College, Kankanady, Mangaluru, Karnataka, India, ³Professor and Head, Department of Radiodiagnosis, Father Muller Medical College, Kankanady, Mangaluru, Karnataka, India

Abstract

Introduction: Colorectal cancer is the third most common cancer in men and the second most common in women worldwide. Multidetector computer tomography (MDCT) has become a useful tool in the assessing gastrointestinal tract and providing accurate information about lumen, its wall and surrounding structures. This study is an attempt to study the role of MDCT in characterizing colorectal lesions as either benign or malignant.

Purpose: The study aims at evaluating the accuracy of MDCT in differentiating benign and malignant lesions of colon.

Materials and Methods: This is a hospital-based retrospective correlative study conducted in the Department of Radiodiagnosis, Father Muller Medical College between October 2015 and March 2016. 45 patients of both sexes and all age groups, with wall thickening involving the colon and rectum on computerized tomography (CT) and for whom histopathology diagnosis was available, were included in the study. Wall thickening in patients with colorectal lesions was characterized as either benign or malignant based on the pattern of attenuation; degree of thickening; symmetric versus asymmetric thickening; focal, segmental, or diffuse involvement; and associated perienteric abnormalities. Finally, the radiological diagnosis was correlated with histopathology.

Results: Of the 45 patients, 25 patients were males and 20 were females. Most of the affected patients were in the age group of 61-70 years. All the 36 malignant lesions were correctly diagnosed on CT. 8 of the 9 benign lesions were correctly diagnosed on CT, except 1 case with an inflammatory lesion of the colon which was diagnosed as malignancy on CT. The CT features of benign lesions were homogeneous attenuation, mild symmetric wall thickening, and focal involvement of the bowel. The CT features of malignant lesions were heterogeneous attenuation, marked asymmetric wall thickening, and diffuse involvement of the bowel.

Conclusion: MDCT proved to be an excellent modality in the diagnosis and differentiation of benign and malignant lesions of the colon and rectum.

Key words: Colon cancer, Inflammatory lesions, Multidetector computer tomography, Wall thickening

INTRODUCTION

In India, population-based time trend studies show a rising trend in the incidence of colorectal carcinoma.¹ Computerized tomography (CT) is an increasingly useful

technique in the evaluation of intestinal disease, allowing the evaluation of bowel disease as well as extraintestinal disease. CT also provides an excellent assessment of the perienteric abnormalities, thus improving specificity in diagnosis.² Technological advances in CT have changed the practice of gastrointestinal radiology. Thickening of the bowel wall is the commonly identified abnormality on CT in the case of colorectal lesions.³ This study is an attempt to characterize wall thickening in patients with colorectal lesions as either benign or malignant based on the pattern of attenuation; degree of thickening; symmetric versus asymmetric thickening; focal, segmental, or diffuse involvement; and associated perienteric abnormalities. The

Access this article online



www.ijss-sn.com

Month of Submission : 03-2016
Month of Peer Review : 04-2016
Month of Acceptance : 05-2016
Month of Publishing : 05-2016

Corresponding Author: Dr. Anto J Richie, Flat No. 304, Fredrose Enclave (Near Valencia Church), Valencia, Mangaluru - 575 002, Karnataka, India. Phone: +91-9739681469. E-mail: drantorichie@gmail.com

CT findings are finally correlated with histopathological findings.

MATERIALS AND METHODS

This was a retrospective study conducted in the Department of Radio Diagnosis, Father Muller Medical College, Mangalore, between October 2015 to March 2016. 45 patients of both sexes and all age groups, with wall thickening involving the colon and rectum on CT and for whom histopathology diagnosis was available, were included in the study. CT was performed using 16 slice GE BRIGHT SPEED CT scanner. All patients were placed in the supine position on the CT table, and a rectal tube was inserted. Room air was gently insufflated into the colon to get adequate colonic distension. CT acquisitions were performed in the arterial phase (start delay of 25-35 s) and in the portal venous phase (start delay of 50-70 s) with a section width of 5 mm. When wall thickening is identified, it is characterized according to the location, attenuation pattern (homogeneous, heterogeneous, and mixed),

degree of wall thickening (as mild <2 cm and marked >2 cm), symmetric versus asymmetric wall thickening, focal/segmental or diffuse wall thickening, presence of lymph nodes, presence of pericolic fat stranding, infiltration of adjacent viscera, and presence or absence of metastasis. Multidetector computer tomography (MDCT) findings were correlated with histopathology. Collected data were analyzed using kappa statistics. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated.

RESULTS

A total of 45 patients were included in our study, of these 25 (55.6%) were males while 20 (44.4%) were females (Figure 1, Table 1). Most of the affected patients were in the age group of 61-70 years. Of the 37 lesions identified as malignancy on CT, histopathology confirmed malignancy in 36 cases. One case diagnosed as malignancy on CT was confirmed as inflammatory on histopathology. Hence, in our study, CT had a sensitivity of 100%, specificity of 88.90%, positive predictive value of 97.30%, and a negative predictive value of 100% in the diagnosis of malignant lesions. All the cases diagnosed as benign on CT were confirmed as benign on histopathology. One

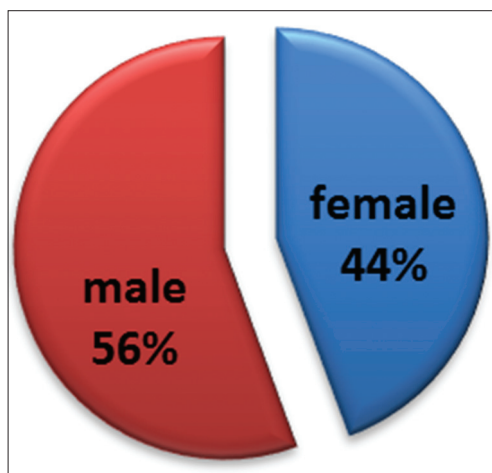


Figure 1: Sex distribution among cases. Of the 45 patients with bowel wall thickening involving the colon and rectum on CT, 25 (55.6%) were males & 20 (44.4%) were females

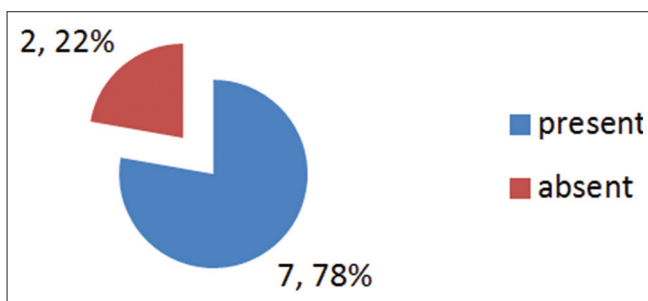


Figure 2: Lymph nodal involvement in benign lesions. Enlarged lymph nodes were present in 7 cases (78%) and absent in 2 cases (22%)

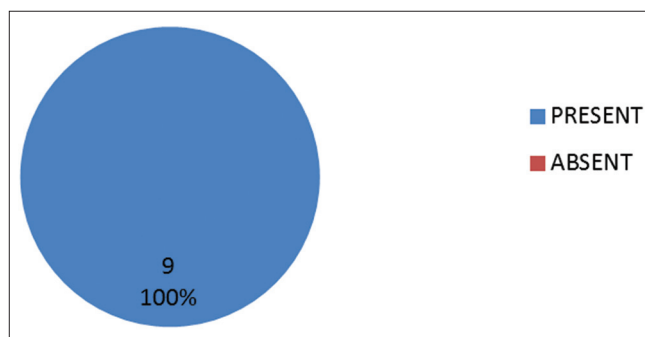


Figure 3: Pericolic fat stranding in benign lesions. Pericolic fat stranding was seen in all benign lesions (100%)

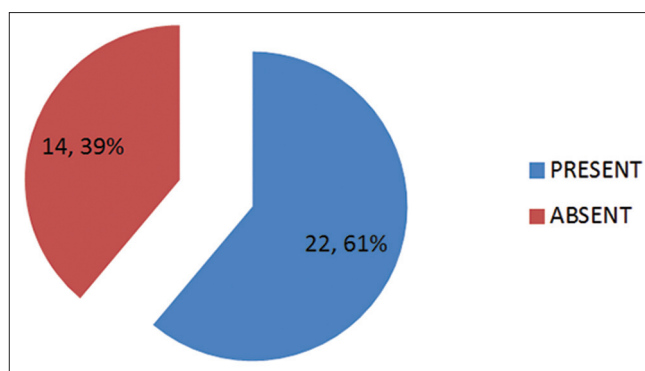


Figure 4: Pericolic fat stranding in malignant lesions. Pericolic fat stranding was present in 22 cases (61%) and absent in 14 cases (39%) with malignant lesions of the bowel

case diagnosed as malignant on CT was confirmed as inflammatory on histopathology. Hence, in our study, CT had a sensitivity of 88.90%, specificity of 100%, positive predictive value of 100%, and a negative predictive value of 97.30% in the diagnosis of benign lesions ($K = 0.8$ excellent agreement) (Table 7). The CT features of benign lesions were homogeneous attenuation, mild symmetric wall thickening, and focal involvement of the bowel. The CT features of malignant lesions were heterogeneous

Table 1: Age distribution among cases

Age group (in years)	Number of patients (%)
< OR=30	3 (6.7)
31-40	7 (15.6)
41-50	9 (20)
51-60	7 (15.6)
61-70	10 (22.2)
Above 70	9 (20)
Total	45 (100)

Table 2: Sites of distribution in malignant lesions

Site of lesion	Frequency (%)
Cecum+ascending colon	1 (2.8)
Ascending colon	3 (8.3)
Transverse colon	1 (2.8)
Descending colon	1 (2.8)
Descending colon	8 (22.2)
Descending colon+rectum	4 (11.1)
Rectum	18 (50)
Total	36 (100)

Table 3: Pattern of attenuation of lesions

Attenuation of bowel wall	Histopathology (%)		Total (%)
	Adenocarcinoma	Inflammatory/infective	
Homogeneous attenuation			
Count	1	8	9
	11.10	88.90	100.00
	2.80	88.90	20.00
Heterogeneous stratified attenuation			
Count	0	1	1
	0.00	100.00	100.00
	0.00	11.10	2.20
Heterogeneous mixed attenuation			
Count	35	0	35
	100.00	0.00	100.00
	97.20	0.00	77.80
Total			
Count	36	9	45
	80.00	20.00	100.00
	100.00	100.00	100.00

$\chi^2=39.44$, $P=0.000$ HS. Of the 9 benign cases, 8 cases (88.90%) had homogeneous attenuation and 1 case (11.10%) had heterogeneous stratified attenuation. Of the 36 malignant cases, 35 cases (97.20%) had heterogeneous mixed attenuation and 1 case (2.80%) had homogeneous attenuation on CT

attenuation, marked asymmetric wall thickening, and diffuse involvement of the bowel.

DISCUSSION

This is a hospital-based correlative study to describe the role of MDCT in the evaluation of colorectal lesions. In our study, 45 patients with wall thickening involving the region of the colon and rectum were studied. Of these, 25 (55.6%) were males, whereas 20 (44.4%) were females, thus showing a slight male preponderance (Figure 1). The age group commonly affected was 61-70 years (22.7%)

Table 4: Degree of bowel wall thickening of lesions

Degree of bowel wall thickening	Histopathology (%)		Total (%)
	Adenocarcinoma	Inflammatory/infective	
Mild thickening			
Count	2	8	10
	20.00	80.00	100.00
	5.60	88.90	22.20
Marked thickening			
Count	34	1	35
	97.10	2.90	100.00
	94.40	11.10	77.80
Total			
Count	36	9	45
	80.00	20.00	100.00
	100.00	100.00	100.00

$\chi^2=28.92$, $P=0.000$ HS. Of the 10 cases with mild wall thickening 8 were benign, and 2 were malignant. Of the 35 cases with marked wall thickening, 34 were malignant and one was benign. Mild wall thickening in the diagnosis of benign lesions:

Sensitivity - 88.9%, specificity - 94.4%. Positive predictive value - 80%, negative predictive value - 97.1%. Marked wall thickening in the diagnosis of malignant lesions: Sensitivity - 94.4%, specificity - 88.9%. Positive predictive value - 88.9%, negative predictive value - 80%

Table 5: Symmetric versus asymmetric wall thickening of lesions

Wall thickening	Histopathology (%)		Total (%)
	Adenocarcinoma	Inflammatory/infective	
Symmetric			
Count	0	8	8
	0.00	100.00	100.00
	0.00	88.90	17.80
Asymmetric			
Count	36	1	37
	97.30	2.70	100.00
	100.00	11.10	82.20
Total			
Count	36	9	45
	80.00	20.00	100.00
	100.00	100.00	100.00

$\chi^2=38.91$, $P=0.000$ HS. Of the 37 cases with asymmetric wall thickening, 36 were malignant and 1 was benign. All the cases with symmetric wall thickening were benign. Symmetric wall thickening in the diagnosis of the benign lesion.

Sensitivity - 88.9%, Specificity - 100%. Positive predictive value - 100%, Negative predictive value - 97.3%. Accuracy of asymmetric wall thickening in the diagnosis of the malignant lesion. Sensitivity - 100%, specificity - 88.9%. Positive predictive value - 97.3%, Negative predictive value - 100%

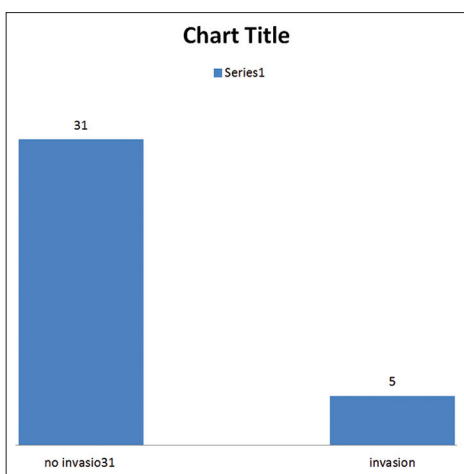


Figure 5: Invasion of the adjacent viscera in malignant lesions. Of the 36 malignant colorectal lesions, there was involvement of the adjacent viscera in 5 cases. There was no involvement of the viscera in the remaining 31 cases

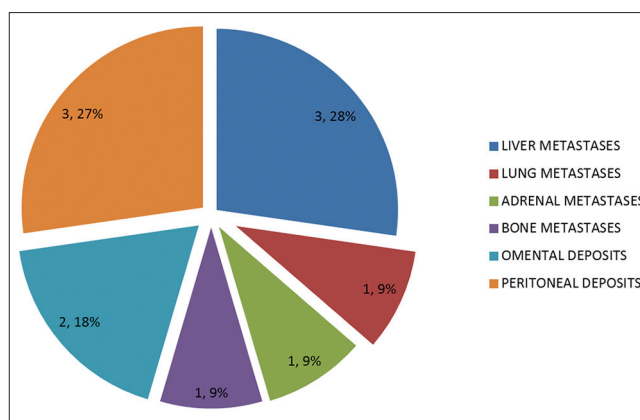


Figure 8: Sites of metastases in case of malignant lesions. Of the 11 cases with metastases, liver metastases were seen in 3 cases (28%), lung metastases were seen in 1 case (9%), adrenal metastases in 1 case (9%), bone metastases in 1 case (9%), omental deposits in 2 cases (18%), and peritoneal deposits in 3 cases (27%)

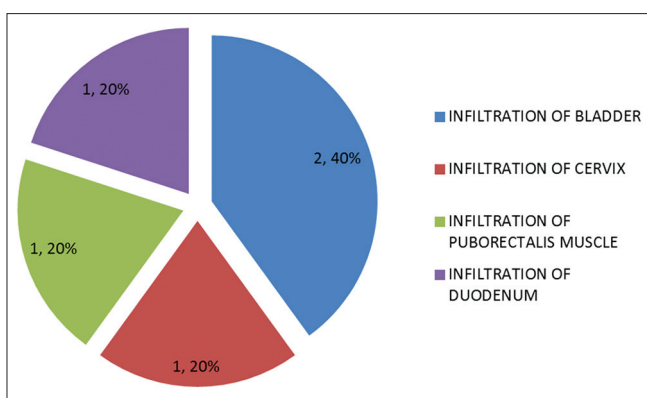


Figure 6: Sites of visceral involvement in malignant lesions. There was infiltration of the bladder in 2 cases (40%), infiltration of the cervix, puborectalis, and duodenum in the other 3 cases

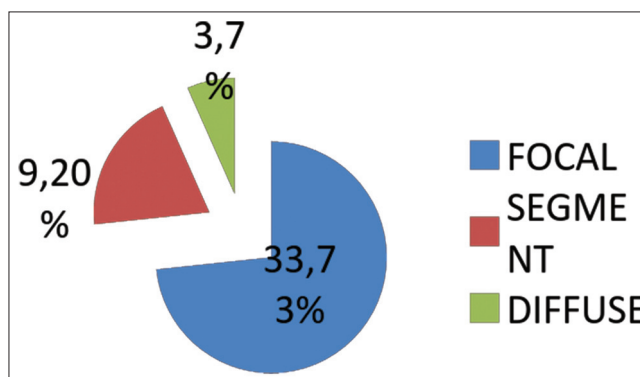


Figure 9: Length of bowel involvement of the lesions. Of the 45 cases 33 cases had focal involvement of the bowel, 9 cases had segmental involvement of the bowel and 3 cases had diffuse involvement of the bowel

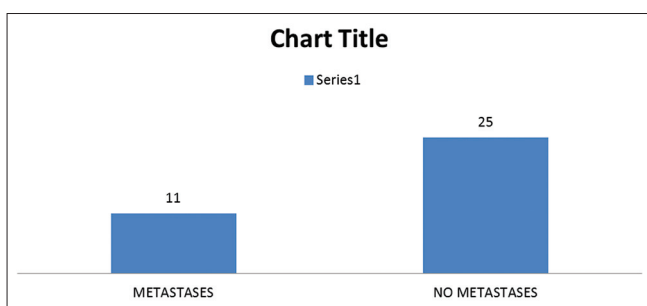


Figure 7: Metastases in case of malignant lesions. Of the 36 malignant cases, metastases were seen in 11 cases (30%). There was no evidence of metastases in 25 cases (70%)

(Table 1). These are in concordance with the study done by Laishram *et al.*⁴

Of the 45 cases, 36 cases were histopathologically proved to be malignant, and 9 cases were proved to be benign. Rectum was the most common site for malignant lesions

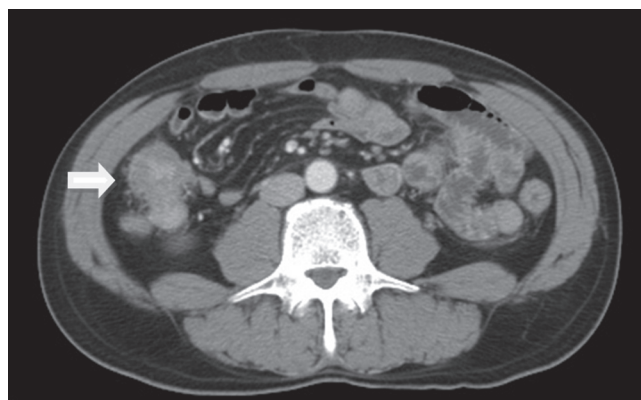


Figure 10a: Asymmetric heterogeneously enhancing wall thickening involving the ascending colon - suggestive of malignancy

(50%) (Table 2). This is in agreement with the study done by Laishram *et al.* In their study, there was involvement of the rectum in 53.71% of the cases. Of the 9 benign

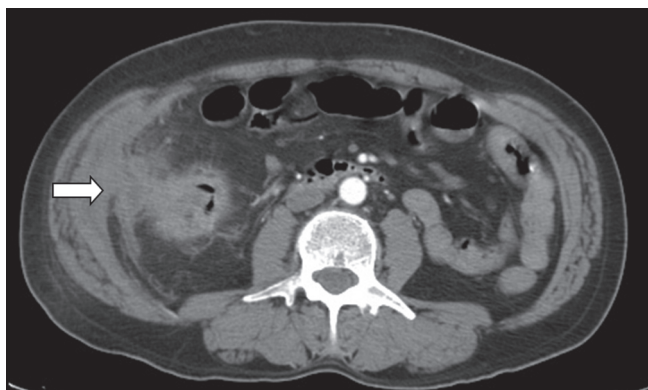


Figure 10b: Short segment heterogeneously enhancing marked wall thickening involving ascending colon with pericolic fat infiltration – suggestive of carcinoma



Figure 10d: Long segment symmetric diffuse wall thickening involving transverse colon – suggestive of inflammatory etiology



Figure 10c: Short segment asymmetric wall thickening involving rectum with luminal narrowing – suggestive of malignancy

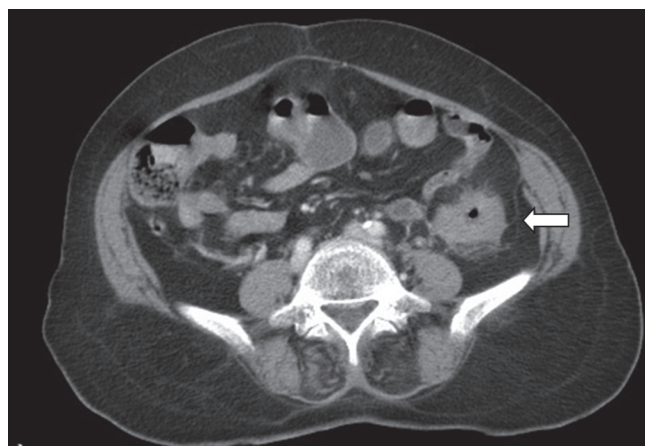


Figure 10e: Short segment asymmetric heterogeneously enhancing wall thickening involving the descending colon – suggestive of malignancy

cases, 8 cases (88.90%) had homogeneous attenuation and 1 case (11.10%) had heterogeneous stratified attenuation (Table 3). Of the 36 malignant cases, 35 cases (97.20%) had heterogeneous mixed attenuation and 1 case (2.80%) had homogeneous attenuation on CT (Figure 10a,e). This is in agreement with studies done by Balthazar⁵ and Macari and Balthazar,⁶ who have told that homogeneous attenuation is a feature of benign disease (inflammatory/infective), and heterogeneous attenuation is a feature of malignancy (adenocarcinoma) (Figure 10b). One case with inflammatory disease of the colon had heterogeneous stratified attenuation (target appearance). This was in agreement with the study done by Ahualli,⁷ who described that the target sign is a feature of benign disease seen in cases of ischemic colitis, inflammatory colitis, and infectious colitis.

Mild wall thickening had a sensitivity of 88.9%, specificity of 94.4%, positive predictive value of 80%, and a negative predictive value of 97.1% in the diagnosis of benign lesions of the colon. Marked wall thickening had a sensitivity of 94.4%, specificity of 88.9%, positive predictive value of 88.9%, and a negative predictive value of 80% in the diagnosis of malignant lesions. This is in agreement with

the study done by Balthazar⁵ and Macari and Balthazar,⁶ who described that mild wall thickening is a feature of inflammatory and infective lesions of colon and marked wall thickening is a feature of malignant lesions of colon such as adenocarcinoma (Table 4).

Symmetric wall thickening had a sensitivity of 88.9%, specificity of 100%, positive predictive value of 100%, and a negative predictive value of 97.3% (Table 5). This is in concordance with the study done by Ahualli,⁷ who described symmetric wall thickening as a feature of the benign intestinal lesion. Asymmetric wall thickening had a sensitivity of 100%, specificity of 88.9%, positive predictive value of 97.3%, and a negative predictive value of 100%. Kottler *et al.*⁸ in their study have found that asymmetric wall thickening is a feature of malignancy, which is similar to the pattern of thickening observed in our study.

Of the 36 malignant cases, 30 cases (83.33%) had focal involvement of the bowel, and 6 cases (16.67%) had

segmental involvement of the bowel. Of the 9 benign cases, 3 cases (33.33%) had focal involvement of the bowel, 3 cases (33.33%) had segmental involvement of the bowel, and 3 cases (33.33%) had diffuse involvement of the bowel. Balthazar⁵ and Macari and Balthazar⁶ in their study have found that focal involvement of bowel is a feature of malignancy which is in concordance with our study. They also found that diffuse involvement of the bowel is a feature of inflammatory/infective etiology which is again in agreement with our study. However, six cases of malignancy had segmental involvement of the colon, which according to their study is a feature of benign lesions. Only 33.33% of the benign cases in our study had

segmental involvement of the colon (Figure 9 and 10c,d). Hence, according to our study, segmental involvement of the colon is not a reliable indicator in differentiating benign from malignant lesions of the colon (Figure 2 and Table 6).

Both benign and malignant lesions had multiple enlarged lymph nodes in approximately 78% of the cases. Hence, according to our study, the presence of enlarged lymph nodes in patients with colonic wall thickening has no role in differentiating benign and malignant lesions of the colon. However, d'Almeida *et al.*² in their study have described that hypo-attenuating bulky lymphadenopathy is a supportive finding in patients with lymphoma of colon. Laishram *et al.*⁴ have described that low-attenuation lymph nodes with a rim of contrast enhancement or calcified lymph nodes should alert one to the possibility of tuberculosis (Figure 3).

All the benign lesions had evidence of pericolic fat stranding (Figure 4). Pericolic fat stranding was present in 22 cases (61%) of malignancy. Pericolic fat stranding was absent in 14 cases (39%) of malignancy. Filippone *et al.* in their study have found that pericolic fat stranding adjacent to a malignant lesion is a feature of invasion of pericolic fat, and hence, is a feature of T3 lesions. However, it is not reliable criteria and may result in over staging of lesions as T3 (Figure 5). Laishram *et al.*⁸ have described that pericolic fat stranding is a common finding seen in inflammatory conditions of the colon. Infiltration of the adjacent structures was seen in five cases (13.80%) of malignancy (Figure 6). Infiltration of the bladder was seen in two cases (40%). Infiltration of the cervix, puborectalis muscle, and duodenum were seen in the other three cases (Figure 7). Infiltration of adjacent structures is highly suggestive of malignancy. Distant metastases were seen in 11 cases (30%) of malignancy (Figure 8). Liver metastases were seen in 3 cases (28%), lung metastases were seen in 1 case (9%), adrenal metastases in 1 case (9%), bone metastases in 1 case (9%), omental deposits in 2 cases (18%), and peritoneal deposits in 3 cases (27%). Horton *et al.*⁹ in their study have described that liver is the predominant organ to be involved with metastases from colorectal cancer.

Table 6: Length of bowel involvement of lesions

Focal, segmental or diffuse	Histopathology (%)	
	Adenocarcinoma	Inflammatory/infective
Focal		
Count	30	3
	90.90	9.10
	83.30	33.30
Segmental		
Count	6	3
	66.70	33.30
	16.70	33.30
Diffuse		
Count	0	3
	0.00	100.00
	0.00	33.30
Total		
Count	36	9
	80.00	20.00

$\chi^2=15.45$, $P=0.000$ HS. Of the 33 cases with focal involvement of the bowel wall, 29 were malignant and 4 were benign. Of the 9 cases with segmental involvement of the bowel, 6 were malignant and 3 were benign. All the 3 cases with diffuse involvement of the bowel were benign

Table 7: CT in diagnosing benign and malignant lesions

CT impression * histopathology cross tabulation			
CT impression	Histopathology (%)		Total (%)
	Adenocarcinoma	Inflammatory/infective	
Malignancy			
Count	36	1	37
	97.30	2.70	100.00
	100.00	11.10	82.20
Benign (inflammatory/infective)			
Count	0	8	8
	0.00	100.00	100.00
	0.00	88.90	17.80
Total			
Count	36	9	45
	80.00	20.00	100.00
	100.00	100.00	100.00

$\chi^2=38.91$, $P=0.000$ HS. CT in the diagnosis of benign lesions. Sensitivity - 88.90%, specificity - 100%. Positive predictive value - 100%, negative predictive value - 97.30%. CT in the diagnosis of malignant lesions. Sensitivity - 100%, specificity - 88.90%. Positive predictive value - 97.30%, negative predictive value - 100%

Role of CT in Differentiating Benign and Malignant Lesions

Of the 37 lesions identified as malignancy on CT, histopathology confirmed malignancy in 36 cases (Table 7). One case diagnosed as malignancy on CT was confirmed as inflammatory on histopathology. Hence, in our study, CT had a sensitivity of 100%, specificity of 88.90%, positive predictive value of 97.30%, and a negative predictive value of 100% in the diagnosis of malignant lesions. All the cases diagnosed as benign on CT were confirmed as benign on histopathology. One case diagnosed as malignant on CT was confirmed as inflammatory on histopathology. Hence, in our study, CT had a sensitivity of 88.90%, specificity of

100%, positive predictive value of 100%, and a negative predictive value of 97.30% in the diagnosis of benign lesions ($K = 0.8$ excellent agreement). Hence, CT is an excellent modality in differentiating benign and malignant lesions of the colon and rectum.

CONCLUSION

MDCT proved to be an excellent modality in the diagnosis and differentiation of benign and malignant lesions of the colon and rectum. MDCT is also useful in the staging of malignant lesions which helps in the proper planning of surgery and further management of the patient. Besides, identifying the lesion MDCT provides further information regarding pericolic abnormalities associated with the lesion, presence of lymph nodes, infiltration of adjacent viscera, and the presence of distant metastases.

REFERENCES

1. Mohandas KM. Colorectal cancer in India: Controversies, enigmas and primary prevention. *Indian J Gastroenterol* 2011;30:3-6.
2. d'Almeida M, Jose J, Oneto J, Restrepo R. Bowel wall thickening in children: CT findings. *Radiographics* 2008;28:727-46.
3. Rockey DC, Halvorsen RA Jr, Higgins JL, Cello JP. Prospective evaluation of patients with bowel wall thickening. *Am J Gastroenterol* 1995;90:99-103.
4. Laishram RS, Kaiho N, Shimray R, Devi SB, Punyabati P, Sharma DC. Histopathological evaluation of colorectal carcinomas status in Manipur, India. *Int J Pathol* 2010;8:5-8.
5. Balthazar EJ. CT of the gastrointestinal tract: Principles and interpretation. *AJR Am J Roentgenol* 1991;156:23-32.
6. Macari M, Balthazar EJ. CT of bowel wall thickening: Significance and pitfalls of interpretation. *AJR Am J Roentgenol* 2001;176:1105-16.
7. Ahualli J. The target sign: Bowel wall. *Radiology* 2005;324:549-50.
8. Kottler NE, Aguirre DA, Sirlin CB. CT evaluation of gastrointestinal tumours: Imaging techniques and key diagnostic findings. *Appl Radiol* 2005;34:7.
9. Horton KM, Abrams RA, Fishman EK. Spiral CT of colon cancer: Imaging features and role in management. *Radiographics* 2000;20:419-30.

How to cite this article: Richie AJ, Mellonie P, Suresh HB. Accuracy of Multidetector Computer Tomography in Differentiating Benign and Malignant Colorectal Lesions with Histopathological Correlation. *Int J Sci Stud* 2016;4(2):77-83.

Source of Support: Nil, **Conflict of Interest:** None declared.