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Original Article

Comparison of tomographic and colonoscopic diagnoses in the presence of colonic wall thickening

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Abstract: Introduction and objective: Colonic wall thickening is a common condition in a number of benignant and malignant diseases. This study investigated the accuracy of radiological diagnoses in patients diagnosed with colonic wall thickening using multislice CT (MDCT). Materials and Method: Files of patients with colonic wall thickening diagnosed with 64-slice MDCT were reviewed retrospectively. The colonoscopy results of these patients were grouped under neoplastic process (cancer and adenomatous polyp), inflammatory bowel disease (IBD), diverticulitis and other etiology (nonspecific events, ischemic colitis, solitary rectal ulcer, external compression, secondary to volvulus and radiotherapy), and the results were statistically evaluated. *p* values < 0.05 were considered statistically significant. Results: The study was performed on 505 files (290 males [57.4%], 215 females [42.6%], mean age: 49.15 ± 18.4 years). CT and colonoscopic diagnoses were reviewed and the following CT to colonoscopy ratios was observed: neoplastic process: 44.4% vs. 40.2%; IBD: 42.4% vs. 42.4%; diverticulitis: 4% vs. 4.2%; other etiology: 9.3% vs. 3.2%. Colonoscopy failed to identify pathology in 9.9% of the patients. The sensitivity, specificity, PPV, NPV and accuracy of CT were 95.6%, 90.4%, 87.1%, 96.8% and 92.4%, respectively, in detecting neoplastic processes; 97.2%, 97.9%, 97.2%, 97.9% and 97.6%, respectively, in detecting IBD; 90.5%, 99.8%, 95%, 99.6% and 99.4%, respectively, in detecting diverticulitis, and 50%, 96,7%, 62.5%, 94.6% and 92%, respectively, in detecting other etiology. Conclusion: While, accuracy of 64 slice-CT in diagnosing colonic wall thickenings secondary especially to neoplastic processes, IBD and diverticulitis was significantly higher, but differential diagnosis is challenging in pathologies due to other etiologies.

Keywords: Colonic wall thickness, CT, colonoscopy, colon cancer, diverticulitis, polyp

Introduction

The colonic wall thickens in many conditions. Colonoscopy is the golden standard in diagnosing colonic pathologies. Because there are no specific guidelines for computerized tomography (CT) in patients with colonic wall thickening (CWT), most physicians do not exactly know what to do [1, 2]. Enhancement pattern, length of involvement, degree of mural thickening, patency of the mesenteric vessels, mesenteric changes, lumen contents are evaluated with CT in the presence of CWT evidence. It has been shown that CWT varies from normal ranges in CT due to the lumen diameter. A study with 100 patients observed that wall thickness varied by 0-2 mm if colonic segment was ≥ 4-6 cm in diameter, by 0.2-2.5 mm if it was 3-4 cm in diameter, 0.3 to 4 mm if it was 2-3 cm in diameter and by 0.5-5 mm if it was 1-2 cm in diameter, and, if the lumen width was < 1 cm, colonic wall thickness (mostly at proximal and distal colon) was 6-8 mm. On the other hand, if the lumen diameter 2-4 cm, 3-5 mm is an increased thickness [3].

Colon cancer is the most common cause of CWT; partial or circular wall thickening of 3 mm or greater, filling defect in the intraluminal soft tissue, weakening of the fatty tissue surrounding the intestines and lymph nodes are observed [4]. A study found an average wall thickness of 1.4 cm and observed that the thickness increased further (1.9 cm) over a follow-up period of ≥ 1 month [5]. In intestinal wall thickening, the length of the affected intestinal segment also matters: if the affected length is < 5 cm the conditions is usually colonic carci-

noma; an affected length of 5-10 cm is seen with diverticulitis, Crohn's disease and ischemia, while an affected length 10-30 cm is seen with inflammatory bowel disease (IBD), ischemic colitis, infective colitis, typhlitis, reperfusion ischemia and in chemotherapy. Because the findings are nonspecific in radiation colitis, patient's history assists in the diagnosis. Complete involvement of the colonic wall or involvement of long segments (diffuse) is seen in IBD. The location, length and appearance of the affected segment are helpful in differentiating ulcerative colitis from Crohn's disease. It has been shown that halo sign in CT in patients with wall thickening is important in the differential diagnosis of benign and malign lesions, and that halo can be seen in 74.5% of the benign lesions and 7.3% of the malign lesions (75.4% sensitivity and 92.5% specificity) [6]. It is estimated that 60% of the people aged 60 years and older will develop diverticula and 10-25% of them will develop diverticulitis [7]. The diagnosis is established in the presence of segmental wall thickening, hyperemia with inflammatory changes at the fatty planes surrounding the intestines. Current guidelines recommend routine monitoring with colonoscopy once diverticulitis is detected with CT because colon cancer may mimic diverticulitis. In fact, colon cancer (Ca) was diagnosed in 2.7% of the 394 patients who underwent colonoscopy from a population of 663 patients diagnosed with acute diverticulitis with CT; among these, 11.4% of the cases with were found with cancer [8]. In clostridium difficile colitis, colonic wall thickness increases (0.5-1.6 cm) and mild pericolic fat stranding occurs [9, 10]. In acute ischemic colitis, CT shows complete wall thickening together with symmetric thickening and thickening of the folds (6-17.5 mm, mean: 10.52 mm) [11].

This study attempts to understand the effectiveness of CT in the radiological diagnosis by performing colonoscopy in patients diagnosed with intestinal wall thickness with CT.

Materials and methods

The study was performed retrospectively at the Gastroenterology Clinic of the Medical Faculty of Bezmialem Vakıf University after obtaining the approval of the local ethics board (B.30.2.BAV.0.05.05/227). Data entered into the registry system of the hospital were reviewed to recover patients' initial diagnoses and clinical findings.

In this study, files of 567 patients, aged 18-70 years, who presented to the hospital between 2010 and 2014 for varied reasons including abdominal pain, anemia, rectal hemorrhage and weight loss, and underwent multislice abdominopelvic CT were examined retrospectively. Patients with colonic wall thickening detected with abdominopelvic CT were selected. Sixty-two patients without colonoscopy report for any reason (including emergency surgery, unfit for colonoscopy, insufficient colon cleansing, poor overall condition, failure to return for follow-up visit, refusing colonoscopy etc.) were excluded. Finally, 505 patients who underwent abdominopelvic CT and colonoscopic examinations were included in the study.

All CT examinations were performed using a 64-detector-row CT scanner (Aquilion, Toshiba Medical Systems, Tokyo). Images were acquired starting from the diaphragmatic dome extending to the pubic symphysis with section thickness of 5 mm at 5 mm interval with beam pitch of 1.5, rotation time of 5 seconds using 120 kV, and 200-350 mA. A neutral oral contrast agent was used in our study. For this purpose, the patients were instructed to drink 100 cc of Osmolak solution (Osmolak 10 g/15 ml 250 ml solution, Biofarma, Istanbul, Turkey) added to in 1400 of drinking water, starting from 2-3 hours before CT. A total of 100 mL of the intravenous nonionic contrast material Iohexole (Omnipaque 350, GE Health Care, Missouri, USA) was administered at a rate of 3 mL/s. The images were acquired in the late portal venous phase at a delay of 60 second. The axial images obtained were sent to the workstation for evaluation. To better visualize the colon anatomy and to detect the location of the anomaly and suspected mass more accurately, images of the sagittal and coronal planes obtained with maximum intensity projection (MIP), multiplanar imaging (multiplanar reformat-MPR) formed by using axial images were examined. For intestines with normal distension, 3 millimeters were considered to be the upper limit of normal for colonic wall thickness for the study.

Files of the patients who were diagnosed with stomach and small intestine wall thickness with CT, had history of familial colorectal cancer syndrome, previous colorectal surgery and those with cardiac, hepatic or renal failure which may cause wall thickness due to intestinal edema were excluded. Patients' diagnoses were reviewed by grouping under four head-

Table 1. Patient's Demographic, Tomographic and Colonoscopic Findings (n = 505)

Age (mean ± SD)	49.15 ± 18.4
Gender	
Female (%)	42.6%
Male (%)	57.4%
Abdominal CT	
Colonic wall thickening consistent with neoplastic processes, % (n)	44.4% (224)
Colonic wall thickening consistent with IBD, % (n)	42.4% (214)
Colonic wall thickening consistent with diverticulitis, % (n)	4% (20)
Other causes of colonic wall thickening, % (n)	9.3% (47)
Colonoscopic diagnosis	
Colon cancer	38% (192)
Adenomatous polyp (≥ 1 cm)	2.4% (12)
Ulcerative colitis	37.4% (189)
Crohn's disease	5% (25)
Diverticulitis	4.2% (21)
Ischemic colitis	1% (5)
Solitary rectal ulcer	0.8% (4)
Volvulus	0.6% (3)
External compression, colitis secondary to radiotherapy	0.8% (4)
Normal	9.9% (50)

ings, i.e. neoplastic processes (cancer and adenomatous polyp; based on pathology result), inflammatory bowel diseases, diverticulitis and other etiology (nonspecific events, ischemic colitis, solitary rectal ulcer, external compression, volvulus and radiotherapy secondary intestinal wall thickening). Only patients with ≥ 1 cm polyp size with CT were included, those with smaller sizes were excluded. Colonic wall thickness figures with CT were disregarded in this study. Patients' symptoms and physical examination findings and laboratory test results including CEA, CRP, and sedimentation were not considered (since their values may be within normal ranges even in the presence cancer). Patients who underwent colonoscopy [with *I-scan* videocolonoscope (*Pentax*, Tokyo, *Japan*)] within one month (16 ± 11 days) following CT were included in the study. In colonoscopy, the lesion sites were limited as follows: rectum + rectosigmoid region, sigmoid and descending colon, left flexura-transverse colon-right flexura, ascending colon-cecum.

Statistical Analysis: quantitative data are presented as means and standard deviations, while categorical variables are expressed as rates and proportions. We calculated the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of CT for the detection of colonic wall thickening. The results were evaluated statistically and *p* values of 0.05 were considered statistically significant.

Results

The study included 567 patients diagnosed with CWT with CT. Sixty-two patients without colonoscopy report for any reason (emergency sugery, unfit for colonoscopy, insufficient colon cleansing, poor overall condition, failure to return for follow-up visit, refusing colonoscopy etc.) were excluded. The study was performed on 505 patient files. Of the patients, 290 were males (57.4%) and 215 were females (42.6%). The mean age was 49.15 ± 18.4 years.

With abdominal CT, wall thickening consistent with neoplastic processes (cancer, ≥ 1 cm polyp) was detected with a rate of 44.4% (n = 224); wall thickening consistent with IBD was detected with a rate of 42.4% (n = 214); wall thickenings due to other etiologies (nonspecific conditions, ischemic colitis, solitary rectal ulcer, external compression, volvulus and radiotherapy secondary intestinal wall thickening) was detected with a rate of 9.3% (n = 47) and wall thickening consistent with diverticulitis was detected with a rate of 4% (n = 20) (**Table 1**).

With colonoscopy, wall pathologies due to neoplastic processes were detected with a rate of 40.2% (n = 204) [(cancer: 38% (n = 192); polyps (≥ 1 cm): 2.4% (n = 12)]; wall pathologies due to IBD were detected with a rate of 42.4% (n = 214); wall pathologies due diverticulitis were detected with a rate of 4.2% (n = 21); and of other etiologies; wall pathologies due ischemic colitis were detected with a rate of 1% (n = 5); solitary rectal ulcer with a rate of 0.8% (n

Table 2. Sensitivity, Specificity, PPV, NPV and Accuracy in Detecting Colonic wall Thickening with 64-Slice CT

	Sensitivity (%, n)	Specificity (%, n)	PPV (%, n)	NPV (%, n)	Accuracy (%, n)
Colonic wall thickening consistent with neoplastic processes	95.6% (195/204)	90.4% (272/301)	87.1% (195/224)	96.8% (272/281)	92.4% (467/505)
Colonic wall thickening consistent with IBD	97.2% (208/214)	97.9% (285/291)	97.2% (208/214)	97.9% (285/291)	97.6% (493/505)
Colonic wall thickening consistent with diverticulitis	90.5% (19/21)	99.8% (483/484)	95% (19/20)	99.6% (483/485)	99.4% (502/505)
Colonic wall thickening due to other etiologies	50% (25/50)	96,7% (440/455)	62.5% (25/40)	94.6% (440/465)	92% (465/505)

Table 3. Sensitivity, Specificity, PPV, NPV and Accuracy of CT in Colon Malignancies by Affected Site

Site	Sensitivity	Specificity	PPV	NPV	Accuracy
Rectum and rectosigmoid	93.5% (72/77)	95.3% (408/428)	78.3% (72/92)	98.8% (408/413)	95% (480/505)
Sigmoid and descending colon	87% (60/69)	98.4% (429/436)	89.6% (60/67)	97.9% (429/438)	96.8% (489/505)
Left flexura, transverse colon and right flexura	96.2% (25/26)	99.6% (477/479)	92.6% (25/27)	99.8% (477/478)	99.4% (502/505)
Ascending colon and cecum	100% (31/31)	98.9% (469/474)	86.1% (31/36)	100% (469/469)	99% (500/505)

= 4); volvulus with a rate of 0.6% (n:3), external compression and radiotherapy with a rate of 0.8% (n4). The proportion of patients with no pathology (normal) with colonoscopy despite the presence of CWT evidence with CT was 9.9% (n = 50). In the diagnosis of neoplastic processes, CT had a sensitivity, specificity, PPV, NPV and accuracy of 95.6%, 90.4%, 87.1%, 96.8% and 92.4%, respectively, while the same values were 97.2%, 97.9%, 97.2%, 97.9% and 97.6%, respectively, for IBD diagnosis; 90.5%, 99.8%, 95%, 99.6% and 99.4%, respectively, for diverticulitis diagnosis; and 50%, 96,7%, 62.5%, 94.6% and 92%, respectively, for diagnosing pathologies due to other etiologies (**Table 2**).

By location, the sensitivity, specificity, PPV, NPV and accuracy of CT in diagnosing neoplastic processes accurately were 93.5%, 95.3%, 78.3%, 98.8% and 95%, respectively, for the rectum and rectosigmoid region; 87%, 98.4%, 89.6%, 97.9% and 96.8%, respectively, for sigmoid and descending colon; 96.2%, 99.6%, 92.6%, 99.8% and 99.4%, respectively, for the left flexura, transverse colon and right flexura; and 100%, 98.9%, 86.1%, 100% and 99%, respectively, for the ascending colon and cecum (**Table 3**).

Discussion

In PubMed, there are conflicting studies which compared radiological diagnoses with colonoscopy results in patients with evidence of CWT with CT. In our clinic's study, the values found for the predictive factors of the diagnostic efficacy of CT were higher compared to other studies.

In our study, the values obtained from the comparison of CT and colonoscopy were 44.4% vs. 40.2% for neoplastic processes, while the sensitivity, specificity, PPV, NPV and accuracy of CT in diagnosis were 95.6%, 90.4%, 87.1%, 96.8%, 92.4%, respectively. Another study found the sensitivity, specificity, PPV and NPV of contrast CT in colon cancer as 100%, 95.7%, 33.3%, and 100%, respectively [12]. In their study with 109 patients, Karim MS et al. found a PPV value of 33% [13]. In a meta-analysis by Plumb AA et al. involving 622 patients, CT colonography had a sensitivity of 88.8% and specificity of 75.4% in detecting adenomatous polyps larger than 6 mm [14]. In their study, using 64-row MDCT, Stermer E. et al. diagnosed neoplastic process in 48 of the 94 patients who were inadvertently diagnosed with CWT, while, with colonoscopy, they detected lesions in 34 patients (71%, 26 malign, 8 benign) and no pathology in 14 (29%). They commented that colon thickening inadvertently detected with CT correlated poorly with colonoscopic examinations [4]. In our study, PPV in the diagnosis of neoplastic processes was higher compared to other studies (33.3% vs. 87.5%). In addition, PPV of CT in determining the exact colon segment affected by neoplastic processes was higher for splenic flexura-transverse colon-hepatic flexura regions (98.6%) and lower for the rectum and rectosigmoid regions (78.3%). This may be explained by the facts that the transverse colon is more distensible than the rectum, radiologists are not as attentive to luminal distention, and that feces remaining in the rectum of poorly cleansed patients may be misleading.

In a meta-analysis, CT had a sensitivity of 95% and specificity of 96% in diagnosing diverticulitis [15]. In a study by Shen SH et al. including 40 patients with acute diverticulitis and 14 patient with colon cancer (control group), the sensitivity, specificity, PPV, NPV and accuracy of CT in detecting diverticulitis in the presence of CWT were 82.5%, 14.2%, 73.3%, 22.2% and 64.81%, respectively [16]. In our study, comparison of CT with colonoscopy in terms of diverticulitis diagnosis yielded a ratio of 4% vs. 4.2%, and diagnostic sensitivity, specificity, PPV, NPV and accuracy of CT were 90.5%, 99.8%, 95%, 99.6% and 99.4%, respectively. A somewhat higher diagnostic accuracy for diverticulitis (inflamed appearance surrounding the diverticulum) with colonoscopy compared to CT was an expected result. The failure of CT in diagnosing diverticulitis could be explained by lesion size, interference and operator errors.

In a meta-analysis by Horsthuis K et al., CT had a sensitivity of 84.3% and specificity of 95.1% in diagnosing IBD [17]. In our study, CT and colonoscopy had the same diagnosis rates in IBD (42.4% vs. 42.4%). The sensitivity, specificity, PPV, NPV and accuracy of CT in diagnosing IBD were 97.2%, 97.9%, 97.2%, 97.9% and 97.6%, respectively. Affected colon segments are longer and have almost a uniform pattern in IBD compared to other groups, which may have contributed to higher predictive values.

CT and colonoscopic diagnosis rates for CWT due to other etiologies (nonspecific, ischemic colitis, solitary rectal ulcer, external compression, volvulus and radiotherapy secondary) were 9.3% vs. 3.4%, and the corresponding sensitivity, specificity, PPV, NPV and accuracy of CT were 50%, 96,7%, 62.5%, 94.6% and 92%, respectively, in our study. PPV values were higher in IBD, diverticulitis and neoplastic processes (97.2%, 95% and 87.1%) and lower in wall thickenings due to other etiologies (62.5%). The explanation of this is that colon pathologies due to other etiologies do not have characteristics to enable a specific diagnosis, making differential diagnosis challenging.

In the study, colonoscopy did not demonstrate any pathology in 9.9% of the patients although their CT showed lesions (false positivity). In a study by Stermer E et al., colonoscopy filed to demonstrate pathology in 29.9% of the cases with neoplastic processes and in 65% of the cases with solitary wall thicknesses, which are higher than the figures observed in our study. Presence of feces, fluid and residue within the intestinal lumen may lead to false positive results.

CT was successful particularly in diagnosing IBD, neoplastic processes and diverticulitis in patients with CWT, in our study. Overall, this may be because in CT, colon cleansing is performed more meticulously, whether intestinal wall is distended or collapsed is taken in consideration, finer slices are obtained for investigations, and lesions are evaluated by a radiology team experienced in the gastrointestinal tract. Because radiologic diagnosis with CT is close to colonoscopic diagnosis particularly in IBD, diverticulitis and neoplastic process, one might question the need for performing colonoscopy. The answer to this question is simple: it is necessary to visually inspect the lesion, to make a cell-based diagnosis by obtaining biopsy, and to eliminate errors, the rate of which was 10% in our study.

Disclosure of conflict of interest

None.

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