Computed tomography findings of bowel wall thickening: its significance and relationship to endoscopic abnormalities

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ABSTRACT

INTRODUCTION The aim of this study was to conduct retrospective analysis of abdominopelvic computed tomography (CT) reports, identifying those patients in whom bowel wall thickening (BWT) was observed, and to correlate these reports with subsequent endoscopic evaluation.

METHODS Formal reports for all patients undergoing abdominopelvic CT between February 2007 and September 2009 were reviewed. Where patients were identified as having colorectal 'wall thickening', results of subsequent endoscopic evaluations were documented. Only those patients with a report of BWT who had follow-up endoscopy (colonoscopy, sigmoidoscopy) were included in the analysis.

RESULTS A total of 165 patients were included. Abnormalities on endoscopy at the exact site of the BWT on CT were found in 95 patients (57.58%); in 36 cases (21.82%) this was a malignant lesion. BWT of the transverse colon was significantly more likely to correspond to an endoscopic finding of cancer than other sites ($p=0.034$). Rectal bleeding was reported significantly more often in patients with BWT and neoplastic disease on endoscopy compared with those with normal endoscopy ($p=0.04$). Excluding patients with inflammatory/diverticular lesions, 59.02% of Caucasians had a neoplastic lesion at the site of reported BWT, significantly higher than the other ethnic groups ($p=0.008$). There were 38 patients (23.03%) who did not present with bowel symptoms and, of these, 6 were diagnosed subsequently with colorectal cancer.

CONCLUSIONS This study supports endoscopic evaluation to investigate patients with CT evidence of BWT, especially in cases involving the transverse colon, in Caucasian patients or in association with symptoms of rectal bleeding.

KEYWORDS

Bowel wall – Thickening – Computed tomography – Endoscopy – Colonoscopy – Sigmoidoscopy

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Computed tomography (CT) has become one of the most important imaging techniques for evaluating the abdomen and pelvis. Recent technological advances (eg helical/multi-detector scanners) and accumulated experience in image interpretation have made it possible to detect subtle gastrointestinal tract disorders on CT. Bowel wall thickening (BWT) is an increasingly recognised entity seen on CT.¹ It could represent inflammatory, infectious, ischaemic or neoplastic pathology affecting the bowel or it may be a sign of early pathological changes of an unidentified disease. Conversely, incidental reports of thickening may represent normal findings.

It is quite common for the clinician to be faced with a CT report implying the presence of BWT with an accompanying suggestion for 'further endoscopic evaluation'. However, the absence of published guidelines on this issue presents a dilemma, particularly in the elderly or patients in whom the index of suspicion for sinister pathology is low, such as

the young. Should these patients be subjected to an invasive procedure?

Several studies have attempted to shed light on this issue by looking at the correlation between CT reports of BWT and subsequent endoscopic findings.^{2–12} In addition, several reports in the literature have attempted to differentiate benign and malignant cases of BWT.^{15–15} These studies are relatively small and, as yet, no consensus has emerged on how this issue should be tackled.

Our study is the largest to date to seek to clarify this issue and was conducted in a district general hospital in a large city with a mixed patient population, precisely the sort of clinical environment in which this diagnostic dilemma is frequently encountered. The initial aim was to determine whether a CT finding of BWT predicted a pathological finding (neoplastic or otherwise) on subsequent endoscopic evaluation of the reported site of BWT. The important question for the clinician, who may request CT for a variety of

reasons, is whether an incidental finding of BWT signifies the presence of bowel cancer. We therefore also sought to determine whether a specific endoscopic finding of neoplastic disease (either adenomatous polyp or cancer) was related to factors such as haemoglobin (Hb) value, loose stools and rectal bleeding. Finally, we sought to determine whether ethnic origin had an effect on the correlation between BWT and neoplastic findings on endoscopy.

Methods

This was a retrospective analysis of abdominopelvic CT carried out between 1 January 2007 and 30 June 2009 at the North Middlesex University Hospital, London. All patients with BWT on CT were included and the correlation with endoscopic findings was calculated. Demographic data were recorded for all subjects. Data pertaining to symptoms and Hb were recorded by reviewing the notes. We did not distinguish between elective and emergency cases. Subjects were excluded if they were under 18 years of age, had a history of bowel cancer and/or previous colorectal surgery, or if there was a specific CT finding related to the bowel *other* than BWT (a mass, stricture, abscess or confirmed cancer).

All subjects had helical CT with intravenous contrast (Omnipaque®; Amersham Health Inc, Princeton, NJ, US) and abdominal imaging was obtained at 5–7mm increments. The CT scanners used at our institution were LightSpeed® VCT scanners (GE Healthcare, Chalfont St Giles, UK). The colonic wall was considered thickened if it measured >3mm in the presence of satisfactory distension. All scans were reported by consultant radiologists.

The decision to proceed with endoscopy was made by the individual surgeon’s response to BWT on CT. In some cases, clinicians referred the decision to a multidisciplinary team meeting, where a gastrointestinal (GI) radiologist would review and confirm the CT suspicion, before proceeding to endoscopy. In those patients who had an endoscopic evaluation, the radiological findings of BWT were compared with the endoscopic examination of the affected part of the colon. Depending on the site of the lesion on CT, either a flexible sigmoidoscopy or colonoscopy was performed with direct-view endoscopes (CF-Q160AL; Olympus, Tokyo, Japan). At our unit, a magnetic imager such as Olympus ScopeGuide™ to locate colonic lesions was not

available. Biopsies or polypectomies were performed only at sites of visible disease. All endoscopies were performed by consultant gastroenterologists or colorectal surgeons. Data were analysed with SPSS® v11 (SPSS Inc, Chicago, IL, US).

Results

After exclusions, a total of 165 patients (84 men, 81 women) had abdominopelvic CT with a report of BWT as well as a follow-on endoscopy specifically to look at the site of concern: 92 scans (55.76%) were performed electively and 73 (44.24%) were carried out as an emergency. The mean age was 66.6 years (standard deviation: 14 years). There were 78 Caucasian patients (47.27%), 38 were Afro-Caribbean (23.30%), 24 (14.55%) were of Mediterranean descent and 20 (12.12%) were Asian.

The most common site where BWT was reported was the rectum (*n*=50, 30.30%) followed by the caecum (*n*=44, 26.67%). The rectum and sigmoid colon accounted for nearly half of all cases of BWT (*n*=80, 48.48%). Abnormalities on endoscopy at the exact site of BWT on CT were found in 95 patients (57.58%). In 70 patients (42.42%), the endoscopy was normal at the reported site of BWT.

In 15 cases (7.88%) a lesion was found on endoscopy at a different site to that of the BWT on CT. In these cases, 11 patients had thickening proximal to the actual lesion identified and 2 had thickening distal to the actual lesion seen on endoscopy. Additionally, in these thirteen patients, we found cancer in seven patients, polyposis in two patients and diverticulosis in four patients. As these 13 patients were not deemed to have positive endoscopic findings correlating with the exact location of CT wall thickening, they were not considered further in the analysis.

Table 1 shows the incidence of any abnormality noted on endoscopy. BWT in the descending colon was significantly more likely to be associated with an abnormality on endoscopy compared with the other sites in the colon (*p*=0.04). CT findings of BWT and abnormal endoscopic findings were significantly greater for the left side (58/93 patients, 62.37%) compared with the caecum and ascending colon (30/62 patients, 48.39%) (*p*=0.048).

Details of the specific abnormalities seen on endoscopy at sites of BWT are shown in Table 2. Of the 165 patients, 36 (21.82%) were found to have a cancer at the site of BWT and

Table 1 Sites of bowel wall thickening (BWT) and positive endoscopy findings of any pathology at that site		
Site	Number of patients with BWT	Abnormal endoscopy
Caecum	44	20 (44.44%)
Ascending colon	18	10 (55.56%)
Transverse	10	7 (70.00%)
Descending colon	13	10 (76.92%)
Sigmoid	30	18 (60.00%)
Rectum	50	30 (60.00%)
Total	165	95 (57.58%)

Table 2 The incidence of specific abnormalities seen on endoscopy in patients with a computed tomography finding of bowel wall thickening (BWT)

Site	Number of patients with BWT	Normal endoscopy	Inflammation (eg proctitis, colitis) or diverticular disease	Adenomatous polyps	Cancer
Caecum	44	24 (54.55%)	8 (18.18%)	4 (9.09%)	8 (18.18%)
Ascending colon	18	8 (44.44%)	3 (16.67%)	4 (22.22%)	3 (16.67%)
Transverse	10	3 (30.00%)	1 (10.00%)	1 (10.00%)	5 (50.00%)
Descending colon	13	3 (23.07%)	4 (30.77%)	5 (38.46%)	1 (7.69%)
Sigmoid	30	12 (40.00%)	8 (26.67%)	3 (10.00%)	7 (23.33%)
Rectum	50	20 (40.00%)	12 (24.00%)	6 (12.00%)	12 (24.00%)
Total	165	70 (42.42%)	36 (21.82%)	23 (13.94%)	36 (21.82%)

Table 3 Clinical features in patients with normal endoscopy (excluding inflammatory and diverticular lesions) versus patients with neoplastic disease (adenomatous polyp or cancer)

Endoscopic diagnosis at sites of CT-detected BWT	Mean age (SD)	Mean Hb (SD)	Loose stools	Rectal bleeding
Normal endoscopy (<i>n</i> =70)	65.83 (15.62)	12.24g/dl (2.13g/dl)	16 (22.86%)	11 (15.71%)
Neoplastic disease on endoscopy (<i>n</i> =59)	68.61 (15.11)	11.54g/dl (2.72g/dl)	10 (16.95%)	18 (30.51%)
<i>p</i> -value (Student's <i>t</i> -test)	0.31	0.13	0.41	0.04

CT = computed tomography; BWT = bowel wall thickening; SD = standard deviation; Hb = haemoglobin

Table 4 Comparison of different ethnic groups and correlation between bowel wall thickening (BWT) on computed tomography (CT) and neoplastic disease (excluding inflammatory and diverticular lesion) on endoscopy

CT finding of BWT	Caucasian (<i>n</i> =61)	Afro-Caribbean (<i>n</i> =27)	Mediterranean (<i>n</i> =21)	Asian (<i>n</i> =20)	<i>p</i> -value (ANOVA)
Normal endoscopy (<i>n</i> =70)	25 (40.98%)	19 (70.37%)	11 (52.38%)	15 (75.00%)	–
Neoplastic disease on endoscopy (<i>n</i> =59)	36 (59.02%)	8 (29.63%)	10 (47.62%)	5 (25.00%)	0.008

59 (35.76%) had a neoplastic lesion (either adenomatous polyp or cancer). BWT of the transverse colon was significantly more likely to correspond to an endoscopic finding of cancer than other sites ($p=0.034$). Interestingly, patients with CT evidence of BWT were equally likely to be diagnosed with cancer or an inflammatory and/or diverticular disease (36 patients in each group, 21.82%).

Table 3 shows the association between clinical factors such as age, Hb level and a history of either loose stools or fresh rectal bleeding, and the presence of neoplastic disease on endoscopy at the sites of BWT. Rectal bleeding was reported significantly more often in patients with BWT and neoplastic disease on endoscopy compared with those with normal endoscopy ($p=0.04$). There were no differences

in the other clinical features between those patients with normal endoscopy and those with neoplasia. Of the 165 patients, 38 were asymptomatic or did not present with bowel symptoms (eg surveillance scans for other conditions, chest symptoms). Within this group of patients with incidental CT findings of BWT, six patients were subsequently diagnosed with colorectal cancer. This comprises 16.67% of the cancer patients and 3.64% of the total study population.

Table 4 shows the distribution of neoplastic endoscopic findings in patients with CT evidence of BWT in the different ethnic groups (excluding patients with inflammatory/diverticular lesions). Over half of the Caucasians (59.02%) had a neoplastic lesion at the site of reported BWT, significantly higher than the other ethnic groups ($p=0.008$).

Discussion

This is the largest study to date to examine the importance of BWT on abdominopelvic CT. Overall, we showed that the correlation between CT findings of BWT and abnormal endoscopy at the exact same site was 57.58%. We found that a CT finding of BWT with evident pathology of any kind on endoscopy was fairly evenly spread throughout the bowel, with higher frequencies at the caecum and the rectosigmoid, in keeping with the known higher frequencies of colonic pathology at these sites.

The correlation between CT findings of BWT and neoplastic lesions was 35.76%, of which 13.94% were benign (polyp) lesions. The cancer rate (21.82%) was similar to that of diverticular disease or inflammatory lesions. We also found that BWT of the transverse colon was significantly more likely to be associated with a finding of cancer than other sites ($p=0.054$). This perhaps reflects the overall dearth of neoplastic pathology encountered at this site and indicates that BWT of the transverse colon should be treated with greater suspicion than at other sites.

Our study also shows fresh rectal bleeding was significantly higher in those patients with BWT and neoplastic disease confirmed on endoscopy compared with patients who had a normal endoscopy ($p=0.04$). Analysis of the data based on ethnic origin demonstrates that Caucasian patients were significantly more likely to have neoplastic disease (adenomatous polyps or cancer) on endoscopy at the reported site of BWT compared with either Asian or Afro-Caribbean patients ($p=0.008$). The reasons for these findings are not clear but may simply represent differences in incidence of neoplastic disease among various ethnic groups.

CT visualises the entire bowel including luminal, intramural and extramural portions. Bowel wall thickness is measured as the distance from the outer colon wall edge (as defined by identifying the interface between mesenteric fat and bowel) to the inner bowel wall edge, which is demarcated by noting the interface between bowel wall and intestinal gas, faeces or contrast.¹⁵ Usually, the bowel wall should measure 3mm. Some clinicians accept rectal wall values of 5mm.^{14,15} The degree of BWT has been graded by Bharucha *et al* as mild (3–6mm), moderate (6–12mm) and severe (>12mm).¹⁶ CT can detect lesions larger than 3–5mm but recent technological advances such as CT colonography may improve the sensitivity for smaller lesions.¹⁷

One of the first studies correlating BWT on CT with endoscopic follow-up studies was performed by Rockey *et al*.² They showed the likelihood of detecting an abnormality on endoscopy in their cohort of 50 patients with a CT diagnosis of BWT was 67%. Moraitis *et al* found an even higher correlation rate of 72% in their cohort of 35 patients⁵ while Wolff *et al* discovered that 73.9% had abnormalities on endoscopy.⁴ Overall, most studies recommend endoscopic examination in patients with BWT on CT. This includes a study by Tellez-Avilla *et al* in 2009.⁵ Although only 12/31 asymptomatic patients with incidental CT findings of BWT (38.8%) had abnormalities on endoscopy, the authors still recommended this investigation.

In the present study, 21.82% of patients with BWT on CT were diagnosed with cancer on endoscopy. This is higher

than the incidence of cancer reported by other studies in the literature such as Moraitis *et al* (14%)⁵ and Rockey *et al* (15%).² However, Nicholson *et al* showed that 26.6% of cases of BWT were later diagnosed with cancer.⁶

It is important to note that our study has shown almost 16.67% (6 patients) of the cancers were detected in patients with no colonic symptoms. This suggests that the presence of BWT on CT may be the first and only feature of an underlying colonic neoplasia. Moraitis *et al* also discovered that 4/5 patients (80%) who had cancer on endoscopy did not have any colonic symptoms.⁵ Tellez-Avilla *et al* found that 29% of asymptomatic patients presenting with GI wall thickening (including stomach and duodenum) had cancer on endoscopy.⁵ Bleibel *et al* showed that 18% of patients with incidental CT findings of GI wall thickening had a malignancy on endoscopy.⁷ In that study, all the patients diagnosed with cancer were over 50 years of age and the authors therefore suggested the use of follow-up endoscopy in patients above this age.⁷ Stermer *et al* argued against the routine use of colonoscopy but agreed that high risk patients (family history, positive faecal occult blood, age >50 years) with incidental BWT would benefit.⁸

In the present study, lesions affecting the caecum and ascending colon on CT were least likely to yield abnormal findings on endoscopy (48.4%) compared with left-sided lesions (62.4%). This confirms the results of Cai *et al*.⁹ They showed an 81% correlation with rectosigmoid lesions but only a 13% correlation with caecal lesions in patients with CT reports of BWT.⁹ Similar findings were observed by Eskaros *et al*¹⁰ and Shin *et al*.¹¹

Cai *et al* suggested that the relatively high mobility of the caecum makes it more likely to collapse and give artefactual pictures.⁹ In addition, the effects of contrast agents are likely to induce less distension on the right colonic wall compared with the left side, predisposing to more false positive readings. Furthermore, there are differences in venous drainage pathways, hydrostatic pressures and collateral formation that could explain the inconsistent correlations between right and left colonic segments. Despite this, these three studies recommended all incidental findings (both of the left and right colon) on CT warrant further endoscopic evaluation.^{9–11}

The further management of patients who showed BWT on CT but had a subsequent normal endoscopy is controversial. One of the factors to be considered is the time lapse as the cause of the BWT may have resolved by the time the endoscopy is performed. In addition, although most bowel pathologies produce luminal changes, there may be a few instances where luminal changes are not present. Therefore, the value of BWT may be underestimated as true pathology detected on CT may not be subsequently detected on endoscopy. In cases with normal endoscopic features and biopsies, a pathological process in the deeper mural layers should be considered for high risk groups.

Another factor to consider is that colonoscopic assessment of the location of a colonic lesion is not always accurate. This is why colonic tattooing is necessary to mark a colonic lesion before laparoscopic resection. The use of magnetic imaging such as with Olympus ScopeGuide™,

which would give an accurate anatomical location of a lesion,^{18,19} would have been useful to clarify the accuracy of endoscopic evaluation in locating lesions in this study. Rockey *et al*² and Padda *et al*¹² suggested that patients who have high clinical suspicion for GI pathology but a negative endoscopy should have a double contrast barium enema or repeat CT with emphasis on optimal luminal distension. CT colonography can also be considered as it can detect very small polyps missed during endoscopy.^{17,20} Conversely, in those patients where there is low clinical suspicion of pathology, no further investigations are recommended if endoscopic findings are normal.^{2,12}

Conclusions

There is an important correlation between a CT finding of BWT and a subsequent endoscopic finding of neoplastic pathology. The association is particularly strong where there is BWT of the transverse colon. The association is also strong in white (Caucasian) patients and in those with a history of rectal bleeding. We suggest that all patients with a finding of BWT should, at the very least, be recalled and assessed fully because most of these patients will require endoscopic follow-up.

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