Can computed tomography aid in diagnosis of intramural hematomas of the intestinal wall ?

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Abstract

Background : **We sought to use computed tomography (CT) data to support the correct differential diagnosis of patients with spontaneous intramural hematomas of the gastrointestinal tract, to aid in the clinical management of those using oral anticoagulants.**

Methods : **Patient data were retrospectively analyzed and patients were divided into two groups. The first group contained 10 patients (5 females, 5 males, median age 65 years [range 35-79 years]) who had been diagnosed with spontaneous intramural hematomas of the gastrointestinal tract. The second group contained nine patients (5 females, 4 males, median age 41 years [range 24-56 years]) who exhibited intestinal wall thickening on CT, and who had been diagnosed with ulcerative colitis, Crohn's disease, ameboma, and lymphoma. The enhancement patterns in the CT images of the two groups were compared by an experienced and inexperienced radiologist. The differences in values were subjected to ROC analysis.**

Results : **Inter-observer variability was excellent (0.84) when post-contrast CT images were evaluated, as were the subtraction values (0.89). The subtracted values differed significantly between the two groups ($p = 0.0001$). A cutoff of +31.5 HU was optimal in determining whether a hematoma was or was not present.**

Conclusions : **Contrast enhancement of an intestinal wall hematoma is less than that of other intestinal wall pathologies associated with increased wall thickness. If the post-contrast enhancement of a thickened intestinal wall is less than +31.5 HU, a wall hematoma is possible.** (Acta gastroenterol. belg., **2015**, 78, **399-405**).

Key words : intestinal wall hematoma, CT, oral anticoagulant.

Introduction

Spontaneous intramural hematoma in the gastrointestinal tract (SIHGT) is rare. However, with recent increases in anticoagulant use, the condition is becoming more familiar to the specialist. The pathophysiological feature of SIHGT is intramural bleeding caused by shredding of terminal arteries at the points where they leave the mesentery and penetrate the muscular layer of the bowel wall (1-3). The bleeding or hematoma is usually self-limiting, and is sometimes accompanied by a hemoperitoneum or obstruction of the intestinal lumen. SIHGT may involve a long segment of the bowel (4,5).

The standard computed tomography (CT) imaging finding in SIHGT is circumferential thickening of the small bowel in a patient using anticoagulants. However, the presentations of many other intestinal diseases, including Crohn's disease, ulcerative colitis, and intestinal lymphoma, are similar. Thus, we sought a useful criterion facilitating differential diagnosis by the radiologist.

It was impossible to examine only pre-contrast CT images because differences in hematoma age, and spontaneous resolution, can cause confusion (6). Thus, the enhancement scans were examined, because it was felt that the enhancement pattern of a hematoma should differ from those of other pathologies.

Our hypothesis was that a hematoma would enhance less than other similar intestinal diseases (Crohn's disease, ulcerative colitis, or intestinal lymphoma). In this retrospective analysis, we sought to support a correct differential diagnosis of patients with SIHGT and to assist clinicians in managing patients using oral anticoagulants.

Materials and Methods

Patients

This study was retrospective in nature. The medical records of 19 patients with thickened intestinal walls were reviewed. The patients were divided into two groups. The first contained patients visiting our emergency department with acute abdominal pain (10 patients ; 5 females, 5 males, median age 65 [range 35-79] years) (the SIHGT group), and the second contained the other patients (9 patients ; 5 females, 4 males ; median age 41 [range 24-56] years) with intestinal wall-thickening disorders including ulcerative colitis, Crohn's disease, ameboma, and lymphoma. The patients in the second group were chosen blindly. The size of the second patient group was small, because we do not routinely obtain abdominal CT without contrast at our hospital. Consequently, we had to exclude many patients who did not undergo pre-contrast CT. Data on 10 patients diagnosed with SIHGT and nine patients (the other group) diagnosed with conditions that were not SIHGT, between December 2010 and January 2014, were analyzed.

Imaging protocol and image analysis

All CT examinations were performed using a 16-channel Multi-detector platform (Somatom Emotion 16 ; Siemens, Erlangen, Germany). The scanning parameters were contiguous collimation of 1.5 mm ; a 16-s table

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speed ; and a pitch value of 1.5. Slices 1 and 3 mm thick were secondarily reconstructed at 1-mm intervals. The portal phase images were acquired 60 s after administering 100-mL intravenous boluses of non-ionic contrast material (Iohexol, 300 mg/mL ; Omnipaque™ ; Amersham, Cork, Ireland). CT images for all patients were analyzed using the Volume Wizard platform (Siemens Medical Systems). Each thickened intestinal wall region was evaluated on pre- and post-contrast scans, using the ROI approach, by two specialists, one experienced (SU) and one a young radiology fellow (BÇP). The experienced abdominal radiologist has has worked in this field since 2002 ; she performed all calculations in a non-blinded manner, being familiar with all medical findings when estimating pre- and post-contrast intestinal wall thicknesses. However, BÇP lacked such knowledge. The ROI size and shape varied according to lesion configuration.

The study was approved by our institutional review board.

Statistical Analysis

Statistical analysis was performed using SPSS ver. 17.0 (SPSS, Chicago, IL). Normality of data distribution was evaluated with the aid of the Kolmogorov-Smirnov test. If continuous variables were normally distributed, data are given as means with standard deviations (the comparisons yielded p-values > 0.05 in the Kolmogorov-Smirnov or Shapiro-Wilk test [n < 30]). If continuous variables were not normally distributed, median values are presented. The values of continuous variables were compared between groups using the chi-square or Mann-Whitney *U*-test, as appropriate.

Receiver operating characteristic (ROC) curves were constructed and areas under the curves (AUCs), sensitivities, and specificities of various subtraction values were calculated. Between-observer agreement was assessed by calculation of infraclass correlations. A p-value < 0.05 was considered to reflect statistical significance.

Results

Demographic, medical, and CT data on all patients are summarized in Tables 1 and 2. The pre-contrast densities of thickened intestinal walls were subtracted from the post-contrast values to obtain enhancement values for the entire regions of pathologically thickened intestinal walls (Table 3). Examples of the patient pathologies are shown in Figures 1-4.

Our gold standard for diagnosing intramural hematomas and other pathologies is accepted surgical and colonoscopy findings.

Inter-observer agreement was poor (0.51) when pre-contrast data were analyzed, but excellent (0.84) when post-contrast scans were examined. Also, the subtraction values were in excellent agreement (0.89). The agreement between subtraction values is shown in Schematic 1.

The subtracted values differed significantly according to patient group ($p = 0.0001$). Pre-contrast data derived by either radiologist did not differ between the groups (p = 0.006 and p = 0.95 ; radiologists 1 and 2, respectively). This was also true of post-contrast data (p = 0.95 and p = 0.35 ; radiologists 1 and 2, respectively) (Table 4).

ROC analysis (Fig. 2) performed to evaluate the diagnostic utilities of subtracted values identified 31.5 HU as a useful cutoff. An enhancement over 31.5 HU is compatible with the conditions of patient group 2 (the non-SIHGT group). Below that value, SIHGT is indicated. The cutoff has a sensitivity of 88.9% and a specificity of 88.9%.

Table 1. — **Demographic, medical and Computed Tomography data on first group patients whit SIGHT are summarized**

Patient no	Sex	Age	Part of GIS	Measurement of segment (cm)	Reason of oral anticoagulant	Peritoneal/retroperitoneal fluid
1	M	58	Jejunum	30	Prosthesis valve CVO	Peritoneal fluid
2	M	57	Duodenum + jejunum	15	Prosthesis valve	Peritoneal fluid
3	M	35	Ileum	20	Prosthesis valve	Peritoneal fluid
4	M	65	Duodenum	20	DVT, AF	Peritoneal fluid
5	M	68	Gastric antrum + Duodenum	20	Prosthesis valve Vascular stent	Peritoneal fluid
6	F	72	Ileum	30	CVO, AF	Peritoneal fluid
7	F	35	Ileum	20	Anti phospholipids syndrome, DVT	Peritoneal fluid
8	F	69	Ileum	20	Prosthesis valve , CVO	Peritoneal fluid
9	F	79	Colon	5	CVO	Retroperitoneal fluid
10	F	65	Caecum	5	Prosthesis valve , CVO	Retroperitoneal fluid

CVO, cerebral vascular occlusion; DVT, deep venous thrombosis; AF, atrial fibrillation.

Table 2. — **Demographic, medical and Computed Tomography data on first group patients without SIGHT are summarized**

Patient no	Sex	Age	Part of GIS	Measurement of segment (cm)	Reason of thickening intestinal wall	Peritoneal/retroperitoneal fluid
1	F	41	Right colon + distal ileum	30 + 45	Crohn's disease	Peritoneal fluid/Retroperitoneal fluid
2	F	48	Terminal ileum	25	Terminal ilitis	Peritoneal fluid
3	M	38	jejunum	40	Jejunal ameboma	Peritoneal fluid
4	F	56	Sigmoid colon + distal ileum	40 + 20	Crohn's disease	Peritoneal fluid
5	M	24	Jejenum	30	lymphoma	Peritoneal fluid
6	F	55	Jejunum,	30	Celiac disease	Peritoneal fluid
7	M	50	Duedonum + gastric antrum	10 + 10	lymphoma	Peritoneal fluid
8	M	28	Distal Colon	40	Crohn's disease	Peritoneal fluid
9	F	32	Ascending Colon	30	Crohn's disease	Peritoneal fluid/Retroperitoneal fluid

Table 3. — **The pre-contrast densities of thickened intestinal walls were subtracted from the post-contrast values to obtain enhancement values for the entire regions of pathologically thickened intestinal walls (OAC : oral anticoagulant)**

Radiologist 1						Radiologist 2					
Patient group 1 (with OAC)			Patient group 2 (without OAC)			Patient group 1 (with OAC)		Patient group 2 (without OAC)			
Pre cont CT HU (intestine wall)	Post cont CT HU (intestine wall)	Subtraction value	Pre cont CT HU (intestine wall)	Post cont CT HU (intestine wall)	Subtraction value	Pre cont CT HU (intestine wall)	Post cont CT HU (intestine wall)	Subtraction value	Pre cont CT HU (intestine wall)	Post cont CT HU (intestine wall)	Subtraction value
44	64	20	-24	+28	52	44	57	13	6	51	45
37	42	5	38	103	65	37	45	8	37	90	53
45	66	21	21	51	30	41	65	24	24	61	37
35	43	8	40	118	78	28	42	14	45	115	70
45	57	12	28	81	53	33	57	24	18	65	47
39	61	22	15	80	65	42	69	27	59	104	45
61	75	14	41	95	54	45	77	32	41	97	56
44	62	18	35	101	66	55	67	12	40	86	46
66	75	9	28	51	33	39	43	4	24	55	31
33	35	2				15	19				

Discussion

New-generation multidetector CT plays an important role in the detection and identification of bowel abnormalities. The normal small bowel wall thickness on CT should not exceed 3 mm despite luminal distention, while the colon wall can range from 1-2 mm, when the lumen is distended, to 5 mm, when the wall is contracted or the lumen is collapsed (9-11).

Thickening of the bowel wall may be caused by several malignant and non-malignant disorders. The differential diagnosis for thickening of the bowel is very complex, making the correct diagnosis very difficult, and it includes malignancies (lymphoma, small or large bowel cancers, malignant gastrointestinal tumors, and others), inflammatory or infectious bowel disease, bowel wall ischemia, and spontaneous bowel hematomas (9-11).

When thickening of the bowel wall is identified on CT, several CT findings must be considered to simplify the differential diagnosis : length of involvement, degree of thickening, symmetric versus asymmetric involvement, pattern of attenuation, and perienteric abnormalities (9-11). Each of these findings may have a different level of significance depending on whether the symptom onset is acute or chronic (9-11). When thickening of the small or large bowel wall is identified on CT, it is first necessary to assess the extent of the involved bowel and distinguish between (1) focal (extent < 5 cm) and (2) segmental (6-40 cm) or diffuse (> 40 cm) involvement (9-11). This is an important step for differentiating between

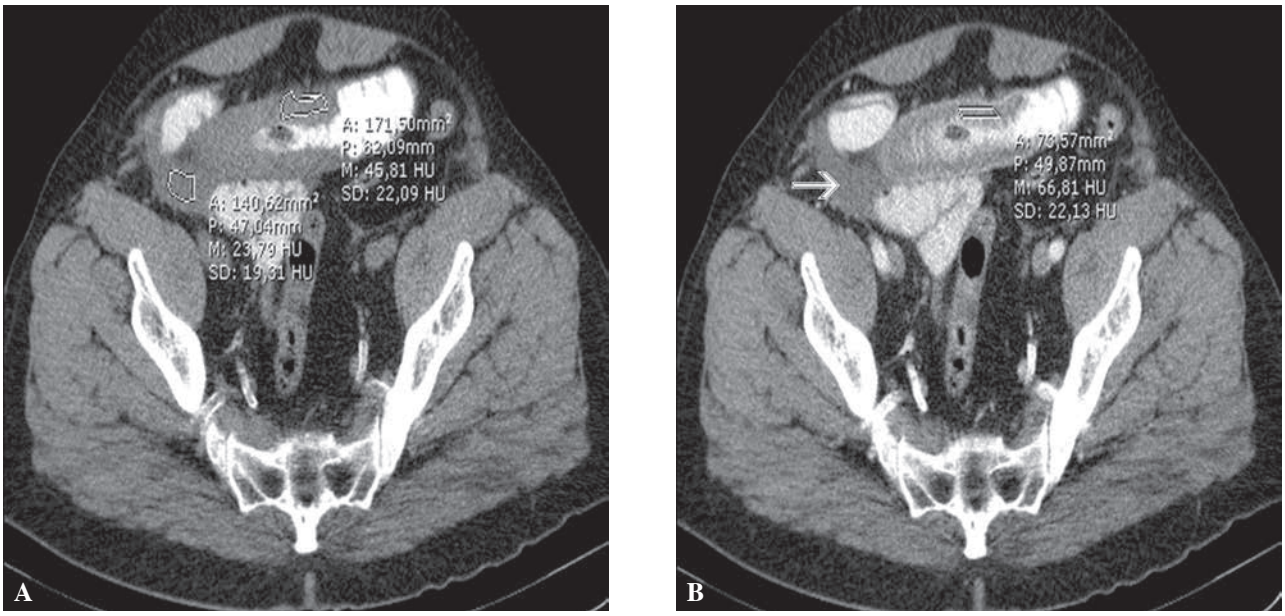

Fig. 1. — A 35 year-old male who used an oral anticoagulant after placement of a prosthetic valve (patient #3 of Table 1) (A) Axial pre- and (B) post-contrast CT images show a thickened ileal wall (pre-contrast value ; +45 HU, post-contrast value ; +66 HU). The white arrow shows a hemoperitoneum.

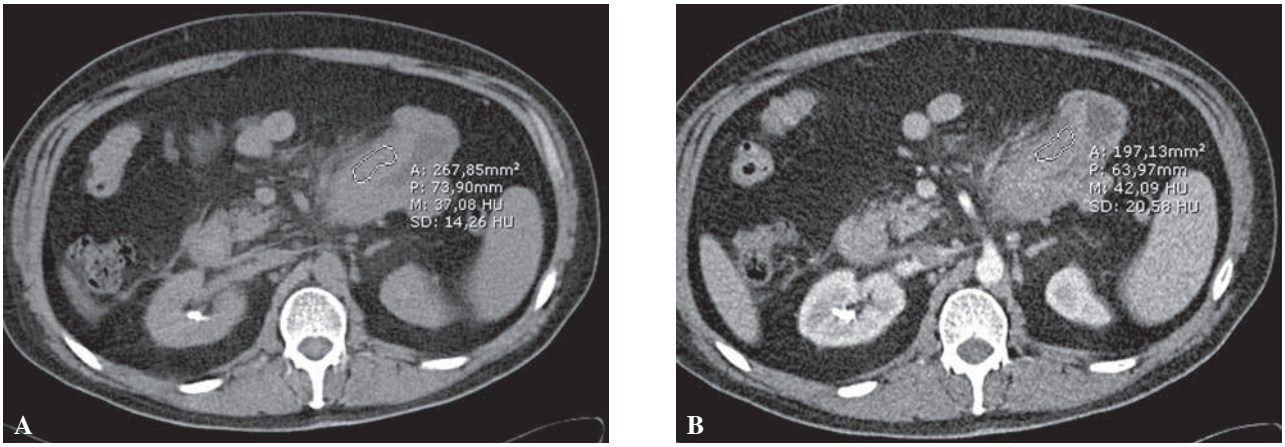

Fig. 2. — A 57 year-old male who used an oral anticoagulant after placement of a prosthetic valve (patient #2 of Table 1) (A) Axial pre- and (B) post-contrast CT images ; and (C) a coronally reformatted CT image, reveal a thickened jejunal wall (double white arrows) (pre-contrast value ; +37 HU, post-contrast value ; +47 HU). The aterix shows a hemoperitoneum.

benign and malignant causes of bowel wall thickening : while most bowel tumors present with focal involvement, segmental and diffuse thickening of the bowel wall are usually caused by non-malignant conditions (9-11). The exception is small bowel lymphoma, which typically has a segmental distribution (9-11).

Inflammatory or infectious diseases of the bowel are usually centered in the bowel wall and can cause segmental or diffuse, symmetrical wall thickening (9-11). In a few inflammatory enteric or perienteric conditions, however, the inflammatory changes are more prominent in the mesentery adjacent to the bowel, rather than in the bowel wall itself. In these conditions, the bowel involvement is usually focal and mild, and the fat stranding is disproportionately greater than the degree of wall thickening. This is helpful for narrowing the differential diagnosis to four main conditions : diverticulitis, epiploic appendagitis, omental infarction, and appendicitis (9-11).

Although asymmetric, heterogeneous focal thickening of the bowel wall usually indicates malignancy, non-malignant inflammatory conditions, such as intestinal tuberculosis and Crohn's disease, may present with similar imaging features that sometimes mimic carcinomas (9-11). Bowel wall thickening with a stratified pattern may also be seen in ulcerative colitis and Crohn's disease, indicating acute, active disease (9-11). Crohn's disease may occur in any part of the gastrointestinal tract, but predominantly affects the small bowel, particularly the

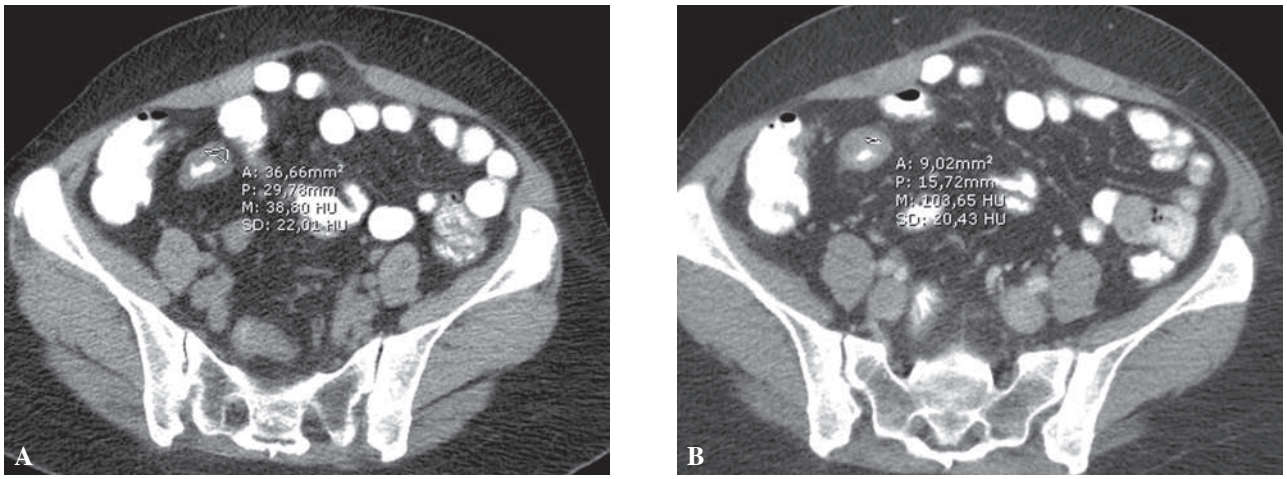

Fig. 3. — A 47 year-old female with terminal ileitis (patient #2 of Table 2). Axial (A) pre- and (B) post-contrast CT images reveal a thickened ileal wall (pre-contrast value ; +38 HU, post- contrast value ; +103 HU).

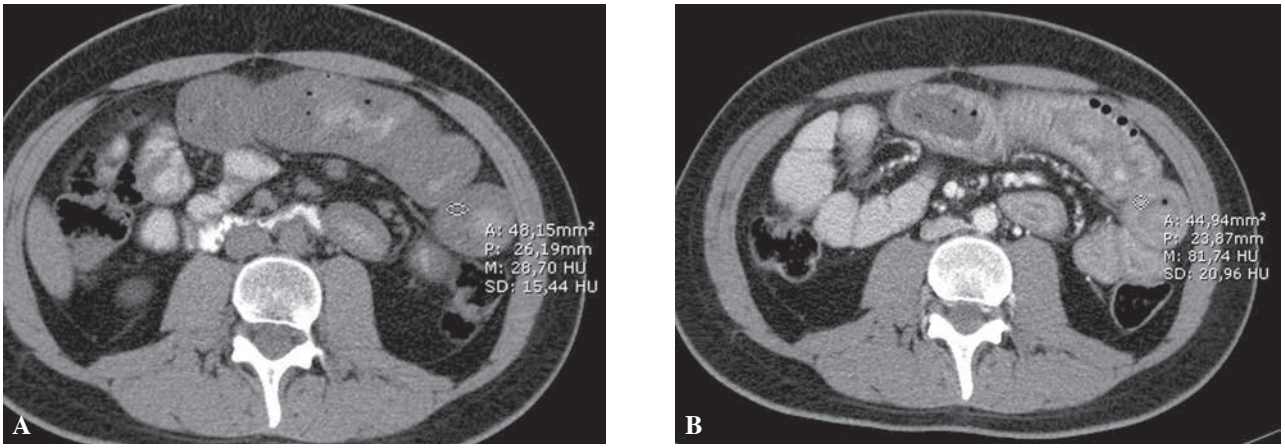

Fig. 4. — A 24 year-old male with T-cell lymphoma featuring intestinal presentation (patient #5 of Table 2). (A) Axial pre- and (B) post-contrast CT images reveal a thickened jejunal wall (pre-contrast value ; +28 HU, post-contrast value ; +81 HU).

ileum and right colon (9-11). CT signs favoring Crohn's disease include discontinuous involvement of the bowel wall ("skip areas"), prominent vasa recta ("comb sign"), and signs of transmural inflammation, such as fistulas and abscesses, and proliferation of the fat along the mesenteric border of the bowel (9-11).

Spontaneous bowel hematomas have several causes, including anticoagulant therapy for medical reasons and rat poison ingestion (9-12). The CT findings of intestinal wall hematomas are very similar to those of other malignant and non-malignant pathologies. The wall thickening due to SIHGT can appear as single or multiple lesions. The wall thickening is circumferential and includes intramural hyperdensity (pre-contrast CT), luminal narrowing, and intestinal obstruction. Sometimes, peritoneal-retroperitoneal-free hemorrhagic fluid can accompany these CT findings (6). No CT finding is specific for the true diagnosis.

Patients visiting the emergency room with abdominal pain may refuse oral contrast administration, and emergency room physicians often prefer to avoid the use of oral contrast agents in case the patient requires an emergency abdominal laparotomy. For routine CT examinations, a positive (water soluble) or negative (water only) oral contrast is often recommended. If the oral contrast material is balanced, there are no artifacts (13). Conversely, oral contrast is not recommended for CT enterography or mesenteric vascular protocols (9,13). The type of oral contrast material used (white or negative) depends on the patient's clinical findings.

Analysis of pre-contrast CT data suffered from excessive inter-observer variability. However, post-contrast CT figures were compatible between observers 1 and 2, because the contrast material had rendered intestinal pathology considerably more visible. The less-experienced observer could not detect the pathological segment in pre-contrast CT slices, but had no such difficulty when observing contrast-enhanced CT data. Thus, intravenous contrast material must be administered if CT is to assist in hematoma diagnosis. Also, the subtracted values were

Table 4. — **The statistically results is summarized. The pre-contrast densities of thickened intestinal walls were subtracted from the post-contrast values to obtain enhancement values for the entire regions of pathologically thickened intestinal walls (CT : Computed tomography)**

Group	1			2			
	Median	Minimum	Maximum	Median	Minimum	Maximum	P
Age	65	35	79	41.00	24	56	0.006
Measurement of segment	20.00	5	40	30.00	10	40	0.101
Pre cont CT HU (intestine wall) (Radiologist 1)	44.00	33	66	28.00	-24	41	0.006
Post cont CT HU (intestine wall) (Radiologist 1)	61.50	35	75	81.00	28	118	0.095
Subtraction value (Radiologist 1)	13.00	2	22	54.00	30	78	0.0001
Pre cont CT HU (intestine wall) (Radiologist 2)	40.00	15	55	37.00	6	59	0.447
Post cont CT HU (intestine wall) (Radiologist 2)	57.00	19	77	86.00	51	115	0.035
Subtraction value (Radiologist 2)	14.00	4	32	46.00	31	70	0.0001

comparable between observers 1 and 2. Thus, the technique may be useful for determining whether an intestinal wall hematoma is or is not present, independently of the experience of the radiologist.

In this study, the mean length of the intestinal segment affected by a hematoma was 20 cm in the SIHGT group, and the mean length of the intestinal segment affected by a different problem was 30 cm in the other group (Table 4). The lengths of the intestinal wall hematomas were similar to those described by Abbas *et al*. (6). As was also observed by the cited authors, few of our patients (two, or 20%) presented with more than one affected intestinal segment ; most SIHGT patients had only one affected segment.

Differentiation of an intestinal wall hematoma from other intestinal wall pathologies has received little attention. It might be asked : Why is such differential diagnosis necessary ? When evaluating CT images, we radiologists seek to find features supporting the patient's medical history and laboratory findings. We initially found no such features upon retrospective analysis of archived data. The morphological features of intestinal wall hematomas mimic those of other benign or malignant pathologies. However, radiologists are under great pressure to overdiagnose, and no radiologist wants to overlook a malignant disorder. We believe that overdiagnosis reduces the credibility of a radiologist. Non-traumatic spontaneous intramural intestinal hemorrhage is a complication of anticoagulant therapy, presenting as acute abdominal pain in the emergency department (7,8). Prompt, accurate diagnosis of such a hematoma is important to prevent prescription of unnecessary medication or pointless exploratory surgery.

Upon further analysis, we were able to define a helpful enhancement cutoff value. If the enhancement is above +31.5 HU, an intestinal wall hematoma should be absent. Enhancement of such a hematoma is less than those of other intestinal wall pathologies associated with thickened walls.

One major problem is that most patients do not undergo pre-contrast examinations. Without pre-contrast examinations, no enhancement can be calculated. If we are considering SIHGT as a possible diagnosis, a pre-contrast examination is helpful. Nevertheless, the radiologist might have concerns about the radiation dose. This is less of a problem in the elderly. Therefore, good clinical information (i.e., anticoagulant use or increased bleeding risk and up to date coagulation parameters) are essential before scanning.

In conclusion, CT can be useful in instances of uncertainty ; this modality can determine whether or not a hematoma is present. Our current study has the limitations of retrospectivity and small numbers of patients. Thus, the findings should be regarded as preliminary, and may encourage further work with larger groups. Notably, it is essential to obtain pre-contrast and post IV contrast CT if using the new diagnostic method.

Acknowledgment

The English in this document has been checked by at least two professional editors, both native speakers of English. For a certificate, please see :

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