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Original Article

Utility of Emergency Department CT Scans in Patients with Ulcerative Colitis

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Abstract

Background: Patients with Ulcerative Colitis (UC) are frequently subjected to Computed Tomography (CT) in the Emergency Department (ED), but the utility of this test is unclear. The aims of this study were to determine the predictors of significant CT findings in these patients.

Methods: UC patients seen in the ED at a single institution from 2009-2015 were eligible. Patients without gastrointestinal complaints or who had colectomy were excluded. Demographic, clinical, laboratory and radiological data were collected from the electronic medical record. Active UC findings were censored. Variables were analyzed using chi-square, Fisher's exact test or the Student t-test as appropriate. Multivariate regression analysis was performed to assess the association of clinical predictors with Significant New radiological Findings (SNF).

Results: Of the 551 UC patients seen in the ED, 413 were excluded (non-GI symptoms, no UC diagnosis, prior colectomy). The remaining 138 had 260 ED visits of which 38.1% resulted in a CT scan and 36.4% had significant findings. Only 4 (4%) were related to the UC diagnosis. Abdominal pain (RR=1.5; CI 1.2-1.7) was a negative predictor of ordering a CT scan, while rectal bleeding (RR=0.38, CI 0.2-0.7) and using any Inflammatory Bowel Disease (IBD) medication (RR=0.86, CI 0.75-0.98) were positive predictors in univariate analysis. Rectal bleeding (RR=0.14), diarrhea (RR=0.33), and elevated CRP (RR=0.45) predicted SNF. On multivariate analysis, diarrhea remained a significant negative predictor (RR=0.19, CI 0.065-0.58) for major CT findings. Ordering a CT had no impact on hospital admission.

Conclusion: A substantial proportion of UC patients are exposed to CT in the emergency department and a substantial proportion had significant findings most of which were not related to their IBD. Candidate negative and positive predictors of significant radiological findings were identified.

Keywords: Computed tomography; Emergency department; Inflammatory bowel disease; Ulcerative colitis

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Introduction

Ulcerative Colitis (UC) is an inflammatory bowel disease of unclear etiology characterized by continuous mucosal inflammation of the colon starting in the rectum. The disease itself is primarily diagnosed by endoscopy and biopsies. Although several medical treatments exist, patients with ulcerative colitis typically experience flares of active disease characterized by diarrhea, bleeding and abdominal pain, separated by periods of remission of variable duration. Severe flares of UC are a true medical emergency as patients can develop severe anemia, dehydration, malnutrition or rarely toxic megacolon and other perforations. Such complications typically require admission to the Emergency Department (ED) [1-6]. Ulcerative colitis symptoms and particularly abdominal pain are non-specific and therefore radiographic imaging such as a Computed Tomography (CT) of the abdomen is utilized for assessing intra-abdominal complications. CT imaging is often performed as part of the ED evaluation in patients with ulcerative colitis. However, the value of this imaging modality in determining the disposition of UC patients in the ED is unclear and subjects are exposed to radiation or risk of renal injury [7-11]. Several studies have indicated a marked increase in ED-based cross-sectional imaging over the past 10 years in US hospitals, for reasons that are not entirely clear. Despite the easy accessibility, CT scans result in a substantial additional cost and risks including contrast-induced nephropathy and radiation exposure [8,12-20]. Thus, identifying predictors of significant intra-abdominal abnormalities could result in substantial reductions in healthcare costs and patient exposure to risks without a decrease in the quality of care. A few studies have evaluated the utility of radiological imaging in the ED in patients with inflammatory bowel disease [7,10,11,21]. However, risk factors for significant abdominal pathology in UC patients presenting with symptoms that require emergency evaluation are not well defined. Furthermore, disease presentation may be different in community-based versus referral-based cohort studies. The goals of our study were to determine the frequency of CT usage in the ED among patients with UC as well as predictors for Significant New Findings (SNF). We also aimed to

determine the impact of cross-sectional imaging on immediate outcomes such as hospitalization in UC patients presenting to the ED in a large urban medical center.

Methods

Patients

This was a retrospective single institution cohort study which was approved by the Institutional Review Board of the Benaroya Research Institute at Virginia Mason (a tertiary referral medical center in Seattle, Washington). Adult patients (> 18) with UC were identified from the actively maintained established IBD database which incorporates patients with IBD seen in our center since 1996. All UC patients evaluated in the ED department at our hospital from January 1, 2009 to December 16, 2015 were considered eligible for the study. Patients with a new (less than 3 months) diagnosis of UC, eventual diagnosis of Crohn's disease or microscopic colitis, infectious colitis without IBD, history of colectomy for ulcerative colitis or colonic neoplasia, as well as patients presenting to the ED without Gastrointestinal (GI) complaints were excluded. We also excluded patients with no follow-up at this institution after the ER visit.

Clinical data

Demographic and clinical data including age, sex, ethnicity, clinical diagnosis, reason for ED admission, presenting symptoms, current medications, as well as microbiology, laboratory, and radiological investigations in the ED were collected from the institution's electronic medical record. For the purpose of this study, abdominal pain was defined as any discomfort from xiphoid to the perineum. Having a fever was not an eligible symptom unless accompanied by other GI complaints. An order for Clostridium difficile testing was considered a surrogate marker for diarrhea, even if the latter was not listed specifically as a presenting complaint. Medication history specifically related to a diagnosis of IBD, including 5-ASA, steroids, immunomodulators and biologic agents was also collected. The use of biologic agents was ascertained by reviewing both office and hospital records as well as outpatient infusion center data. We also collected data regarding prior cross-sectional imaging studies such as CT or Magnetic Resonance Imaging (MRI) scans of the abdomen and pelvis performed at our institution in the preceding 5 years. All CTs at time of ED visit were reviewed for the presence, location and significance of findings. An imaging finding was classified as intestinal or extra-intestinal (including processes such as obstructing kidney stones, abdominal masses, or abscesses), and considered new if not present on a previous imaging study or significant if it necessitated further workup, change in patient management, or intervention. Findings indicative of active or chronic colitis without complications on Emergency Department CT scans (EDCT) were censored as they are usually not relevant in patients presenting with a UC flare, since imaging is neither necessary nor sufficient for the diagnosis. The emergency department disposition such as hospitalization or discharge to home was also recorded from the electronic medical record.

Statistical analysis

For the purpose of the main study outcomes - the frequency of EDCT, the incidence and predictors of SNF - as well as the ED visit disposition, each ED presentation was considered as an independent episode. Descriptive statistics were used to analyze demographic and clinical data. We used the chi-square test or the Fisher's exact test where appropriate to analyze categorical variables and the Student t-test to analyze continuous variables that could predict the presence of SNF on EDCT. The results were adjusted for missing values by list wise deletion and missing value imputation. All variables with resulting $p < 0.1$ in the univariate analysis were introduced in a multivariate logistic regression model without adjustments for multiple comparisons.

Results

From our institutional IBD database, we identified 551 subjects with UC who presented to the ED from January 1, 2009 to December 16, 2015. Of these, 184 were excluded because they did not have a GI chief complaint at presentation, 157 because they did not have an established diagnosis of UC, and 72 due to a prior total colectomy. This resulted in 138 patients with UC (260 total ED episodes) who were included in the study. Demographic and baseline clinical variables are shown in table 1. In the overall cohort, 51% were male, 89% white, and had a median of 1 (range 1-16) visits to the ED of which 99 (38.1%) resulted in a CT scan (median 1, range 1-8/patient). The majority of patients (81.2%) were on UC medications including 5-ASA, steroids, immunomodulators or biologics. In univariate analysis (Table 2) abdominal pain was a significant positive predictor for ordering a CT scan (RR=1.5; CI 1.2-1.7), while rectal bleeding (RR=0.38, CI 0.2-0.7), and being on any IBD medications (RR=0.86, CI 0.75-0.98) were significant negative predictors. Plain abdominal X-ray was associated with a negative trend for ordering a CT. Of all patient-visits to the ED, 48.9% had a CT or MRI in the previous year and this did not affect the chance of getting a new EDCT. Overall, 36 of the 99 EDCT obtained during this period (36.4%) revealed significant new findings (both intra and extra-intestinal). The most common SNF were appendicitis (n=7), small bowel obstruction (n=4), diverticulitis (n=4), kidney stones (n=3), pelvic abscess (n=3), cholecystitis (n=2), and abdominal mass (n=2) (Table 1). Overall, 67.3% ED visits resulted in hospitalization, a rate which was not significantly affected by ordering a CT but was associated with the presence of SNF (RR 1.28, CI 1.02-1.62). In univariate analysis, rectal bleeding (RR=0.14) and an elevated CRP (RR=0.45) were non-significantly associated with a lower risk of finding a SNF whereas diarrhea as a presenting symptom (RR=0.33) was a significant negative predictor of CT findings. No association between significant radiological findings and taking any IBD medications was observed (Table 3). On multivariate analysis (Table 4), only diarrhea remained a significant negative predictor (RR=0.19, CI 0.065-0.58).

Discussion

Our study demonstrates that a large proportion of UC patients presenting to the ED undergo CT imaging and a substantial minority had significant findings, most of which are not related to active disease. The vast majority of patients suspected to have a UC flare (82%) had no significant radiological abnormalities aside from changes consistent with chronic inflammation. In addition, among UC patients who had relevant CT findings, only five (12.8%) were potentially related to their underlying IBD diagnosis. The likelihood of undergoing a CT scan in the ED was not affected by prior imaging studies, but patients on biologics were less likely to receive cross-sectional imaging. The prevalence of CT in the ED in our cohort is within the range published in other studies [7,10]. In the paper by Israeli et al., the frequency of

ED CT scans among UC patients was 18%, whereas in the study by Gashin et al., CT was reported in 43% of ED visits. Since all studies were conducted in referral centers, the difference in the rates of CT scans may be attributable to local practice patterns or accessibility rather than patient variables. However, due to the retrospective nature, a direct comparison of disease severity across studies could not be performed.

Variable	Overall* n=260 (%)	Had CT n=99 (%)	No CT n=161 (%)
Age (mean, range)	50.5 (20-94)	52.8 (22.0-87.4)	49.1 (18.3-94.9)
Sex (% Male)	131 (50.3)	50 (50.5)	81 (50.3)
Race (% White)	232 (89.2)	93 (93.9)	139 (86.3)
Abdominal pain	161 (61.9)	76 (76.8)	85 (52.8)
Fevers/Chills	57 (21.9)	18 (18.2)	39 (24.2)
Vomiting	50 (19.2)	13 (13.1)	37 (23.0)
Rectal bleeding	63 (24.2)	12 (12.1)	51 (31.7)
Diarrhea	113 (43.5)	43 (43.4)	70 (43.5)
Temp > 38.5	20 (7.7)	4 (4.0)	16 (9.9)
WBC > 12,000/mm3	79 (31.1)	33 (33.0)	46 (29.3)
Hgb < 10 g/dL	37 (14.6)	11 (11.1)	26 (16.6)
Plateletes < 150K	19 (7.5)	7 (7.2)	12 (7.7)
Cr ≥ 1.3 mg/dL	10 (3.9)	5 (5.2)	5 (3.2)
LTs** Elevated	82 (33.3)	27 (28.4)	55 (36.4)
CRP > 10 mg/dL	40 (75.5)	18 (78.3)	22 (73.3)
ESR > 15 mm/h	32 (76.2)	12 (70.6)	20 (80.0)
C. diff sent	95 (36.5)	39 (39.4)	56 (34.8)
C.diff +	10 (10.5)	3 (7.7)	7 (12.5)
ABD Film	24 (9.2)	5 (5.1)	19 (11.8)
Flare Considered	101 (38.8)	39 (39.4)	62 (38.5)
Admission	175 (67.3)	71 (71.7)	104 (64.6)
CT past yr	109 (41.9)	46 (46.5)	63 (39.1)
CT past 5 yrs	146 (56.2)	54 (54.5)	92 (57.1)
MRI past 1 yr	45 (17.3)	18 (18.2)	27 (16.8)
MRI past 5 yrs	59 (22.7)	23 (23.2)	36 (22.4)
Any UC Medications	211 (81.2)	73 (73.7)	138 (85.7)
5-ASA	159 (61.2)	58 (58.6)	101 (62.7)
Steroids	85 (32.7)	31 (31.3)	54 (33.5)
Immunomodulators	56 (21.5)	20 (20.2)	36 (22.4)
Biologics	39 (15.0)	8 (8.1)	31 (19.3)
Abdominal imaging prior year	129 (49.6)	53 (53.5)	76 (47.2)
Admission (% ED Visits)	175 (67.3)	71 (71.7)	104 (64.6)

Table 1: Demographic and Clinical data for all patients with ulcerative colitis.

*Available data; ** Liver tests

CT: Computed Tomography; UC: Ulcerative Colitis; 5-ASA: 5-Aminosalicylic Acid; ED: Emergency Department; SNF: Significant New Finding; SBO: Small Bowel Obstruction

Significant new findings include:

Appendicitis n=7	Intrahepatic Stricture n=1
SBO n=4	Liver Metastases to Lung n=1
Diverticulitis n=4	Biliary Stent Dysfunction n=1
Kidney Stone n=3	Perinephric Fat Stranding n=1
Pelvic Abscess n=3	Liver Hypodensities n=1
Abdominal Mass n=2	Pancreatitis n=1
Cholecystitis n=2	Colonic Perforation n=1
Abscess/Mass Near Rectum n=1	Fecal Impaction n=1
Pubic Fracture n=1	Gastric Volvulus n=1
Pneumatosis n=1	

	RR	95% CI	p-Value
Age > 50	1.07	0.95-1.15	0.1348
Gender	1.00	0.78-1.28	0.9757
Abdominal Pain	1.45	1.21-1.74	0.0001
Diarrhea	0.99	0.75-1.32	0.9945
Rectal Bleeding	0.38	0.21-0.68	0.0004
CRP ≥ 10	1.06	0.78-1.44	0.6794
WBC ≥ 12	1.16	0.80-1.67	0.4297
Hgb ≤ 10	0.67	0.34-1.29	0.2272
IBD Medications	0.86	0.75-0.98	0.0165
5-ASA	0.93	0.76-1.14	0.5053
Steroids	0.93	0.64-1.34	0.7101
Immunomodulators	0.90	0.55-1.46	0.681
Biologics	0.41	0.20-0.87	0.0143
ED abdominal X-ray	0.43	0.17-1.11	0.0678
CT in prior year	1.18	0.89-1.58	0.2445
MRI in prior year	1.08	0.63-1.86	0.7702

Table 2: Univariate analysis: likelihood of receiving a CT scan.

CT: Computed Tomography; CRP: C-reactive Protein; WBC: White Blood Cell; Hgb: Hemoglobin, IBD: Inflammatory Bowel Disease; 5-ASA: 5-Aminosalicylic Acid; MRI: Magnetic Resonance Imaging

	RR	95% CI	p-Value
Age > 50	2.12	0.78-12.48	0.1042
Gender	1.07	0.72-1.59	0.7324
Abdominal Pain	1.20	0.98-1.47	0.0961
Diarrhea	0.33	0.16-0.66	0.0002
Rectal Bleeding	0.14	0.01-1.07	0.0038
CRP ≥ 10	0.45	0.15-1.33	0.0482
WBC ≥ 12	0.96	0.54-1.72	0.9126
Hgb ≤ 10	0.63	0.17-2.24	0.7416
IBD Meds	1.02	0.80-1.30	0.8291
5-ASA	0.85	0.59-1.22	0.3751
Steroids	0.71	0.37-1.38	0.3059
Immunomodulators	0.58	0.23-1.47	0.237
Biologics	1.05	0.26-4.14	0.9444
CT in prior year	0.84	0.53-1.34	0.4693
MRI in prior year	1.11	0.47-2.61	0.8055

Table 3: Univariate analysis: likelihood of significant new CT finding.

CT: Computed Tomography; CRP: C-reactive Protein; WBC: White Blood Cell; Hgb: Hemoglobin, IBD: Inflammatory Bowel Disease; 5-ASA: 5-Aminosalicylic Acid; MRI: Magnetic Resonance Imaging

	RR	95% CI	p-Value
Age > 50	3.64	0.84-15.65	0.082
Abdominal Pain	2.46	0.65-9.32	0.184
Diarrhea	0.19	0.06-0.58	0.004
Rectal Bleeding	0.36	0.03-3.65	0.390

Table 4: Multivariate analysis: significant new CT finding.

In the present study, we found that abdominal pain on the one hand and rectal bleeding and being on IBD medications on the other hand, were positive and negative predictors of ordering a CT scan respectively. In fact, 76.8% of UC patients whose main complaint was abdominal pain underwent a CT. While pain may signal the presence of significant intra-abdominal pathology, the association with IBD medications is unclear. It is possible that UC patients on medication and particularly biologics are less symptomatic and therefore less likely to undergo imaging. Interestingly, we did not find an association between ordering a CT scan and the documentation of previous radiological studies. This may be explained by the low specificity and reliability of certain symptoms, particularly the pain. Several population-based studies have described an increasing trend for CT for reasons that are not entirely clear [8,19,21-26]. In our study we were unable to determine whether any particular patient or provider-related variable was associated with repetitive imaging.

Slightly more than one third of CT scans in our study revealed a significant finding, a rate which is similar to previously published data (range 12 to 36%) [7,10,11]. Most relevant findings in our study were consistent with the usual acute abdominal conditions seen in the ED, namely appendicitis, bowel obstruction and kidney stones. The proportion of patients with either appendicitis or small bowel obstruction in our study (19.4% and 11.1% respectively) is similar to the study by Gashin et al., (8.3% and 9.2% respectively) but higher than in the paper by Israeli et al., (3.4% and 0% respectively) [7,10]. This may be due to differences in methodology. For instance, we excluded colectomy patients from our cohort since the nature of acute presentations in these patients is very different from patients with an intact colon. The rate of intra-abdominal or pelvic abscesses (8.3%) and intra-abdominal masses or malignancy (5.6%) in our study was similar other studies [7].

In terms of relevant new findings, our results show that only diarrhea as a presenting symptom was a significant negative predictor of SNF, whereas rectal bleeding and elevated CRP were only associated with SNF in univariate analysis. Many of the candidate variables could be interdependent and therefore a significant association may only be detected by increasing the sample size. Overall, however, this suggests that abdominal CT scans have a low yield in patients presenting to the ED with typical UC flares but may be of more diagnostic value in those with atypical symptoms. Given that most of the significant findings in these patients were quite diverse and not related to UC, it is likely that identifying strong predictors for positive findings will be difficult [7]. Whether the yield would be higher in CT scans performed after the patient was hospitalized for a UC flare is unclear.

The rate of hospital admissions following ED visits in our study was 67%, which is comparable to the rate described elsewhere [7,10]. The hospitalization rate was not different in patients who underwent a CT compared to those who did not; however, we found that significantly more hospitalizations occurred in patients with noteworthy radiological findings. This suggests, on the one hand, that the disposition of most UC patients is based on the clinical presentation and, on the other hand, that selective use of imaging may lead to a better stratification of patients who warrant admission. Due to the retrospective nature of our study, we could not quantify the severity of symptoms such as pain, bleeding or diarrhea. However, we attempted to compensate for these limitations by relying on objective parameters such as the WBC count, C-reactive protein and hemoglobin. None of these showed a significant association with radiological findings which is consistent with previous publications [7,10,11].

Our study has several limitations. First, the number of episodes with relevant CT findings was small (36 out of 99) which decreased our power to detect a significant association with certain clinical or laboratory variables. We could not account for imaging studies performed outside our institution in the previous years. However, this is a real world experience likely to be reflective of other ED settings. In addition, given the retrospective design, some of the data was incomplete and we could not adjust for symptom severity. As mentioned earlier, we attempted to control for these shortcomings by assessing objective parameters such as inflammatory biomarkers, and prescription medication use.

In conclusion, in our study we found that a substantial proportion of UC patients evaluated in the ED receive abdominal CT scans regardless of previous imaging studies. However, most findings are not related to active disease. Hematochezia, an elevated CRP and especially diarrhea appear to be negative predictors of radiological findings. If confirmed, the combination of these widely available parameters may help identify patients who may not benefit from ED-based imaging. Additional prospective studies are needed to substantiate our findings and further refine predictors that can maximize the yield and decrease the risks and costs associated with imaging studies.

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Conflict of Interest Statement

Michael Chiorean has provided consulting work for AbbVie and has received research or educational grant support from AbbVie and Takeda.

Conference Presentation

This data was presented at Digestive Disease Week in San Diego California (2016).

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