Utility of plain abdominal radiography in adult ED patients with suspected constipation

Brian E. Driver, MD [a,*], Chaitanya Chittineni, BS [b], Gautham Kartha, MD [a], Jon B. Cole, MD [a], Lauren R. Klein, MD [a], Megan Rischall, MD [a]

[a] Department of Emergency Medicine, Hennepin County Medical Center, Minneapolis, MN, USA
[b] University of Minnesota School of Medicine, Minneapolis, MN, USA

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ABSTRACT

Background: Abdominal radiographs are often obtained in ED patients with suspected constipation, although their utility in adults is not well understood. We sought to compare ED management when an abdominal radiograph is and is not obtained.
Methods: We performed a retrospective chart review study of adult ED patients with a chief complaint of constipation from 2010 through 2016. Trained abstractors recorded radiologic tests ordered, treatments received, and final diagnosis. We determined the physician interpretation of the abdominal radiograph and its use in clinical decision making.
Results: Of 1142 eligible patients, 481 (42%) patients underwent abdominal radiography. Stool burden rated moderate or large was observed in 271 patients (46%). Sixteen patients (3%) were diagnosed with small bowel obstruction; 15/16 of these patients had high risk features such as old age, complex surgical history, history of small bowel obstruction, abdominal malignancy, or presented with vomiting or inability to pass flatus. Of the 197 patients with no or mild stool burden or normal radiograph, 109 (55%) were diagnosed with constipation and 89 (45%) received constipation treatment in the ED. Conversely, of the 271 patients with moderate or greater stool burden, 114 (42%) received no treatment for constipation in the ED and 104 (38%) were prescribed no discharge medications for constipation; 77 of these 271 patients (28%) were diagnosed with something other than constipation.
Conclusion: Plain abdominal radiography did not appear to significantly affect the ED management of patients presenting with constipation; it was common for patients to receive treatment that was in direct opposition to radiographic findings. Though a small number of patients had concerning diagnoses identified on plain radiography, the history and physical examination should have sufficiently excluded simple constipation, prompting an alternate diagnostic approach. Fecal loading on radiography does not preclude a more serious diagnosis. In conclusion, abdominal radiography appears to have low value in patients with constipation.

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1. Introduction

Constipation is a common chief complaint in the emergency department (ED); ED visits related to constipation occur >700,000 times per year in the United States, with an annual cost of >1.6 billion dollars [1]. According to expert opinion, many ED patients presenting with constipation can be managed based on the history and physical exam alone, without radiographic testing [2]. However, because definitions and perceptions of constipation might differ between the patient and physician [3], sometimes patients with a chief complaint of constipation actually have an alternate, more sinister, diagnosis [2]. For this reason, there is

significant variation in clinical practice between physicians regarding the use of plain abdominal radiography in this patient population. Abdominal radiography is ostensibly performed to "rule-in" or "rule-out" constipation. Some clinicians obtain abdominal radiographs in all patients presenting with constipation, some never obtain radiographs, and still others perform radiography when high risk features are present. There is no established consensus or standard of care as to whether or when abdominal radiography should be performed.

There are potential downsides to the use of abdominal radiography in this patient population. The presence of fecal loading on radiography does not exclude other pathology, [4] which sometimes leads to misdiagnosis of constipation when a more serious diagnosis is present [5,6]. Fecal loading on radiography does not correspond well to stool colonic transit time or the patient's symptoms [7]. Additionally, the agreement between raters of the degree of constipation on radiography has been

found repeatedly to be poor [7-9]. Ionizing radiation is also a potential downside if the test is of little utility.

Most existing literature of abdominal radiography and constipation has examined children, and to our knowledge there are no studies of the utility of abdominal radiography in the setting of suspected constipation in adult ED patients. Therefore, in adult ED patients with a chief complaint of constipation, we sought to compare ED management when an abdominal radiograph is and is not obtained.

2. Materials and methods

2.1. Study design and setting

This was a retrospective, observational study conducted in the ED of an urban Level 1 trauma center that cares for approximately 100,000 patients annually. There is no ED protocol for the care of patients with suspected constipation. The institutional review board at Hennepin County Medical Center approved this study.

2.2. Selection of participants

Adult ED patients (≥18 years old) with a chief complaint of constipation from December 2010 through December 2016 were identified in the electronic medical record. We excluded patients who underwent computed tomography only or computed tomography prior to radiography, as this represents a patient population who the physician has deemed not to have simple constipation. We used the chief complaint of constipation rather than a final diagnosis of constipation in order to examine a population of patients who the physician considered constipation as a diagnosis from the outset; examining patients with a diagnosis of constipation would exclude those who were at first suspected to have constipation but were later found to have an alternate diagnosis.

2.3. Methods of measurement

Using the electronic medical record (Epic Systems, Verona, WI), trained abstractors reviewed each eligible chart, including physician and nursing notes, imaging reports, ED orders, and the discharge plan. We recorded patient demographics, radiologic tests ordered and their final results, treatments received in the ED, the final diagnosis, and discharge prescriptions. We also reviewed physician notes to determine how the abdominal radiograph was interpreted and how it was used in the clinical decision making for the patient. For abdominal radiographs, we recorded the reported radiographic stool burden (none, small, moderate or greater, or no mention of stool burden), as well as other abnormal radiographic findings including both gastrointestinal and non-gastrointestinal pathology. We reviewed further the charts of those diagnosed with small or large bowel obstructions to describe their clinical history and presentation.

2.4. Outcome measures

Main outcomes of the study included whether treatment for constipation was administered in the ED and whether constipation was the primary ED diagnosis.

2.5. Data analysis

All data analyses are descriptive. Baseline characteristics, radiography findings, and ED management are described using counts and proportions. ED management, diagnosis, and discharge prescriptions are stratified by whether an abdominal radiograph was obtained, and differences are presented as absolute differences with associated 95% confidence intervals. We compared ED management, diagnosis, and disposition using the chi square test. No a priori sample size was

calculated. We used Stata (Version 15, Stata Corporation, College Station, TX) for all data analyses.

3. Results

During the study period 1218 patients met initial inclusion criteria; 76 underwent computed tomography only or before abdominal radiography and were excluded, leaving 1142 for analysis. Of these, 481 (42%) had an abdominal radiograph and 661 (58%) did not. The median age was 46 y (IQR 30–61 y) and 548 were women (48%). Baseline characteristics are presented in Table 1.

Abdominal radiograph findings are presented in Table 2. Stool burden rated moderate or large was observed by the radiologist or emergency physician in 271 patients (46%). There were 87 patients (18%) with other abnormal findings observed in the radiograph, including 33 (7%) with small bowel obstruction (Table 3). Of the 33 with small bowel obstruction seen on abdominal radiography, only 16 were diagnosed with small bowel obstruction by the treating physician; the remainder were diagnosed with constipation (N = 11), ileus (N = 2), incarcerated hernia (N = 2), and abdominal pain (N = 2).

Table 1
Baseline characteristics.

Variable	Radiograph obtained (N = 481)	No radiograph obtained (N = 661)
Age, median (IQR) – y	53 (36–65)	41 (27–57)
Male gender – no. (%)	262 (54)	332 (50)
Race – no. (%)		
Native American	12 (2)	25 (4)
Asian	22 (5)	13 (2)
African American	226 (47)	336 (51)
Hispanic	39 (8)	55 (8)
White	171 (36)	211 (32)
Other/unknown	11 (2)	21 (3)
Comorbidities – no. (%)		
Hypertension	148 (31)	159 (24)
Diabetes mellitus	107 (21)	136 (21)
Coronary artery disease	25 (5)	26 (4)
Heart failure	15 (3)	20 (3)
History of cerebrovascular accident	15 (3)	21 (3)
Chronic obstructive pulmonary disease	22 (5)	25 (4)
Liver disease/cirrhosis	8 (2)	2 (<1)
Chronic kidney disease	25 (5)	19 (3)
Initial vital signs, median (IQR)		
Heart rate - beats per min	88 (74–100)	86 (75–98)
Systolic blood pressure – mm Hg	131 (120–146)	128 (116–142)
Temperature – degrees C	36.7 (36.4–36.9)	36.7 (36.4–36.9)
Urinalysis results – no. (%)		
Positive nitrites	11/152 (7)	12/123 (10)
Proteinuria	7/152 (5)	11/123 (9)
Red blood cells >0–5 per hpf	24/152 (16)	17/123 (14)
White blood cells >0–5 per hpf	31/152 (20)	38/123 (31)
Serum laboratory results – median (IQR)[a]		
Creatinine – mg/dL	0.9 (0.7–1.0)	0.8 (0.6–1.1)
Hemoglobin – g/dL	12.9 (11.7–14.3)	12.7 (11.2–13.8)
White blood cell count – thousand/cubic mm	8.2 (6.3–10.5)	8.8 (6.6–11.2)
Sodium – meq/L	138 (136–140)	139 (137–140)
Potassium – meq/L	3.8 (3.6–4.2)	3.9 (3.6–4.2)
Total carbon dioxide – meq/L	26 (24–28)	26 (23–28)
Lactate – mmol/L	1.4 (1–1.9)	2 (1.7–2.2)

hpf, high powered field.
This table displays demographic information, stratified by whether an abdominal radiograph was obtained. Variables statistically different between groups included age, Asian ethnicity, hypertension, chronic kidney disease, and white blood cells >0–5 per hpf.

[a] Creatinine, sodium, potassium, and total carbon dioxide obtained in 269 patients, hemoglobin and white blood cell count in 217 patients, and lactate in 69 patients.

Table 2
Abdominal radiograph findings.

Variable	Final radiology read	Radiograph findings documented in ED physician note
Normal radiograph - no. (%)	185 (38)	106 (22)
Abnormal finding, excluding moderate or greater stool burden[a] - no. (%)	87 (18)	58 (12)
Stool burden - no. (%)		
Minimal or small	12 (2)	17 (4)
Moderate or large	220 (46)	263 (55)
No mention of stool burden	249 (52)	201 (42)

This table displays the findings for the 481 patients who had an abdominal radiograph obtained during the ED encounter. The "radiology read" column displays the final read by the attending radiologist. The "Radiograph findings documented in ED note" column displays how the findings of the radiograph were documented in the ED note, whether from personal review of the images or from the reading the radiology read. Patients could have both mention of a stool burden and an abnormal finding, hence the sum for each column exceeds 481.

[a] See Table 3 for the abnormal findings.

ED treatment, diagnosis, disposition, and whether a bowel regimen was prescribed are displayed in Table 4. Those with a radiograph obtained were more likely to receive treatment in the ED for constipation (55% vs 44%), less likely to be diagnosed with constipation (59% vs 65%), and more likely to be diagnosed with abdominal pain, small bowel obstruction, or large bowel obstruction, and to be admitted to the hospital (18% vs 4%).

Of the 197 patients with no or mild stool burden or normal radiograph, 109 (55%) were diagnosed with constipation and 89 (45%) received an enema, suppository, or magnesium citrate in the ED–in direct opposition to the radiographic findings. Conversely, of the 271 eventually discharged patients with moderate or greater stool burden as documented in the final radiology read or emergency physician note, 114 (42%) received no treatment for constipation in the ED and 104 (38%) were prescribed no discharge medications for constipation; 77 of these 271 patients (28%) were diagnosed with something other than constipation at the end of the encounter.

Table 3
Abnormal radiographic findings.

Finding	Number (% with finding/no. patients with radiograph obtained)
Small bowel obstruction[a]	33 (7)
Fecal impaction	10 (2)
Large bowel obstruction	6 (1)
Other GI problems	19 (4)
Ileus	6 (1)
Gas-filled/dilated/distended loops	6 (1)
Air-fluid levels	4 (1)
Ascites	1 (<1)
RLQ calcification (possible ovarian dermoid)	1 (<1)
AAA battery in sigmoid colon	1 (<1)
Non-GI findings	19 (4)
Pleural effusion	4 (1)
Nephrolithiasis	4 (1)
Other[b]	12 (2)

This table displays other abnormal findings for the 87 (of 481 with a radiograph obtained) patients with an abnormality seen, apart from findings related to stool burden.

[a] Of the 33 patients with a final read of small bowel obstruction on the abdominal radiograph, only 16 were diagnosed with small bowel obstruction by the treating physician during the encounter. The other 17 were diagnosed with constipation (N = 11), ileus (N = 2), incarcerated hernia (N = 2), and abdominal pain (N = 2).

[b] Other non-GI findings included (each finding had one patient): punctate kidney calcification, vascular calcifications, ureteral stent present, inferior vena cava filter present, fractured cerclage wire, ankylosing spondylitis, scoliosis, compression deformity of L4, disc height loss L5-S1, protrusio hip defects, hiatal hernia, pneumatosis of the left lateral rectal wall.

The clinical details for those diagnosed with a small or large bowel obstruction are displayed in Supplementary Table 1. Those with a small bowel obstruction tended to be older (median age 56 [IQR 44–65]), have a complex surgical history (10/16, 63%), history of small bowel obstruction (7/16, 44%), abdominal malignancy (3/16, 19%), or present with vomiting (10/16, 63%) or inability to pass flatus (4/16, 25%). Only 1 of the 16 patients had none of these features. This patient was admitted to the hospital but did not need nasogastric tube placement or surgical intervention. She was discharged 40 h after admission.

4. Limitations

We included only patients with a self-reported chief complaint of constipation; this population differs slightly from patients thought by the physician to have constipation at the initial evaluation, or those eventually diagnosed with constipation. This population includes both high and low-risk patients, and the results would probably be substantially different if we included only patients with a final diagnosis of constipation. We only abstracted for outcomes ascertained at the index ED encounter. It is possible that some patients discharged with a benign diagnosis were later found to have a more serious diagnosis; in prior pediatric literature this has occurred in <1% of encounters, and highlights the folly of overreliance on abdominal radiography to diagnose constipation [6].

5. Discussion

In this study of 1142 patients, we were unable to discern any true utility to the abdominal radiograph in the setting of suspected constipation apart from the detection of small bowel obstruction in high-risk patients. While there were small differences between study groups, including slightly a higher rate of ED treatment for constipation and, paradoxically, a lower rate constipation diagnosis in those who underwent abdominal radiography, these differences are of unclear significance and perhaps are related to physician practice patterns rather than related to the outcome of the radiologic test.

For the abdominal radiograph to have value in the setting of suspected constipation, the radiograph should establish the diagnosis of constipation or exclude it, or at least provide some reliable measure of the degree of constipation. In the current study, there was no clear association between findings or absence of constipation and ED treatment; patients without fecal loading on radiography commonly received treatment for constipation, conversely, patients with fecal loading commonly had no treatment for constipation. Therefore, the radiograph did not seem to dictate management. Rather, physician judgment often overrode radiographic findings.

This practice may be prudent. The radiographic degree of fecal loading does not correlate well with constipation symptoms or stool colonic transit time, [7] bolstering the case that physician judgment should supersede radiographic findings. Furthermore, interrater agreement of fecal loading on radiography is poor to fair, even when formal rating scales are used [7-9]. These data, when synthesized, suggest that radiographic fecal loading is difficult to objectively determine and does not necessarily aid in the clinical diagnosis of constipation. Constipation is a clinical diagnosis and treatment should be based on the history and examination [2,4]. If constipation is clinically suspected, but uncertain, administration of an enema in the ED may assist in the diagnosis; patients who have a large bowel movement and feel significantly better can be presumed to have constipation; alternate diagnoses can be explored for patients who don't improve after an enema.

In this cohort, it is difficult to reason why treatment rates for constipation were slightly higher in those who underwent radiography. Perhaps fecal loading on radiography prompted treatment where it otherwise would not have been given, a questionable practice as fecal loading does not equate to colonic transit time or symptoms.

Table 4
ED management and diagnosis.

Variable	Radiograph obtained (N = 481)	No radiograph obtained (N = 661)	Difference	P-value
ED treatment, any - no. (%)	264 (55)	289 (44)	11% (5 to 17%)	<0.001
Enema	226 (47)	239 (36)	11% (5 to 17%)	<0.001
Manual disimpaction	43 (9)	45 (7)	2% (−1 to 5%)	0.18
Suppository	16 (3)	17 (3)	1% (−1% to 3%)	0.45
Magnesium citrate	23 (5)	26 (4)	1% (−2% to 3%)	0.49
Final diagnosis[a] - no. (%)				
Constipation	282 (59)	428 (65)	−6% (−12 to 0%)	0.03
Abdominal pain	31 (6)	21 (3)	3% (1 to 6%)	0.009
Small bowel obstruction	16 (3)	0 (0)	3% (2 to 5%)	<0.001
Large bowel obstruction	6 (1)	0 (0)	1% (0 to 2%)	0.004
Fecal impaction	3 (<1)	3 (<1)	0% (−1 to 1%)	0.70
Other	143 (30)	209 (32)	−2% (−7% to 4%)	0.50
Discharged from the ED - no. (%)	398 (83)	636 (96)	−14% (−18 to −10%)	<0.001
Discharged with bowel regimen, any - no. (%)	226 (47)	356 (54)	−7% (−12 to −1%)	0.02

[a] Final diagnosis lists the primary ED diagnosis. The most common diagnoses are displayed. There were no diagnoses of appendicitis, cholecystitis, or diverticulitis.

Additionally, the presence of fecal loading does not preclude the co-presence of more serious diagnoses.

These results are consistent with prior work examining pediatric patients with constipation [5,6,10]. To our knowledge, no study has found that abdominal radiographs are useful for diagnosing constipation. Some argue that they should never be obtained, [10] others have found the use of radiographs is associated with misdiagnosis of more serious pathology [5,6]. Freedman et al., studying 3685 children diagnosed with constipation in the ED, showed that 7 day revisits resulting in hospitalization or a procedure were more common when a radiograph was obtained or abdominal pain or tenderness was present, emphasizing that the presence of stool on abdominal radiography does not preclude a more serious diagnosis [6].

Some may cite other potential benefits of abdominal radiography in this population, including the detection of alternate diagnoses or incidental findings. In this study, abnormal findings were present in 87 patients (18% of those with a radiograph), the most common findings being fecal impaction, small and large bowel obstruction, and ileus. These findings may seem frequent, but most of these diagnoses should be clinically apparent and not confused with simple constipation. Fecal impaction is easily diagnosed by rectal examination; ileus has specific historical clues. Judging from the narratives of patients diagnosed with small bowel obstruction (Supplementary Table 1), those with small and large bowel obstructions generally were older, had complex surgical histories, abdominal malignancies, prior bowel obstructions, or had historical features more consistent with diagnoses more serious than constipation, such as vomiting or inability to pass flatus. Other incidental findings discovered in this cohort were largely clinically insignificant and not worthy of an indication to obtain abdominal radiography.

Patients with higher risk features, including significant abdominal pain or tenderness, moderate pain or tenderness that does not improve with an enema, complex surgical histories, recurrent bowel obstructions, or concerning historical features such as vomiting or inability to pass flatus, should likely undergo computed tomography rather than plain radiography to determine if a serious diagnosis is present. If recurrent small bowel obstruction is suspected, however, it may be reasonable to use plain abdominal radiography as a preliminary test, moving to computed tomography if the radiograph is negative and suspicion remains high [11]. If the plain radiograph reveals obstruction, further testing may not be required if bowel ischemia is not clinically suspected. For other diagnoses existing data and expert opinion agree that the role of plain abdominal radiography is limited and computed tomography or ultrasound are better imaging modalities, depending on what diagnosis is suspected [2,11-13].

In summary, plain abdominal radiography did not appear to significantly affect the management of patients presenting to the ED with constipation; it was common for patients to receive treatment that was in direct opposition to radiographic findings. Though a small number of patients had concerning diagnoses identified on plain radiography, the history and physical examination should have sufficiently excluded simple constipation as the reason for their visit, prompting an alternate diagnostic approach. Fecal loading on radiography does not preclude a more serious diagnosis. In conclusion, abdominal radiography appears to have low value in patients with constipation.

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Previous presentation

None.

Declaration of Competing Interest

This was an unfunded investigation. No authors have any conflicts of interest to report.

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