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Computed Tomography in Patients with Abdominal Pain and Diarrhea: Does the Benefit Outweigh the Drawbacks?

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INTRODUCTION

The role of computed tomography (CT) in the evaluation of abdominal pain in patients without trauma is well established.¹⁻³ However, its diagnostic role when diarrhea is also present is unclear. One algorithmic approach to acute diarrhea⁴ involves the documentation of drug usage and travels, physical examination for evidence of bleeding or dehydration, laboratory tests, and colonoscopy; however, no role is assigned to CT.

Radiation toxicity,^{5,6} contrast-induced nephropathy,⁷ and the escalating cost of CT are typically of concern, particularly in a clinical setting when the current evidence does not necessarily support the test. We performed a retrospective study to determine whether the use of abdominal CT resulted in a major change in the management of patients who presented with abdominal pain and diarrhea.

PATIENTS AND METHODS

We reviewed all abdominal CT scans that had been performed at our tertiary-care hospital from October through December 2010 in patients 18 years of age or older. Our institutional review board approved the study. We excluded patients whose CT imaging was requested for reasons that would have indicated the scan regardless of the presence of diarrhea, such as for cancer staging, postoperative complications, the evaluation of abdominal masses, and renal-stone protocol. The remaining scans were divided into those performed in patients who presented with diarrhea (PPWDs) and in those who did not present with diarrhea (PPNDs).

We examined the patients' medical records to determine whether the management of their condition was substantially altered because of the scan results. We defined a major change in management as an intervention that would not have occurred had the CT scan not been performed. For example, when pyelonephritis was the presumptive diagnosis, CT changed management when it showed collections that necessitated drainage or stones that necessitated removal. When pancreatitis was the initial diagnosis, CT changed management when the findings prompted surgery or the prescription of antibiotics, such as for certain pseudocysts or necrotic tissue. Only one author (GMA) reviewed these data.

A standardized data-collection instrument was developed for retrieving information from the hospital's data system. Data collection included demographic aspects such as age, sex, and race. Certain clinical findings on the day the CT was ordered were also recorded, including

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the presence or absence of diarrhea, the location and nature of abdominal or pelvic pain, and the presence of vomiting or gastrointestinal bleeding. The patients' final diagnoses were also documented, as were the presence of anemia (hemoglobin level, <10 g/dL) or fever (rectal or oral temperature, >38 °C). Abdominal pain that lasted longer than 1 week and diarrhea that lasted longer than 2 weeks were considered to be chronic conditions.

Statistical analysis

MedCalc® version 12.3.0 (MedCalc Software; Mariakerke, Belgium) was used in the statistical analysis. Categorical variables were analyzed by means of the Fisher exact test, and discrete variables were analyzed with use of the Student *t* test for unpaired samples. A 2-sided *P* value <0.05 was considered statistically significant.

RESULTS

During the 3-month period of study, 1,699 abdominal CT scans had been performed in 1,569 patients. After applying the selection criteria, we excluded 1,125 scans. The remaining 574 scans had been performed in 564 patients. Of these, 124 scans were in 120 patients who presented with diarrhea (PPWDs), and 450 scans were in 444 patients without diarrhea (PPNDs). Age, sex, and race were comparable in both groups.

The indication for all the CT scans was abdominal pain. Table 1 lists the patients' clinical presentations. There was no significant difference in the presence of fever or the location of abdominal pain.

The CT changed management in 13 of the PPWDs (11%) and in 233 of the PPNDs (52%) ($p<0.001$).

Among the 124 scans in PPWDs, the most frequent final diagnoses in which management did not change were gastroenteritis (43 events) and unspecified abdominal pain (30 events). The 13 patients in whom management changed had the following final diagnoses: appendicitis (3 patients), diverticulitis (3 patients), and bowel obstruction, infective endocarditis, hernia, intestinal perforation, liver cancer, psoas abscess, and neutropenic enteritis (1 patient with each).

Table 2 shows the characteristics of the PPWDs in whom management did and did not change. There were no statistically significant differences in presentation between the 2 groups. More PPWDs in whom management changed were admitted to the hospital.

DISCUSSION

The current study shows that in patients with acute abdominal pain and diarrhea, the results of CT scans seldom changed management. The scans did result in management changes in patients whose conditions rarely present with diarrhea, such as appendicitis and diverticulitis.⁸⁻¹⁰

Studies have shown that CT is helpful in the diagnosis of diseases that can present with diarrhea. In 1 study,¹¹ 12% of patients with diarrhea and abdominal pain had CT diagnoses of diseases that necessitated surgery. Computed tomographic findings are nonspecific and therefore nondiagnostic in ischemic¹² and *Clostridium difficile*¹³ colitis. Abdominal CT was found to be beneficial in the diagnosis and management of neutropenic enterocolitis.¹⁴ In patients who had abdominal pain and diarrhea and who underwent CT that revealed colonic mucosa thickening, subsequent colonoscopies disclosed inflammatory bowel disease in 5% and colon cancer in 2%.¹⁵ In some of the above conditions, the results of plain abdominal

radiographs will be diagnostic; however, abdominal CT might increase diagnostic accuracy when radiographic appearance is inconclusive.^{16,17}

Because of radiation toxicity, CT can be a risky procedure. The annual per capita radiation dose from medical sources in the United States increased 6-fold from 1980 through 2006; during the same period, the radiation dose generated by CT increased 49-fold. The dose varies with the body area being studied and the diagnostic indication. Although an association has not been strongly established, epidemiologic studies suggest a higher cancer risk among patients who are exposed to radiologic diagnostic procedures.¹⁸ When used in abdominal CT scanning, the oral contrast agent Gastrografin® (Bracco Diagnostics Inc.; Princeton, NJ) and the intravenous agent Renografin-60® (Bracco) have been implicated in episodes of severe colitis and perforation in the setting of colonic obstruction.¹⁹ Moreover, intravenous iodinated contrast agents administered in the presence of hypotension (an expected sign in acute diarrheal diseases) increase the risk of contrast-induced nephropathy.⁷

In addition, abdominal/pelvic CT scans are costly. According to a survey in 4 major Houston hospitals,²⁰ the rates for these scans in the earlier 2000s (excluding professional fees) ranged from approximately U.S. \$2,500 to \$4,000. At the midpoint of this range (\$3,250), the 124 CT scans in our study cost \$403,000—or, an average of \$31,000 for each of the 13 cases in which the management of patients changed. The costs in today's dollars were undoubtedly higher.

This study's chief limitation is its retrospective nature, which precluded confirming the presence and nature of diarrhea and other symptoms, as well as the thought processes of the attending physician. In addition, we used the original (unreviewed) radiologic diagnoses as they appeared in the medical records. This weakness can also be viewed as a strength because it equates to real-world circumstances. Moreover, all the scans were initially reviewed by 2 residents and an attending physician who was Board-certified in radiology, which probably resulted in highly accurate evaluations of the scans.

Another limitation is the definition of management-change. Defining how an action changes management is ultimately subjective, because even if no action is taken, the inaction itself could be the appropriate change from the original management idea. We strove to overcome this limitation by applying strict inclusionary rules and by using only one chart-reviewer, in order to decrease conflicts.

CONCLUSION

We determined a low clinical likelihood that management of patients with abdominal pain and diarrhea would change on the basis of CT scan results. We don't intend to discourage the use of CT abdomen on patients with abdominal pain, but to call for a thoughtful approach when diarrhea is also present. In such circumstance, the low yield, potential radiation toxicity, and procedural cost may instead invite to a cautious period of observation.

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Table 1
Clinical Presentations in Patients with and without Diarrhea

Presentation	Patients with Diarrhea (n=124)	Patients without Diarrhea (n=450)	P Value
Abdominal pain <7 d	90 (73)	282 (63)	0.04
Vomiting	75 (60)	179 (40)	<0.001
Gastrointestinal bleeding	24 (19)	23 (5)	<0.001
Anemia	23 (19)	38 (8)	0.003
Fever	25 (20)	65 (14)	0.13

Data are presented as number and percentage. $P < 0.05$ was considered statistically significant.

Table 2
Characteristics of PPWDs with and without CT-Based Management Change

Variable	Change in Management (n=13)	No Change in Management (n=111)	P Value
Demographics			
Male sex	7 (54)	47 (42)	0.56
Age, yr	52 ± 18	45 ± 15	0.76
Race *			
Hispanic	11	60	—
Black	1	23	—
White	1	20	—
Asian	0	3	—
Signs and symptoms			
Diarrhea >14 d	12 (92)	89 (80)	0.45
Abdominal pain <7 d	11 (85)	79 (71)	0.29
Vomiting	6 (46)	69 (62)	0.37
Gastrointestinal bleeding	2 (15)	22 (20)	1.00
Anemia	4 (31)	19 (17)	0.26
Fever	4 (31)	21 (19)	0.29
Additional studies required			
Other imaging	1 (8)	13 (12)	1.00
Colonoscopy	0	9 (8)	0.6
Admission required	11 (85)	52 (47)	0.02
To Department of Medicine	5 (38)	48 (43)	0.001
Average length of hospital stay, d	10.27	6.63	0.16

CT = computed tomography; PPWDs = patients presenting with diarrhea

Data are presented as mean ± SD or as number and percentage. $P < 0.05$ was considered statistically significant.

* Data were unavailable for 5 patients who underwent no change in management.