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EFFICACY OF NONCONTRAST COMPUTED TOMOGRAPHY OF THE ABDOMEN AND PELVIS FOR EVALUATING NONTRAUMATIC ACUTE ABDOMINAL PAIN IN THE EMERGENCY DEPARTMENT

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☐ **Abstract—Background: Computed tomography (CT) clarity has significantly improved since it became widely available in the early 1980s, making the utility and benefit of contrast material for image quality of the abdomen and pelvis uncertain, and so far, minimally studied. Objectives: This study sought to assess the efficacy of a noncontrast CT scan of the abdomen and pelvis by evaluating patients presenting to the emergency department (ED) with acute nontraumatic abdominal pain by following them for 7 days and observing for signs and symptoms of clinically significant acute emergent pathology. Methods: We enrolled, and for 7 days followed, a prospective observational convenience sample of patients who received a noncontrast CT scan of the abdomen and pelvis in the ED for acute nontraumatic abdominal pain. The primary outcome, and defined as a failure, was abdominal surgery or death as the result of an intraabdominal process not found on the original noncontrast CT scan, or a subsequent contrasted CT scan with a finding that could explain the original complaint of abdominal pain that was also not seen on the initial noncontrast CT, during the 7-day observation. Results: Seventy-two patients were enrolled in the study. The incidence of failure was 0% (0/72), 46% of patients (33/72) had a negative CT scan, 54% (39/72) had a positive CT scan, 57% (41/72) were admitted, 43% (31/72) discharged, 11% (8/72) had abdominal surgery, and a repeat contrasted CT scan was done on 4% (3/72). Conclusions: With certain inclusion and exclusion criteria, noncontrast CT of the abdomen and pelvis is likely a reliable diagnostic modality for the evaluation of acute nontraumatic abdominal pain in the ED.** © 2015 Elsevier Inc.

☐ **Keywords—computed tomography; noncontrast CT; noncontrast computed tomography; CT; emergency; emergency department; ED; abdominal pain; acute abdominal pain; nontraumatic**

INTRODUCTION

Of the millions of people who present to the emergency department (ED) each year, approximately 5–10% of them are there for abdominal pain (1,2). Since computed tomography (CT) became widely available in 1980, it has become a primary diagnostic tool in the workup of abdominal pain in the ED, with one study

Author contributions: Payor conceived the study and was aided in the design and execution by Jois, Wilson, Kedar, and Nallamshetty. Payor and Wilson supervised the conduct of the trial and data collection. Payor, Wilson, Sullivan, Grubb, and Fowler enrolled patients and completed the data collection forms. Grubb compiled the data and constructed the graphs. Wilson provided statistical advice on study design. Payor drafted the manuscript and will revise. Payor takes reasonability for the paper as a whole.

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showing a 72% increase in abdominal CT scans performed from 2000 to 2005 (3). The majority of CT scans completed in the ED for abdominal pain are performed with some form of contrast material: intravenous, oral, rectal, or some combination thereof. In early models of CT scanners with fewer detector rings and slower rotation speeds that produced motion artifact from respirations or peristalsis that led to poor image quality, contrast material was instrumental to radiologists for improved conspicuity of pathology. Now, with newer helical and multi-detector CT scanners, motion artifacts are reduced and three-dimensional images can be produced from sub-millimeter slices, making the utility and benefit of contrast material for image quality uncertain, and so far, minimally studied.

Intravenous (i.v.) contrast is helpful for diagnosing vascular abnormalities, infarctions, abscesses, inflammatory disorders, distinguishing bile ducts, and enhancing solid viscera. However, iodinated i.v. contrast material is the third leading cause of acute kidney injury in the hospitalized patient and can cause several adverse effects ranging from mild allergic reactions, to nephrotoxicity, to death (4). Nephrotoxicity from i.v. contrast ranges from 0% to 10% of people with normal renal function and from 12% to 27% in those with preexisting renal impairment (4). Due to the advent of low-osmolality contrast agents, incidence of both mild and severe adverse reactions has decreased to 3% and 0.04%, respectively, but fatal reactions remaining unchanged at 1 in 170,000 for both forms of contrast medium (5).

Rectal contrast allows for detailed imaging of the colon and can be given in just over a few minutes, but there is no opacification of the small bowel, and patients frequently complain of discomfort. Patient cooperation is essential to the procedure and those with poor sphincter tone cannot retain the contrast.

Oral contrast is used to opacify the lumen of the gastrointestinal tract and to delineate soft tissue planes between intraperitoneal structures. Tolerance in the nauseated or vomiting patient and the time required to opacify the entire bowel have always been obstacles of oral contrast. Transit time through the gastrointestinal tract can take several hours, thereby increasing patient time spent in the ED. The time interval between arrival to the ED and disposition can be increased up to 3 h (6).

Several published studies have demonstrated the effectiveness of noncontrast CT in diagnosing specific types of abdominal pain caused by nephrolithiasis and even acute appendicitis. After review of the current literature, only three studies have been conducted which evaluated the use of noncontrast CT of the abdomen and pelvis in the ED for primarily undifferentiated abdominal pain. All three concluded that noncontrast CT was the preferred diagnostic imaging modality in patients presenting to the ED with acute abdominal pain, with specific parameters. Two of the three studies focused on radiologist interpretation agreement between noncontrast and contrast-enhanced abdominal CT images of the same patient and whether the contrast-enhanced images improved their ability to accurately diagnose the cause of the abdominal pain (7,8). The other study focused on throughput time in the ED and commented on outcome of patients who were either admitted or returned to their own institution within 72 h (9). No study has focused on the short-term outcome of patients who were discharged or admitted from the ED after a noncontrast CT of the abdomen and pelvis was utilized as part of their initial assessment in the ED.

In the current climate of frequently crowded EDs and the increasing cost of health care, the noncontrast CT for patients presenting with acute abdominal pain would reduce cost, as well as time spent in the ED, while streamlining the flow of patients through the ED and expediting the appropriate treatment pathway.

MATERIALS AND METHODS

This was a prospective observational study of a convenience sample of patients presenting to the ED for 3 months, August 1, 2013 through October 31, 2013, with acute nontraumatic abdominal pain who received a noncontrast CT scan of the abdomen and pelvis. This study was performed at an urban academic tertiary care center with an Emergency Medicine residency and annual ED volume of 90,000 patients per year. The ED uses a Philips Brilliance CT 64 channel scanner (Philips North America Corporation, Andover, MA) 24 hours per day, 7 days per week, and all images are interpreted initially by radiology residents and then by board-certified radiology attendings. The ED was fortunate to have the full support and encouragement of the Radiology Department, and the study was conducted as a joint effort. Prior to initiating the study, all radiology residents and attendings were briefed. This study was approved by the hospital's university-affiliated institutional review board.

This study sought to assess the efficacy of a noncontrast CT scan of the abdomen and pelvis by evaluating all patients with acute abdominal pain in the ED with a noncontrast CT and following them for 7 days and observing for signs and symptoms of clinically significant acute emergent pathology. We believed that any missed emergent acute pathology would continue to progress and worsen within this 7-day observational window, which would lead to either a repeat contrasted CT scan or abdominal surgery, which would reveal a different and true etiology of their abdominal pain or the patient would die as a result of an unrecognized intraabdominal process. Therefore, by default, if no such event occurred