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Effects of eliminating routine use of oral contrast for computed tomography of the abdomen and pelvis: A pilot study

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ABSTRACT

Introduction: Computed tomography (CT) of the abdomen and pelvis using only intravenous contrast has been shown to have a high degree of accuracy in evaluating abdominal pain. The aim of this study was to determine the effect on time to completion of study, time to radiologist read, and length of stay in the emergency department (ED) of implementing a protocol that stopped the routine use of oral contrast for CT of the abdomen and pelvis.

Methods: This was a single-center, retrospective cohort study. All patients ≥18 years of age who presented to the ED and required a CT of the abdomen and pelvis during the hours 0700–1500 were included. There were two one-month study periods, before and after implementing a protocol that specified oral contrast should only be used for CT scans of the abdomen and pelvis if body mass index < 25 kg/m^2 or age < 30 years, or if there was history of inflammatory bowel disease, gastrointestinal surgery, or suspected bowel malignancy.

Results: During the pre- and post-implementation periods, there were 93 and 83 patients, respectively, with mean times to CT completion of 158 min and 135 min, representing a reduction of 23 min (15%). The mean lengths of stay in the pre- and post-implementation periods were 365 min and 336 min, a decrease of 29 min (8%).

Conclusion: A protocol without the routine use of oral contrast for CT of the abdomen and pelvis can result in improved time to completion and ED length of stay.

1. Introduction

Abdominal pain is a common presenting complaint in the emergency department (ED). Computed Tomography (CT) of the abdomen and pelvis has become the imaging modality of choice for evaluating these patients. Traditionally, patients with acute abdominal pain spend disproportionately more time before disposition than most other groups of ED patients [1]. A major factor in CT turnaround time (TAT) is the use of oral contrast, which has been part of protocols for ED patients undergoing CT scans of the abdomen and pelvis [2]; this results in a lead time of at least 90–120 min to allow for opacification of the bowel prior to the CT scan, contributing to a substantial portion of the ED LOS [3].

As EDs continue to see increased numbers of patients, there is a constant focus on reducing the LOS without compromising quality of care. ED LOS is important to physicians, patients, and hospital administrators. ED overcrowding is also a serious problem, which has been associated with adverse patient outcomes [4]. Reducing CT TAT has been shown to allow the earlier identification of intra-abdominal pathology, reduce ED overcrowding, improve overall clinical care, and increase patient satisfaction [5].

Earlier generations of CT scanners required longer image acquisition times. This resulted in a higher likelihood of movement artifact. It was, therefore, necessary to administer oral contrast (in addition to intravenous (IV) contrast) to opacify the bowel and maximize image accuracy, and few studies compared oral versus no oral contrast. Newer-generation CT scanners have improved data acquisition and image quality as compared to older models. In multiple recent reviews, CT of the abdomen and pelvis without oral contrast has been shown to have a high degree of accuracy in the evaluation of abdominal pain, without compromising quality of care [6–8]. These studies also found a decreased LOS; however, many did not investigate throughput parameters such as time to CT completion and time to radiologist read, which may also contribute to throughput time and offer opportunities for further improvement. Furthermore, most of these studies were conducted at larger institutions.

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The present study was a pilot study to determine whether such a protocol could be effectively implemented with similar results at an urban community hospital. In 2015, our institution developed a new protocol which stopped the routine use of oral contrast for CT of the abdomen and pelvis. The aim of this study was to determine the effect of implementing such a protocol on the TAT and LOS in the ED, taking into consideration time to CT completion and time to radiologist read.

2. Materials and methods

This was a single-center, descriptive study with a pre-/post-test design, based on retrospective reviews of electronic medical records. The study was conducted in the ED of a community-based urban hospital with an annual volume of 35,000 patient visits per year. The department is staffed by 8 full-time and 20 part-time board-certified ED physicians. The study was approved by our institutional review board.

The study included two one-month periods a year apart. The pre-implementation period used for comparison was October 1–31, 2014, and the post-implementation period was October 1–31, 2015. All patients ≥18 years of age who had presented to the ED on any day of the week and required a CT abdomen and pelvis scan during the hours 0700–1500 were included. The intervention was the new protocol which stopped the routine use of oral contrast for CT scans of the abdomen and pelvis. Oral contrast was only required when one or more of the following criteria were met: body mass index (BMI) < 25 kg/m^2; age < 30 years; a history of inflammatory bowel disease (Crohn's Disease or ulcerative colitis); a history of intestinal surgery (small or large bowel) or gastric surgery; or suspected bowel malignancy. This guideline was established based on the findings of published reports by a consensus panel of radiology and ED leadership physicians within our institution. The full text of the guideline is included as Appendix A.

The primary outcome measure of CT TAT was defined as the time from when the CT was ordered to the time it was completed by a technician, excluding the time taken by the radiologist to generate an imaging report. The secondary outcomes were the time from ordering the CT by the ED physician to the time the CT was reported by a radiologist, and the ED LOS, defined as the time of ED registration to the time of discharge. Demographic data were also obtained from the records. All CTs were performed using a GeEOptima CT660 scanner (GE Healthcare, Chicago, Illinois).

The data were collected and managed using Research Electronic Data Capture (REDCap), a secure, web-based application designed to support data capture for research studies. REDCap provides an intuitive interface for validated data entry, audit trails for tracking data manipulation and export procedures, automated export procedures for seamless data download to common statistical packages, and procedures for importing data from external sources.

No optimal sample size was calculated because this was a pilot study. The data were analyzed using descriptive statistical methods and were expressed as frequency counts and percentages for categorical variables or as mean and standard deviation or median and interquartile range (IQR), as appropriate, for continuous variables. Extreme outliers in the time to radiology reading (> 500 min) were excluded from the analysis as they confounded the data. The data were analyzed in Microsoft Excel (Microsoft Corporation, Redmond, WA).

3. Results

During the pre- and post-implementation study periods, 93 and 83 patients, respectively, were identified as subjects, and all were included in the final analysis. Their demographic characteristics are listed in Table 1. Of the patients with CT scans that were negative for acute findings, none underwent subsequent imaging within 72 h at our institution that led to a change in diagnosis.

The mean CT TATs in the pre- and post-implementation periods were 158 (SD = 77) min and 135 (SD = 75) min, respectively. This represented a reduction of 23 min (15%). Stratification of these results by the type of contrast used is presented in Table 2.

Table 1
Demographic data.

	Pre	Post	*P* value
Disposition			
Total Discharged (n)	62 (67%)	58 (70%)	0.65
Total Admitted (n)	31 (33%)	25 (30%)	
Age (mean, [SD])	50 [21]	57 [19]	
Sex			
Females	49 (53%)	52 (63%)	0.18
Males	44 (47%)	31 (37%)	
Race			
Black	2 (2%)	1 (1%)	0.46
Causcasian	81 (87%)	77 (93%)	
Asian	2 (2%)	0	
Other	8 (9%)	5 (5%)	
Insurance Status			
Insured	88 (95%)	81 (98%)	0.31
Uninsured	5 (5%)	2 (2%)	

Table 2
Number of subjects and average turnaround time by CT type.

	Pre-Implementation Period		Post Implementation Period		
	N	Mean [SD]	N	Mean [SD]	*P* value
Oral + IV Contrast	55 (59%)	195 [52]	28 (34%)	198 [62]	0.12
Oral Contrast Only	6 (11%)	131 [72]	6 (7%)	136 [66]	0.77
Intravenous Contrast Only	1 (1%)	182	15 (18%)	138 [68]	0.08
No Contrast	31 (33%)	98 [76]	34 (41%)	81 [43]	0.14
Total	93	158 [77]	83	135 [75]	0.003

The pre- and post-implementation median times to radiology reading were 176 min (IQR, 107–249 min) and 223 min (IQR, 148–286 min), respectively, an overall increase of 47 min (27%). A more detailed analysis of the time to radiology reading according to the type of contrast used is shown in Fig. 1.

The mean ED LOS in the pre- and post-implementation periods was 365 (SD = 110) min and 336 (SD = 121) min, an absolute decrease in LOS of 29 min (8%). A further breakdown of LOS according to the disposition is presented in Table 3.

4. Discussion

The results of this study showed that stopping the routine use of oral contrast for CTs of the abdomen and pelvis resulted in the time from when the CT was ordered to the time of completion by a technician decreasing by a mean of 23 min (15%). Stopping the use of oral contrast for these CTs for most patients would be expected to result in fewer CTs with both oral and IV contrast and more with IV only. In this study, 55 studies with both oral and IV contrast were ordered pre-implementation and 28 post-implementation; 1 study with IV contrast alone was ordered pre-implementation and 15 post-implementation. As expected, there was no difference between pre- and post-implementation numbers of studies ordered with oral contrast alone or no contrast. Together, these changes imply that implementation of the policy affected appropriately the ordering patterns of the physicians.

The implementation of this protocol resulted in an unexpected increase in time to radiology reading of 47 min (27%). It is unclear why the new protocol would have this effect. It could be argued that the time to radiology read would increase due to streamlining the process