Does High Body Mass Index Obviate the Need for Oral Contrast in Emergency Department Patients?

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INTRODUCTION

Background
An estimated 62 million computed tomographies (CT) are performed annually in the United States (U.S.). A substantial number of these are performed in emergency departments (ED). Many scans targeting the abdomen and pelvis require oral and intravenous contrast, which is currently believed to enhance the accuracy of the radiologist’s read of the scan. However, in a study in the American Journal of Surgery in 2005, no difference in sensitivity was found when...
radiologically diagnosing acute appendicitis whether or not
the patient received oral contrast.2

Intra-abdominal infectious and inflammatory conditions
often manifest with abnormalities of the adjacent fat of
the peritoneal cavity and omentum, which are detectable
without oral contrast. Because intra-peritoneal infectious and
inflammatory conditions manifest with abnormalities of the
adipose tissue adjacent to the inflamed organ, it is presumed
that with a larger percentage of adipose surrounding a given
organ, visualization of the inflammatory changes would be
more readily apparent. In addition, abdominal abscesses
can be detected without oral contrast. Bowel wall pathology
may be better delineated with bowel distension secondary to
contrast, but given the time constraints in the ED, oral contrast
doesn’t usually reach the colon in time for the scan. Also, the
detection of pneumatosis intestinalis is not improved by oral
contrast. Lee and colleagues did a prospective study of 100
ED patients with abdominal pain. These patients were initially
scanned without oral contrast and then again 90 minutes after
oral contrast was given, with identical scanning parameters.
Experienced radiologists were given no information about
medical history before they interpreted the noncontrast CTs;
the interpretation of the noncontrast scans matched scans in
which the patients were given oral contrast.3

Because the yearly patient census at most U.S. EDs is
increasing, rapidly examining, treating, and dispositioning
patients is crucial for effective ED operation, maintaining
patient safety, and sustaining hospital revenue.4 Eliminating
the need to give oral contrast for abdominal/pelvic CTs
performed on patients would greatly reduce the time some
patients spend in the ED, allowing more to be seen, and
improving ED throughput.

Do higher body mass index values sufficiently enhance the
ability of a radiologist to read a CT of the abdomen and pelvis,
so that the need for oral contrast to be given is precluded?

METHODS
Study Design, Setting, and Selection of Participants
This was a comparative study. An institutional review
board exemption was granted for this study as no direct
intervention was performed on the patients involved. Heights
and weights were recorded on ED patients who underwent an
abdominal/pelvic CT without oral contrast during the dates
12/4/10–1/4/11, and 4/22/11–5/20/11. This data was either
obtained by weighing and measuring patients in triage by ED
nurses (58 patients), or in the patient’s room, by the principle
investigator (12 patients). It was collected at various times
of the day and night, including weekdays, and weekends. We
obtained data using a single scale/tape measure that recorded
weight in kilograms and height in centimeters, and could be
rolled from triage to the patient’s room. We excluded patients
from the study if they presented to the ED secondary to any
type of trauma. Individuals younger than 18 were excluded,
as were any individuals who received oral contrast. In

| BMI category |
|-------------|
| Normal      |
| Overweight  |
| Obese       |
| Morbidly obese |

addition, we used only the data from a patient’s initial CT if
the patient presented to the ED, and was scanned multiple
times within the patient data collection period.

Methods of Measurement
We calculated body mass indices (BMI) on these
patients using the collected data, and the formula: weight
(in kilograms) divided by height (in meters) squared. The
remaining patients were divided into 4 groups using the
National Institute of Health’s BMI categories: <24.9, 25–29.9,
30–39.9, and >40. Two board-certified radiology attendings,
including the department chair, and an expert in body CT
reviewed the cases. The radiologists were blinded as to the
purpose of the study; their objective was to read the scans as
they normally would.

The radiologists filled out a form as they reviewed the CT
for each patient. Both radiologists were assigned a number,
which they would place atop each form to identify it as theirs.
They also identified each form with the patient’s medical
record number. The radiologists were to then specifically
examine 4 organs on every CT: the gallbladder, appendix,
pancreas, and colon. For each organ, they were to answer the
question, “how well can you visualize the following anatomic
structure for pathology?” by making a mark on a modified
Likert scale located below the name of each organ. The scale
was 12 cm long with the phrases, “Not at all” on the extreme
left, and “Excellent” on the extreme right, without any marks
or numbers in between. The radiologist was to place a mark on
the line corresponding to how well each organ was visualized.
If the radiologist could visualize a specific organ and
completely identify all pathology related to that organ, he/she
was to place a mark on “Excellent” for that organ. If the organ
could not be visualized at all, a mark was to be placed on “Not
at all.” If the organ could be identified with average difficulty,
a mark was to be placed midway between the two ends of the
scale, etc. The radiologists, while assessing each organ for
pathology, were not instructed to delineate the pathology they
identified on the grade sheet, but only to assess the difficulty

Table. Spreadsheet compiling the grader’s data, from which
Kappa analysis was performed.

| BMI category   | Contrast need | MD #1 | MD #2 | Total |
|---------------|---------------|-------|-------|-------|
| Normal        | No            | 9     | 4     | 13    |
|               | Yes           | 1     | 2     | 16    |
| Overweight    | MD #1         |       |       |       |
|               | Yes           | 2     | 1     | 19    |
| Obese         | No            | 11    | 0     | 13    |
| Morbidly obese| Yes           | 6     | 0     | 6     |
|               | No            | 0     | 0     | 6     |
with which they identified it and their ability to identify it. At the lower portion of the form was an additional question for the radiologists to answer, based on how accurately each preceding organ was identified. That question asked, “was there a need for contrast in this patient?” The radiologist was to circle, “yes,” or “no.”

**Data Collection and Processing**

Seventy patients identified during the data collection period met criteria for inclusion in the study. Five were excluded initially: 1 for receiving intravenous contrast, 3 because they had undergone recent surgery secondary to metastatic carcinoma, and 1 because his CT was of poor technical quality and unreadable. One additional patient was overlooked during the CT reading period and was excluded because there was no read for his scan. It was determined that an additional 18 patients had missing data on their grade forms, after the radiologists finished reading their CTs, and were excluded from the study as well due to missing data. Any attempt to have the radiologists re-read these scans was futile, as they maintain a robust clinical and academic schedule and did not afford the time necessary to re-read 18 CTs. Forty-six patients were included in the study: 27 females, and 19 males. The average age was 37 years, and average BMI was 29. The average age for patients in the “normal BMI” category was 36, and percent female was 46. The average age for patients in the “overweight” category was 37, and percent female was 56. The average age for patients in the “obese” category was 38, and percent female was 72. The average age for patients in the “morbidly obese” category was 35, and percent female was 66.

**Primary Data Analysis**

We performed Kappa analysis on the data to ascertain whether there was a statistical measure of inter-rater agreement between radiologists in determining whether or not oral contrast was needed in the study subjects.

**RESULTS**

In the “normal BMI” group (<24.9), the radiologists agreed that no contrast was needed in 9 of 16 cases. In the “overweight” group (25–29.9), they agreed no contrast was needed in 16 of 19 cases. In the “obese” group (30–39.9), they agreed no contrast was needed in 11 of 13 cases. And in the “morbidly obese” group (>40), they agreed no contrast was needed in all 6 cases.

In the “normal BMI” group, a Kappa value of 0.259 was calculated, with a p-value of 0.247. In the “overweight” group, a Kappa value of 0.457 was calculated, with a p-value of 0.018. In the “obese” group, a Kappa value of 0.629 was calculated with a p-value of 0.015. And in the “morbidly obese” group, a Kappa value of 1.0 was calculated with a p-value of 0.00.

**CONCLUSION**

There was increasingly significant agreement between radiologists regarding contrast use, as the study subject’s BMI increased. In addition, there was an advancing tendency of the radiologists to state that there was no need for contrast to be administered in patients with higher BMIs. Eliminating the need to give oral contrast to patients undergoing abdominal and pelvic CTs in the ED (even if only eliminating the need to give contrast to patients with higher BMIs), would greatly reduce the length of stay for some ED patients, decrease wait times, increase ED throughput, increase hospital revenue, and theoretically decrease the percentage of complications from patients receiving contrast material. In addition, this and future studies regarding this topic could be helpful medico-legally as they provide a degree of evidence (albeit small) to defend a practice that is becoming increasingly popular among ED providers: that of scanning patients who present to the ED with abdominal pain without oral contrast. Perhaps there is a subset of these patients - those with a high BMI - who deserve to be scanned without oral contrast. A larger study is needed to verify the results of this pilot study and to determine at what BMI radiologists feel comfortable scanning patients without contrast.

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