Multi-detector CT (MDCT) in bowel and mesenteric injury

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ABSTRACT

Objectives: To evaluate multi-detector CT (MDCT) findings in bowel and mesenteric injury due to blunt abdominal trauma.

Method: Retrospective evaluation of MDCT scan reports of patients admitted in Hamad Medical Corporation, Doha, Qatar with bowel and mesenteric injury during the period of January 2005 to April 2008.

Results: MDCT, without using oral contrast, clearly demonstrated various specific and less specific findings of bowel and mesenteric injury.

Conclusion: Multi-detector CT is an excellent diagnostic modality in bowel and mesenteric injury. Routine administration of oral contrast agent is not mandatory for initial evaluation of these patients.

Keywords: Bowel, mesentery, injury, MDCT, contrast agents

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INTRODUCTION
Bowel and mesenteric injury (BMI) is an infrequent, albeit not rare, injury that can lead to devastating complications if not properly diagnosed. CT scan is the diagnostic modality of choice in stable patients with blunt abdominal trauma and is considered superior to other techniques, such as diagnostic peritoneal lavage (DPL) and ultrasound (FAST). Since 1999, most studies of CT performance in bowel and mesenteric injury is with single-detector helical scanners. Few recent studies using MDCT show promising results. High diagnostic accuracy is due to better image quality and increased awareness of various CT findings of this injury among radiologists and trauma surgeons.

MATERIALS AND METHOD
Multi-detector CT scan reports of patients admitted through the Emergency Department of Hamad Medical Corporation, Doha, Qatar with bowel and mesenteric injury due to blunt abdominal trauma from January 2005 to April 2008 were retrospectively evaluated. Patients were identified by searching medical records and only those patients that underwent a scan with 16- or 64-slice multi-detector CT as part of the initial evaluation were included in the study. None of the patients received oral contrast agent. The scan reports were searched for various specific findings of bowel and mesenteric injury, such as extraluminal air, absent bowel wall enhancement and active extravasations from mesenteric vessels, as well as less specific findings, like intraperitoneal fluid, bowel wall thickening, ileus, bowel wall enhancement and foci of fat stranding, fluid, air or hematoma in the mesentery. These findings are compared with mode of management and laparotomy findings.

RESULTS
Twenty nine patients were identified (mean age group 27 years, male female ratio 26:3) with bowel and mesenteric injury that underwent multi-detector CT (16 or 64 slice) without using oral contrast as part of the initial clinical work up. Major cause of injury was road traffic accident (55%) followed by fall from height (34%) and blunt object falling on abdomen (11%). Percentages of cases showing different specific findings are: extra luminal air (24%), active extravasation of intravenous contrast (17%), absent enhancement of bowel wall (10.3%) (Figures 1–3). less specific findings include: intraperitoneal fluid (89%), bowel wall thickening (48%), ileus (20%), retroperitoneal fluid (13.7%), intramesenteric fluid (21%), mesenteric fat stranding (38%) and mesenteric hematoma (24%) (Figures 4–10). 20 patients underwent laparotomy and 9 were managed conservatively. Surgically proven bowel injury occurred in stomach (n = 1), duodenum (n = 2), jejunum (n = 7), ileum (n = 7) and colon (n = 4). Among this surgically managed group 2 had isolated mesenteric injury, 4 had isolated bowel injury and the rest 14 had a combination of both. 3/4 cases of bowel gangrene were clearly identified by multi-detector CT as
Figure 2. Extravasation of IV contrast.

Figure 3. Absent enhancement of bowel wall.
Figure 4. Intraperitoneal fluid.

Figure 5. Bowel wall thickening.

Figure 6. Ileus.
Figure 7. Retroperitoneal fluid and hematoma in duodeno-pancreatic injury.

Figure 8. Intramesenteric fluid.

Figure 9. Mesenteric fat stranding.
absent enhancement of bowel wall. Considering the detection and localization injured bowel, 100% concordance was noted between scan reports and surgical findings.

DISCUSSION

Bowel and mesenteric injuries (BMI) are identified in about 5% of patients with blunt abdominal trauma during laparotomy and approximately in 1% patients undergoing CT scan as part of initial clinical evaluation. Early detection is crucial because of its devastating complications. Clinical detection of bowel and mesenteric injury is difficult due to lack of physical examination signs. In the past, most of the diagnosis were made during exploratory laparotomy. Procedures like focused abdominal sonography (FAST) and diagnostic peritoneal lavage (DPL) has a limited role in identifying this type of injury. Invasive nature and low organ specificity are the two main disadvantages of DPL. More over, artificial pneumoperitoneum created by DPL can cause difficulty in CT image interpretation. Even though FAST is highly sensitive in detecting hemoperitoneum, it is seen that, over a substantial intra-abdominal injury can present without hemoperitoneum. Hence, bowel and mesenteric injury is one of the common injuries missed on FAST.

Since 1999, many studies were published highlighting the efficacy of CT scan in bowel and mesenteric injury. At present, CT is considered as the investigation of choice in hemodynamically stable patients.

The risk of ionizing radiation exposure is a matter of concern associated with CT abdomen and a plethora of literature is available on this subject. More over, these concerns are more important in children due to higher radiation sensitivity and longer life expectancy. The estimated effective dose from abdominal CT is approximately 8 mSv and is equivalent to exposure from 400 chest x-rays. However, high benefit-to-risk ratio of CT, in an emergency setting makes it an unavoidable tool in managing patients with this type of potentially dangerous injury.

Allergic reaction to IV contrast media was an important issue in the past. Nonetheless, adverse reactions to newer non-ionic contrast agents are extremely rare and hence generally considered safer.

Early studies with single detector helical CT scanners showed a sensitivity of 80 to 90% in BMI, but a low specificity. However, a few recent articles have included the data with MDCT and show high sensitivity, specificity, positive predictive value and negative predictive value. A consistent observation is that, thinner section imaging, fast acquisition of data, multi-planar reformation capability and increased awareness about various CT findings are the main contributory factors for better diagnostic efficacy of MDCT.

CT FINDINGS

CT findings of bowel and mesenteric injury are broadly classified as specific and less specific findings (Tables 1 & 2).
In our study, one or more less specific findings were noted in all the cases of BMI and specific CT findings in 31%.

**Diagnostic Pitfalls**

In a trauma setting, conditions like pulmonary barotrauma, pneumothorax, chest injury, entrance of air through fallopian tube; performance of DPL prior to CT scan and catheterization for bladder injury can cause pneumoperitoneum and mimic bowel injury. Moreover, air bubbles from surgical emphysema can track deeply and collect in between the deeper layers of abdominal wall and parietal peritoneum. This is known as pseudopneumoperitoneum and should be interpreted carefully to avoid diagnostic errors. Another important pitfall is thickening and increased enhancement of bowel wall seen in shock bowel secondary to hypovolemia. Associated features like flat IVC, small aorta, small spleen, hyperattenuating adrenals, kidneys and pancreas help in the differentiation of this condition.

**Surgical Versus Non-Surgical Findings**

Like any other injury, the ultimate decision of surgical management rests mainly on the treating surgeon. The role of radiologist is to convey the significance and implication of each finding to the trauma surgeon. Even in isolation, specific CT findings, except pneumoperitoneum are generally considered as potentially surgical lesions. It is essential to exclude other causes of pneumoperitoneum before proceeding for laparotomy. Importance of less specific findings depends mainly on general condition of the patient, presence or absence of other injuries and preexisting illnesses. A significant exception is intramesenteric fluid, with triangular morphology that is considered as surgically significant finding by some authors.

**Oral Contrast in Bowel Injury**

Administration of oral contrast in blunt abdominal trauma is a controversial topic. Advantages of using oral contrast agents are better delineation of bowel wall thickness and ability to demonstrate contrast leak. Main drawbacks are risk of aspiration, difficulty in administration and relatively long transit time needed for bowel opacification, especially when there is associated ileus, due to stress of trauma. More over waiting for the passage of oral contrast is strongly against the rule of ‘golden hours’ of trauma.
management. Hence, consensus emerging from emergency medicine, trauma surgery and radiology is favoring protocols without using oral contrast. In this study also MDCT, without using oral contrast agents clearly identified bowel injury in all the cases. More over associated lack of enhancement of bowel, a highly specific sign of post-traumatic bowel gangrene was well demonstrated in proved cases.

CONCLUSION
Multi-detector CT is an excellent diagnostic modality in bowel and mesenteric injury. Routine administration of oral contrast agent is not mandatory for initial evaluation of these patients. CT protocol using IV contrast is sufficient for depicting the important findings of this condition. Finally, an accurate preoperative diagnosis of trauma induced bowel gangrene is possible with MDCT by identifying the non-enhancing segment of bowel.

REFERENCES