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## IMAGING-SURGICAL CORRELATION

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# Computed Tomographic Images of Bowel Gangrene Secondary to Mesenteric Injury

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### ABSTRACT

*A case of bowel gangrene secondary to mesenteric injury is described. Although computed tomography is the primary imaging modality for the assessment of patients with blunt abdominal injury, computed tomography findings in bowel and mesenteric injury can be subtle and non-specific. Close collaboration between radiologist and clinician is required to achieve a timely and correct diagnosis in such cases.*

*Key Words: Abdominal injuries, Computed tomography, Pneumoperitoneum*

### INTRODUCTION

CT scanning is the primary imaging examination for patients with blunt abdominal injury. While solid organ injury in the abdomen is well assessed, the detection and diagnosis of mesenteric and bowel injury by CT continues to be a challenging task for radiologists.

### CASE REPORT

A 44-year-old Chinese man was admitted to hospital after a work injury in which he was hit on the lower abdomen and right thigh by a heavy falling object. Plain radiography showed fracture of the mid-shaft of the right femur. CT scanning of the abdomen and pelvis was performed on admission using a multislice scanner (Philips, Marconi Medical System, MX 8000, Ohio, USA), with and without contrast injection. Non-ionic contrast (95 mL Iopamiro 300) was used. Scan delay was 60 seconds and the injection rate 2 mL/sec. The pitch factor was Q 0.875 with 4 x 2.5 mm detector array.

A retroperitoneal haematoma in the right perinephric region and a sacral ala fracture were detected. A small amount of intraperitoneal fluid, consistent with haemorrhage, was noted both in the abdomen and pelvis (Figure 1).

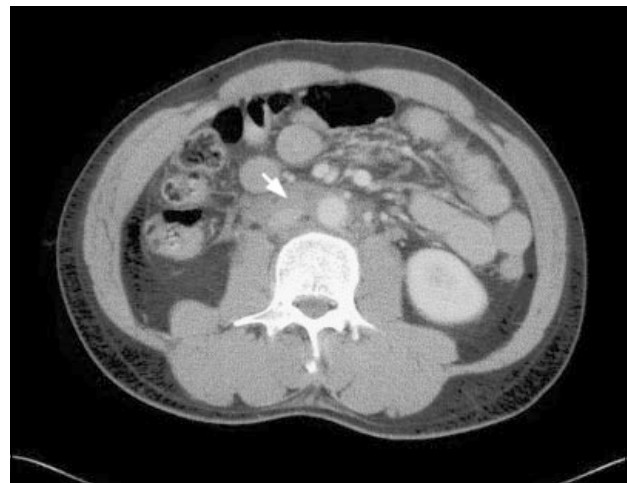
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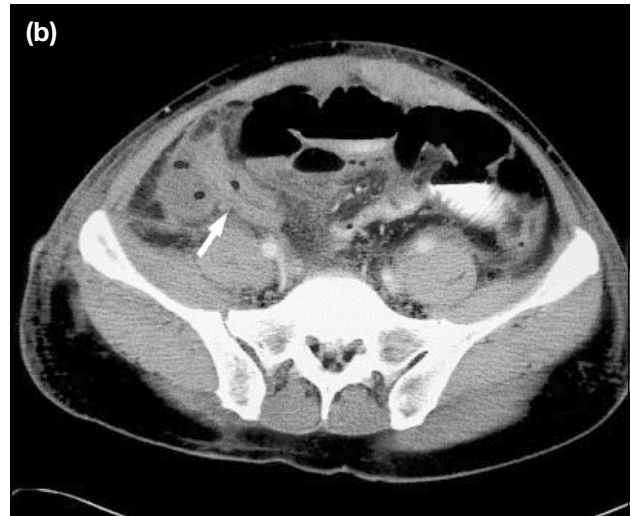
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**Figure 1.** Initial CT of the abdomen shows a small amount of intra-peritoneal fluid (arrow) in the region of the root of the mesentery. This is a rather subtle finding.

The abdominal injury was treated conservatively. A close reduction and locking femoral nail procedure for the right femur fracture was performed under spinal anaesthesia. The patient then gradually developed clinical signs and symptoms of bowel obstruction. A second CT scan was performed three days after the injury with the same scan setting as previously. Increased intraperitoneal fluid was noted and dilatation of the small bowel seen. Two segments of collapsed small bowel, with subtle evidence of thickened bowel wall, were noted in the right lower quadrant of the abdomen and in the pelvis (Figure 2).

Increased intraperitoneal fluid was observed in the region of the attachment of the mesentery (Figure 3).



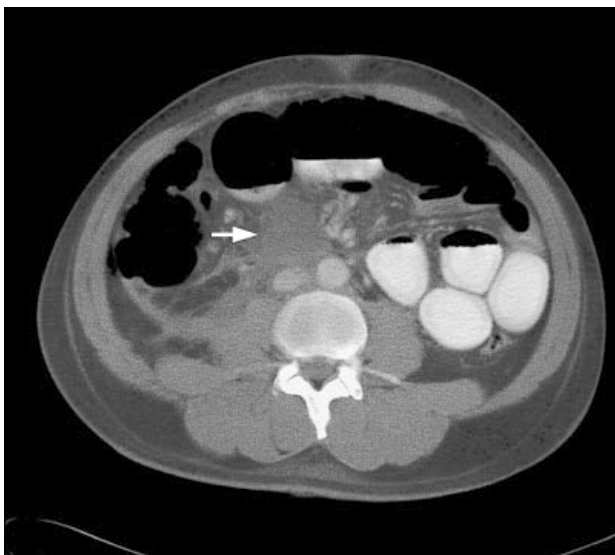
**Figure 2.** The small bowel involved is shown on the first (a) and second (b) CT examinations by an arrow. Subtle bowel wall thickening and the 'target sign' are better appreciated on the first scan after viewing the bowel appearance on the second examination. Dilated small bowel and an abnormal intraperitoneal fluid collection with air pockets can also be seen on the second CT scan.

Small pockets of air density were noted in the right subphrenic space as well as in the right paracolic and pelvic region (Figure 4). The main superior mesenteric artery and vein demonstrated normal opacification with contrast on both the first and second CT examinations.

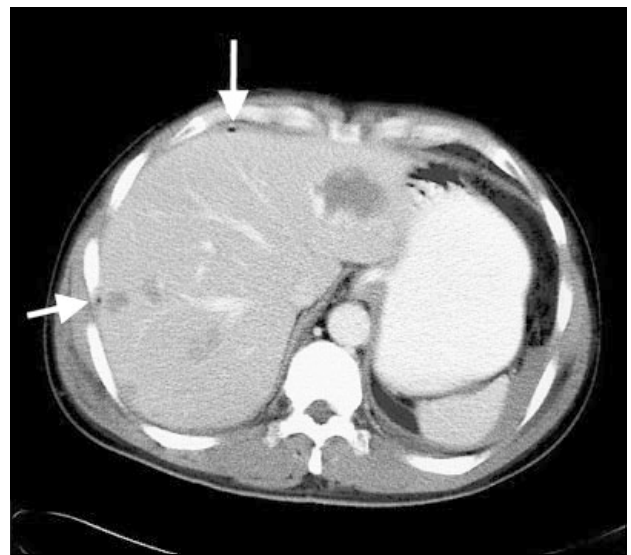
Laparotomy was then performed in view of both clinical and CT findings. Distended small bowel as far as the ileum was noted. A loop of gangrenous ileum, approximately 30 cm in length, was found in the pelvis along with torn mesentery up to the bowel wall (Figure 5). Another area of torn mesentery was also noted near the ileocolic junction. The affected segments of small

bowel were resected. Pathological examination of the resected bowel specimens showed transmural infarction. On gross examination, the entire length of the small intestine was congested, without evidence of perforation.

Focal areas of the serosal surface were covered by fibrinous exudates. On microscopic examination, widespread transmural infarction was evident, with acute inflammation of the peritoneal surface. One week following bowel resection, a third CT scan was performed for suspected sepsis. Right-sided intra-abdominal and pelvic abscesses were noted, and operative drainage was subsequently performed. The patient then made a good recovery.



**Figure 3.** The intraperitoneal fluid collection (arrow) in the region of the root of mesentery is much more prominent on this second CT scan.



**Figure 4.** Small pockets of air (arrows) are discernible in the subphrenic space. Multiple haemangiomas are noted in the liver as an incidental finding.



**Figure 5.** The gangrenous small bowel appears dark blue in colour in this photograph taken during surgery.

## DISCUSSION

CT scanning has been used extensively for the assessment of patients with blunt abdominal injury and is now the primary modality of imaging for this group of patients.<sup>1-3</sup> It is generally agreed that CT imaging is both sensitive and specific for the diagnosis of solid organ injury in the abdomen. However, the detection of bowel and mesenteric injury continues to be a challenging task for the radiologist, as imaging findings may be subtle and non-specific.<sup>4,5</sup> Moreover, clinical presentation may also be misleading in the initial period following the injury. Consequently, the radiologist and clinician need to consult together, as early diagnosis and appropriate management are crucial to decreasing morbidity and mortality.<sup>3</sup>

With respect to this case, the imaging findings on the admission CT scan were non-specific and subtle with regard to identifying mesenteric injury. Only a small amount of intraperitoneal fluid, likely to be due to haemorrhage in the abdomen and pelvis, was seen. The presence of a small amount of free intraperitoneal fluid after blunt abdominal injury without obvious solid organ injury is not specific for the diagnosis of bowel or mesenteric injury. However, Cunningham et al<sup>6</sup> did report that isolated intraperitoneal fluid on CT scan after blunt trauma was highly associated with underlying bowel or mesenteric injury. Specific CT findings for bowel injury or perforation include bowel wall thickening, leaking of oral contrast, free intraperitoneal gas, and abnormal bowel wall enhancement.<sup>3,4</sup> None of these features were noted on the first CT scan. Though the presence of fluid in the region of the attachment of the mesentery is indicative of mesenteric injury, this

was a very subtle finding on the first CT scan, as only a minimal amount of fluid could be detected.

With the clinical progression of bowel obstruction three days after admission, the second CT scan was performed, showing generalised small bowel dilatation, a small amount of free intraperitoneal gas, and a significantly increased amount of intraperitoneal fluid. Intraperitoneal fluid collections were mainly located in the right paracolic and pelvic regions, as well as at the root of the mesentery. The prominence of the fluid collection at the root of the mesentery was a specific confirmatory sign for mesenteric injury. The right paracolic and pelvic locations of fluid collection were probable indicators of the site of disease involvement. Two segments of collapsed small bowel with subtle bowel wall thickening were detected at the region of the distal ileum.

Bowel wall thickening was easier to appreciate when comparison was made with the normal appearance of the bowel on the first CT examination. Thin alternating layers of attenuation with central hypodensity could be seen in the mildly thickened bowel wall on post-contrast study. This stratified appearance or 'target' sign has been described as a common finding in ischaemic bowel disease,<sup>7</sup> but may also be seen in association with inflammatory and infective causes of bowel disease. The two segments of collapsed small bowel with bowel wall thickening and the proximal small bowel dilatation together indicated bowel injury. CT findings thus documented the progression of significant bowel and mesenteric injury and were correlated with the findings at operation of bowel gangrene caused by torn mesenteric vessels.

Pneumoperitoneum is diagnostic for rupture or perforation of bowel structure. CT scanning, with its high contrast resolution and tomographic nature, is much more sensitive than plain radiography for detecting free intraperitoneal gas. In the second CT examination, the major finding of pneumoperitoneum suggested an imaging diagnosis of bowel perforation. However, bowel perforation was not evident at laparotomy, while bowel gangrene and torn mesenteric vessels were seen.

There have been reports of pneumoperitoneum without bowel perforation in the literature.<sup>8</sup> The underlying cause of pneumoperitoneum was unclear in most reported cases, although the majority were attributed to peritoneal lavage. Mechanical ventilation and chest tube

insertion were other suggested causative factors. In this case, the patient did not undergo diagnostic peritoneal lavage before CT examination; neither did he undergo mechanical ventilation or chest tube insertion. No abscess collection was demonstrated at operation, negating the possibility of the air collections being within an abscess.

A causal relationship in this case between the finding of pneumoperitoneum and the bowel gangrene is strongly suggested by the presence of pneumoperitoneum on the second but not the first CT examination. The exact mechanism of air leakage associated with bowel gangrene is not known but could be transmural and at the microscopic level. It is also possible that a minute perforation was present, or that a small perforation sealed off by fibrinous exudate evaded gross inspection.

In conclusion, the CT findings in this patient illustrate the challenges inherent in evaluating bowel and mesenteric injury with this imaging modality. Careful patient review and consultation between the radiologist

and clinician is necessary in such cases in order to achieve a timely and correct diagnosis.

## REFERENCES

1. Wolfman NT, Bechtold RE, Scharling ES, Meredith JW. Blunt upper abdominal trauma: evaluation by CT. *AJR Am J Roentgenol* 1992;158:493-501.
2. Sriussadaporn S. CT scan in blunt abdominal trauma. *Injury* 1993;24:541-544.
3. Brody JM, Leighton DB, Murphy BL, et al. CT of blunt trauma bowel and mesenteric injury: typical findings and pitfalls in diagnosis. *Radiographics* 2000;20:1525-1537.
4. Levine CD, Gonzales RN, Wachsberg RH, Ghanekar D. CT findings of bowel and mesenteric injury. *J Comput Assist Tomogr* 1997;21:974-979.
5. Sherck J, Shatney C, Sensaki K, Selivanov B. The accuracy of computed tomography in the diagnosis of blunt small-bowel perforation. *Am J Surg* 1994;168:670-675.
6. Cunningham MA, Tyroch AH, Kaups KL, Davis JW. Does free fluid on abdominal computed tomographic scan after blunt trauma require laparotomy? *J Trauma* 1998;44:599-603.
7. Macari M, Balthazar EJ. CT of bowel wall thickening: significance and pitfalls of interpretation. *AJR Am J Roentgenol* 2001;176:1105-1116.
8. Hamilton P, Rizoli S, McLellan B, Murphy J. Significance of intra-abdominal extraluminal air detected by CT scan in blunt abdominal trauma. *J Trauma* 1995;39:331-333.