



Original Research Article

## Spectrum of CT Findings in Blunt Small-Bowel and Mesenteric Trauma: A Hospital-Based Study from a Tertiary Care Institute in South Kashmir

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### ABSTRACT

**Background:** Blunt small-bowel and mesenteric injuries are uncommon but potentially life-threatening. Computed tomography (CT) is the primary modality for evaluation; however, CT findings vary widely in sensitivity and specificity.

**Objective:** To describe the spectrum of CT findings in blunt small-bowel and mesenteric trauma at a tertiary care institute in South Kashmir and to correlate CT findings with same centre operative outcomes.

**Methods:** This retrospective observational study included 20 patients within a span of 12 months with blunt abdominal trauma who underwent contrast-enhanced multidetector CT (MDCT). CT signs were recorded using a structured checklist. CT overall impression was graded (Grade 1–4). Operative findings and clinical follow-up were used as the reference standard.

**Results:** The most frequent CT findings were free intraperitoneal fluid (70%), mesenteric fat stranding (65%), bowel wall thickening (50%), and mesenteric hematoma (30%). Direct signs were less frequent: free air (20%), bowel wall defect (15%), and active contrast extravasation (10%). Nine patients were classified as having surgically significant bowel/mesenteric injury. CT overall impression (Grade 3–4 positive) showed sensitivity 77.8% and specificity 90.9%. Direct signs showed very high specificity (100%) but low sensitivity.

**Conclusion:** In blunt small-bowel and mesenteric trauma, indirect CT signs such as free fluid and mesenteric stranding are common but less specific, while direct signs are highly specific though uncommon. Structured reporting and correlation with clinical status are essential to improve detection and timely management.

**Keywords:** Blunt abdominal trauma, small bowel injury, mesenteric injury, CT, mesenteric hematoma, bowel perforation.

### INTRODUCTION

Blunt abdominal trauma remains a major cause of morbidity and mortality worldwide, particularly in road traffic collisions and falls. Among abdominal injuries, small-bowel and mesenteric trauma is relatively uncommon compared with solid organ injury, but delayed diagnosis can lead to bowel ischemia, perforation, peritonitis, and sepsis [1–4].

Computed tomography (CT), particularly multidetector CT (MDCT), is the imaging modality of choice for stable patients with blunt abdominal trauma. While CT has excellent specificity for direct signs such as pneumoperitoneum, bowel wall discontinuity, and contrast extravasation, sensitivity is variable because many injuries manifest only as subtle indirect signs, including free fluid without solid organ injury, bowel wall thickening, and mesenteric fat stranding [1,2,5,6].

Most studies emphasize that CT performance improves when multiple signs are evaluated together, rather than relying on a single finding [2,6,7]. Given differences in injury mechanisms, patient population, and CT protocol, institutional data remain valuable.

This study was conducted at a tertiary care institute in South Kashmir and aims to describe the spectrum of CT findings in blunt small-bowel and mesenteric trauma, correlate imaging with operative findings, and compare institutional patterns with published literature.

## MATERIALS AND METHODS

### Study design and setting

A retrospective observational study was conducted at, Government Medical College, Anantnag, a tertiary care institute in South Kashmir. Imaging and clinical records were reviewed for a 5-year period (January 2020 to December 2024).

### Study population

A total of **20 consecutive patients** who underwent contrast-enhanced CT for blunt abdominal trauma with clinical or radiological suspicion of small-bowel or mesenteric injury were included.

### Inclusion criteria

- Age  $\geq$  16 years
- Blunt abdominal trauma
- CT performed with intravenous contrast
- Imaging and clinical records available

### Exclusion criteria

- Penetrating trauma
- Patients with isolated solid organ injury and no suspicion of bowel/mesenteric injury
- Incomplete CT study or missing records

### CT protocol

CT was performed using MDCT (128-slice) with intravenous contrast (portal venous phase minimum). Axial and coronal reconstructions were routinely generated with thin slices. Oral contrast was not routinely administered due to emergency setting and time constraints.

### Image analysis and CT signs recorded

Two radiologists reviewed all CT scans in consensus using a structured checklist. The following CT signs were recorded:

#### Indirect signs

- Free intraperitoneal fluid (any)
- Free fluid without solid organ injury
- Bowel wall thickening
- Abnormal bowel wall enhancement (hyper/hypo)
- Mesenteric fat stranding
- Mesenteric hematoma
- Interloop fluid
- Localized bowel dilatation / focal ileus
- Peritoneal enhancement

#### Direct signs

- Free intraperitoneal air
- Bowel wall defect/discontinuity
- Active contrast extravasation
- Pneumatosis intestinalis

### CT overall impression grading

CT was graded as follows:

<b>Grade 1:</b>	No evidence of bowel/mesenteric injury
<b>Grade 2:</b>	Equivocal (subtle indirect signs only)
<b>Grade 3:</b>	Suspicious (multiple indirect signs)
<b>Grade 4:</b>	Highly suggestive (direct signs present)

CT was considered **positive** if Grade 3 or Grade 4.

### Reference standard

The reference standard was:

- Operative findings in patients who underwent laparotomy
- Clinical follow-up in conservatively managed patients (minimum 30-day follow-up documented)

Surgically significant injury included:

- Small bowel perforation or transection
- Duodenal rent
- Mesenteric tear with devascularization
- Mesenteric hematoma requiring operative management

### Statistical analysis

Data were summarized as frequencies and percentages. Diagnostic accuracy measures were calculated: sensitivity, specificity, PPV, and NPV.

## RESULTS

### Demographic profile

A total of **20 patients** were included.

- Mean age: **34.5 years** (range 18–62)
- Sex: **16 males (80%)**, 4 females (20%)

### Mechanism of injury

- Road traffic collision: 12 (60%)
- Fall from height: 5 (25%)
- Other blunt trauma: 3 (15%)

### Frequency of CT findings

The most frequent CT findings were:

- Free intraperitoneal fluid: 14/20 (70%)
- Mesenteric fat stranding: 13/20 (65%)
- Bowel wall thickening: 10/20 (50%)
- Free fluid without solid organ injury: 9/20 (45%)

Direct signs were less frequent:

- Free intraperitoneal air: 4/20 (20%)
- Bowel wall defect: 3/20 (15%)
- Active contrast extravasation: 2/20 (10%)

The full spectrum is shown in Table 1.

### Surgical correlation and final diagnosis

- Laparotomy performed: 12/20 (60%)
- Conservatively managed: 8/20 (40%)

Final classification using surgery and follow-up:

- Surgically significant bowel/mesenteric injury: **9/20 (45%)**
- No surgically significant injury: **11/20 (55%)**

### Injury distribution (surgically significant)

- Jejunal perforation: 4
- Ileal perforation: 2
- Duodenal rent: 1
- Mesenteric tear/devascularization: 2

### Diagnostic accuracy of CT

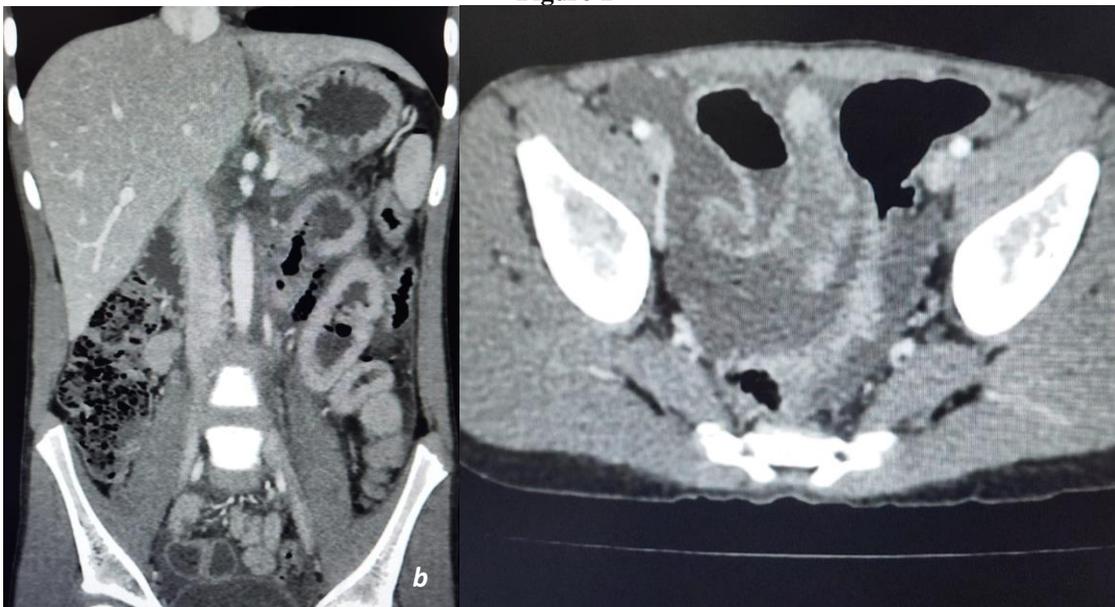
CT overall impression (Grade 3–4 positive) demonstrated:

- **Sensitivity:** 77.8%
- **Specificity:** 90.9%
- **PPV:** 87.5%
- **NPV:** 83.3%

Direct signs (free air, bowel wall defect, active extravasation) demonstrated very high specificity (100%) but lower sensitivity, consistent with published literature [1,2,6].

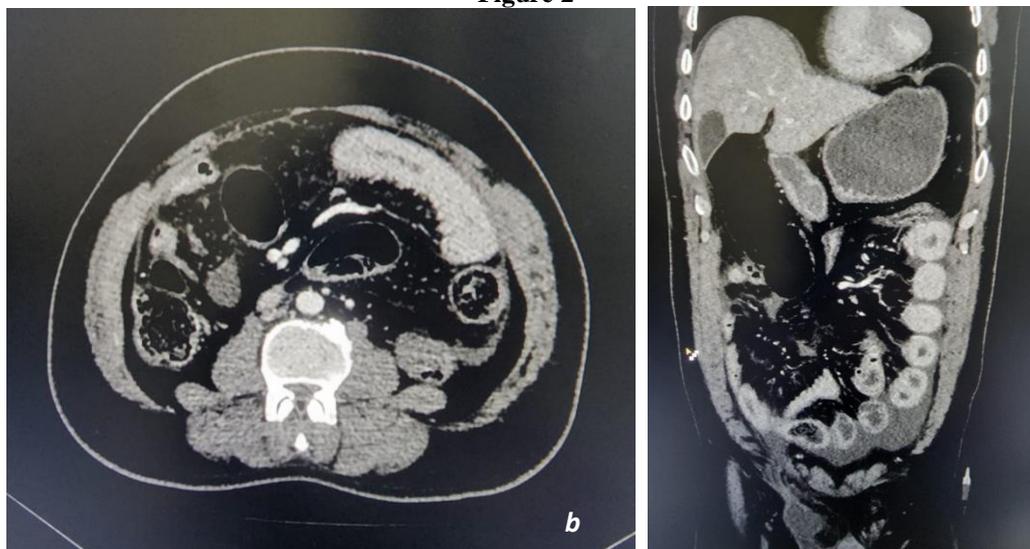
## Figures

**Figure 1**



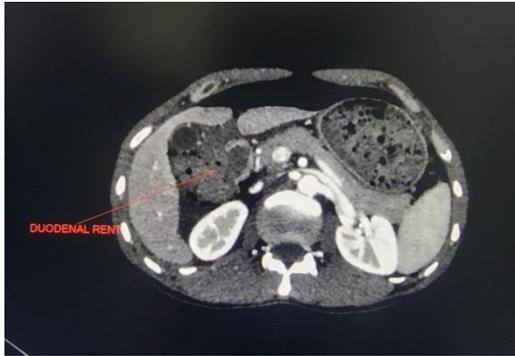
Male patient aged 35 years with history of blunt trauma to abdomen (RTA). CECT Coronal (a) reveals bowel wall thickening and hyper enhancement in proximal jejunum with bowel wall discontinuity. Associated exoluminal interloop collection (air containing) and free fluid is seen. Axial pelvic cuts (b) reveal significant pelvic free fluid.

**Figure 2**



20 years male patient with history of fall. Axial CECT (a) shows mural thickening and hyper enhancement involving jejunal loops. Coronal CECT (b) reveals diffuse jejunal hyper enhancement and free fluid.

**Figure 3**



40 years old male patient with history of RTA. CECT reveals large pneumoperitoneum, distended stomach and free fluid. A large rent along D2 segment of duodenum with localized air containing collection in right anterior pararenal space.

**Tables**

**Table 1. Spectrum of CT findings in blunt small-bowel and mesenteric trauma (n = 20)**

CT finding	Present n (%)
Free intraperitoneal fluid (any)	14 (70%)
Free fluid without solid organ injury	9 (45%)
Mesenteric fat stranding	13 (65%)
Mesenteric hematoma	6 (30%)
Bowel wall thickening	10 (50%)
Abnormal bowel wall enhancement	5 (25%)
Interloop fluid	7 (35%)
Localized bowel dilatation / focal ileus	4 (20%)
Free intraperitoneal air	4 (20%)
Bowel wall defect/discontinuity	3 (15%)
Intramural hematoma	2 (10%)
Pneumatosis intestinalis	1 (5%)
Active contrast extravasation	2 (10%)
Associated solid organ injury	6 (30%)
Pelvic fracture	3 (15%)

**Table 2. Distribution of injuries (final diagnosis) (n = 20)**

Final diagnosis	n (%)
Jejunal perforation	4 (20%)
Ileal perforation	2 (10%)
Duodenal rent	1 (5%)
Mesenteric tear with devascularization	2 (10%)
Contusion / minor mesenteric injury managed conservatively	3 (15%)
No bowel/mesenteric injury	8 (40%)
<b>Total</b>	<b>20 (100%)</b>

**Table 3. Diagnostic accuracy of CT overall impression (Grade 3–4 positive)**

Reference standard: surgery + follow-up  
Total injury = 9, no injury = 11

CT overall result	Injury present	Injury absent	Total
CT positive (Grade 3–4)	7	1	8
CT negative (Grade 1–2)	2	10	12

<b>Total</b>	<b>9</b>	<b>11</b>	<b>20</b>
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#### Diagnostic values

- Sensitivity = 7/9 = **77.8%**
- Specificity = 10/11 = **90.9%**
- PPV = 7/8 = **87.5%**
- NPV = 10/12 = **83.3%**

**Table 4. Diagnostic performance of selected CT signs (n = 20)**

CT sign	TP	FP	TN	FN	Sens (%)	Spec (%)
Free fluid without solid organ injury	7	4	7	2	77.8	63.6
Mesenteric fat stranding	6	5	6	3	66.7	54.5
Bowel wall thickening	6	3	8	3	66.7	72.7
Mesenteric hematoma	4	1	10	5	44.4	90.9
Abnormal enhancement	4	1	10	5	44.4	90.9
Free intraperitoneal air	3	0	11	6	33.3	100
Bowel wall defect	2	0	11	7	22.2	100
Active contrast extravasation	2	0	11	7	22.2	100

**Table 5. CT grading and surgical correlation**

CT Grade	n	Injury present	Injury absent
Grade 1	6	0	6
Grade 2	6	2	4
Grade 3	5	4	1
Grade 4	3	3	0
<b>Total</b>	<b>20</b>	<b>9</b>	<b>11</b>

## DISCUSSION

This hospital-based study describes the spectrum of CT findings in blunt small-bowel and mesenteric trauma in a South Kashmir tertiary care setting. Our findings demonstrate that indirect CT signs were more frequent than direct signs, while direct signs remained highly specific. This pattern closely matches established literature [1–6].

In our cohort, the most common CT findings were free intraperitoneal fluid (70%), mesenteric fat stranding (65%), and bowel wall thickening (50%). Prior studies and reviews have reported similar trends, with mesenteric stranding and free fluid being the most frequently encountered indirect signs [1,2,6]. Free fluid without solid organ injury is widely recognized as a red-flag finding for hollow viscus injury, especially when moderate or localized to the interloop region [2,6,8].

Direct signs such as free intraperitoneal air, bowel wall discontinuity, and active contrast extravasation were uncommon in our dataset, but when present they showed very high specificity (100%). This is consistent with the established concept that direct signs are highly specific but insensitive, because small perforations may not produce detectable pneumoperitoneum early, and bowel wall discontinuity is not always visible [1,2,6].

The diagnostic performance of CT in our study (sensitivity 77.8%, specificity 90.9%) is consistent with pooled systematic reviews reporting moderate sensitivity and high specificity for surgically significant bowel and mesenteric injury [2,5]. This supports the continued use of CT as the primary imaging tool for stable blunt trauma patients. However, false negatives remain clinically important. In our cohort, two injuries were missed on initial CT (Grade 2), highlighting the importance of repeat clinical evaluation and follow-up imaging when suspicion remains high.

Mesenteric hematoma demonstrated high specificity (90.9%) but moderate sensitivity (44.4%) in our cohort. Prior studies similarly report that focal mesenteric hematoma, particularly when adjacent to bowel loops, is a strong predictor of clinically significant injury [1,6].

Our study reinforces the value of structured reporting using a checklist and impression grading system, which reduces the chance of overlooking subtle indirect signs and helps clinicians stratify patients for observation versus surgery [6,7,9].

#### Limitations

1. Small sample size (n = 20) limits statistical power and generalizability.
2. Not all patients underwent surgery; follow-up was used as reference in conservatively managed cases.
3. Single-center retrospective design may introduce selection bias.
4. Oral contrast was not routinely used; thus, luminal contrast extravasation could not be assessed.

## CONCLUSION

Blunt small-bowel and mesenteric trauma shows a broad spectrum of CT findings. Indirect signs such as free intraperitoneal fluid and mesenteric fat stranding are frequent but less specific, while direct signs such as free air, bowel wall defect, and active contrast extravasation are uncommon but highly specific. In our cohort, CT overall impression demonstrated sensitivity 77.8% and specificity 90.9%, consistent with published literature. Structured CT reporting and careful clinical correlation remain essential to reduce missed injuries.

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