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Original Research Article

Diagnostic Accuracy of MDCT Scan in Detection of Intestinal and Mesenteric Injury in Blunt Abdominal Trauma

Sangada Santosh Surmalbhai[1], Majmudar Drusty Krishnasevak[2], Darda Mihir Gautam[3], Vaidya Chirayu Vijaykumar[4]

[1]Second Year Resident, Department of Radio diagnosis, NHL Medical College Shardaben Hospital, Saraspur, Ahmedabad-380018, Gujarat, India

[2]Associate Professor, Department of Radio diagnosis, NHL Medical College Shardaben Hospital, Saraspur, Ahmedabad-380018, Gujarat, India

[3]Senior Resident, Department of Radio diagnosis, NHL Medical College Shardaben Hospital, Saraspur, Ahmedabad-380018, Gujarat, India

[4]Associate Professor, Department of Medicine, Nootan Medical College & Research Center, Visnagar, Pin- 384315, Gujarat, India

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Corresponding Author: Dr. Vaidya Chirayu Vijaykumar

Conflict of interest: Nil

Abstract:

Background: Abdominal trauma caused by blunt force is a common presentation in the emergency room. The chief causes of blunt abdominal trauma are motor vehicle accidents, falls from heights, assault, bicycle injuries, injuries sustained during sporting activities, and industrial accidents. There are several recognized signs of blunt bowel and mesenteric injury at multidetector CT. Familiarity with the appearance of the signs as well as the limitations is crucial to making a timely diagnosis.

Results: Most patients were males (77.21%) & most common age group was 21-40 years (73%). Most common mode of injury was road traffic accidents (70%). Ileum (35%) was the most common site of injury followed by jejunum (25%). Most common CT scan findings were mesenteric stranding (73%) followed by free fluid (80%) 93%. The most common solid organ injured was the spleen followed by the liver. The skeletal injury was the most common extra-abdominal injury.

Conclusion: Males were more commonly injured most common mode of injury is road traffic/motor vehicle accidents. Most common site of injury is ileum. Most common associated solid organ injury is spleen. Most frequent MDCT findings are mesenteric stranding, free fluid and bowel wall thickening. Most specific findings are bowel wall discontinuity, active extravasation and reduced bowel wall enhancement.

Keyword: MDCT Scan, Accidents, Blunt Abdominal Trauma, Contrast Extravasation.

Introduction

Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups. Blunt abdominal trauma usually results from motor vehicle collisions, recreational accidents, or falls. Men tend to be affected slightly more often than women. The most commonly injured organs are the spleen, liver, retro peritoneum, small bowel, kidneys, bladder, colorectal, diaphragm, and pancreas.

Blunt bowel and mesenteric injuries (BBMI) are rare injuries with high morbidity and mortality, and occur in only 1-5% of blunt abdominal traumas [1-4] . Accurate diagnosis is of great importance since delayed diagnosis of BBMI may result in serious complications and mortality. Early diagnosis of isolated BBMI is difficult in patients with blunt abdominal trauma as clinically apparent signs and symptoms of peritonitis caused by perforation can be observed only after a considerable period of time, causing delayed diagnosis. As a result of delay in diagnosis, intraabdominal complications, such as abscess, sepsis, and even mortality, can be seen after surgical repair. [5-7]

Signs and symptoms of peritonitis like rigidity, tenderness, and rebound are sometimes undetectable and abdominal examination findings may be obscure in patients critically injured or neurologically compromised or in those experiencing an altered sensorium resulting from drugs, alcohol intoxication, or central nervous system trauma simultaneously. Currently, the diagnostic modalities besides physical examinations are paracentesis, diagnostic peritoneal lavage, focused abdominal sonogram for

trauma, computed tomography (CT) scan, and laparoscopy. [7-15] Multidetector computed tomography (MDCT) is an excellent imaging modality for diagnosing and managing patients with abdominal injuries while playing critical role in describing and grading solid-organ injuries, diagnosing the significance of BBMI, and deciding whether surgical intervention is required. MDCT readily detects direct and indirect features of bowel and/or mesenteric injury which is an important advance given that unrecognized bowel and mesenteric injuries may result in high morbidity and mortality.

Multidetector computed tomography (MDCT) offers significantly faster scanning times and improved image resolution due to thinner collimation and reduced partial volume and motion artifacts. The ability of CT to perform and produce fast-processing images, such as multiplanar reconstruction (MPR), is important for accurate interpretation of abnormalities.

If patients are hemodynamically unstable, detection of suspected bowel and mesenteric injuries is necessary for emergency surgical treatment. However, if patients are hemodynamically stable and no suspicious BBMI is present on MDCT, nonsurgical management is the acceptable standard care for blunt abdominal trauma.

Materials and Methods:

Study Design: This is a hospital based prospective study done of patients with blunt abdominal injury who underwent CT scan evaluation of abdomen and pelvis in the Department of radiodiagnosis, after obtaining approval from the institutional ethics committee. The study period was from September 2022 to October 2023.

In this study 30 cases of blunt abdominal trauma with bowel and mesenteric injury are selected. In all these cases haemodynamic stabilization was done if required before being referred for CT scan. All patients underwent x-ray and ultrasound examinations prior to CT scan evaluation. Individual details, clinical history and any significant past history was recorded. Also relevant laboratory investigations were done. Follow up with surgical department was done to compare our findings.

Inclusion Criteria:

1. CT scan is performed in hemodynamically stable blunt abdominal injury cases in whom findings on clinical abdominal examination or sonologic findings are equivocal,
2. In whom important signs such as guard-ing/rigidity could not be adequately evaluated due to altered mental status.
3. Patients in whom ultrasound shows free fluid and further evaluation for bowel injury is sought by clinician.

Exclusion Criteria:

1. Hemodynamically unstable patients
2. Patients with obvious clinical signs who re-quire immediate surgery.
3. Isolated solid organ injury.
4. Consent not given.

MDCT Technique: All studies were obtained on a Philips MX 16-slice MDCT with collimation 16x1.5mm, pitch 0.8632, tilt zero, rotation time 0.75 seconds and 300 FOV. Area of examination was taken from the diaphragm to pubic symphysis with 200 mAs and 120 kVp. Patients were supine. A multiphase 16-slice MDCT scan, including plain, arterial, portal and venous phases, was conducted by the same technique at 5 mm slice thickness, and reconstructed in the axial, coronal, and sagittal planes at 0.625 mm section thickness.

Pre intravenous contrast administration scans were obtained without oral & rectal contrast. Thereafter, an intravenous contrast agent (Iohexol)) containing 300 mg/ml iodine was administrated in a dose of 1 mL/kg , saline infusion 25-30 ml at a rate of 3 mL/s using a power injector. The arterial and portal phases were initiated at 25–30s and 60–70s delay, respectively. An excretory phase (3–5 min) was performed in case blunt renal-collecting-system injury was suspected.

Results:

Twenty-five of 30 patients in present study underwent surgery. Five patients were conservatively treated. Twenty of 25 patients had surgically proven BBMI and 5 patients had no BBMI. Of the twenty patients with BBMI, 15 (75%) had bowel injury, 2 (10%) had mesenteric injury, and 3 (15%) had bowel and mesenteric injury.

Table 1: Sex Wise Distribution Pattern (N=30)

Sex	Frequency	Percentage (%)
Male	23	77
Female	7	23

Table 2: Age Wise Distribution Pattern (N=30)

Age	No. of Patients	Percentage (%)
11-20yr	1	4
21-30yr	13	43
31-40yr	9	30
41-50yr	4	14
51-60yr	3	9

Our results showed that male patients were overwhelming with a rate of 77.21% & most common age group was 21-40 years (73%).

Table 3: Mode of Injury wise Distribution Pattern

Mode of injury	No. of patients	Percentage (%)
Traffic accident	21	70
Abuse/Work-relatedaccident	6	20
Other	3	10

The majority of the patients (70%) in our study sustained injuriesdue to road traffic accidents.

Table 4: Site of Injury Wise Distribution (N=20)

Site of Injury	Frequency	Percentage(%)
Stomach	1	05
Duodenum	2	10
Jejunum	5	25
Ileum	7	35
Cecum	1	05
Appendix	0	0
Colon	2	10
Mesentery	5	25

In this study, ileum (35%) was the most common site to get injured followed by jejunum (25%).

Table 5: Distributions Based On Ct Findings (N=30)

MDCT findings	Frequency	Percentage (%)
Bowel wall discontinuity	4	13
Active extravasation	2	6
Free fluid	24	80
Bowel wall thickening	18	60
Reduced bowel-wallenhancement	7	23
Pneumoperitoneum	14	46
Mesenteric hematoma	5	16
Mesenteric stranding	22	73

In our study the most frequently suspected injuries based on CT scan were mesenteric stranding (73%) followed by free fluid(80%) and bowel wall thickening(60%). Bowel wall discontinuity was reported in 13% of the cases in our study.

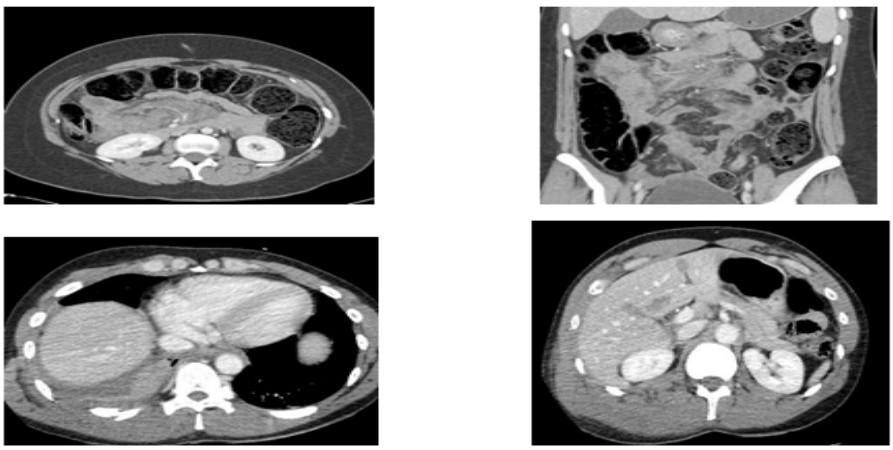

Figure 1: Case 2- 32 yr old patient with blunt trauma. CT findings are mesenteric haematoma, mesenteric stranding and free fluid with liver contusions andrib fractures

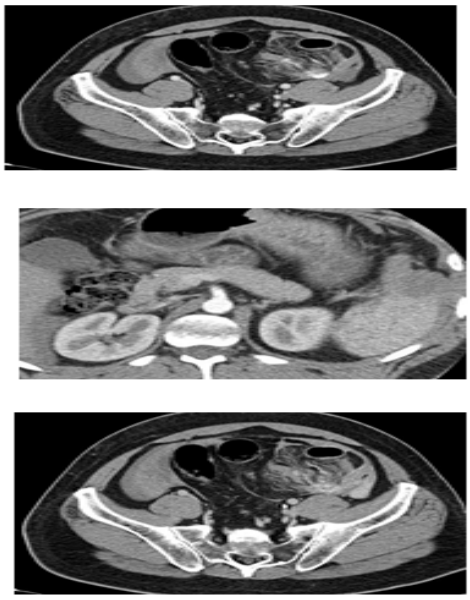

Figure 2: Case 1 - 25 yr old patient with RTA. CT findings showing active contrastextravasation, free fluid, mesenteric stranding and splenic contusion

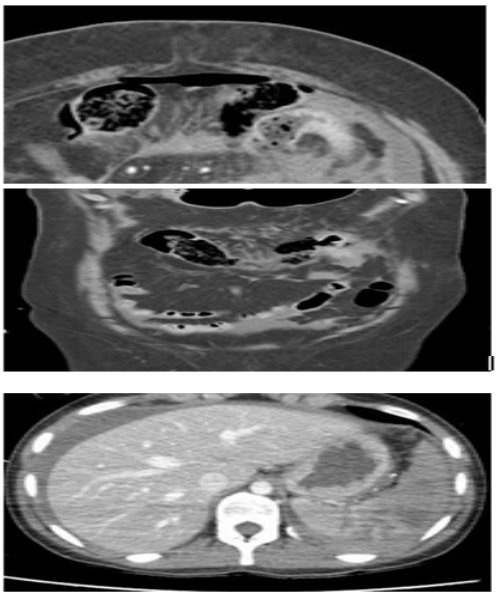

Figure 3: Case 19 - 25 yr old patient with RTA. CT images show transverse colonbowel wall defect, pneumoperitoneum, free fluid and splenic contusions

Table 6: Statistics of MDCT Findings

	Bowel-Wall Discon Tinuity	Active Extra Vasati On	Free Fluid	Bowel-Wall Thickeni Ng	Reduced Bowel- Wall Enhance Ment	Pneum Operit Oneum	Mesente Ric Hemato Ma	Mesente Ric Strandin G
True positive	4	2	17	11	7	13	4	15
True Negative	5	20	1	3	5	6	4	2
False positive	0	0	4	4	0	1	1	3
False negative	16	3	3	7	13	5	16	5
Sensitivity	20	40	85	61	35	85	20	75
Specificity	100	100	20	42	100	72	80	40
Positive pre-dictivevalue	100	100	80	73	100	92	80	83
Negative pre-dictivevalue	23	86	50	30	27	54	20	28

Bowel-wall discontinuity was considered as a direct finding of blunt bowel injury, and active extravasation suggested that an active bleeding condition has high specificity of 100% and 100% and low sensitivity of 20% and 40%, respectively. In our study, Pneumoperitoneum had a sensitivity and specificity of 85% and 72%, respectively.

Table 7: Associated Abdominal Injuries (N=30)

Organ	Frequency	Percentage(%)
Spleen	10	33
Liver	7	23
Kidney	4	13
Pancreas	3	10
Urinary Bladder	2	6
Other organs	4	13

Table 8: Categorizations on Extra-AbdominalInjury

Type of injury	Frequency	Percentage (%)
skeletal system	7	23
Blunt trauma chest	5	16
Head injury	1	0.03
Other	1	0.03

In our study, 93% patients had associated intra-abdominal injuries and 46 % patients had extra-abdominal injuries. The most common solid organ injured was the spleen followed by the liver. The skeletal injury was the most common extra-abdominal injury followed by a blunt chest trauma.

Discussion

Our results showed that male patients were overwhelming with a rate of 77.21%. Similar rates were reported by Duy Hung N et al [16] with 87.21 %and Elton et al. [17] 70.4%. Blunt bowel and mesenteric injuries are often present and can be misdiagnosed in multiple simultaneous accidents [18]

The most common age group in the present study was 21-40 years (73%). Wadhwa M et al [19] and Ayoade et al. [20] also found this age group to have the highest incidence in their study 54% & 68.9% respectively. This might be for the reason that this age group forms a major segment of the workforce. The majority of the patients in our study as well as other studies sustained injuries due to road traffic accidents. In Duy Hung N et al [16] it was (79.1%), In Polat AV et al [21] (88%) & In Elton et al [17] (63%).

In this study, ileum was the most common site to get injured followed by jejunum which was the same as reported by Polat AV et al [21] with Ileum (50%), Duy Hung N et al [16] and Wadhwa M [19] et al reported jejunum (41%) & (50%) respectively followed by ileum as the most common site. Small bowel injuries mainly happen within proximity to the duodenojejunal flexure and ileocecal junction, i.e., close to fixed points, and a majority of them are located on the anti-mesenteric border. Large bowel injuries generally occur in penetrating trauma, whereas in blunt trauma, it is a less common finding. In our study, the large bowel was injured less frequently in comparison to small bowel injury. This has also been reported in various other studies that colonic injuries occurred less frequently than small bowel injuries [22].This is mainly due to its location and the lack of redundancy, which prevents the formation of closed loops. [22-23]

In our study the most frequently suspected injuries based on CT scan were mesenteric stranding followed by free fluid and bowel wall thickening. Studies by T. Be`ge et al24 and Polat AV et al [21] also suggest similar findings. Bowel wall discontinuity was reported in 13% of the cases in our study. In a study by Brofman et al. [25], 7 % cases were reported. They postulated that the relative infrequency of observations of this feature is likely due to small size of the discontinuities, which are evident at surgery only with careful inspection.

Bowel-wall discontinuity was considered as a direct finding of blunt bowel injury, and active extravasation suggested that an active bleeding condition has high specificity of 100% and 100% and low sensitivity of 20% and 40%, respectively. Our result was comparable to those reported by Polat AV et al [21], Duy Hung N et al [16] and Hiba Abdel-Aziz et al [26] which confirmed that these characteristics are not highly sensitive. Since bowel-wall rupture frequently occurs at the antimesenteric side of bowel loops, it could be misdiagnosed on a MDCT scan if its size is small. [27] Similarly, a small vessel tear could be occulted by mesenteric hematoma 32Nonetheless, a finding of active extravasation should be taken into consideration as an indication for simultaneous surgery [5-25].Reduced bowel-wall enhancement may represent an ischemic bowel due to the rupture of supplied arteries or arterial occlusions. [17] In our study, this feature had a sensitivity of 35%, which was lower than that reported

by Polat AV et al [21], and higher than the result reported by Duy Hung N et al; [16] it also had specificity of 100%, which was in line with findings that reported by these authors.

Pneumoperitoneum was, according to previous studies, a highly specific indication for intestinal perforation but it could contribute to a false-positive diagnosis of bowel perforation [21,25,28] In our study, this finding had a sensitivity and specificity of 85% and 72%, respectively. Our result was comparable to those reported by Duy Hung N et al. [16] Polat AV et al [21] and Hiba Abdel-Aziz et al [26] reported low sensitivity and high specificity. Free intraperitoneal air can also be induced by pneumothorax, diaphragm disruption or mechanical ventilation. [23] Bowel-wall thickening, mesenteric hematoma, mesenteric stranding, and free fluid are indirect findings of blunt bowel and mesenteric injuries. The sensitivity and specificity of these findings were differently described in previous studies. Mirvis et al. [30] stated that free fluid and bowel-wall thickening were unspecific findings that might be present in cases of hypovolemic shock in the setting of the trauma, particularly associated with liver or splenic injuries [30]. Our study showed that free fluid and mesenteric stranding are sensitive but less specific findings. Mesenteric hematoma was more specific and less sensitive finding. Bowel wall thickening was more sensitive and less specific finding.

Abdominal trauma is commonly associated with other injuries that complicate the management and also affect the outcome. [31] In our study, 93% patients had associated intra-abdominal injuries and 46 % patients had extra-abdominal injuries. The most common solid organ injured was the spleen followed by the liver. In Duy Hung N et al [16] and Wadhwa M et al [19] also showed similar results. The skeletal injury was the most common extra-abdominal injury followed by a blunt chest trauma. Ayoade et al. [20] and Wadhwa M et al [19] also showed skeletal injuries to be the most common associated extra-abdominal injury.

Conclusion

Males were more commonly injured as compared to females. Most common age group involved is 21-40 years. Most common mode of injury is road traffic/motor vehicle accidents. Most common site of injury is ileum. Most common associated solid organ injury is spleen. Most frequent MDCT scan findings are mesenteric stranding, free fluid and bowel wall thickening. Most specific findings are bowel wall discontinuity, active extravasation and reduced bowel wall enhancement. Hence, multidetector CT scan can be used as the modality of choice in case of patients with suspected intestinal and mesenteric injury in blunt abdominal trauma. Also the indirect signs should be given as much importance as the direct signs. Bowel-wall thickening, mesenteric stranding, and free fluid are indirect findings of blunt bowel and mesenteric injuries. They are less specific findings. However, showed a higher sensitivity and are more frequently seen.

References

1. Holmes JF, Offerman SR, Chang CH, Randel BE, Hahn DD, Frankovsky MJ, et al. Performance of helical computed tomography without oral contrast for the detection of gastrointestinal injuries. Ann Emerg Med 2004; 43:120-8.
2. Killeen KL, Shanmuganathan K, Poletti PA, Cooper C, Mirvis SE. Helical computed tomography of bowel and mesenteric injuries. J Trauma 2001; 51:26-36.
3. Watts DD, Fakhry SM; EAST Multi-Institutional Hollow Viscus Injury Research Group. Incidence of hollow viscus injury in blunt trauma: an analysis from 275,557 trauma admissions from the East multi-institutional trial. J Trauma 2003; 54:289-94.
4. Atri M, Hanson JM, Grinblat L, Brofman N, Chughtai T, Tomlinson G. Surgically important bowel and/or mesenteric injury in blunt trauma: accuracy of multidetector CT for evaluation. Radiology 2008; 249:52433.
5. Scaglione M, de Lutio di Castelguidone E, Scialpi M, Merola S, Diettrich AI, Lombardo P, et al. Blunt trauma to the gastrointestinal tract and mesentery: is there a role for helical CT in the decision-making process? Eur J Radiol 2004; 50:67-73.
6. Fakhry SM, Brownstein M, Watts DD, Baker CC, Oller D. Relatively short diagnostic delays (<8 hours) produce morbidity and mortality in blunt small bowel injury: an analysis of time to operative intervention in 198 patients from a multicenter experience. J Trauma 2000; 48:408-14.
7. Rodriguez A, DuPriest RW Jr, Shatney CH. Recognition of intra- abdominal injury in blunt trauma victims. A prospective study comparing physical examination with peritoneal lavage. Am Surg 1982; 48:457-9.
8. Drost TF, Rosemurgy AS, Kearney RE, Roberts P. Diagnostic peritoneal lavage. Limited indications due to evolving concepts in trauma care. Am Surg 1991;57:126-
9. Malhotra AK, Fabian TC, Katsis SB, Gavant ML, Croce MA. Blunt bowel and mesenteric injuries: the role of screening computed tomography. J Trauma 2000; 48:991-1000.
10. Sharma OP, Oswanski MF, Singer D, Kenney B. The role of computed tomography in diagnosis of blunt intestinal and mesenteric trauma (BIMT). J Emerg Med 2004; 27:55-67.
11. Meyer DM, Thal ER, Weigelt JA, Redman HC. Evaluation of computed tomography and

diagnostic peritoneal lavage in blunt abdominal trauma. J Trauma 1989; 29:1168-72.
12. Rozycki GS, Ochsner MG, Jaffin JH, Champion HR. Prospective evaluation of surgeons' use of ultrasound in the evaluation of trauma patients. J Trauma 1993; 34:516-27.
13. Dolich MO, McKenney MG, Varela JE, Compton RP, McKenney KL, Cohn SM. 2,576 ultrasounds for blunt abdominal trauma. J Trauma 2001; 50:108-12.
14. Bode PJ, Edwards MJ, Kruit MC, van Vugt AB. Sonography in a clinical algorithm for early evaluation of 1671 patients with blunt abdominal trauma. AJR Am J Roentgenol 1999; 172:905-11.
15. Coley BD, Mutabagani KH, Martin LC, Zumberge N, Cooney DR, Caniano DA, et al. Focused abdominal sonography for trauma (FAST) in children with blunt abdominal trauma. J Trauma 2000; 48:902-6.
16. Duy Hung N, Duc Ha H, Kim Ngan V, Van Sy T, Thanh Dung L, Minh Duc N. The Role of Computed Tomography in the Assessment of Blunt Bowel and Mesenteric Injuries. Electron J Gen Med. 2020; 17(5):em242.
17. Elton, C. Riaz, A.A. Young, N. Accuracy of computed tomography in the detection of blunt bowel and mesenteric injuries Br J Surg 2005; 92:1024– 1028.
18. Gad MA, Saber A, Farrag S, Shams ME, Ellabban GM. Incidence, patterns, and factors predicting mortality of abdominal injuries in trauma patients. N Am J Med Sci. 2012; 4:129-34.
19. Wadhwa M, Kumar R, Trehan M, et al. Blunt Abdominal Trauma with Hollow Viscus and Mesenteric Injury: A Prospective Study of 50 Cases. Cureus. February 12, 2021; 13(2): e13321.
20. Ayoade BA, Salami BA, Tade AO, Musa AA, Olawoye OA: Abdominal injuries in Olabisi Onabanjo University Teaching Hospital Sagamu, Nigeria. Niger J Orthop Trauma. 2006, 5:45-9.
21. Polat AV, Aydın R, Nural MS, Gul SB, Kamali Polat A, Aslan K. Bowel and mesenteric injury in blunt trauma: diagnostic efficiency and importance of experience in using multidetector computed tomography. Ulus Travma Acil Cerrahi Derg 2014; 20(6):417–422.
22. Sule AZ, Kidmas AT, Awani K, Uba F, Misauno M: Gastrointestinal perforation following blunt abdominal trauma. East Afr Med J. 2007; 84:429-33.
23. Khan I, Bew D, Elias DA, Lewis D, Meacock LM. Mechanisms of injury and CT findings in bowel and mesenteric trauma. Clin Radiol. 2014;69:639–647
24. BEGE, Thierry & Chaumoitre, Kathia & Leone, Marc & Mancini, J. & Berdah, S. & Brunet, C.. (2013). Blunt bowel and mesenteric injuries detected on CT scan: Who is really eligible for surgery? European Journal of Trauma and Emergency Surgery. 40. 75-81.
25. Brofman N, Atri M, Hanson JM, et al. Evaluation of bowel and mesenteric blunt trauma with multidetector CT. Radiographics 2006; 26: 1119e31.
26. Hiba Abdel-Aziz, C Michael Dunham: Effectiveness of computed tomography scanning to detect blunt bowel and mesenteric injuries requiring surgical intervention: A systematic literature review.
27. Okino Y, Kiyosue H, Mori H, Komatsu E, Matsumoto S, , et al. Root of the small-bowel mesentery: correlative anatomy and CT features of pathologic conditions. Radiographics. 2001; 21:1475-90.
28. Steenburg SD, Petersen MJ, Shen C, Lin H. Multi-detector CT of blunt mesenteric injuries: usefulness of imaging findings for predicting surgically significant bowel injuries. Abdom Imaging. 2015; 40: 1026- 1033.
29. Brody JM, Leighton DB, Murphy BL, et al. CT of blunt trauma bowel and mesenteric injury: typical findings and pitfalls in diagnosis. Radiographics 2000; 20:1525e36.
30. Mirvis SE, Shanmuganathan K, Erb R. Diffuse small-bowel ischemia in hypotensive adults after blunt trauma (shock bowel): CT findings and clinical significance. AJR Am J Roentgenol 1994; 163:1375e9.
31. Sherck J, Shatney C, Sensaki K, Selivanov V: The accuracy of computed tomography in the diagnosis of blunt small-bowel perforation. Am J Surg. 1994, 168:670-5.
32. Faget C, Taourel P, Charbit J, Ruyer A, Alili C, Molinari N, et al. Value of CT to predict surgically important bowel and/or mesenteric injury in blunt trauma: performance of a preliminary scoring system. Eur Radiol. 2015; 25: 3620-8.