ORIGINAL ARTICLE

PATTERNS OF VARIOUS INJURIES IN BLUNT ABDOMINAL TRAUMA IN PATIENTS SECONDARY TO ROAD TRAFFIC ACCIDENTS AND FALL PRESENTED TO A TERTIARY CARE HOSPITAL: A CT SCAN BASED STUDY FROM LIAQUAT NATIONAL HOSPITAL, KARACHI

Rizwan Ajmal, Muhammad Ayub Mansoor, Sadaf Nasir

Department of Radiology, Liaquat National Hospital, Karachi, Pakistan.

PJR April - June 2018; 28(2): 138-144

ABSTRACT

BACKGROUND: Blunt abdominal injuries are very common and usually result from motor vehicle collisions, recreational accidents or falls. The appropriate next step investigation plays a very vital role in management of such patients who otherwise face increase morbidity or even mortality. MDCT scans are currently the gold standard for evaluation of posttraumatic patients for evaluation of abdominal injuries. **OBJECTIVES:** To evaluate patterns of various injuries in blunt abdominal trauma patients presented to a tertiary care hospital based on CT scan. **MATERIALS AND METHODS:** A retrospective study was performed on data collected from records of Liaquat National Hospital Radiology department of abdominal trauma patients from 1st July 2015 to 31st December 2016. Patients who were hemodynamically stable, with high clinical suspicion of intra-abdominal injury and those with positive ultrasound fast after blunt abdominal injury secondary to RTA or fall were included. **RESULTS:** A total of 127 stable patients were included in this study. The Mean age of presentation was 28.8 years. The most common CT finding was Hemoperitoneum, which was seen in 74 patients (58%), 56 patients (44.1%) suffered fractures of spine and pelvis. Pleural effusion, hepatic and pulmonary injuries were also significantly common with incidence of 34.6%, 24.4% and 22.8% respectively. The incidence of ascites was found to be 20.5% whereas splenic injuries constituted 19.17%. Pneumothorax was seen in 15 patients (11.8%). Interestingly, Adrenal, Renal, Mesenteric, Bowel, Pancreatic and Urinary bladder were injured in fewer patients with incidence of 9.4%, 7.9%, 3.9, 3.1%, 0.8% and 0.8 % respectively. Only 12 patients (9.4%) were found to be normal. **CONCLUSIONS:** Patients who suffered blunt abdominal trauma should be investigated with MDCT to rule out visceral and bony injuries, which has significant impact on the management and morbidity and increases the patient survival.

Key words: Blunt abdominal trauma, CT scan, Intra abdominal injuries.

Introduction

Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups worldwide. It is particularly the most common cause of mortality in young patients. Trauma is one of the most challenging conditions in emergency department that physicians encounter because of varied presentations.[1] Blunt abdominal trauma usually results from motor vehicle collisions, recreational accidents or falls. Men tend to be affected more than women.[1,2] The management of blunt abdominal trauma has changed considerably.[3]

Correspondence : Dr. Rizwan Ajmal
Department of Radiology,
Liaquat National Hospital,
Karachi, Pakistan.
Email: drrizwan72@yahoo.com

Submitted 20 December 2017, Accepted 3 March 2018

CT scan is currently a widely available imaging technique in clinical practice.[4] CT radially detects direct and indirect features of bowel and / or mesenteric injury an important advance because unrecognized bowel or mesenteric injuries may result in high morbidity and mortality.[5] The ability of CT to perform and produce fast processing images such as MPR (multiplannar reformatted images) is important for accurate interpretation of abnormalities.[6]

At trauma, three kinds of blunt force can impact on abdomen to result in viscera injuries. The three mechanism forces are deceleration, external compression and crushing. These forces impact on solid or hollow organs and can cause laceration of solid organs, tear at vascular pedicles and mesenteric attachments, and burst of hollow viscera. All these injuries may lead to bleeding. If the bleeding restricts intra-organ or a space, it may manifest a hematoma. In most situations, non-clotted blood often flows into peritoneal cavity, hemorrhagic peritoneal fluid can be seen. Initially, the hemorrhage tends to accumulate in gravity depended recesses. If the bleeding persists, blood will fill the peritoneal cavity completely. Therefore, hemoperitoneum is the most common CT finding of viscera injuries in patients with blunt abdominal trauma.[18]

The crushing or shearing force at blunt abdominal trauma due to knocking into abdominal walls or rapid deceleration can break the solid organs. Spleen is the most commonly involved organ at blunt abdominal trauma, followed by liver, kidney and pancreas. Lacerations often appear as linear or focal low attenuation across the parenchyma. The involvement of large vessels can result in obvious bleeding. If the laceration is focalized within the capsular, hematoma within the organ or sub capsular may be seen.[19]

Hollow viscera and mesenteric injuries are rare, occur only in approximately 5% of patients with severe blunt abdominal trauma. The leak of bowel content may result in peritonitis and sepsis. Delay diagnosis often results in substantial negative consequences, such as prolonged hospital stays, increased morbidity and mortality. Surgical managements are often required to control the damage. Therefore, diagnostic radiologists should bear in mind to look for subtle CT signs of bowel and mesenteric injuries in every patient with blunt abdominal trauma. These signs include bowel wall transaction discontinuity, extraluminal air, focal bowel wall thickening, free peritoneal fluid, mesenteric infiltration or hematoma.[20]

The aim of this study was to record the incidence and patterns of various injuries secondary to blunt abdominal trauma that presented to a tertiary care hospital over a period of 18 months.

Material and Methods

A retrospective study was performed on data collected from computerized records and CT scan images of abdominal trauma patients. The Data was collected from 1st July 2015 to 31st December 2016. The study center was the Department of Radiology, Liaquat National Hospital, Karachi, Pakistan. During the study period total 127 patients were enrolled into the study with history of blunt abdominal trauma secondary to RTA or fall. They were referred from emergency department with a detailed trauma request after stabilization of their general condition. Inclusion criteria was all hemodynamically stable patients presented with history of blunt abdominal trauma and who were subjected to portable plain X-rays and portable ultrasound FAST before requesting CT scan. All these patients were evaluated with Multi detector Computed Tomography (MDCT) using non-ionic intravenous contrast and diluted water-soluble oral contrast. All examinations were performed on standard CT protocols and reporting was done on PACS workstation by experienced radiologists. Exclusion criteria were hemodynamically unstable patients, and those patients who presented with stab wounds and firearm injuries.

Results

A total of 127 hemodynamically stable patients presented to Liaquat National Hospital, Department of Radiology with the history of blunt abdominal trauma over a period of 18 months.

STATISTICAL ANALYSIS:

SPSS version 21 was used for data compilation and analysis. Frequencies and percentages were computed for qualitative variables like gender, age group, mode of injury, hemoperitoneum, liver, spleen, pancreas, kidneys, ascites, adrenal, mesenteric injuries, bowel injuries, fractures, urinary bladder,

lung contusions, pleural effusion and pneumothorax (Tab. 3). Quantitative variable was presented as ± SD like age. Pie charts and bar graphs were plotted for categorical data. Effect modifier like age and gender will be controlled through stratification. Mean age of presentation was 28.8 years with 60.6% patients under 28 years and 39.4% patients were above 28 years (Tab. 1). The sample consisted of 106 males (83.5%) and 21 females (16.5%) (Fig. 1a). Out of these 127 patients, 99 patients (78%) presented with road traffic accident while 28 patients (22%) presented with history of fall (Fig. 1b).

	Mean ± SD
Age	28.83 ± 14.76
Gender	
Male	28.81 ± 14.01
Female	28.95 ± 18.52

Table 1: Demographics

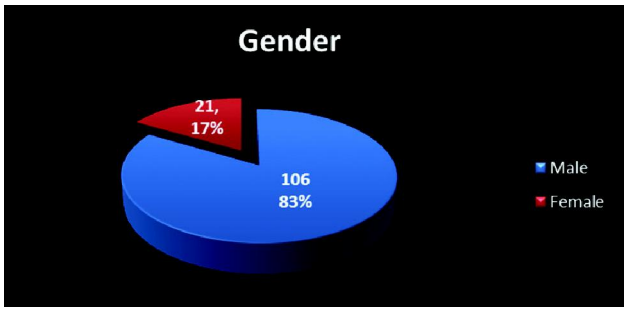

Figure 1a

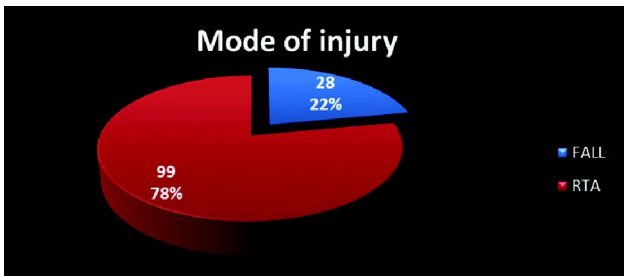

Figure 1b

In both the groups, Hemoperitoneum was found to be the most frequent pattern of injury with incidence of 58.3% followed by fractures of spine and pelvis in 44.1%. Pleural effusion, Hepatic and Pulmonary injuries were also significantly common with incidence of 34.6%, 24.4% and 22.8% respectively. The incidence of Ascites was found to be 20.5% whereas splenic injuries constituted 19.17%. Pneumothorax was seen in 15 patients (11.8%). Interestingly, Adrenal, Renal, Mesenteric, Bowel, Pancreatic and Urinary bladder were injured in fewer patients with incidence of 9.4%, 7.9%, 3.9, 3.1%, 0.8% and 0.8 % respectively. (Tab. 2) (Fig.2, 3 and 4).

Pattern	N (%)
Hemoperitoneum	74 (58.3)
Fracture	56 (44.1)
Pleural Effusion	44 (34.6)
Hepatic injury	31 (24.4)
Lung Contusion	29 (22.8)
Ascites	26 (20.5)
Splenic injury	25 (19.7)
Pneumothorax	15 (11.8)
Adernal hematoma	12 (9.4)
Renal injury	10 (7.9)
Mesenteric Injury	5 (3.9)
Bowel injury	4 (3.1)
Pancreatic injury	1 (0.8)
Urinary Bladder injury	1 (0.8)

Table 2: Pattern of injuries

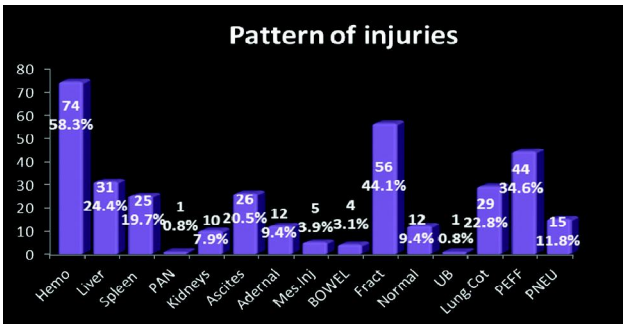

Figure 2: Pattern of injuries in patients of blunt abdominal trauma.

Figure 3: 3D reconstructed Pelvis showing fractures involving bilateral acetabula, left iliac blade along left sacroiliac joint, diastasis of left sacroiliac joint and pubic symphysis and posterio-superior dislocation of right femoral head.

Figure 4: CT abdomen axial cut showing hepatic laceration and right adrenal hematoma.

We also separately analyze the incidence of various injuries in both road traffic accident and fall groups. Hemoperitoneum, fractures and pleural effusions are the three most common injuries in both the groups.

In the patients with road traffic accidents, the incidence of Hemoperitoneum was 21% followed by fractures of spine and pelvis in 16%. Pleural effusion, Hepatic and Pulmonary injuries were also significantly common with incidence of 14%, 10% and 9% respectively. The incidence of splenic injuries was found to be 8% whereas Ascites constituted 7%. Pneumothorax was seen in 15 patients (5%). Interestingly, Adrenal, Renal, Mesenteric, Bowel, Pancreatic and Urinary bladder were injured in fewer patients with incidence of 4%, 2%, 1%, 1%, 0.8% and 0.8 % respectively (Tab. 5) (Fig. 6a,6b).

In patients with history of fall, the incidence of Hemoperitoneum was 26% followed by fractures of spine and pelvis in 15%. Pleural effusion and Ascites were 9%. Pulmonary injuries were seen 7% while Hepatic, Renal and Splenic injuries were found to be 5%. Adrenal and Mesenteric injuries were 3% while Pneumothorax and Bowel injuries had incidence of 2% only. Interstingly, no patient was suffered from Pancreatic or Urinary bladder injuries in this group (Tab. 4) (Fig. 5a, 5b).

Only 12 patients (9.4%) were found to be normal on CT scan that showed ultrasound positive for trauma (False positive).

Frequency Distribution	
Characteristics	**n (%)**
Age Group	
≤ 28	77 (60.6)
> 28	50 (39.4)
Gender	
Male	106 (83.5)
Female	21 (16.5)
Mode of injury	
FALL	28 (22)
RTA	99 (78)
Hemoperitoneum	
Yes	74 (58.3)
No	53 (41.7)
Liver	
Yes	31 (24.4)
No	96 (75.6)
Spleen	
Yes	25 (19.7)
No	102 (80.3)
Pancreas	
Yes	1 (0.8)
No	126 (99.2)
Kidneys	
Yes	10 (7.9)
No	117 (92.1)
Ascites	
Yes	26 (20.5)
No	101 (79.5)
Adernal	
Yes	12 (9.4)
No	115 (90.6)
Mes.Inj	
Yes	5 (3.9)
No	122 (96.1)
Bowel injury	
Yes	4 (3.1)
No	123 (96.9)
Fractures	
Yes	56 (44.1)
No	71 (55.9)
Normal	
Yes	12 (9.4)
No	115 (90.6)
Urinary bladder	
Yes	1 (0.8)
No	126 (99.2)
Lung contusions	
Yes	29 (22.8)
No	98 (77.2)
Pleural effusion	
Yes	44 (34.6)
No	83 (65.4)
Pneumothorax	
Yes	15 (11.8)
No	112 (88.2)

Table 3: Frequency distribution of injuries

Injuries	RTA Group
Hemoperitoneum	15
Liver	3
Spleen	3
Pancreas	0
Kidneys	3
Ascites	5
Adernal	2
Mesenteric injuries	2
Bowel injury	1
Fractures	9
Normal	5
Urinary bladder	0
Lung contusions	4
Pleural effusion	5
Pneumothorax	1

Table 4: Number of injuries in fall group

Injuries	RTA Group
Hemoperitoneum	59
Liver	28
Spleen	22
Pancreas	1
Kidneys	7
Ascites	21
Adernal	10
Mesenteric inuries	3
Bowel injury	3
Fractures	47
Normal	7
Urinary bladder	1
Lung contusions	25
Pleural effusion	39
Pneumothoarx	14

Table 5: Number of injuries in RTA group

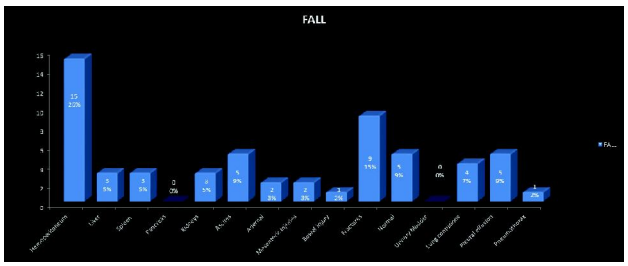

Figure 5a: Pattern of injuries in patients of fall group.

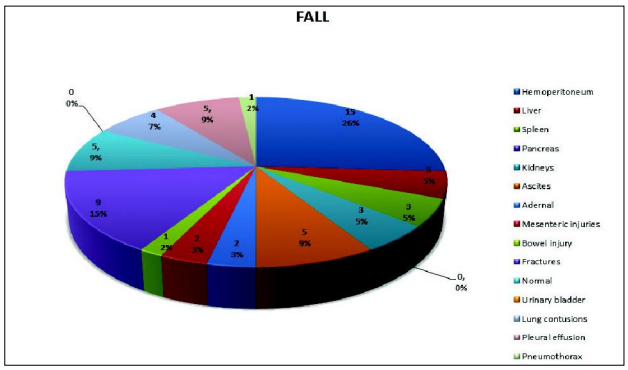

Figure 5b: Pattern of injuries in patients of fall group.

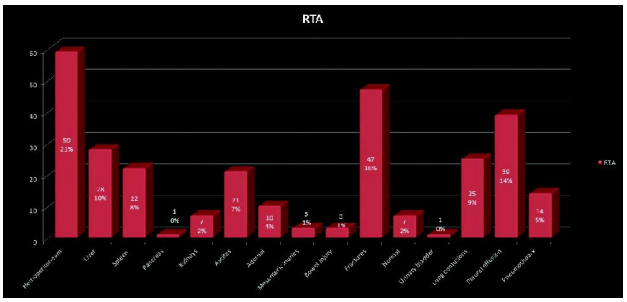

Figure 6a: Pattern of injuries in patients of RTA group.

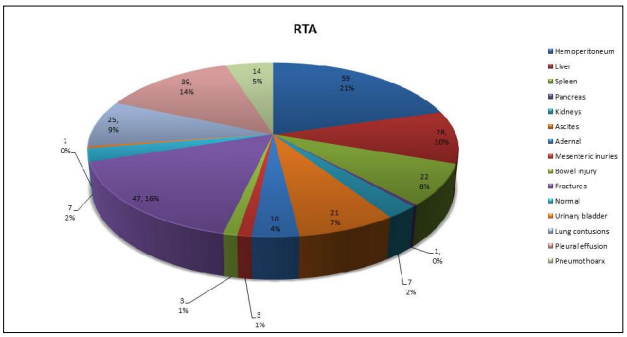

Figure 6b: Pattern of injuries in patients of RTA

Discussion

Blunt abdominal trauma is very common and can occur due to various causes some of which includes Road Traffic accidents, fall, Stabbing, Sports related injuries etc. The most common cause however is RTA; which is in line with the results of our study which showed 78% (99 patients) who presented with blunt abdominal injury due to Road traffic accident while 22% patients had history of fall.

Injuries to the stomach, duodenum, small intestine, and colon are common in penetrating trauma and relatively rare in blunt trauma. Violation of the peritoneum occurs in between 20% and 80% of patients with penetrating trauma, depending on the type of weapon used. Conversely, hollow viscus injuries are found in approximately 1% or less of blunt trauma admissions. The most common site of injury in both blunt and penetrating trauma is the small intestine.[15]

Ultrasound and Plain X-ray abdomen are the first line of investigation in patients with blunt abdominal injury particularly to rule out any free fluid or pneumoperitoneum, emphysema, fractures of chest wall and pelvis. However, currently multi detector computed tomography (MDCT) scanning with intravenous con-

trast is the gold standard diagnostic modality in thermodynamically stable patients.[3] With MDCT the scanning time has progressively decreased while image resolution has increased. High quality image data can also be further processed into multiplannar reformatted (MPR) images or maximum intensity projection (MIP) images and three - dimensional volumetric (3D) images, which often aid in the diagnosis of complex injuries in trauma patients.[7] Furthermore, MDCT scan has advantage over ultrasound as it is less operator dependent and is not limited by the abdominal wall, subcutaneous emphysema, obesity and intestinal obstruction.[8]

Bowel injuries remain a diagnostic challenge for radiologists. Contrast enhanced CT may show abnormal bowel wall enhancement, but its sensitivity is only 10 - 15%.[16] Oral contrast materials administration can demonstrate leak of oral contrast materials with a specificity of 100%, but its sensitivity is only 8-10%.[1] Routine administration of oral contrast materials in patients with blunt abdominal trauma remains controversial. A meta-analysis shows that there was no difference in detecting bowel injuries with or without oral administration of contrast materials.[17] When multiple solid-organ injuries were found, the incidence of bowel injury increases substantially.

According to Pirandini et al in 2010 MIP follow the complete course of the structure even if they are tortuous.[7] Daly et al in 2008 reported that MDCT plays an important role in accurate radiologic characterization of injury and can help in selecting patients who need urgent surgical intervention, as opposed to those in whom non-operative management is possible.[9]

It was observed in our study that no age group was exempted from traumatic injury of abdomen. However, it was more common in 2nd and 3rd decade of life. This indicates that young adults were more prone to abdominal trauma probably because of more exposure to day to day hazards. It was also evident that males were more commonly exposed to blunt abdominal trauma (83.5%) as compared to females (16.5%). These results were close to the studies conducted by Ahmed[10] in Lahore and in France by Kunin et al.[11]

In our study liver was most frequently injured solid viscera seen in 31 patients (24.4%). These results were close to liver injuries reported by Hussain et al (22.7%)12and in study conducted by Hoyt, which reported liver injury in 15% of cases.[13]

According to Awe et al in 2013, in their study abdominal injury predominantly affects young male patients reaching the peak in twenty to fifty age groups and the incidence of male patients was 86.9% to female patients was 13.1% but they have not categorize bony and chest related injuries.[14]

Conclusion

No abdominal organ or bone is safe from injury in blunt abdominal trauma. Hemoperitoneum was the commonest injury followed by fractures and liver injuries. In our study, liver is the most commonly injured solid organ followed by spleen, kidneys, bowel and other organs. CT is an excellent imaging modality to evaluate blunt abdominal trauma, being reliable, safe and non invasive which can guide the management of post-traumatic cases and in follow up of cases. CT scan also decreases the unnecessary surgical exploration reducing post-operative morbidity and increases the patient survival. Oral contrast materials are also administrated to confirm questionable findings of bowel injuries. Recently, FAST (Focused Assessment with Sonography for Trauma) has been introduced, which may alternate the work flow of blunt abdominal trauma. Perhaps, after FAST screening, most patients with blunt abdominal trauma do not need to undergo CT examination, while contrast enhanced-CT with tailored protocol may be indicated in a small portion of patients for special purpose.

CONFLICT OF INTEREST: None declared
DISCLOSURE OF FUNDING: Nothing to disclose.

References

1. Bodhit AN, Bhagra A, Stead LG. Abdominal Trauma: Never Underestimate It. Emerg Med. 2011; 2.

2. Udeani J, Salomone JA, Keim SM, Legome EL, Salomone JP. Blunt abdominal trauma; 2011. http://medicine,medscape.com/article/1980980-overview.

3. Van DerVlies CH, Olthof DC, Gaakeer M,Ponsen KJ, Goslings JC. Changing patterns in diagnostic strategies and the treatment of blunt injury to solid abdominal organs. Int J Emerg Med. 2011 Jul 27; **4:** 47.

4. Sun Z, Ng KH, Vijayananthan A.Is utilisation of computed tomography justified in clinical practice? Part I: application in the emergency department. Singapore Med J. 2010 Mar; **51(3):** 200-6.

5. Yu J, Fulcher AS, Turner MA, Cockrell C, Halvorsen RA. Blunt bowel and mesenteric injury: MDCT diagnosis. AbdomImag 2011; **36:** 50-61

6. Hassan R, Aziz AA. Computed tomography (CT) imaging of injuries from blunt abdominal trauma: a pictorial essay Malays J Med Sci. 2010; **17:** 29-39.

7. Perandini S, Faccioli N, Muceli PR. The diagnostic contribution of CT volumetric rendering techniques in routine practice. Indian J RadiolImag. 2010; **20:** 92-7.

8. Zago MT, Pereira BMT, Fraga PG.Nonoperative management for patients with grade IV blunt hepatic trauma. World J Emerg Surg. 2012; 7(1): S8.

9. Daly PK, Persson DL, Gray BS. Traumatic retroperitoneal injuries: review of multidetector CT findings. Radiographics. 2008; **28:** 1571-90.

10. Ahmad I. Abdominal trauma. A prospective study. Pak J Surg 1992; **8:** 37-42.

11. KuninN, Letoquart JP, LaGamma A, Chaperon J, Mambrini A.Intestinal-mesentericlesions of closedabdominaltraumas. J Chir (Paris). Mar 1994; **131(3):** 129-34.

12. Hussain R, Rathore AH, Zulfiqar R. Hepatic injuries due to blunt abdominal trauma. Specialist 1991; **7:** 15-7.

13. Hoyt DB Moosa AR Trauma: general consideration. Essentials of surgical practice. Oxford: Butterworth-Heinemann: 3rd edn.1995; 501-7.

14. Awe JAA, Soliman AM. Abdominal trauma: a five year experience in a military hospital. Glob Adv Res J Med Med Sci. 2013; **2:** 177-83

15. Jamie J. Coleman, Ben L. Zarzaur. Surgical management of abdominal trauma: Hollow viscus injury. Surg Clin N Am 97 2017; 1107-17.

16. Soto JA, Anderson SW. Multidetector CT of blunt abdominal trauma. Radiology 2012; **265:** 678-93.

17. Lee CH, Haaland B, Earnest A, Tan CH. Use of positive oral contrast agents in abdominopelvic computed tomography for blunt abdominal injury: meta-analysis and systematic review. Eur Radiol 2013; **23:** 2513-21.

18. Hughes TM, Elton C. The pathophysiology and management of bowel and mesenteric injuries due to blunt trauma. Injury 2002; **33:** 295-302.

19. Pommerening MJ, DuBose JJ, Zielinski MD, Phelan HA, Scalea TM, Inaba K, Velmahos GC, Whelan JF, Wade CE, Holcomb JB, Cotton BA, AAST Open Abdomen Study Group Time to first take-back operation predicts successful primary fascial closure in patients undergoing damage control laparotomy. Surgery 2014; **156:** 431-8.

20. Bates DD, Wasserman M, Malek A, Gorantla V, Anderson SW, Soto JA, LeBedis CA. Multidetector CT of Surgically Proven Blunt Bowel and Mesenteric Injury. Radiographics 2017; **37:** 613-25.