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A prospective evaluation of computerized tomography scan findings in blunt abdominal trauma

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Abstract

Background and objective: Evaluating patients with blunt abdominal trauma remains one of the most challenging aspects of acute trauma care. CT scan of abdomen remains the standard imaging modality for evaluation of abdominal trauma cases.
The aim of this study is to evaluate CT scan findings in blunt abdominal trauma victims with respect to solid organ injuries, hollow viscus injuries, associated thoracic and abdominal wall injuries, associated hemoperitoneum, cause of injury and type of management.
Methods: A cross-sectional study was conducted among 96 hemodynamically stable patients with history of blunt abdominal trauma who underwent CT scan examination in Rozh-halat Emergency Hospital from June 2021-January 2022; using a 64 multi-detector helical slice CT scanner. Data analysis were performed on patient's demographics, mode and type of injury, CT scan findings and severity scorings, associated injuries and type of management.
Results: The mean age of enrolled cases was 28.6 ± 18.6 ranged from 4-70 years. About two third (63.5%) were males and one third were females (36.5%). The most common cause of trauma was road traffic accident (64% of cases). Out of 96 trauma cases; 87.5% of patients had positive CT findings of which 50% had hemoperitoneum, 21.9% had pneumoperitoneum, 66.7% had no hallow viscous involvement, while 33.2% had hollow viscus involvement. One third of cases had associated abdominal wall injury. 56.4% of patients had multiple organ injury. Regarding solid organ injury; 66.7% of cases had spleen injury, (36.5%) had liver injury, Pancreas was involved in 12.5% of cases. RT& LT – kidneys showed grade 2 injury in (9.4%) & (6.3 %) respectively. Half of patients with positive CT scan findings had no lower chest injury findings. This study showed that 43.8% of cases were managed conservatively, 45.9% underwent laparotomy, the incidental finding of intra-operative hemoperitoneum which was negative in CT scan was only 1%.
Conclusion: CT imaging is the diagnostic tool of choice for the evaluation of blunt abdominal trauma in haemo-dynamically stable patients as it can assist in detecting and evaluating other co-existing injuries such as lower thoracic, pelvic and spine injuries apart from its main role in accurate identification of intra -abdominal injuries and associated bleeding.
Keywords: Blunt trauma; Abdomen; CT scan; Kurdistan; Emergency.

Introduction

Blunt abdominal injury can occur in all age groups and is associated with a high morbidity and mortality. Each year thousands of patients with blunt abdominal injury are seen in emergency departments, and this substantially increases the cost of healthcare.[1,2] Blunt abdominal trauma can cause damage to the internal organs, resulting in internal bleeding, cause

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contusions, or injuries to the bowel, spleen, liver, and intestines. Patients can also present with extra-abdominal injuries such as extremity injuries.[3,4]

Management of blunt abdominal trauma (BAT) is challenging task even to the best of traumatologists. Injuries varies from single to multi organ involvement, sometimes clinical evaluation of BAT may be masked other more obvious external injuries, on the other hand potentially life-threatening abdominal injuries may result from even minor trauma.[5] Spleen and liver are the most frequently inured organ during blunt abdominal trauma in all age groups if recognized; traumatic death can be prevented.[6,7] The decision of surgical intervention of BAT patients was essentially depending on clinical signs instead of imaging investigations, the use of CT scan in evaluating such cases has affected the direction of management, focusing mainly on the conservative treatment. CT scan information raised the diagnostic information and reduced unnecessary laparotomies.[8,9]

In the line of the recent recommendations, an abdominal CT scan is considered to be a gold standard investigation in haemo-dynamically stable patients with blunt abdominal trauma.[10,11]

Current research aimed to study the CT scan findings in blunt abdominal trauma with respect to type of management and our objectives are to study the mode of injury, associated hollow viscus, lower chest and abdominal wall involvement.

Methods

From June 2021 until January 2022, 96 hemodynamically stable patients with history of blunt abdominal trauma who underwent CT scan examination were enrolled in this study, the CT scan findings analyzed and correlated with their outcome and management. Ethical approval was obtained from Rozh-halat Emergency hospital and the Ethical Committee of college of Medicine/Hawler Medical University (HMU) before the commencement of the study. Informed consent was obtained from each subject.

This cross-sectional study was conducted in Rozh-halat Emergency Hospital; this is the main emergency care center in the Eastern part of Hawler, Kurdistan region of Iraq. The hospital is 100 bedded and receiving an average of 500 patients a day. Trauma cases are managed in the resuscitation room and trauma bay which is an area that is specifically allocated for management of trauma.

Using a 64 multi-detector helical slice CT scanner; routinely a native scanning from the lung base to upper thigh was performed, a collimation of 1.5mm and a pitch of 1.1 was used with a kilovoltage of 120kVp and auto-modulated current. 2mm axial sections with a gap of 1mm were reconstructed at first. Axial, coronal and sagittal reformatted images were obtained at a contiguous 5 mm section. The protocol was tailored according to the need of individual patient. If necessary, a bolus of IV contrast materials (CM)(low/ iso-osmolar non-ionic iodinated CM in a concentration of 350 mgI/ml was injected at a rate of 3-5 ml/sec. with addoes of 100-150 ml (1-1.5 ml/kg) through an 18–20 -gauge cannula and chased by 20 ml saline solution Arterial phase scanning of the abdomen and or pelvis (25-30 sec. after injection) followed by portal venous phase (75-80 sec.). Then delay phase after (5-10 minutes) from the beginning of injection was acquired to achieve enhancement of most solid organs, MIP, MPR, VRT, SSD, lung window in cases of associated pulmonary base contusions and bone window for suspected bone fractures were used.[12,13]

Data analysis were performed for patient's demographics, mode and type of injury, CT scan findings and severity scorings, presence of associated injuries and proportion of patients who managed conservatively or underwent operative intervention.

American Association for Surgery of Trauma (AAST) injury scoring scales was

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used which is the most widely used method for categorizing traumatic injuries.[14-16] Hemoperitoneum on CT was graded as described by Federle and Jeffrey et al.[17] The Statistical Package for Social Sciences (SPSS, Chicago, IL, USA), version 26) was used for data entry and analysis. Two approaches were used; descriptive and analytic. The descriptive approach included calculation of frequencies, percentages, means, S.Ds. while in the second approach; Chi-square test of association was used to test the significant association between categorical variables. Fisher's exact test was used for categorical variables when more than 20% of cells have expected count less than 5. *P* value of ≤0.05 was considered as statistically significant.

Results

Out of 96hemodynamically stable trauma cases admitted to the emergency unit in Rozh-halat Emergency Hospital, the mean age ± S.D of patients was 28.6 ± 18.6 ranged from 4-70 years. About two third (63.5%) were males and the other one third were females (36.5%). About (64%) of patients were presented with road traffic accident (RTA), 10.4% with FFH and 25% due to other causes like motor vehicle crashes, pedestrian injuries and assaults Figure 1. This study revealed that 87.5% of patients had CT findings, Figure 2.

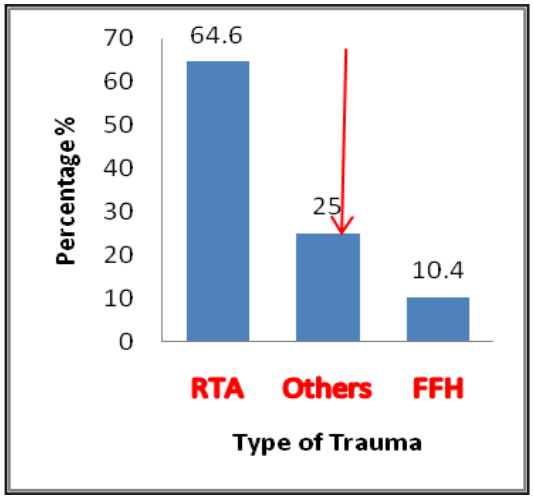

Figure 1 Frequency of trauma

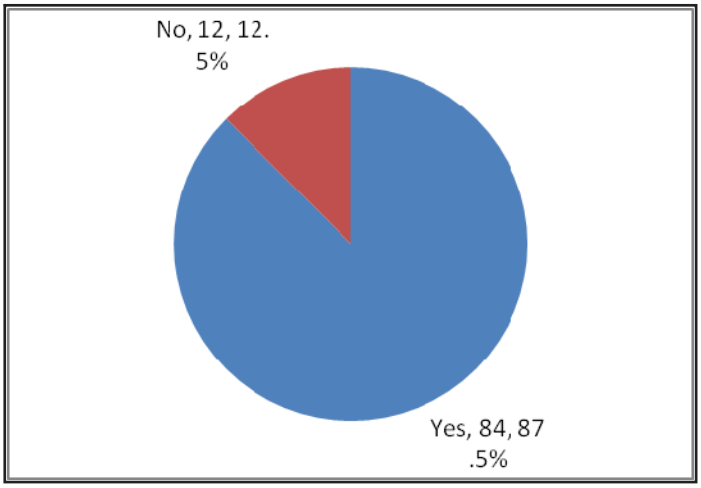

Figure 2 Frequency of CT findings

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Among total 96 trauma cases; half of patients had hemoperitoneum of which 19.8% had severe hemoperitoneum and only 21.9% of cases presented with pneumoperitoneum. Regarding hallow viscous involvement this study revealed that in 66.7% of cases there was no hallow viscous involvement, 33.2% of cases had hollow viscus involvement of which small bowel injury was constituting 12.5% and urinary bladder 6.3% of cases.

The current study revealed that one third of cases had associated abdominal wall injury: contusion (15.6%), muscle strain (11.5%) and abdominal hernia of (3.1%). More than half of patients (56.4%) had multiple organ injury, Table 1

Table1 Frequency of findings among study sample

Variables	Frequency	Percentage (%)
Hemoperitoneum		
No	48	(50.0)
Mild	14	(14.6)
Moderate	15	(15.6)
Severe	19	(19.8)
Pneumoperitoneum		
Yes	21	(21.9)
No	75	(78.1)
Hollow viscous		
Not Involved	64	(66.7)
Stomach	4	(4.20)
Duodenum	1	(1.00)
Small bowel	12	(12.5)
Urinary bladder	6	(6.30)
Ureter	1	(1.00)
Gall bladder and bile duct	3	(3.10)
Stomach and duodenum	1	(1.00)
Duodenum and small bowel	1	(1.00)
Small and large bowel	2	(2.10)
Urinary bladder and ureter	1	(1.00)
Abdominal wall		
No Involvement	67	(69.8)
Contusion	15	(15.6)
Muscle strain	11	(11.5)
Abdominal wall hernia	3	(3.10)
Vascular		
Yes	5	(5.20)
No	91	(94.8)
Mesentery		
Yes	9	(9.40)
No	87	(90.6)
Multi organ		
Yes	54	(56.3)
No	42	(43.8)
Surrounding		
Not involved	77	(80.2)
Diaphragm	9	(9.00)
Pelvic bone	9	(9.40)
Spine	1	(1.00)
Total	96	(100.0)

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Regarding solid organ injury, Table 2 shows that 66.7% of cases had spleen injury with various degree, most of them (34.4%) with grade 1 ,19.8% and 12.5% with second and third degree of spleen injury respectively. Liver is the second most commonly injured organ (36.5%) of which most of the cases were grade 2 (14.6%) and grade 3 (11.5%). Pancreas was involved in 12.5% of cases. About renal injury; Right kidney grade 2 injury was (9.4%) and grade 2 left kidney injury was (6.3%), Table 2.

Table 2 Frequency of solid organ injury among study sample

Variables	Frequency	Percentage (%)
Spleen		
No injury	30	(31.3)
Grade1	33	(34.4)
Grade2	19	(19.8)
Grade3	12	(12.5)
Liver		
No injury	61	(63.5)
Grade1	3	(3.10)
Grade2	14	(14.6)
Grade3	11	(11.5)
Grade4	5	(5.20)
Grade5	2	(2.10)
Pancreas		
No injury	84	(87.5)
Grade1	5	(5.20)
Grade2	5	(5.20)
Grade3	2	(2.10)
Kidney		
No injury	69	(71.9)
1R	2	(2.10)
2R	9	(9.40)
2L	6	(6.30)
3R	5	(5.20)
3L	2	(2.10)
4R	1	(1.00)
4L	2	(2.10)
Adrenal gland		
No injury	93	(96.9)
1R	2	(2.10)
1L	1	(1.00)
Total	96	(100.0)

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This study showed that 43.8% of cases were managed conservatively, 45.9% underwent laparotomy for variable intra-abdominal organ injuries, the incidental finding of intra-operative hemoperitoneum which was negative in CT scan was only 1%, Table 3.

A statistically significant (*P* <0.001) association was found between age of patients and cause of trauma, that RTA was more common in age 20-to-70-year, Table 4.

Table 3 Frequency of the outcomes among study sample

Variables	Frequency	Percentage (%)
1. Normal CT	10	(10.4)
2. Conservative treatment	42	(43.8)
3. Negative hemoperitoneum in CT scan Positive hemoperitoneum during surgery	1	(1.00)
4. Solid organ operation	1	(1.00)
5. Positive hemoperitoneum and solid organ operation	9	(9.40)
6. Positive hemoperitoneum and hollow viscous operation	21	(21.9)
7. Positive hemoperitoneum and missing intra-abdominal organ injury in CT	6	(6.30)
8. Positive hemoperitoneum and solid organ and hollow viscous	6	(6.30)
Total	96	(100.0)

Table 4 Association between common cause of trauma with certain variables

Variable	Total	Trauma causes						*P* Value
		RTA		FFH		Others		
		No.	(%)	No.	(%)	No.	(%)	
Gender								
Male	61	43	(70.5)	4	(6.60)	14	(23.0)	0.167
Female	35	19	(54.3)	6	(17.1)	10	(28.6)	
Age in years								
<10	15	6	(40.0)	4	(26.7)	5	(33.3)	0.020*
10-19	22	12	(54.5)	2	(9.10)	8	(36.4)	
20-29	28	24	(85.7)	1	(3.60)	3	(10.7)	
30-39	3	3	(100.0)	0	(0.00)	0	(0.00)	
40-49	10	6	(60.0)	3	(30.0)	1	(10.0)	
50-59	7	3	(42.9)	0	(0.00)	4	(57.1)	
60-70	11	8	72.7	0	(0.00)	3	(27.3)	

*Fisher Exacts Test

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Routinely lung bases are included in CT scan examination of abdomen, that is why pulmonary base involvements, pleural collection and lower thoracic cage fractures were regarded as incidental associated lower chest findings. Figure 3 shows more than half of patients had no lower chest injury finding, while 25% had pulmonary base consolidation and 9.4% had pleural fluid collection associated with pulmonary base consolidation.

Discussion

The study included all patients underwent CT scan examination for blunt abdominal trauma who presented to Rozh-halat Emergency Hospital over 7months since June 2021 to January 2022, the sample size was 96 patients. Two third (63.5%) of victims were male and one third (36.5%) were females. The study showing that males were much more in comparison to females. This can be explained by the fact that in our locality male are predominantly engaged in outdoor activities and operation of automobiles and are more vulnerable to trauma accidents however, male predominancy among trauma victims is seen in most of the previous trauma studies.[18,19] Other studies[20] with the same findings of more young male involvement in trauma accidents found a relationship to alcohol and drug misuse in this group of victims however this influence was not studied in our study.

Anarase and Anarase[18] found that RTAs were the most common cause of trauma. Ina study by Rahman and Das;[21] the most common cause of BAT was found to be RTA. Arumugam et al[22] showed that RTAs (61%) were the most frequent mechanism of injury followed by FFH (25%) and fall of heavy objects (7%). In our study the most common causes of BAT were due to RTA (64.6%), falls (10.6%) and assaults (25%).

Regarding the frequency of solid organ injuries; our study showed that spleen and liver are the most frequently injuries solid organs of various degree of involvement, other studies[23] also showed that these two organs are the most frequently involved organs in BAT. Anarase S and Anarase[18] found that spleen and liver were the most commonly injured intra abdominal organ 37.69% and 25% respectively. While Ravikanth et al[24] found liver injury (26%)

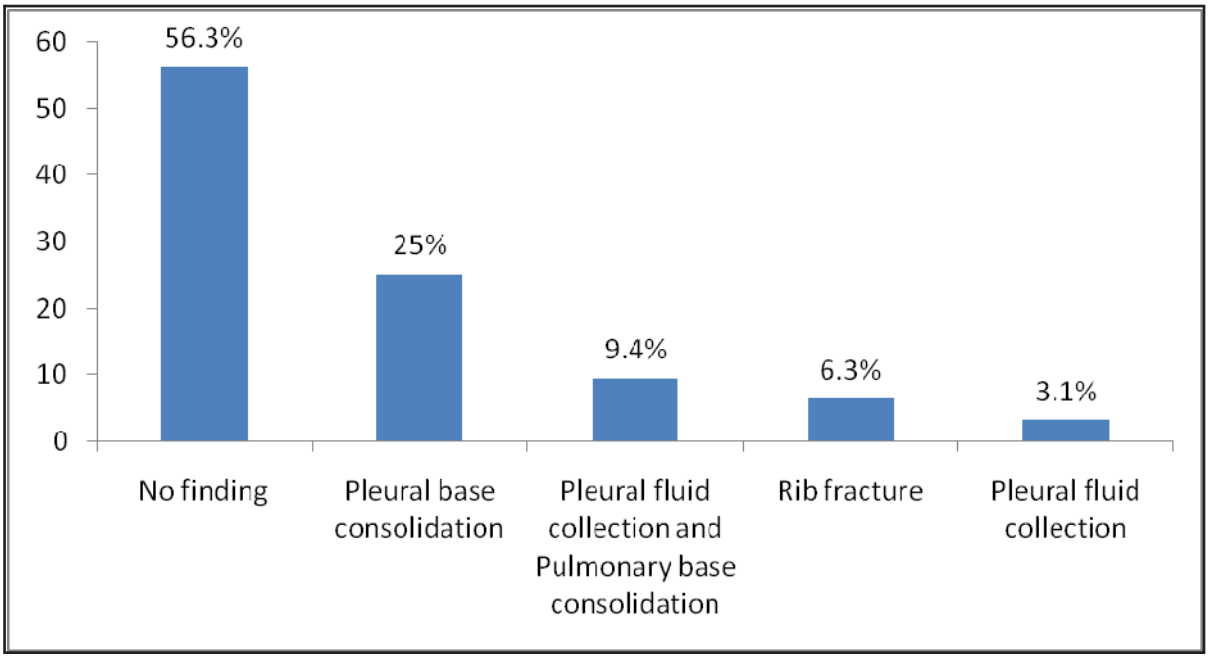

Figure 3 Percentage of chest injury finding

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more than splenic injury (20%). Sener et al[25] reported that the most commonly injured solid organ was liver which was observed in 57.3% of abdominal trauma cases. A study reported by Hassan et al.[26] in 2010, carried out on 92 patients, reported that the spleen is the most frequently injured abdominal organ during blunt abdominal trauma accounts for up 45% of all visceral injuries, the liver is the second most frequently injured and pancreatic injury is encountered in only 3–12% of all abdominal injury while renal injury was about 10%.

Our study revealed that renal and pancreatic injuries are the next common solid organs that were involved by blunt injuries about 28% and 12.5% respectively. Pancreatic injuries are relatively uncommon but, nevertheless, represent serious problem because of high morbidity and mortality rates that accompany them, with morbidity rates ranging between 45% and 60%, and mortality rates ranging between 23.4% and 30.2%.[27] Regarding adrenal glands; they are rarely affected by trauma due to its small size and deep retroperitoneal position in the upper part of abdomen with the presence of full fat surrounding the gland; the possibilities of traumatic suprarenal injuries were scarce (0.03% to 4.95%) of all abdominal injuries[28] this fact is also confirmed by our result in which adrenal gland injury was only seen 3.1% of cases.

Blunt bowel and mesenteric injuries account for 1% of emergency trauma injuries and 1-5% of BAT of which over 50% of cases are small bowel injuries, these injuries can be overlooked and misdiagnosed in multiple simultaneous accidents.[29,30] Hollow viscus injury in our study was about 33.3% of which small bowel injury was about 12.5% and urinary bladder injury was 6.3%.

Diaphragm injury in BAT is variable in different previous studies, study done by Desir et al. in 2012 estimated that diaphragmatic injuries occur in 0.8% to 8% of patients with blunt abdominal trauma.[31] Dwari et al. in 2013, reported that, the incidence of diaphragmatic rupture is between 0.8 and 1.6 % of blunt abdominal trauma and most of them are in the third decade of life.[32] In our study among the 96 cases 'diaphragm was involved in 9% (9 cases) whether unilateral or bilateral.

Every patient with abdominal trauma should be evaluated for lower thoracic injuries regardless of the presence or absence of any overt sign of thoracic trauma, in our study; abdominal trauma in association with lower thoracic injuries was 43.7% ,with lower rib fracture constituting 6.3%, lower lobe pulmonary base contusion 25% ,pleural collection 3.1% ,combined pleural collection and pulmonary basal consolidation 9.4%. A study by Panchal et al[33] has observed that; isolated abdominal trauma without any other systemic trauma in 46% of their patients. Also, they have noted that abdominal trauma is commonly associated with lower thoracic injury in 38% of patients and orthopedic injuries in 34%. In other study, by Culp and Silverstein in 2015;[34] lower thoracic injury was associated with abdominal trauma in 27% of patients.

The CT scan finding of hemoperitoneum of variable degrees was 50% and during laparotomies the incidence of missing hemoperitoneum was only 1%; indicating that CT scan of abdomen is excellent in the detection of such finding and it should raise the suspicion of underlying intra abdominal organ injury. Traumatic hemoperitoneum can be the result of solid organ, vasculature, bowel, mesenteric, or bladder injuries with the spleen and liver being the most frequently injured organs by blunt force and penetrating trauma.[35]

Nowadays, the management of BAT has undergone a paradigm shift from immediate explorations to a conservative and more selective management because of better intensive care monitoring of patients aided by noninvasive technology, development of newer therapeutic modalities like embolization of bleeding vessels, ultrasound or CT guided drainage

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and advances in critical care management have increased the chances of nonsurgical management[36]

In this study, conservative management were performedin most of the cases (43.8%). Umare et al[19] showed that 58% of BAT patients were managed conservatively while operative intervention was required in 42%. Rahman and Das showed that 53.52% of patients having intra-abdominal solid organ injuries were managed conservatively. A study done by Saksobhavivat et al;[37] 171 patients underwent CT scan examination with splenic injuries. Treatment decisions were conservative in 50%, surgical in 11% or splenic angiography and embolization in 39%. Meanwhile in the study by Kharbandaetal. and Selim et al;[38] the main line of management was conservative.

Recommendations:

To get better and more accurate results regarding incidence of CT scan findings in BAT cases we recommend studies to be conducted over longer period of time and in all the emergency centers in our locality.

Conclusion

CT imaging is the diagnostic tool of choice for the evaluation of blunt abdominal trauma in haemo-dynamically stable patients, it can assist in detecting and evaluating other co-existing injuries such as lower thoracic, pelvic and spine injuries.

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Competing interests

The authors declare that they have no competing interests.

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