

A Clinical Study on CT Scan Findings in the Diagnosis of Blunt Injuries Abdomen

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ABSTRACT

BACKGROUND

Blunt injuries of abdomen are very common emergencies encountered in general surgical practice. Conservative management is preferred in all such cases except those with injury to solid organs in the abdomen and hence accurate Radiodiagnosis with CT scan is ideal when performed accurately and in time. In cases of haemoperitoneum, the active extravasations and their rate of bleeding are more useful in the management than merely report of volume of free blood in the abdomen. We wanted to study the efficacy of computed tomography (CT) scan of abdomen as a diagnostic tool for accurate diagnosis of blunt injuries to abdomen.

METHODS

77 patients presenting with blunt injuries abdomen from Al Azhar Medical College and Hospital, between March 2018 and May 2020 were included in the study. Patients with a normal CT scan not requiring admission or those who were discharged after a short, stay not more than 3 days without any further investigation were excluded. Protocol consisting of portal venous phase images of the abdomen and pelvis, were acquired 65 - 80 seconds after the beginning of intravenous contrast material administration. In few cases, longer delay time was used- up to 75 to 80 seconds for CT imaging. Findings like haemoperitoneum, contrast blush consistent with active extravasations of blood, Laceration (linear shaped hypodense areas), haematomas (oval or round shaped areas), contusions (vague ill-defined hypodense areas that are less well perfused), pneumoperitoneum, devascularization of organs or parts of organs and sub-capsular haematomas were recorded.

RESULTS

Among the 77 patients with blunt injuries to abdomen included in the present study, there were 49 (66.23%) male patients and 28 (36.36%) female patients with a male to female sex ratio of 2.38:1. The youngest patient was aged 7 years and the eldest patient was aged 53 years with a mean age of 43.15 ± 3.45 years. Out of 77 patients, 55 (71.42%) patients were treated conservatively and the remaining 22 (28.57%) were surgically explored for treatment. An overall sensitivity of diagnosing injuries to solid organs was 97% and specificity was 98%. The positive predictive value was 81% and negative predictive value was 98%. In case of bowel injuries, the sensitivity and specificity were calculated and found that they were 96% and 97% respectively.

CONCLUSIONS

Majority of the patients with blunt injuries to abdomen can be successfully managed conservatively. Only 28.57% of the patients in the present study required surgical intervention, which was for Grade IV / V Splenic injuries, hepatic injury with active contrast extravasations and bowel injuries.

KEY WORDS

Abdomen, Blunt Injury, Haemoperitoneum, CT Scan, X-Ray and Ultrasound.

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BACKGROUND

Trauma is the commonest cause of death among populations aged below 40 years. Of all traumatic deaths, blunt injury to abdomen is responsible for 10% of the deaths.¹ Motor vehicle accidents account for more than 50% of the blunt injuries to abdomen. The other 50% of blunt injury to abdomen are found to be due to fall from heights, physical assaults, injuries during sports, accidents in industries, armed conflict and injuries caused by domestic or wild animal.² Blunt injuries of abdomen require emergency treatment and the accuracy of evaluating the patients is challenging. Because based on the diagnosis surgeons decide the course of management. Clinical examination alone becomes unreliable due to associated co-morbid conditions like external injuries, altered state of mind, intake of drugs and alcohol and shock.³ Men are affected more commonly than women.⁴ The commonly involved organs are the spleen, liver, retro-peritoneum, small bowel, kidneys, bladder, colorectum, diaphragm. The basic mechanisms of injury to internal organs in the abdomen are explained in three ways as it requires considerable forces to produce damage to organs. They are deceleration, external compression, and crushing injuries.⁵ Multispecialty approach is necessary with a radiologist as an integral member, with speed and efficiency to reach a reasonable diagnosis in the patients with blunt injuries to abdomen. In cases of polytrauma the primary assessment itself should prioritize identifying the potentially lethal but treatable injuries which requires immediate intervention like maintaining haemodynamics to perfuse vital organs and allow adequate gas exchange and oxygenation of blood. The CT scan abdomen remains the standard diagnostic tool for the detection of solid organ injuries.⁶ Moreover CT scan of the abdomen can reveal other associated injuries, notably vertebral and pelvic fractures and injuries in the thoracic cavity.⁷ Even a direct peritoneal lavage (DPL) or Focused Assessment with Sonography for Trauma (FAST) examinations can give evidence of bleeding in the abdomen but CT scan has the capability to determine the source of haemorrhage.⁸

CT scans provide excellent imaging of the pancreas, duodenum and genitourinary system. The images can help measure the amount of blood in the abdomen and can reveal individual organs with precision.⁹ Whereas the limitations of CT scan of abdomen include marginal sensitivity for diagnosing diaphragmatic, pancreatic and hollow viscus injuries. They are also relatively expensive and time consuming and require oral or intravenous contrast, which may cause adverse reactions.^{10,11,12} The sensitivity and specificity of CT scan of abdomen in the diagnosis of acute blunt injuries to abdomen varies from 91% to 93% and 94% to 98% respectively.¹³ In the current practice of General surgery most of the blunt injuries of abdomen are being treated conservatively without surgical intervention. More than 50% of Splenic injuries, 80% of liver injuries and virtually all renal injuries are managed non-operatively, because patients proved to have better outcomes on the

long term related to visceral salvage. CT scan has provided as an important tool in the hands of radiologists is used to evaluate patients with blunt trauma not only initially, but also for follow up, when patients are treated non-operatively.¹⁴ The present study is conducted to study the efficacy of computed tomography (CT) scan of abdomen as a diagnostic tool for accurate diagnosis of blunt injuries to abdomen.

METHODS

A total number of 77 patients presenting with clinical signs of Blunt injuries to Abdomen to the Emergency room of Al Azhar Medical College and Hospital between March 2018 and May 2020 were included in the study. The CT scan signs noted in the clinical charts of the patients between March 2018 and December 2019 were taken on retrospective basis and the data from January 2019 to April 2020 were taken on prospective basis. An ethical committee clearance was obtained from the institutional ethical committee. An ethical committee cleared consent form was used for the patients included in the prospective study period.

Inclusion Criteria

1. Patients belonging to all the age groups and genders were included.
2. Patients with blunt injuries abdomen and were stable haemodynamically were included.
3. Patients who had normal serum creatinine values were included.

Exclusion Criteria

1. Patients who were unstable haemodynamically were excluded.
2. Patients who had undergone previous abdominal surgeries were excluded.
3. Patients with a normal CT scan not requiring admission or those who were discharged after a short, stay not more than 3 days without any further investigation were excluded. All the patients subjected to haematological, biochemical laboratory tests and Plain X-Ray chest and abdomen and Ultrasonography (USG) of Abdomen and pelvis. Blood investigations included: haemoglobin, total count, differential count, blood urea, serum creatinine, liver function tests, RBC count and blood grouping.

Multidetector CT Scan Technique with Contrast and Multiphasic Imaging

All the patients were subjected to the same protocol consisting of portal venous phase images of the abdomen and pelvis, acquired 65-80 seconds after the beginning of intravenous contrast material administration. In few cases longer delay time was used up to 75 to 80 Seconds. This delayed series was to detect injuries related to urinary tract,

as well as further characterizing solid visceral organ injuries that involve the vasculature.^{15,16,17} In 08 cases an arterial phase series (25–30 seconds after injection) of the abdomen CT scan was done. This arterial phase CT imaging was to help detect trauma to the major vessels and demonstrate vascular injuries of the solid organs that are not apparent on portal venous or delayed phase images.¹⁸ A subsequent delayed excretory scan 3-5 minutes later was undertaken if injury is detected on the initial CT scan. CT scan was done with patient in supine position and the beam passing perpendicular to the sagittal plane. Initial cuts of thorax were taken to rule out any pathology on the chest. Before contrast is given a scan was done followed by infusion of the contrast (100-150 ml of contrast agent: Iopamide 370 mg/ml. It was IV at an injection rate of 3.5 ml/s. The radiological findings looked for were: haemoperitoneum, Contrast blush consistent with active extravasations of blood, Laceration: Linear shaped Hypodense areas, haematomas: oval or round shaped areas, Contusions: vague ill-defined Hypodense areas that are less well perfused, Pneumoperitoneum, Devascularization of organs or parts of organs and Sub-capsular haematomas. Signs of haemoperitoneum were classified according to "Federle and Jeffrey system"¹⁹ into small, Moderate and Large groups. Solid organ injuries were graded according to Organ Injury Scale (OIS) in the study.²⁰ CT scan was also done in 12 patients who were not improving during conservative management as a follow measure to monitor the changes found initially. All the data was analysed using standard statistical methods.

RESULTS

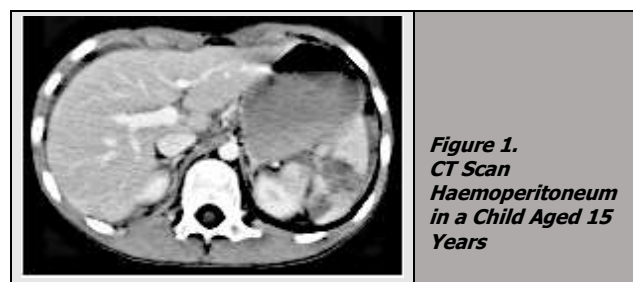
Among the 77 patients with blunt injuries to abdomen included in the present study there were 49 (66.23%) male patients and 28 (36.36%) were female patients with a male to female sex ratio of 2.38: 1. The youngest patient was aged 7 years and the eldest patient was aged 53 years with a mean age of 43.15 ± 3.45 years.

Observations	5-14 Yrs.- 07 (09.09%)	15-24 Yrs.- 18 (%)	25-34 Yrs.- 22 (28.57%)	35-44 Yrs.- 15 (19.48%)	45-54 Yrs.- 15 (19.48%)
RTA-	02	06	07	04	02
21 (27.27%)	(02.59%)	(07.79%)	(07.79%)	(05.19%)	(02.59%)
Industrial-		02	03	05	07
17 (22.07%)	-	(02.59%)	(03.89%)	(06.49%)	(07.79%)
Assault-	0	03	03	02	03
11 (14.28%)		(03.89%)	(03.89%)	(02.59%)	(03.89%)
Fall-	03	03	03	01	01
11 (14.28%)	(03.89%)	(03.89%)	(03.89%)	(01.29%)	(01.29%)
Sports Injury-	01	02	04	02	01
10 (12.98%)	(01.29%)	(02.59%)	(05.19%)	(02.59%)	(01.29%)
Animal related-	01	02	02	01	01
07 (09.09%)	(01.29%)	(02.59%)	(02.59%)	(01.29%)	(01.29%)

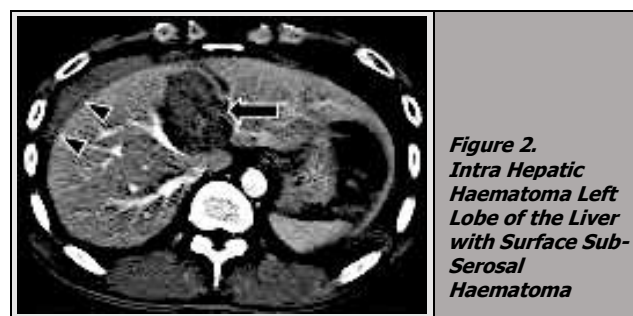
Table 1. Incidence of Causes of Blunt Injury Abdomen According to Age Groups (n-77)

In this study out of 77 patients, 55 (71.42%) patients were treated conservatively and the remaining 22(28.57%) were surgically explored for treatment. Two patients out of 22 (09.09%) treated surgically expired because of

complications. Four out of 55 (07.27%) conservatively treated patients treated conservatively also expired to other associated injuries like head injuries and thoracic injuries. Radiological signs of CT scan of blunt injuries abdomen were tabulated in Table 2. Signs of haemoperitoneum were classified according to "Federle and Jeffrey system" (21) into small, Moderate and Large groups. There was 11/27(40.74%) small group patients, 10/27 (37.03%) moderate group patients and 07/27 (25.92%) large group patients. Among the 11 Moderate group patients two had to be operated upon due to Haemodynamic instability developing in the patients (Table 2). Among 27/77 (35.06%) patients with Haemoperitoneum 13/27 (48.14%) were treated conservatively and the remaining 14/27 (51.85%) were treated with surgery. CT scan abdomen of a child aged 15 years with haemoperitoneum was illustrated in figure (1).



There were 09/55 patients who presented with haematomas in the solid organs and parietal layers of abdomen; A patient with haematoma in the liver was illustrated in Figure 2. All the haematomas were managed conservatively.



Observation	No Surgery 55(71.42%)	Surgery 22(28.57%)	Total 77(100%)
Hemoperitoneum-27			
Small- 11	11 (14.28%)	08 (10.38%)	27 (35.06%)
Moderate- 10	02 (02.59%)	06 (07.79%)	
Large- 06	-		
Contrast blush consistent with active extravasations of blood	08	04	12 (14.28%)
Laceration	07	03	10 (12.98%)
Hematomas	09	-	09 (11.68%)
Contusions	07	-	07 (09.09%)
Pneumoperitoneum	06	-	06 (07.79%)
Devascularization of organs or parts	03	01	04 (05.19%)
Sub capsular haematomas	02	-	02 (02.59%)

Table 2. Radiological Findings According to Gender (n-77)

In the present study the incidence of solid organ involvement was tabulated in Table 3. Out of 77 patients, 67 (87.01%) had solid organ injuries diagnosed on CT scan

abdomen. Among the solid organs the incidence showed that spleen was involved in 25/77 patients (32.46%), Liver in 23/77 (29.87%) patients, Kidney in 16/77 (20.77%) and pancreas in 03/77 (03.89%) patients. 8/67 (11.94%) patients had multi-organ injuries (Table 3). Solid organ injuries were graded according to Organ Injury Scale (OIS) in the study (22). Among the 25 patients with Splenic injuries 11/67 (16.41%) were treated conservatively as they belonged to Grade II, III and IV type OIS injuries. 14/67(20.89%) was treated surgically as their injuries were of Grade IV of OIS scale (Table 3). CT abdomen of an adult with Splenic injury with adjoining parietal haematoma was illustrated in (Figure 3).



Figure 3. CT Abdomen Showing Splenic Injury with Adjoining Parietal Haematoma

Patients with liver injuries were 23/67 (34.32%) and among them 21/67 (31.34%) were treated conservatively and one required surgery. CT scan abdomen of an adult patient with hepatic contusion, haemoperitoneum and bowel injury was illustrated in Figure 4.



Figure 4. Intra Hepatic Contusion (Left Lobe of Liver), Haemoperitoneum and Injury to Bowel (White Arrow)

Similarly, among 16/67 (23.88%) patients with Kidney injuries, 15/67 (22.38%) were treated conservatively and 01/67 (01.49%) was subjected to surgery (Table 3). CT scan abdomen severe injury of parenchyma of kidney in an adult patient was illustrated in (Figure 5).

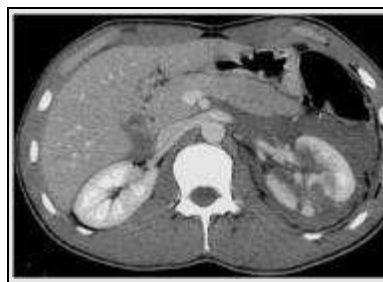


Figure 5. CT Scan Abdomen Showing Severe Injury to Parenchyma of Kidney in an Adult Patient

There were 03 patients with injury to the pancreas: one was treated after surgery and the remaining 02 were managed conservatively (Table 3). The patient underwent surgery for the repair of the tear in the tail of the pancreas was illustrated in (Figure 6).



Figure 6. CT Abdomen Showing Tear in the Tail of Pancreas

Organs Involved	No Surgery- 49 (73.13%)	Surgery- 18 (26.86%)	Total- 67 (100%)
Spleen	11 (16.41%)	14 (20.89%)	25 (37.31%)
Liver	21 (31.34%)	02 (02.98%)	23 (34.32%)
Kidney	15 (22.38%)	01 (01.49%)	16 (23.88%)
Pancreas	02 (02.98%)	01 (01.49%)	03 (04.47%)
Table 3. Involvement of Solid Organs in the Study (n-67)			
(8/67 (11.94%) patients had multi-organ injuries)			

10/77 (12.98%) patients showed CT scan findings of bowel injury, out of which 4/10 were subjected to laparotomy and surgical management. The remaining 06/77 patients were treated conservatively as there were no definitive CT scan findings of bowel injury and the post traumatic period was uneventful. In the present study CT scan was done in 12 patients who were not responding to conservative management, as a follow up measure to monitor the CT findings found initially. It was observed that in 05 out of 12 patients (06.49%) with Splenic injury there was increase in the size of haematoma. In 04 patients (05.19%) there was increase contrast blush due to increased retroperitoneal extravasations. In three out of 12 patients (03.89%) there was increased haemoperitoneum requiring immediate surgery. In this selected group of 77 patients CT scan evaluation in patients with blunt injuries to abdomen correlated with clinical monitoring showed an overall sensitivity of diagnosing injuries to solid organs was 97% and specificity was 98%. The positive predictive value was 81% and negative predictive value was 98%. In case of bowel injuries, the sensitivity and specificity were calculated and found that they were 96% and 97% respectively.

DISCUSSION

A total number of 77 patients presenting with clinical signs of Blunt injury to Abdomen in the Emergency room of Al Azhar Medical College and Hospital between March 2018 and April 2020 were included in the study. The CT scan signs noted in the clinical charts of the patients between March 2018 and December 2019 were taken on retrospective basis and the data from December 2019 to April 2020 were taken on prospective basis. Among the 77 patients with blunt injuries to abdomen included in the present study there were 49 (66.23%) male patients and 28 (36.36%) were female patients with a male to female sex ratio of 2.38: 1. The youngest patient was aged 7 years and the eldest patient was aged 53 years with a mean age of 43.15 ± 3.45 years. Diagnostic peritoneal tapping (DPL) was not performed in any of them. A 16 slice GE CT scan machine was used for all

the CT scans in the study. Oral contrast was not given to any of the patients in this study. A relatively simple protocol was used in this study for patients with blunt trauma based on scanning the entire abdomen in the portal venous phase and a subsequent delayed excretory scan 3-5 minutes later if injury is detected on the initial scan. In a recent study of 2,774 patients by Livingstone D and Lavery R et al concluded that the negative predictive value (99.63%) of CT was sufficiently high to permit safe discharge of blunt injuries of Abdomen patients following a negative CT scan.²¹ Haemoperitoneum was observed in 11/27 (40.74%) small group patients, 10/27 (37.03%) moderate group patients and 07/27 (25.92%) large group patients. CT scan abdomen of an adult with haemoperitoneum and haematoma in left lobe of liver and contusion of liver was illustrated in Figure (2, 3). Among the 11 Moderate group patients two had to be operated upon due to Haemodynamic instability developing in the patients (Table 2). There was good correlation between the CT quantification of the Haemoperitoneum with the management approach. All the 27 patients with Haemoperitoneum were treated conservatively in this study. Taylor et al. also reported a similar experience from their study.²² There were 16/67 (23.88%) patients with Kidney injuries, 15/67 (22.38%) were treated conservatively and 01/67 (01.49%) was subjected to surgery (Table 3).

Webster V, in his series of 444 patients, in whom CT was performed to evaluate renal injuries, expressed similar views; Another advantage of CT scanning over other diagnostic modalities is its ability to evaluate the retroperitoneal structures. 10/77 (12.98%) patients showed CT scan findings of bowel injury, out of which 4/10 were subjected to laparotomy and surgical management. The remaining 06/77 patients were treated conservatively as there were no definitive CT scan findings of bowel injury and the post traumatic period was uneventful. Review of literature showed that, few authors quote that in patients at risk for mesenteric or hollow visceral injury, DPL is generally felt to be a more appropriate test.^{23,24,25} But a negative CT scan in such a patient cannot reliably exclude intra-abdominal injuries. The specific signs of bowel injury included transaction of the wall with focal discontinuity, pneumoperitoneum and pneumoretroperitoneum. CT scan abdomen of an adult haemoperitoneum, contusion of liver and bowel injuries illustrated in Figure (4 and 5). There were 03 patients with pancreatic gland injuries in the study. The appearance of pancreatic gland in injury may appear normal within 12 hours after trauma: the sensitivity of Multidetector CT has been reported between 70% and 95%.^{26,27} Indirect signs such as fluid in the peri-pancreatic fat or in the plane separating the pancreas from the splenic vein and thickening of the left anterior renal fascia are helpful in its diagnosis. Majority of the patients with blunt injuries of abdomen are being treated conservatively since the advent of Multidetector CT scan imaging.^{28,29} CT scan imaging is highly sensitive in the detection of intra peritoneal free fluid which is associated with abdominal visceral injury in most of the cases.³⁰ Among the 25 patients with Splenic injuries 11/67

(16.41%) were treated conservatively as they belonged to Grade II, III and IV type OIS injuries. 14/67 (20.89%) was treated surgically as their injuries were of Grade IV of OIS scale (Table 3). Splenic preservation after trauma is the current standard of care. Currently success rates of non-surgical management vary from 80 - 90%.³¹ Similar results were also reported by Poletti et al.³²

CONCLUSIONS

Majority of the patients with blunt injuries to abdomen can be successfully managed conservatively. Only 28.57% of the patients in the present study required surgical intervention, which was for Grade IV / V Splenic injuries, hepatic injury with active contrast extravasations and bowel injuries. CT scan imaging is performed in patients where abdomen cannot be evaluated adequately by clinical examination because of altered mental status due to alcohol intake. CT scan should not be performed in haemodynamically unstable patients and in patients with obvious signs of peritonitis or gas under right dome of diaphragm in x-ray abdomen who required immediate surgery.

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