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Original Research

Role of Multidetector Computed Tomography in the Evaluation of Liver Trauma

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ABSTRACT
The morbidity, mortality, and economic costs resulting from trauma in general, and abdominal trauma/injury in particular, are substantial. The computed tomographic [CT] scan of the head, neck, chest, abdomen, and pelvis) has become an essential tool in the early evaluation and decision-making algorithm for hemodynamically stable patients with abdominal trauma. CT has virtually replaced diagnostic peritoneal lavage for the detection of important injuries. At the outset of the study, a detailed history was taken, general physical examination and relevant laboratory examination findings were recorded. The in juries were classified, categorized and tabulated, subjected to quantitative statistical analysis, and valid conclusions were drawn. Total 100 patients with abdominal trauma, 86(86%) male and 14 (14%) female patients were observed. Roadside accidents (RSA) were the most common cause of abdominal trauma 66%(66 cases) followed by 12%(12 cases) of physical assault, Gunshot injuries 12%(12 cases), and stab injury 10 (10%) of all cases. The most common injured organ was the liver 36(36%). Therefore, MDCT evaluation for early assessment and grading or classify the injuries as per imaging features/appearance which ultimately helps the clinician to take better & quick decisions for the management of the patient thus reducing the morbidity and mortality.

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INTRODUCTION

The morbidity, mortality, and economic costs resulting from trauma in general, and blunt abdominal trauma/injury in particular, are substantial. The computed tomographic [CT] examination of the head, neck, chest, abdomen, and pelvis has become an essential tool in the early evaluation and decision-making algorithm for hemodynamically stable patients with abdominal trauma. CT has virtually replaced diagnostic peritoneal lavage for the detection of important injuries. Over the past decade, substantial hardware and software developments in CT technology, especially the introduction and refinement of multidetector scanners, have expanded the versatility of CT for examination of the polytrauma cases in multiple facets: higher spatial resolution, faster image acquisition & reconstruction, and better patient safety (optimization of radiation delivery and safety methods).[1]

Globally, approximately one-third of trauma patients have abdominal trauma and it accounts for an oversized fraction of tragic loss of life and unrecognized abdominal injury remains a distressing frequent reason behind preventable death.[2]The abdomen is the 3rd most common injured area with injuries requiring surgery in about 25% of civilian trauma victims.[3]The abdomen is liable to injury since there's minimal bony protection for underlying organs.[4]

Abdominal trauma is classified as either penetrating trauma or blunt trauma. Road traffic accidents are the

commonest cause of blunt abdominal injury in the population.[5,6,7] The clinical findings are usually not consistent with many injuries such as fractures of lower chest ribs, contusion, hematoma, and abrasions of the abdominal wall. The management of patients with abdominal trauma has several important essentials: adequate pre-hospital care, rapid transport to a specialized or tertiary center, in-hospital care, and rehabilitation after hospital discharge & recovery. In recent years many abdominal injuries especially those involving solid organs are managed without any surgical interventions. This has been made possible by the invention and advancement of imaging techniques like ultrasonography, computerized tomography (CT) scan, and magnetic resonance imaging (MRI) which shows the site and extent of the injury accurately. The injured organ can then be observed over time as it heals and follow-up imaging is done if required.[8,9,10]

Mechanism or cause of injury in abdominal injury is either penetrating or blunt. Blunt trauma includes roadside accidents, physical assault, fall from height, and natural disasters like an earthquake. The penetrating trauma includes firearm/gunshot injuries, stab wounds, and blast injuries.

However, in resource-limited countries like ours, these modern diagnostic facilities are lacking making non-surgical management a major challenge. Most abdominal injuries are now preventable. The establishment of preventive policies as well as management and treatment guidelines require a clearer understanding of the causes, injury features, and treatment outcomes of these patients. However, such data are lacking in our setting. It is on this background that this study seeks to describe our own experience on the imaging of this condition outlining the causes, injury characteristics to help in management and treatment in our institution and to have baseline data for future comparison.[11]

MATERIALS AND METHODS

The prospective study was conducted in Guru Nanak Dev Hospital, Government Medical College, Amritsar on patients reporting from September 2019 to August 2021 after obtaining Institutional Thesis Committee and Ethics Committee approval and written informed consent from the patient/guardian.

SOURCE OF DATA

The main source of data for the study was the patients referred to the department of Radiodiagnosis and Imaging, Government Medical College, Amritsar.

EQUIPMENT

The equipment to be used was CT scan 64-slice Philips machine. CT windows to be used will be soft tissue, lung, and bone for all suspected abdominal trauma patients. Iohexol (omnipaque) will be used as a contrast material wherever required.

DURATIONOFSTUDY

Two years(September 2019toAugust2021)

SAMPLE SIZE

Hundred patients with abdominal trauma/polytrauma were enrolled in the study, including 86 males and 14 females, aged 10-65 years, with a mean age of 33.4 years. They were referred from the surgical/emergency department.

INCLUSION CRITERIA

Clinical suspicion of abdominal trauma in Hemodynamically stable patients.

EXCLUSION CRITERIA

All hemodynamically unstable patients.

TECHNIQUE

All patients with abdominal trauma will be subjected to multidetector computed tomography (MDCT) imaging. Initially, non-contrast MDCT imaging will be done. Post-contrast MDCT imaging will be performed in hemodynamically stable patients wherever required.

INTRAVENOUSCONTRAST

Iohexol (iodinated) 1ml/kg body weight with the help of an 18- or 20-gauge cannula will be injected in a peripheral vein.

Oral Contrast: Iohexol(iodinated) 20mldiluted in 2Lofwater will be given orally if required to opacify the gut.

The American Association for the Surgery of Trauma (AAST) injury scoring scales was used to classify and categorize traumatic injuries.

The imaging findings were noted and tabulated, subjected to quantitative statistical analysis, and valid conclusions were drawn.

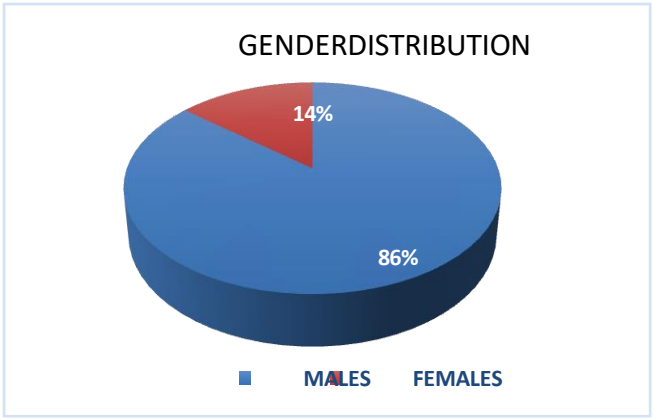
RESULT

The present study included 50 patients having acute and chronic abdominal trauma, who were admitted to Guru Nanak Dev Hospital, Govt. Medical College, Amritsar.

Table I: Gender distribution (Total no. Of cases=100)

Gender	No. Of cases	Percentage
Male	86	86.%
Female	14	14%
Total	100	100%

Chart I

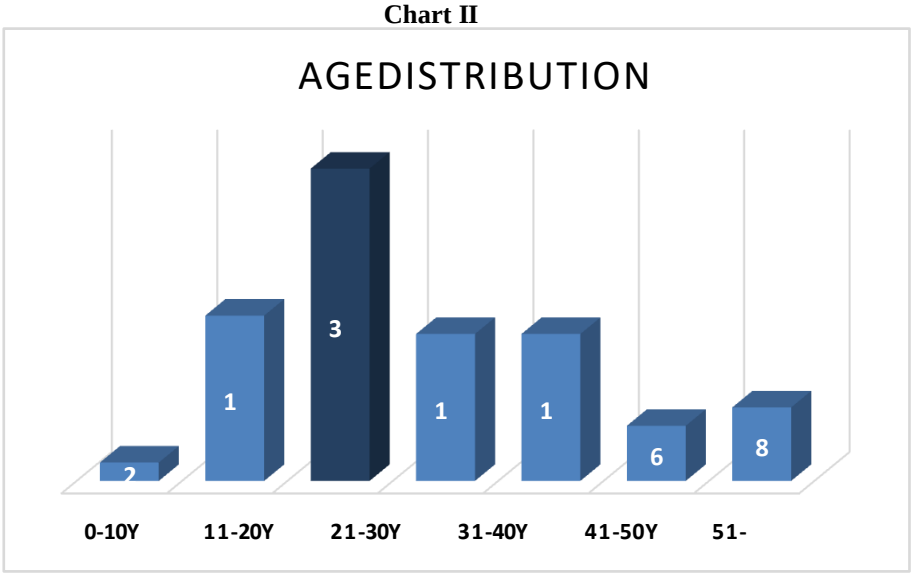


Out of 100 patients with acute and chronic abdominal trauma, 86 cases (86%) were male patients and 14 cases (14%) were female patients. The male to female ratio was 6.14**:**1, males outnumbered females (TABLE I & CHART I).

Table II: Age distribution (Total no. of cases=100)

Age group (in years)	No. of cases	Percentage
0-10	02	2%
11-20	18	18%
21-30	34	34%
31-40	16	16%
41-50	16	16%
51-60	6	6%
61+	8	8%
TOTAL	100	100%

Chart II



The maximum number of patients were in the age group of 21-30 years, comprising 34% of the cases. Peak incidence was seen in the age group of 21-30 years. The least number was in the age group 0-10 years with only 4 (4%) cases. The mean age of the patients in our series was 33.4 years (TABLE II & CHART II)

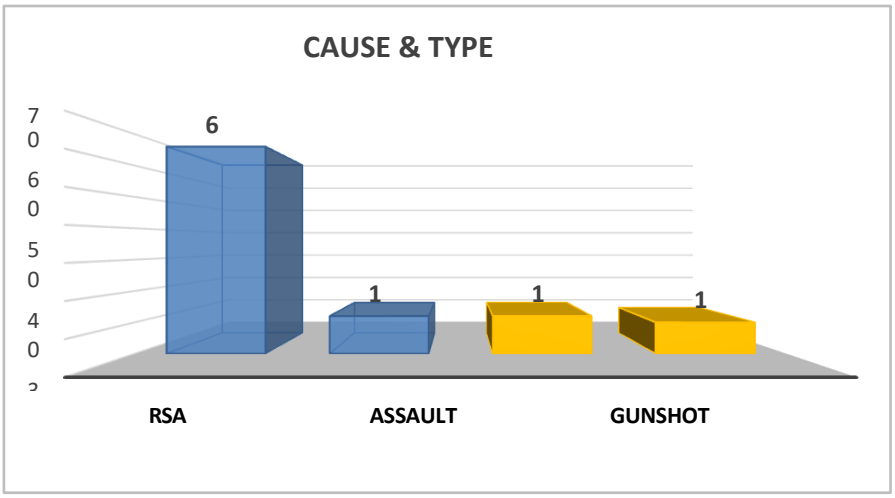
Table III: Injury cause& type distribution(Total no. Of cases=100)

Type of injury	Cause of in jury	No. of cases	Percentage
Blunt	RSA Assault	78	78%
Penetrating	Gunshot Stab	22	22%
Total		100	100%

Table: IV

Cause of trauma	Type of trauma	No. of cases	Percentage
RSA	**Blunt**	66	66%
Assault		12	12%
Gunshot	**Penetrating**	12	12%
Stab		10	10%
Total		100	100%

Chart III



Blunt trauma was the most common cause of abdominal trauma 39 (78%) while penetrating trauma was seen in 11 (22%) of the cases. Roadside accidents were the most common cause of blunt abdominaltrauma33(66%) followed by6 (12%)of assault. Gunshot injuries account for the majority of the penetration trauma 6 (12%) and stab injury 5 (10%) in the rest of the cases (TABLE III-IV & CHART III)

TableV:Hemoperitoneum/intraabdominalfreefluid(Totalno.ofcases=100)

Hemoperitoneum/ Intra abdominal free fluid	Assault		Gunshot		RSA		Stab		Total
	No.	%	No.	%	No.	%	No.	%	
No	0	0.0	4	33.3	4	6.1	2	20.0	10
Yes	12	100	8	66.7	62	93.9	8	80.0	90
Total	12	100	12	100	66	100	10	100	100

Free intraabdominal fluid or hemoperitoneum is the most common associated finding in abdominal trauma, comprising 90% (45 cases) out of 100 patients. It was seen in 62 cases of RSA out of 66 patients, 12 cases of assault out of 12 cases, 8 cases of gunshot out of 12 cases, and 8 cases of stab injury out of 12 cases (TABLE V).

Table VII: Solid-organ &gastrointestinal/bowel in juries

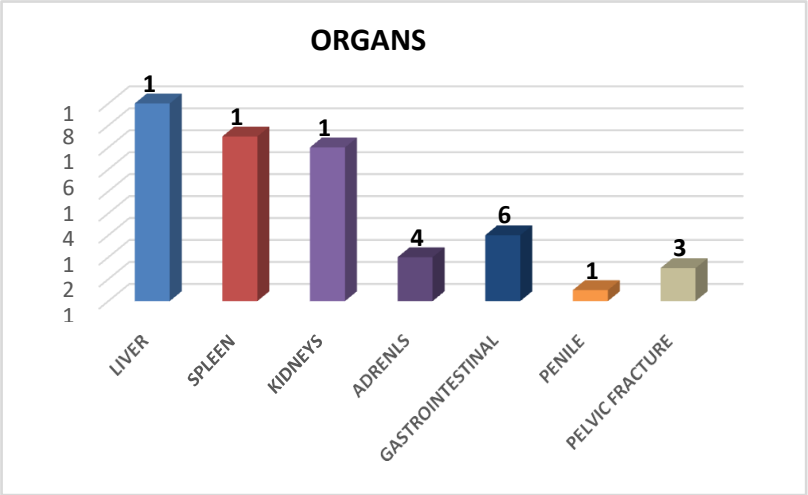
Injuries	Total cases	Percentage
Solid-organ injury	76	76%
GIT	12	12%
No organ injury	20	20%

Solid-organ injury was seen in the majority of cases, compromising about 38 (76%) and bowel/ gastrointestinal injury was seen in 6 (12%) of cases. The pelvic fracture was noted in 3 (6%) cases (TABLE VII)

Table VIII: Injured abdominal organs

Abdominal in juries	No. of cases	Percentage
Liver	36	36%

Chart: IV



The most common injured organ was the liver, with cases 18(36%).

Table IX: Specificorgan in jury with AAS Tin jury grading

Organ injured	AAST Grade I	AAST Grade II	AAST Grade III	AAST Grade IV	AAST Grade V	Total
Liver	10	12	14	0	0	36

A liver laceration is the most common form of injury which was seen in 94.7% of cases followed by contusion, seen in 47.3% of cases of all liver injuries. Grade III injury was most seen in 14 cases followed by grade II 12 cases and grade I 10 cases.

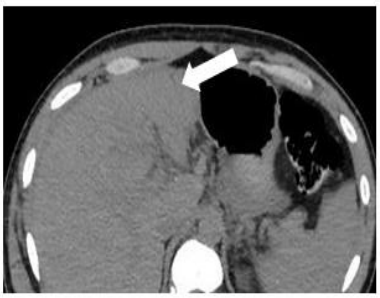


Image1

Image2

Axial CT images of grade I liver injury. (1) non-contrast shows a linear hypodense laceration in the liver(arrow) and (2) contrast-enhanced shows round hypodense hematoma in the liver

DISCUSSION

The present study entitled "Role of multidetector computed tomography in the evaluation of abdominal trauma" was conducted in the department of Radiodiagnosis and imaging, Government medical college, Amritsar. Fifty patients were recruited for the study.

DISTRIBUTIONOFGENDER

In our study, outof100 patients with acute and chronic abdominal trauma, 86(86%) were male patients and only14(14%) were female patients. The maximum number of patients were in the age group of 21-30 years (34% of cases). This correlates with the study done by Vaishnav KU et al (2014). They observed that out of 140 patients involved in t he study, 119(89%)were males and 21(11%) were female.[12]The male predominance is common because of their more exposure to roadside accidents, partly due to male family members being more in volved in outdoor activities and the fact that most of the vehicle drivers are males.

DISTRIBUTIONOFAGE

In our study, a maximum number of patients(34%) were in the age group of 21-30 years. The mean age of the patients in our series was 33.4 years. This correlates with the study done by **Shergill JS et al (2018).** They

observed a maximum number of patients (28%) were in the age group of 21-30 years.[13]The young age probably reflects the most active age in life, especially regarded to vehicle driving and traveling hence most of the patients are probably from this age group.

DISTRIBUTION OF CAUSE OF TRAUMA

Blunt trauma is the most comm. on type of injury, comprising 78% of the case and penetrating type trauma comprising only 22% of the cases. Roadside accident involving vehicles was seen to be the most common cause of injury (66%) followed by assault (12%) and gunshot (12%). Stab injury comprises only10% of the total cases. This correlates with the study done by Sher gill JS et al (2018). Incidence of road accident injury was reported in 88% ofcases.[14]A high number of traffic accidents depends on many factors like speed limit, road conditions, no use of safety helmets and belts, bad weather, drink and drive, traffic rule violation, etc. This reflects the urgent need for better regulation of traffic on the roads and strict adherence to traffic rules by vehicle drivers.

HEMOPERITONEUM/FREE INTRAABDOMINAL FLUID AS FINDING

In our study, free intraabdominal fluid/hemoperitoneum is seen in 45(90%) patients out of50 patients with abdominal trauma. This correlates with the study done by Kumar M Metal **(2005)**. They found out of 63 patients with abdominal trauma, free peritoneal fluid/hemoperitoneum was noted in 53(75%) patients.[14]Hemoperitoneum usually starts near the site of injury and flows along expected anatomic pathways& collected independent locations of the abdomen like hepatorenal fossa (Morison pouch), and the most dependent portion of the pelvis is the pelvic cul-de-sac (pouch of Douglas).

SOLID-ORGAN, GIT& PELVIC FRACTURES

In our study, solid organ in jury was seen in the majority of cases, comprising about 76 (76%). The pelvic fracture was noted in 3 (6%) cases. This correlates with study done by Stuhl faut JW et al (2004). The solid- organ injury was seen in 102 cases and bowel and mesenteric in jury was seen in 14 cases out of their total 932 patients.[15] According to a study was done by Drasin TE et al (2008), the pelvic fracture was seen in 4 patients, solid organ injury was seen in 29 patients out of 669 patients.[16] Abdominal organ injuries are common because the abdomen lacks bony protection like the chest(ribs). In any cause of trauma, the number of solid organ injuries is more as it occupies more space and has more in number followed by hollo viscous organ injury. Bony injury(pelvic &spine) is more common in blunt injuries like roadside accidents and physical assault.

LIVER INJURIES

In our study, the most common injured organ was the liver. This correlates with the studydone by Maqsood S et al (2018). The most common injured was liver 16(34.78%).[17]The two most common injured organs in abdominal trauma are liver and spleen as they are large and cover a good space in the abdominal cavity.

In our study, the most common injured abdominal organ was the liver, seen in 36% (total18 cases) of cases. A liver laceration is the most common form of injury which was seen in 94.7%ofcases followed by contusion,seenin47.3%ofcasesofallliverinjuries.GradeIII injury was most seen in 7 cases followed by grade II 6 cases and grade I 5 cases.

Miele V et al (2013**)** observed that out of their 30 cases of liver trauma most of the injuries were grade III (17 patients), followed by grade II injury (7 patients) and 5 cases each of grade I & IV injury in Contrast MDCT.[18]Hepatic lacerations are the most common type of parenchymal liver injury and appear as irregular linear or branching low-attenuation areas at contrast- enhanced CT. Parenchymal hematomas or contusions are characterized by focal low- attenuation areas with poorly defined irregular margins in the liver parenchyma at contrast- enhanced CT.

Active hemorrhage following blunt liver trauma is typically identified at early phase contrast-enhanced CT as focal high-attenuation areas that represent a collection of extravasated contrast material secondary to arterial bleeding. These posttraumatic complications include delayed bleeding, infection/abscess, posttraumatic hemobilia and pseudoaneurysm, and biliary complications such as biloma.[19]

Another study conducted by El Wakeem AM et al in 2015 amongst 50 patients concluded that MDCT is the gold standard method for evaluation of blunt abdominal trauma as it play an important role not only in detection of organ injury, but also in the grading of this injury on which the management will be performed. Also it is important in the follow up of cases which undergo conservative treatment. In addition MDCT proved to be highly sensitive in detection of active hemorrhage which is a life threatening condition. Liver was the most

FOREIGNBODY

Out of100 cases in our study, the foreign body(metallic) was seen in 12 (12%) patients. All of these metallic foreign bodies are seen in gunshot injury suggesting the metallic foreign body (bullet fragment or pellets) as an important radiological finding in abdominal trauma with gunshot and firearm-related injury.

Foreign objects embedded in the body through penetrating in jury are a common problem in emergency departments. The foreign object is often wood, glass, or metal, and bullet fragment or pellets. CT enables precise localization of radiopaque foreign bodies. There are three main mechanisms of injury caused by firearms or bullets- laceration, cavitation, and shockwave. CT plays an integral role in the evaluation of gunshot injuries owing to widespread availability, fast acquisition, the type of in formation it provides, and also the familiarity of the trauma team with this imaging modality.

ASSOCIATEDTHORACICFINDINGS

Out of 100 cases in our study, associated thoracic findings include pleural effusion which was seen in 54

(54%) cases, pneumothorax in 12 (12%) of cases, lung contusion in 8 (8%) cases, and lung laceration in only 4 cases.

Brink M et al (2003) in their study observed that out of their 464 patients with thoracoabdominal trauma, pneumothorax was seen in 105 (23%) patients, hemothorax in 29 (6.3%) patients, and lung contusion in 156 (34%) of the patients.[21]The roadside accident is overall the most common cause of the trauma usually results in polytrauma which can involve any region from head to toe. In our study, we were able to explore only the limited part of the lower thorax i.e., the visualized part of the lower thorax so, probably we were able to see the small proportion of thoracic injuries. However, in these conditions, the patient needs a dedicated MDCT of the thorax for better evaluation.

CONCLUSION

Nowadays MDCT scan has become an integral part of the trauma protocol for managing the emergency department. MDCT scan provides high image quality in less time with multiplanar reconstruction and 3D volumetric rendered images, it has become very easy to make diagnosis and grading with great accuracy and rapidity. Therefore, due to the added diagnostic value of MDCT scan, patients coming to the emergency department with abdominal trauma or polytrauma should undergo early MDCT evaluation for earl yas sessment and grading or classify the injuries as per imaging features/appearance which ultimately helps the clinician to take better & quick decision for the management of the patient thus reducing the morbidity and mortality.

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