

Role of USG and MDCT in Blunt Abdominal Trauma

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Abstract: Introduction: Trauma is becoming one of the common cause of hospitalization. Both USG and CT modalities are widely used to detect blunt abdominal trauma. This study was undertaken to compare the efficacy of CT scans and Ultrasonography in patients with blunt abdominal trauma. Aims and Objectives: To evaluate role of USG and MDCT in blunt abdominal trauma. Materials and Methods: The present study of computed tomography and ultrasound evaluation of blunt abdominal trauma was a prospective study of patient with non-penetrating injuries to the abdomen using ultra sound and CT scan modality. The present study is carried out at department of radiology, Guru Gobind Singh Hospital and M P Shah Medical College, Jamnagar. The study was carried out between 2017 to 2020. Result: In present study, majority of the patients of abdominal trauma are of vehicular accident and fall down is second major cause of trauma and abdominal injuries were common in age group of 11 to 40 years. In present study of 200 cases of abdominal trauma, splenic injuries were most common followed by liver and kidney injuries, minor number of patients have involvement of more than one organ (Poly-trauma). Conclusion: 200 cases of abdominal trauma were included in this study and abdominal USG and MDCT were performed as a result total 174 organ injuries were found. Abdominal injuries were more common in males (79.5%). Spleen was the most common organ to be injured – 74 cases (37%). CT is better than Ultrasound in evaluation blunt trauma abdomen.

Keywords: Blunt abdominal trauma, Computed Tomography, Ultrasound

1. Introduction

- Trauma causes an estimated 10% of worldwide deaths and is the third commonest cause of death after malignancy and vascular disease.
- Abdominal trauma contributes 10% of overall trauma mortality and considerably 1110t•e in tertns of morbidity.
- Today in the era of various emerging modalities in diagnostic radiology, ultrasound and M DC T plays a great role in evaluation of patients with acute abdominal trauma.
- Ultrasound is a fast technique, which can be brought to the patient's bedside and can give rapid information on even quite haemodynamically unstable patients.
- With invention of high resolution ultrasound machines with its excellent capability to detect solid and cystic lesions, easy availability and portability makes ultrasound a versatile tool for diagnosis of patient with acute abdominal trauma.
- The higher accuracy (approximately 98%) of CT in solid viscera assessment, including contained intraparenchymal organ injuries, and assessment of the retroperitoneum has defined its role in trauma.

2. Materials and methods

The present study of computed tomography and ultrasound evaluation of blunt abdominal trauma was a prospective study of patient with non-penetrating injuries to the abdomen using ultra sound and CT scan modality. The present study is carried out at department of radiology, Guru Gobind Singh Hospital and M P Shah Medical College, Jamnagar. The study was carried out between 2017 to 2020.

Results will be checked by two radiologist (PI and CO-PI) and final comparative data will be prepared from Computed Tomography (CT) and Ultrasound study.

Inclusion criteria

All the patients, suspected of having blunt abdominal trauma were referred from surgical, paediatric and gynaec departments for sonographic and CT evaluation on emergency basis.

Exclusion criteria

Patient with penetrating injuries

Description of tool

- 1) 16 Slice Computed Tomography (CT) machine GE Health.
- 2) Esaote my lab 60.

3. Observation and Analysis

Majority of the patients of abdominal trauma are of vehicular accident and fall down is second major cause of trauma.

In present study as the spleen is most commonly injured organ in blunt abdominal trauma the accuracy of USG in location of perisplenic collection is 100% while accuracy of USG in location of laceration, sub-capsular haematoma and intraparenchymal haematoma is 90%, 80% and 92.31% respectively. While CT scan examination shows 100% accuracy in location of splenic laceration, subcapsular or intraparenchymal haematoma and perisplenic collection.

In present study the accuracy of USG to detect intraparenchymal and subcapsular haematoma of liver is

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100% while it is 81.82% for detection of liver laceration. CT scan shows 100 % accuracy in detection of liver laceration, intraparenchymal and subcapsular haematoma.

In present study accuracy of USG for location or intraparenchymal haematoma and perinephric collection for kidney is 100% while it is 83.33% for location of kidney laceration. CT scan shows 100% accuracy in location of renal laceration, intraparenchymal haematoma and perinephric collection.

Table I: Mode of Trauma

No.	Mode of trauma	No. of patients	Percentage %
1.	Vehicular accident	120	60 %
2.	Fall from height fall down	35	17.5%
3.	Assault	26	13%
4.	Other injury (animal, crush injury, collisions)	19	9.5%
5.	Total	200	100

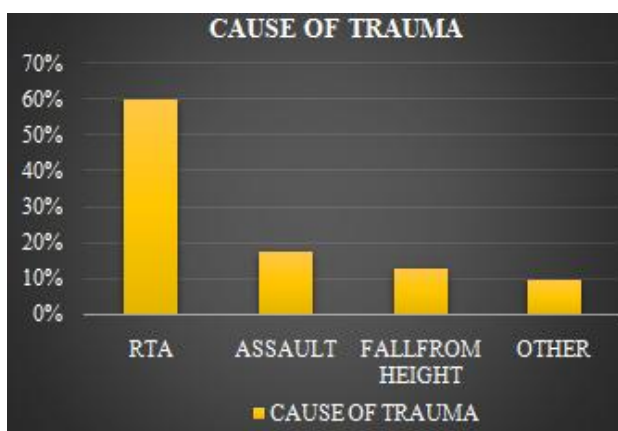


Table II: Age Incidence

No.	Age in years	No. of patients	Percentage %
1.	01 – 10	10	5%
2.	11 – 20	40	20%
3.	21 – 30	50	25%
4.	31 – 40	45	22%
5.	41 – 50	40	20%
6.	51 – 60	15	7%
	Total	200	100

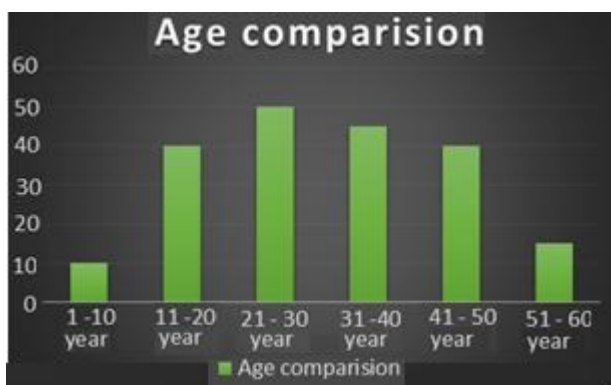


Table III: Sex Incidence

No.	Sex	No. of patients	Percentage %
1	Male	159	79.5
2	Female	41	20.5

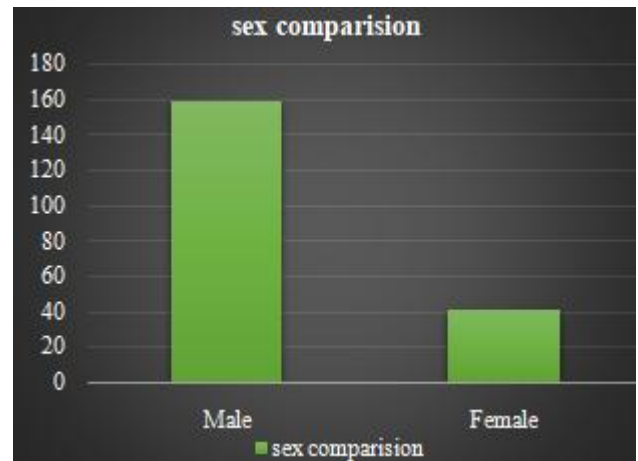


Table IV: Distribution of Visceral Injuries

No.	Organ Injuries	Percentage
1	Spleen	37%
2	Liver	31%
3	Kidney	7.50%
4	Bowel	4%
5	Urinary bladder	3.50%
6	Pancreas	4%

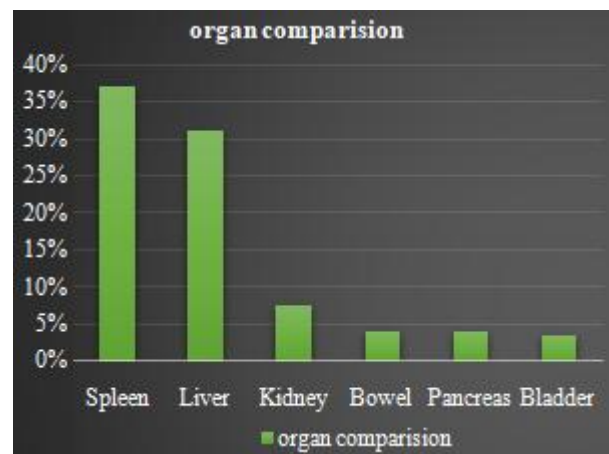


Table V: Accuracy in Case of Trauma Spleen

No.	Findings	USG findings	CT findings	Accuracy	
				USG	CT
1.	Laceration	85	95	89.4	100
2	Subcapsular haematoma	8	10	80	100
3.	Intraparenchymal haematoma	75	81	92.5	100
4.	Perisplenic Collection	16	16	100	100

Table VI: Accuracy in Case of Liver Trauma

No.	Findings	USG findings	CT findings	Accuracy	
				USG	CT
1	Laceration	66	81	81.41	100
2	Intraparenchymal haematoma	12	12	100	100
3	Subcapsular haematoma	10	10	100	100

Table VII: Distribution of Haemoperitoneum

No.	Haemoperitoneum	No. of patients	Percentage %
1.	Associated with visceral injury	160	80%
2	Isolated Haemoperitoneum	1	0.50%
3	Isolated visceral injury without Haemoperitoneum	39	19.50%
4	Total	200	100%

Table VIII: Accuracy in Case of Renal Trauma

No.	Findings	USG	CT	Accuracy	
		findings	findings	USG	CT
1	Laceration	12	15	80	100
2	Intraparenchymal Haematoma	8	8	100	100
3	Perisplenic Collection	13	13	100	100

Table IX: USG Sensitivity and Specificity

Organ involved	True Positive	True Negative	False positive	False negative	Sensitivity	Specificity	Accuracy
Spleen	73	111	07	09	89.02	94.06	92
Liver	58	126	08	08	87.87	94.02	92
Kidney	12	183	02	03	80.71	98.91	97.5
Urinary bladder	04	193	00	03	57.14	100	98.5
Free fluid in peritoneal cavity	159	39	01	01	99.36	97.5	99
Bowel injury	03	192	01	04	37.5	99.48	97.5

Table X: CT Sensitivity and Specificity

Organ Involved	True positive	True Negative	False positive	False Negative	Sensitivity	Specificity	Accuracy
Spleen	74	126	0	0	100	100	100
Liver	62	138	0	0	100	100	100
Kidney	15	185	0	0	100	100	100
Urinary Bladder	4	193	0	3	57.14	100	98.5
Free fluid in peritoneal cavity	160	40	0	0	100	100	100
Bowel Injury	3	192	1	4	37.5	99.48	97.5

4. Discussion

Table 1: Mode of Trauma

No.	Mode of Trauma	ATA UL LATEEF et al study	Arumugam et al study	Aziz et al Study	Present Study
1	Road Traffic Accident	58.9%	61%	58%	60%
2	Fall From Height	32.1%	25%	20%	17.5%
3	Assault	0.18%	-	16%	13%
4	Others	7.1%	14%	14%	9.5%

In this study 60% Patients sustained abdominal trauma following vehicular accident. This figure is more or less similar with the series of Aziz et al study, Ata ullateef et al study and arumugam et al series . The reason behind high percentage of road traffic accidents are speedy transportation, overuse of vehicles, avoidance of safety equipments while driving like helmet in bike and seat belt in car and disobey traffic rules and regulations example like pedestrian not crossing road from zebra crossing.(1,8,10)

Table II: Age Incidence

No.	Series	Most Common Involved Age Group (Years)
1.	Boutros et al study	15 TO 35
2.	SanjeevSuman et al study	21 TO 40
3.	Kalpeshvadodariya et al study	21 TO 30
4.	Present Study	11 TO 40

Here the comparison of age incidence of present study with that of western series shows more or less same age group involved in abdominal trauma in western countries and that of India. The members of this age group may have more active life, increased outdoor activity and speeding may be the possible reason.(2,5,10)

Table III: Comparison of sex incidence with different series

No.	Sex	Sanjeevsuman et al study	Boustros et al study	Kalpeshvadodariya et al study	Present Study
1	Male	81%	90%	87%	79.5%
2	Female	19%	10%	13%	20.5%

All organ injuries were more common among male (79.5%) as compared to female (20.5%) .This ratio is more or less same in western region and previous study. The fact that women are more house bounded and comparatively less involved in risky activities may be the possible explanation. (2,5,10)

Table IV: Comparison between different series for organ involvement

No.	Organ Involved	Kalpeshvadodariya et al	Ravindernath et al study	Boutros et al study	Sanjeevsuman et al study	Present Study
1	Spleen	43%	41.8%	40%	40%	37.00%
2	Liver	32%	43.2%	33%	34%	31.00%
3	Kidney	11%	16.4%	20%	35%	7.5%
4	Bowel	6%	-	7%	8%	4%
5	Urinary Bladder	2%	-	-	8%	3.5%
6	Pancreas	3%	2.5%	-	12%	3%
7	Free Fluid Only	-	3.9%	-	6%	14%

Spleen and liver are most commonly involved organs in blunt abdominal trauma, because they are superficial and more fragile organs. The other reason associated with fragility is more inflammatory and infective conditions are associated with spleen and liver. For example spleen in malarial endemic area is more prone to have trauma even with minor force. Kidneys are retroperitoneal organ but heavy force especially over flank may lead to renal trauma. The numbers of patients involved are more or less same in comparison with other series. Rest of the organs were like urinary bladder, bowel and pancreas have little incidence, but bowel rupture due to blunt abdominal trauma is more incidence with western countries series.(2,4,5,10)

Table V: USG Diagnosis of Splenic Trauma Comparison of specificity and sensitivity with Other Series

No.	Series	Sensitivity	Specificity
1	Niravpatel et al study	64.7%	97%
2	Boutros et al study	93%	99%
3	Om bahadurkarki et al study	78.9%	50%
4	Present Study	95%	99%

Spleen is most commonly involved organ in blunt abdominal trauma. The specificity and sensitivity is little less in western country and also in present study. The reason may be that spleen may be obscured by the gas in splenic flexure. A small hematoma on laceration in spleen with multiple rib fractures (especially lower rib lt. laterally), patient may not give the good scanning position to demonstrate whole spleen. Thus small lesion may be obscured.24 hours after the splenic trauma, the hematoma becomes iso-echoic, further more difficult to appreciate. USG shows an overall sensitivity of 95% and specificity of 99 % in detecting trauma to the spleen in this study.(6,10,12)

Table VI: USG Diagnosis of liver trauma specificity, sensitivity comparison of other series

No.	Series	Sensitivity	Specificity
1	P.S.L.S. Jyothi et al study	81.2%	97%
2	Boutros et al study	93%	99%
3	Nirav Patel et al Study	64.7%	100%
4	Present Study	93.54%	97.1%

Liver is second most commonly involved organ in blunt abdominal trauma. Comparison of liver trauma incidence with previous study and with western study show similar accuracy. Little variation in sensitivity may be due to in co-operation of patients, small lesion has become iso-echoic after 24 hours. Liver Is the largest solid organ in over body with five surfaces, so multidimensional demonstration of liver in patient of liver trauma may become difficult due to severe tenderness over that area. Sometimes liver trauma with hemoperitoneum causing guarding and rigidity of abdominal wall makes difficult to scan. Sonography shows 93.54 % sensitivity and 97.10% specificity and accuracy is almost similar to all studies.(3,6,12)

Table VII: Renal Trauma USG Specificity and Sensitivity Comparison with Other Series

No	Series	Sensitivity	Specificity
1	Boutros et al study	93%	99%
2	Nirav Patel et al study	98%	100%
3	Present Study	85.71%	99 %

Kidneys are less likely to be involved in blunt abdominal trauma, in comparison with spleen and liver because it is retroperitoneal organ. The comparison of renal trauma with different western study and previous study shows almost similar incidence but sensitivity is little less than specificity and accuracy of same series. That is why most of the renal trauma are treated conservatively. The nephrectomy is taken place, if major vascular trauma is associated with renal trauma or large renal hematoma shows non-functioning kidney on IVP study.(6,10)

Table VIII: Urinary Bladder Trauma comparison of incidence of bladder trauma with different series

No.	Series	Incidence
1	Adnan aziz et al study	4%
2	P.S.L.S. Jyothi et al study	2%
3	Om Bahadurkarki study	2.5%
4	Present Study	3.5%

Incidence of bladder trauma is less than previous study as well as western series. The reason may be that there is no direct sonographic evidence of bladder trauma. Collapsed bladder, even with introduction of more saline per urethral catheterization may suspect the bladder trauma. This diagnosis should be confirmed by cystography.(3,11,12)

Table IX: Pancreatic Trauma Incidence comparison with different series

No	Series	Incidence %
1	SanjeevSuman et al study	2%
2	P.S.L.S. Jyothi et al study	2%
3	Mazen I. hamidi et al study	5.3%
4	Present Study	3%

Incidence of pancreatic trauma by blunt abdominal injury is almost similar in all studies. Most of the time pancreas becomes non visualized due to overlying bowel gas. It may miss the small pancreatic tear. Most of the time small pancreatic trauma is treated conservatively.(3,5,9)

5. Images



Figure 1: CECT abdomen (axial image) of the patient showing splenic laceration contusion complex



Figure 2: USG abdomen of the same patient showing hypoechoic area involving spleen
Case 1: Splenic laceration contusion



Figure 1: CECT abdomen (axial image) of the patient showing right renal laceration with surrounding hematoma



Figure 2: USG abdomen showing ill defined hypochoic area involving kidney

Case 2: Renal Laceration with Peri Renal Hematoma

Case 3: Urinary Bladder Injury



Figure 1: CECT abdomen of patient showing urinary bladder with surrounding fluid involving pelvic cavity



Figure 2: Cystogram of the same patient showing extravasation of contrast through defect

6. Summary and Conclusion

MDCT is universally accepted as a valuable tool for evaluating hemo dynamically stable patient. It is useful in detecting otherwise occult injuries to both intra-abdominal and retro peritoneal structures and grading severity of specific parenchymal injuries.

MDCT allows not only the detection of injuries but provides new information on the severity of injuries with improved detection of vascular injury manifested by “active extravasation.”

Overall ultrasound is a good modality for screening of solid organs injury and detection of free fluid while MDCT is a gold standard modality for detailed evaluation of solid organs parenchymal injuries.

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