Section: Radiodiagnosis

Original Research Article

ROLE OF FAST AND CT SCAN IN ASSESSING BLUNT ABDOMINAL TRAUMA

Pankaj Kumar[1], Anu Sharma[2], Chiranji Lal Goel[3], Sandeep Kumar[4]

[1]*Consultant radiologist, Department of Radiodiagnosis, O P Jindal Institute of Cancer and Cardiac Research, Model Town, Hisar, Haryana, India.*
[2]*Consultant radiologist, Department of Radiodiagnosis, O P Jindal Institute of Cancer and Cardiac Research, Model Town, Hisar, Haryana, India.*
[3]*Jr. Consultant radiologist, Department of Radiodiagnosis, O P Jindal Institute of Cancer and Cardiac Research, Model Town, Hisar, Haryana, India.*
[4]*Consultant Radiologist, Department of Radiodiagnosis, Queen Elizabeth hospital, Lewisham and Greenwich NHS trust, London, United Kingdom.*

Received *: 15/10/2024*
Received in revised form *: 11/12/2024*
Accepted *: 25/12/2024*

Corresponding Author:
Dr. Sandeep Kumar,
Consultant Radiologist, Department of Radiodiagnosis, Queen Elizabeth hospital, Lewisham and Greenwich NHS trust, London, United Kingdom.
Email: radsandeep948@gmail.com

DOI: 10.70034/ijmedph.2024.4.230

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (4); 1255-1260

ABSTRACT

Background: Blunt abdominal trauma is a significant cause of morbidity and mortality, commonly resulting from road traffic accidents, falls, and assaults. Rapid and accurate diagnostic evaluation is crucial to managing such injuries effectively. This study investigates the utility of FAST (Focused Assessment with Sonography for Trauma), and CT (Computed Tomography) scans in assessing hemoperitoneum and visceral injuries in patients with blunt abdominal trauma.

Material and Methods: A cross-sectional study was conducted at the Department of Radiodiagnosis and Imaging, in tertiary centre. A total of 100 patients presenting with blunt abdominal trauma underwent FAST, and CT scans. Imaging findings were compared with operative outcomes or clinical follow-ups. Diagnostic parameters such as sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) were calculated for FAST and CT findings.

Results: FAST demonstrated a sensitivity of 90.28%, specificity of 96.43%, and accuracy of 92% in diagnosing hemoperitoneum compared to CT. For visceral injuries, FAST showed a sensitivity of 77.5% and specificity of 30%. Hemoperitoneum and visceral injuries were more reliably detected by CT, which remains the gold standard. FAST proved effective as a rapid initial diagnostic tool, particularly for identifying hemoperitoneum.

Conclusion: FAST is a valuable screening tool for the initial assessment of blunt abdominal trauma, with high specificity and accuracy for detecting hemoperitoneum. However, CT scan is indispensable for a comprehensive evaluation, particularly for identifying visceral injuries, and guides definitive management strategies. Combining FAST with CT improves diagnostic precision and patient outcomes.

Key Words: Blunt abdominal trauma, hemoperitoneum, FAST scan, CT scan, visceral injuries.

INTRODUCTION

Trauma is the leading cause of death in persons under 45 years of age, with 10% of these fatalities attributable to abdominal injury. Indian statistics reveal a disproportionate involvement of younger age groups (15-25 yrs). The Indian fatality rates for trauma are 20 times that for developed countries.[1] About 30% of such deaths are thought to be preventable. Swift recognition of injury with prompt and appropriate treatment to reduce morbidity and mortality is the goal of modern trauma care and hence accurate diagnosis is essential. Trauma most often result from road traffic accidents (RTA), falls (mainly on the work site), recreational accidents &violence accounting for the other causes.[2] RTAs are the commonest cause and account for up to 50%

of trauma related deaths. Abdominal trauma contributes 10% of overall mortality and considerably more in terms of morbidity.[3]

Abdominal injuries rank third as a cause of traumatic death just after head and chest injuries.[4] Solid organ injuries are most frequently caused by blunt abdominal trauma as the sudden application of pressure to the abdomen is more likely to rupture a solid organ than a hollow viscous. Rapid acceleration-deceleration of abdominal viscera at the time of impact generates shearing forces that result in transection or laceration of the underlying parenchyma & vessels most commonly at the point of relative fixation or at attachments. Commonest involved organs include spleen and liver.[5]

During the so-called golden hour in patients with trauma and shock, if there is intra-abdominal bleeding, the probability of death increases by about 1% for every 3 minutes that elapses before treatment.[6]

The abdomen of trauma victims is routinely evaluated with physical examination and clinical signs that have relatively low diagnostic accuracy (47% to 87%), especially when the patients have a decreased consciousness level, neurological deficit, other associated injuries, or under the influence of drugs or medications.[4] Ultrasound and computed tomography are typical tests used for abdominal evaluation in trauma[7,8]

CT remains the radiologic standard for investigating the injured abdomen but requires patient transfer and inevitable delay (bowel preparation) and is unsuitable for patients who are clinically unstable. US is an accessible, portable, noninvasive, and reliable diagnostic tool for the assessment of presence of abdominal fluid.[12-15] FAST scanning is indicated in any patient who has sustained blunt abdominal trauma, whether haemodynamically unstable or not.[16]

This study aims to evaluate the effectiveness of FAST (Focused Assessment with Sonography for Trauma), and CT (Computed Tomography) scans in diagnosing and managing blunt abdominal trauma.

MATERIALS AND METHODS

The study is a cross-sectional research conducted at the Department of Radiodiagnosis and Imaging in tertiary centre. It involved a total of 100 patients of all ages and sexes presenting with blunt abdominal trauma at the emergency department and referred for further imaging evaluation. The sample size was 100 and it was calculated based on a 95% confidence level, assuming 80% sensitivity for FAST as reported in previous studies, with a relative allowable error of 10%. Ethical clearance was obtained from the institutional ethics committee. The inclusion criteria included patients with clinical signs and symptoms of blunt abdominal trauma resulting from road traffic accidents, falls, train accidents, domestic accidents, or assaults. Patients with penetrating abdominal injuries or associated neurological injuries were excluded.

All patients underwent FAST, and CT scans, with efforts made to minimize the time gap between these investigations. FAST was performed using the GE VOLUSON 730 PRO machine, assessing free intraperitoneal fluid in perihepatic, perisplenic regions, and the pouch of Douglas. The intraabdominal organs were also evaluated for signs of injury.

CT scans were conducted using a Siemens Somatom Emotion 16-slice scanner, with both pre- and post-contrast imaging. Intravenous contrast medium was administered per protocol. Oral and rectal contrast was not given. The scans spanned the diaphragm to the pubic symphysis, with 5 mm contiguous sections and reconstructed sagittal, coronal, and axial views. Delayed scans were performed when kidney or urinary tract injuries were suspected. Imaging findings from FAST and CT were compared, and outcomes were validated with operative findings or clinical follow-ups in cases where surgery was deferred.

For diagnostic purposes, FAST findings were considered positive for hemoperitoneum if intraabdominal free fluid was detected, regardless of volume or location. Visceral injuries were identified based on changes in echogenicity. CT findings were classified and quantified using the Organ Injury Scale (OIS) by the American Association for the Surgery of Trauma (AAST) and its CT-adapted classifications.

Data was analyzed using SPSS 18.0, with Microsoft Word and Excel used for creating charts and graphs. Diagnostic accuracy of FAST and CT was evaluated by categorizing findings into true positives, false positives, false negatives, and true negatives, and calculating sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV). Statistical significance was assessed using the Chi-square test, with a p-value of <0.05 considered significant. This comprehensive methodology allowed for a detailed evaluation of the efficacy of FAST and CT in diagnosing blunt abdominal trauma.

RESULTS

In this study, 11-30 year age category formed the major group (55%). Maximum number of patients were in 3rd decade. 89% of patients were male. M:F ratio was 8:1. RTAs (80%) were most common mode of blunt abdominal trauma followed by fall (14%). Out of 42 hemodynamically unstable patients, 25 were operated. Only 11 were operated out of 58 hemodynamically stable patients. 66 patients were having hemoperitoneum on FAST, out of which 32 were operated. Only 4 were operated out of 34 patients without hemoperitoneum. 72 patients were having hemoperitoneum on CT scan, out of which 31 were operated. Only 5 were operated out of 28 patients without hemoperitoneum. [Table 1]

16 patients were having small amount of hemoperitoneum and all were conservatively managed. 25 patients were having large amount of hemoperitoneum and all were operated. Out of 31 patients with moderate amount of hemoperitoneum 25 were conservatively managed and 6 were operated. [Table 2]

76 patients were positive for visceral injury on FAST out of which 26 were operated. Out of 24 patients with no visceral injury, 10 were operated. [Table 3]

80 patients were positive for visceral injury on CT out of which 36 were operated. 20 patients were not having any visceral injury and all were conservatively managed. [Table 4]

Table 1: Comparison of FAST with CT for Diagnosing Hemoperitoneum

	CT Positive	CT Negative	Total	P Value
FAST Positive	65 (TP)	1 (FP)	66	0.0001
FAST Negative	7 (FN)	27 (TN)	34	
Total	72	28	100	

Sensitivity = 65 / (65+7) x 100 = 90.28%

Specificity = 27 / (27+1) x 100 = 96.42%

Accuracy = 65 + 27 / (65+27+7+1) x 100 = 92%

Positive predictive value (PPV) = 65/(65+1) x 100 = 98.48%

Negative predictive value (NPV) =27/(27+7) x 100 = 79.4%

Table 2: CT Quantification of Hemoperitoneum and Management

	Total no. of patients	No. of conservatively managed patients	No. of operated patients
Small(100-200ml)	16	16	0
Medium(250-500ml)	31	25	6
Large(>500ml)	25	0	25
Total	72	41	31

Table 3: FAST Diagnosis of Visceral Injuries and Management

FAST Finding	Total No. of Patients	No. of Conservatively Managed Patients	No. of Operated Patients
Positive	76	50	26
Negative	24	14	10
Total	100	64	36

Table 4: CT Diagnosis of Visceral Injuries and Management

CTFinding	Total No. of Patients	No. of Conservatively Managed Patients	No. of Operated Patients
Positive	80	44	36
Negative	20	20	0
Total	100	64	36

Table 5: Comparison of FAST with CT for Diagnosing Visceral Injuries

	CT Positive	CT Negative	Total	P Value
FASTPositive	62(TP)	14(FP)	76	0.48
FASTNegative	18(FN)	6(TN)	24	
Total	80	20	100	

Sensitivity = 62 / (62+18) x 100 = 77.5%

Specificity = 6 / (6+14) x 100 = 30%

Accuracy = 62 + 6 / (62+14+18+6) x 100 = 68%

Positive predictive value (PPV) = 62/(62+14) x 100 = 81.58%

Negative predictive value (NPV) =6/(6+18) x 100 = 25%

Table 6: Comparison of Hemoperitoneum on FAST with Visceral Injury on CT

	CT Positive	CT Negative	Total	P Value
FASTPositive	66(TP)	0(FP)	66	0.001
FASTNegative	14(FN)	20(TN)	34	
Total	80	20	100	

Sensitivity = 66 / (66+14) x 100 = 82.5%

Specificity = 20 / (20+0) x 100 = 100%

Accuracy = 66 + 20 / (66+20+0+14) x 100 = 86%

Positive predictive value (PPV) = 66/(66+0) x 100 = 100%
Negative predictive value (NPV) =20/(20+14) x 100 = 58.8%

Table 7: Multiplicity of Organs Injured Diagnosed on FAST

No. of Organs injured	No. of Patients	Total No. of Organs Injured
1	57	57
2	17	34
3	2	6
Total	76	97

Table 8: Types of Viscera Injured Diagnosed on FAST

Types of Viscera Injured	No of Patients
Solid	76
Hollow	0

Table 9: Distribution of Visceral Injuries Diagnosed on FAST

S.No.	Abdominal Viscera Involved	No. of Viscera Injured	Percentage
1	Spleen	39	40.21
2	Liver	38	39.18
3	Kidney	18	18.55
4	Pancreas	2	2.06
5	Others	0	0
	Total	97	100

Table 10: Multiplicity of Organs Involved Diagnosed on CT

No. of Organs	No. of Patients	Total No.of Organisms
1	57	57
2	19	38
3	4	12
Total	80	107

Table 11: Types of Viscera Injured Diagnosed on CT

Types of VisceraI injury	Noof Patients
Solid	69
Hollow	11

Table 12: Distribution of Visceral Injuries Diagnosed on CT

S.No.	Abdominal Viscera Involved	No. of Visceras Injured	Percentage
1	Spleen	39	36.4
2	Liver	35	32.7
3	Kidney	18	16.8
4	BowelandMesentry	8	7.47
5	Pancreas	3	2.8
6	Bladder	3	2.8
7	Diaphragm	1	0.93
	Total	107	100

Table 13: CT- Organ Injury Scale Grading and Management of Solid Organ Injuries

OIS Grade	Total No. ofPatients	No. of Conservatively Managed Patients	No. of Operated Patients
GradeI	8	8	0
GradeII	13	11	2
GradeIII	39	24	15
GradeIV	7	0	7
GradeV	2	0	2
Total	69	43	26

DISCUSSION

In the present study, we evaluated 100 patients of blunt abdominal trauma with FAST and CT scan. The patients in our study were in all age groups ranging from 6 - 56 years. The predominant age group was 11-30 years comprising 55% of the total patients. Maximum no. of patients were in 3rd decade (31%). 12% patients belonged to the pediatric age group of under 12 years. Only 3% patients were above 50 years. Out of 100 patients in our study, 89 patients were males and only 11 cases were females and male:female ratio was (8:1). Similar findings were also observed by Mallik et al,[18] in the study of 33 patients with blunt abdominal trauma in which males with mean age of

21.9 years were commonly affected. MM Kumar et al. 19 in their study of 210 patients with blunt abdominal trauma reported that maximum number of patients were in age group between 21-30 years constituting 31.90% of total patients with a male predominance ofM:F=4:1. Michael I Nnamonu et al,[20] studied 57 patients and found that maximum no. of patients were in age group of 18-26 years and male : female ratio was 3.8:1. Yasmeen iqbal et al,[21] studied 100 patients with blunt abdominal trauma and found that mean age was 31.5 year with 88% males and 12% females. In western studies Rhodes et al. 22 reported a mean age group of 30 years with M:F=1.8:1. So as overall, our study is comparable to previous studies. However, as compared to western countries our study shows a higher male predominance with younger age group involvement.

In our study road traffic accidents (RTA) (80%) was the most common mode of injury followed by fall (14%). Mallik et al,[18] reported that RTA (64%) was the most common mode of trauma. MM Kumar et al.19 reported that RTA accounts for 73% of cases of blunt abdominal trauma. Poletti et al,[23] reported that 71% of cases of blunt abdominal trauma were due to motor vehicle accidents, 18% due to fall and 11% due to assault & miscellaneous causes. Yasmeen iqbal et al,[21] also reported that RTA was most common mode of blunt abdominal trauma accounting for 80% of all cases. So our figures correspond to the previous studies.

In our study, 42 patients were hemodynamically unstable & 58 were hemodynamically stable at the time of admission. 25 patients with hemodynamic unstability underwent surgery. Boulanger BR et al,[12] also found hemodynamic status as a decision making tool for identifying the need for laparotomy in hypotensive patients.

In our study hemoperitoneum was detected in 66 patients on FAST and 72 patients on CT scan. FAST accurately diagnosed hemoperitoneum in 65 patients (true positive) and falsely diagnosed in 1 patient (false positive). FAST missed hemoperitoneum in 7 patients (false negative). In 27 patients (true negative) FAST accurately ruled out hemoperitoneum. So on the basis of these findings sensitivity, specificity, accuracy, positive predictive value and negative predictive value of FAST for diagnosing hemoperitoneum were calculated as compared to CT scan and results were compared with previous similar studies.

When the results of FAST and CT were compared using the chi square test it was found that patients having hemoperitoneum on FAST scan had a statistically significant probability of having hemoperitoneum on CT ($p < 0.0001$) (< 0.05, significant). In our study out of 100 patients, 36 patients underwent laprotomy out of which 32 patients were diagnosed as hemoperitoneum positive and 4 patients as hemoperitoneum negative on FAST. So regarding hemoperitoneum FAST can be considered as a reliable modality for predicting the management approach. Similar results were also reported by Mallik et al,[18] and M M Kumar et al,[19]

FAST accurately diagnosed visceral injuries in 62 patients (true positive), falsely diagnosed visceral injury in 14 patients (false positive). FAST missed visceral injury in 18 patients (false negative) out of which 11 patients had hollow viscus injury (8 bowel & mesentry and 3 bladder), 1 patient had diaphragmatic injury and remaining 6 patients had solid visceral injury. FAST accurately ruled out visceral injury in 6 patients (true negative). [Table 15]

FAST accurately diagnosed hemoperitoneum in 66 patients who were having visceral injuries on CT scan (true positive). FAST accurately ruled out hemoperitoneum in 20 patients who were negative for any visceral injury on CT scan (true negative). In 14 patients who were having visceral injuries on CT scan , FAST failed to detect hemoperitoneum (false negative) .However there was not a single case in which visceral injury was not seen on CT and FAST diagnosed hemoperitoneum(false positive). [Table 16]

When the results of FAST and CT were compared it was found that patients having hemoperitoneum on FAST scan had a statistically significant probability of having a visceral injury on CT.

On FAST we detected 97 visceral injuries in 76 patients. 19 patients were having multiple visceral injuries and 57 were having single visceral injury. These were all solid visceras. FAST could not diagnose any hollow visceral injury. Michael I Nnamonu et al,[20] studied 57 patients and found multi organ involvement in 8 patients and single organ involvement in 38 patients on sonography. Among single organ injuries spleen was most common organ injured (30%). Mallik et al,[18] reported 3 patients had multiorgan involvement out of 33 patients. So, as compared to Mallik et al. our study shows a higher frequency of multiorgan involvement.

Spleen was the most common organ involved (36.4%) followed by liver (32.7%), kidneys (16.8%), bowel & mesentry (7.47%), pancreas (2.8%) bladder (2.8%), & lastly diaphragm (0.93%). Mallik et al,[18] reported that spleen (39.39%) was the commonest organ involved followed by renal (27.27%), liver (18%) & pancreatic & bowel injuries accounting each of 6% cases. MM Kumar et al.19 reported that spleen as the commonly injured organ (36.17%) followed by liver (29.79%), bowel & mesentry (17%), Kidney (6.39%), pancreas (4.25%) and bladder (4.25%).

In our study, 69 patients had 95 solid viscera injuries which were all diagnosed on CT scan and grading was done according to OIS guidelines as advised by AAST. 8 patients had grade I injuries, 13 patients had grade II injuries, 39 patients had grade III injuries, 7 patients had grade IV injuries and 2 patients had grade V injuries. Similar results were seen by M M Kumar et al.[19]

Table 15: Comparison of Results with Similar Previous Studies

Study	Sensitivity %	Specificity %	Accuracy %	PPV %	NPV %
Our study	90.28	96.43	92	98.48	79.41
Lingawi Setal.[24]	94	98	95	78	100
Tsui CL et al.[25]	86	99	97	94	98
Nnamonu MIetal. [20]	91.9	94.3	92.85	96.38	85.96
Iqbal Yetal.[21]	76.92	70.83	74	74.07	73.9

Table 16: Comparison of results with similar previous studies

Study	Sensitivity %	Specificity %	Accuracy %	PPV %	NPV %
Our study	77.5	30	68	81.58	25
Nnamonu MI etal.[20]	71	35	56	62	44

Table 17: Comparison of results with similar previous study

Study	Sensitivity %	Specificity %	PPV %	NPV %
Our study	82.5	100	100	58.8
Poletti PA etal.[23]	65	82	77	71

CONCLUSION

FAST scan is a useful diagnostic tool in the initial assessment of blunt abdominal trauma patients. It is accurate with high specificity and positive predictive value for diagnosing hemoperitoneum. The high negative predictive value makes it a useful screening tool for detecting hemoperitoneum. However It has low sensitivity and specificity in directly demonstrating visceral injuries specially for hollow visceras. Although FAST diagnosis of hemoperitoneum increases the chances of surgical management, accurate imaging diagnosis by CT scan regarding visceral injuries are the main determinants which dictate the type of management strategies. Hence it is imperative that all the FAST positive patients and FAST negative but symptomatic patients should undergo CT scan however negative FAST scan and asymptomatic patients with normal clinical examination can be followed up without CT scan or indoor admission.

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