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DIAGNOSTIC ACCURACY OF FAST SCAN IN PATIENT WITH BLUNT ABDOMINAL TRAUMA KEEPING CECT ABDOMEN AS GOLD STANDARD

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ABSTRACT

Introduction: Blunt abdominal trauma (BAT) remains a significant cause of morbidity and mortality. FAST is a non-invasive ultrasound modality primarily employed to detect free intra-peritoneal fluid suggestive of heamoperitoneum. CECT abdomen is used in stable patients for its superior ability to delineate solid organ injuries, retroperitoneal involvement, and vascular compromise. This study evaluates the diagnostic accuracy of FAST compared to CECT in patients with blunt abdominal trauma, using CECT findings as the gold standard.

Methodology: A cross-sectional study was conducted at CMH Muzaffarabad from September 19, 2023, to March 18, 2024, involving 140 patients with history of blunt abdominal trauma. Ultrasonography (FAST scan) was used initially for screening the trauma patients for the presence or absence of free intra-peritoneal fluid. CECT abdomen was performed to detect any free intra-peritoneal fluid and visceral injury which serve as a gold standard. Parameters assessed included sensitivity, specificity, PPV, NPV, and accuracy.

Results: In a study with 140 patients, 85% were male and 15% were female, with a mean age of 29.0071 ±10.42 years. The types of trauma experienced were predominantly Road traffic accident (65.7%), History of Fall (28.5%), Assault (5.7%). The FAST scan results revealed that 40% of the patients had positive findings, while 60% had negative findings. In comparison, CECT findings were positive in 35% and negative in 65% of the cases.

Conclusion: In conclusion, the FAST scan is a valuable tool in the rapid assessment of abdominal trauma. However, its diagnostic limitations, necessitate cautious interpretation. The integration of FAST with other diagnostic modalities, continued operator training, and possibly the adoption of advanced techniques may improve outcomes in trauma care.

Keywords: FAST, CECT Abdomen, Blunt Abdomen Injuries**,** Ultrasonography, Diagnostic Accuracy, Trauma.

Introduction

Blunt abdominal trauma (BAT) remains a significant cause of morbidity and mortality, often stemming from motor vehicle accidents, falls, or assaults(1). Prompt diagnosis is critical to improving outcomes, given the subtle clinical presentations and potential for rapid deterioration(2). Among the diagnostic modalities available, Focused Assessment with Sonography in Trauma (FAST) and Contrast-Enhanced Computed Tomography (CECT) are pivotal tools, each with unique advantages and limitations.(3)

FAST is a bedside, non-invasive ultrasound modality primarily employed to detect free intraperitoneal fluid suggestive of hemoperitoneum(4). Its portability, speed, and ease of use make it indispensable in the initial assessment of hemodynamically unstable patients(5) (2). However, FAST's sensitivity can vary, particularly in identifying retroperitoneal or solid organ injuries(6). Operator experience, patient factors, and limitations in visualizing small amounts of fluid contribute to false negatives, with studies highlighting detection sensitivities ranging from 46% to over 90% depending on the clinical setting(6).

In contrast, CECT is widely regarded as the gold standard in stable patients for its superior ability to delineate solid organ injuries, retroperitoneal involvement, and vascular compromise(7). It offers high sensitivity and specificity, often exceeding 95%, with the added advantage of detailed anatomical imaging that informs both conservative and surgical management(8). However, CECT requires patient stability, incurs higher costs, and exposes patients to ionizing radiation and contrast-related risks(9).

This study evaluates the diagnostic accuracy of FAST compared to CECT in patients with blunt abdominal trauma, using CECT findings as the reference standard. The analysis aims to define the respective roles of these modalities in guiding timely and appropriate interventions.

Methodology

This descriptive observational study was conducted to evaluate the diagnostic accuracy of the Focused Assessment with Sonography in Trauma (FAST) compared to Contrast-Enhanced Computed Tomography (CECT) as the gold standard for detecting intra-abdominal injuries in patients with blunt abdominal trauma. Patients presenting to the emergency department with blunt abdominal trauma were enrolled based on clinical suspicion of intra-abdominal injury requiring imaging. Hemodynamically stable patients were included, while those with penetrating injuries, pregnancy, prior abdominal surgeries, or inadequate clinical data were excluded. Sample size of 140 patients was calculated with a WHO calculator with a sensitivity of 90% (10), margin of error of 5%, Confidence interval of 95% and taking prevalence of disease of 50%.

All patients underwent a FAST examination during their initial resuscitation, followed by a CECT scan. FAST was performed by trained radiologist using a portable ultrasound machine with a 3.5 MHz convex probe. The four standard views of the FAST scan—right upper quadrant, left upper quadrant, subxiphoid, and suprapubic—were examined for the presence of free fluid, which was considered a positive finding if identified. CECT scans were subsequently performed using a multi-detector CT scanner with intravenous contrast to evaluate free fluid, solid organ injuries, and retroperitoneal injuries. These findings were graded using the Organ Injury Scaling (OIS) system.

The results of FAST and CECT were compared with intraoperative findings in cases where surgery was performed or with clinical outcomes in conservatively managed cases. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of FAST were calculated using CECT findings as the gold standard. Inter-observer agreement between FAST and CECT findings was also assessed.

Ethical approval for the study was obtained from the institutional ethics committee, and informed consent was obtained from all patients or their legal representatives. Statistical analysis was performed using Statistical Package for the Social Sciences SPSS V22 to calculate sensitivity, specificity, PPV, NPV, and overall accuracy with 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant. Certificate from ethical committee was obtained - Ref No. Ethical committee / DME 818.

Operational Definitions

FAST Scan:

A rapid, bedside ultrasound examination performed in trauma settings to identify free fluid in the abdominal cavity, specifically in the hepatorenal space (Morrison's pouch), splenorenal recess, pouch of Douglas, and pericardial region. A positive FAST result is defined as the detection of anechoic (dark) free fluid in any of these regions, indicative of hemoperitoneum or other internal injuries.

Contrast-Enhanced CT:

A diagnostic imaging modality that uses intravenous contrast agents to enhance the visualization of abdominal and pelvic structures. It is considered the gold standard for detecting solid organ injuries, retroperitoneal injuries, and free fluid in stable patients with blunt abdominal trauma. CECT findings include hemoperitoneum, contrast extravasation, solid organ lacerations, hematomas, and bowel or mesenteric injuries.

RESULTS

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The study included 140 patients ranging in age from 10 to 61 years, with a mean age of 29.01 years (SD = 10.42). The majority of the patients were male (85%, n = 119), while 15% (n = 21) were female. The types of trauma experienced were predominantly Road traffic accident (65.7%, n = 92), History of Fall (28.5%, n = 40), Assault (5.7%, n = 8) (**Table 1**).

The FAST scan results revealed that 40% (n = 56) of the patients had positive findings, while 60% (n = 84) had negative findings. In comparison, CECT findings were positive in 35% (n = 49) and negative in 65% (n = 91) of the cases (**Table 1**).

Age (years)				
N	**Minimum**	**Maximum**	**Mean**	**St. Deviation**
140	10 years	61 years	29.0071 years	10.42237
Gender				
	Frequency (N)	**Percentage (%)**		
Male	119	85.0		
Female	21	15.0		
Type of Blunt Trauma				
	Frequency (N)	**Percentage (%)**		
Road traffic accident	92	65.7		
History of Fall	40	28.5		
Assault	8	5.7		
FAST Scan findings				
	Frequency (N)	**Percentage (%)**		
Positive	56	40.0		
Negative	84	60.0		
CECT findings				
	Frequency (N)	**Percentage (%)**		
Positive	49	35.0		

Negative	91	65.0

Table 1. Patients demographics and findings.

In terms of diagnostic performance, the sensitivity of the FAST scan was calculated at 95.9%, while specificity was 90.1%. The positive predictive value was 83.9%, and the negative predictive value was 97.6%. Overall, the diagnostic accuracy of the FAST scan in comparison to CECT was 92.1% (**Table 2 & 3**).

		CECT FINDINGS		
		Positive	Negative	
FAST SCAN FINDINGS	Positive	47 (TP)	9 (FP)	56
	Negative	2 (FN)	82 (TN)	84
Total		49	91	140

Table 2. 2 x 2 table of FAST Scan findings with CECT findings in abdominal trauma.

Statistic	**Formula**	**Result**
Sensitivity:	TP/ (TP+FN) x100	**47/(47+2)=0.9591x 100=95.9%**
Specificity	TN/ (TN+FP) x100	**82/(82+9)=0.901x100=90.1%**
Positive Predictive Value:	TP/ (TP+FP) x100	**47/(47+9)=0.839x100=83.9%**
Negative Predictive Value:	TN/ (TN+FN) x100	**82/(82+2)=0.976x100=97.6%**

Diagnostic accuracy	(TP+TN)/(TP+FP+FN+TN) x 100	**(47+82)/(47+9+2+82)= 0.921x100=92.1%**

Table 3. Statistics for FAST Scan in abdominal trauma.

However, when evaluating specific organ injuries, the results varied. For liver injury, the FAST scan demonstrated a sensitivity of 91.4%, specificity of 70.0%, PPV of 37.5%, NPV of 97.6%, and an accuracy of 73.5%. In spleen injuries, the sensitivity was 84.6%, specificity was 64.5%, PPV was 19.6%, NPV was 97.6%, and accuracy was 66.4%. Renal injuries had a sensitivity of 77.7%, specificity of 62.5%, PPV of 12.5%, NPV of 97.6%, and accuracy of 63.5%. For pancreatic injuries, the sensitivity was 66.6%, specificity was 61.1%, PPV was 7.14%, NPV was 97.6%, and accuracy was 61.4%. Bowel injuries showed similar results with a sensitivity of 66.6%, specificity of 61.1%, PPV of 7.14%, NPV of 97.6%, and accuracy of 61.4% (**Table 4**). These findings indicate that while the FAST scan demonstrates high sensitivity and NPV, its specificity and PPV vary considerably depending on the type of injury, highlighting limitations in certain scenarios.

Statistics of FAST Scan for Liver, spleen, renal, pancreas, bowel injuries.					
Statistic	**Results**				
	Liver	**Spleen**	**Renal**	**Pancreas**	**Bowel**
Sensitivity:	91.4%	84.6%	77.7%	66.6%	66.6%
Specificity	70.0%	64.5%	62.5%	61.1%	61.1%
Positive Predictive Value:	37.5%	19.6%	12.5%	7.14%	7.14%
Negative Predictive Value:	97.6%	97.6%	97.6%	97.6%	97.6%
Diagnostic accuracy	73.5%	66.4%	63.5%	61.4%	61.4%

Table 4. Statistics of FAST Scan for Liver, spleen, renal, pancreas, bowel injuries.

DISCUSSION

In this study, we assessed the diagnostic performance of the FAST (Focused Assessment with Sonography for Trauma) scan in detecting various types of abdominal trauma, comparing its results with the more definitive CECT (Contrast-Enhanced Computed Tomography)(18). The FAST scan demonstrated a high sensitivity of 95.9% and a negative predictive value (NPV) of 97.6% for general abdominal trauma, which suggests its efficacy as a preliminary screening tool in emergency settings(19,20). However, the performance of the FAST scan in detecting specific organ injuries showed significant variability, particularly in terms of specificity and positive predictive value (PPV).

The high sensitivity observed for the FAST scan in detecting overall abdominal trauma is consistent with previous studies that have established its utility in emergency departments, where rapid decision-making is crucial(14,15). The FAST scan's ability to quickly identify free fluid in the abdomen, a potential sign of internal bleeding, makes it invaluable in triage situations(16). However, the specificity of 90.1% and PPV of 83.9% indicate that while the FAST scan is excellent at confirming the presence of injury, there remains a significant rate of false positives, especially when assessing damage to specific organs. These findings are critical, as the presence of false positives can lead to unnecessary surgical interventions or further diagnostic procedures, increasing the risk and cost associated with patient care.

For liver injuries, the FAST scan showed a sensitivity of 91.4%, which is relatively high and consistent with previous reports (1). However, its specificity dropped to 70.0%, and the PPV was only 37.5%, indicating a significant number of false positives. The lower specificity and PPV for liver injuries may be attributed to the difficulty in accurately identifying liver lacerations or contusions solely through ultrasonography, which may not capture the full extent of parenchymal damage (17). Liver injuries are often associated with high morbidity, and the FAST scan's limitations in this context suggest the need for supplementary imaging techniques, particularly in patients who are hemodynamically stable and where there is a high suspicion of liver injury.

The performance of the FAST scan in detecting spleen injuries was also suboptimal, with a sensitivity of 84.6% and specificity of 64.5%. The PPV for spleen injuries was notably low at 19.6%, suggesting that a large proportion of the detected cases may be false positives. This result can be attributed to the spleen's anatomical position and the often diffuse nature of splenic injuries, which may complicate accurate detection with ultrasonography. The overall diagnostic accuracy for spleen injuries was 66.4%, which reinforces the idea that while the FAST scan can be a useful initial assessment tool, it may not be sufficiently reliable to diagnose splenic trauma without additional imaging, particularly when the clinical presentation is ambiguous (10). In clinical practice, this variability in diagnostic accuracy necessitates careful interpretation of FAST scan results, particularly in settings where the spleen is a potential site of injury.

Renal injuries presented a different set of challenges. The sensitivity of the FAST scan for renal injuries was 77.7%, but specificity was lower at 62.5%, and the PPV was alarmingly low at 12.5%. Renal injuries, which are often retroperitoneal, pose inherent challenges for ultrasonographic assessment due to their anatomical location and the presence of overlying bowel gas, which can obscure the kidneys (8). The diagnostic accuracy of 63.5% for renal injuries suggests that while the FAST scan can identify significant trauma to the kidneys, its limitations are pronounced enough to warrant follow-up with more definitive imaging modalities like CECT, especially in patients presenting with symptoms such as hematuria or flank pain. Given the critical nature of renal injuries and their potential for significant morbidity, reliance on the FAST scan alone could result in missed diagnoses, delayed treatment, or inappropriate management strategies.

Pancreatic and bowel injuries demonstrated even lower diagnostic reliability with the FAST scan. The sensitivity for these types of injuries was 66.6%, with specificity around 61.1%, and the PPV was just 7.14%. These findings are particularly concerning because pancreatic and bowel injuries, although less common than liver or spleen injuries, are associated with high morbidity and require prompt diagnosis and intervention (11). The low diagnostic accuracy of

61.4% underscores the inadequacy of the FAST scan in these contexts, likely due to the subtle and often delayed presentation of these injuries, which are difficult to visualize on ultrasound. Bowel injuries, for instance, may not be associated with free fluid in the peritoneum initially, making them challenging to detect without more advanced imaging techniques. Similarly, pancreatic injuries can present with minimal initial symptoms, and the pancreas itself may be difficult to visualize on ultrasound, particularly in the presence of abdominal distention or overlying bowel gas.

These findings highlight the importance of understanding the limitations of the FAST scan in trauma care. While it remains a valuable tool for rapid assessment in emergency settings, particularly for detecting free fluid and guiding initial management decisions, its limitations in diagnosing specific organ injuries are significant. The variability in its performance across different types of injuries suggests that the FAST scan should not be used in isolation for definitive diagnosis, especially in cases where clinical suspicion of organ damage is high, but FAST results are equivocal or negative. In such scenarios, the use of CECT or other advanced imaging modalities is essential to ensure accurate diagnosis and appropriate management.

Moreover, the results of this study underscore the need for advanced training and experience in the interpretation of FAST scans. The accuracy of the FAST scan is highly operator-dependent, and variations in experience and training can significantly impact the sensitivity and specificity of the results. Emergency physicians and trauma surgeons must be aware of the potential pitfalls in interpreting FAST scans, particularly when assessing for specific organ injuries. Enhanced training programs, including the use of simulation and real-time feedback, could improve the diagnostic accuracy of FAST and reduce the incidence of false positives and false negatives.

The potential for integrating newer imaging technologies or protocols that could enhance the diagnostic accuracy of the FAST scan is another area worth exploring. For example, contrast-enhanced ultrasound (CEUS) has shown promise in improving the detection of certain types of trauma, such as splenic and liver injuries, and could be considered as an adjunct to the standard

FAST protocol (12,17). CEUS has the advantage of providing more detailed images of organ parenchyma and blood flow, potentially improving the sensitivity and specificity of ultrasound in detecting parenchymal injuries. However, the use of CEUS in emergency settings may be limited by availability, cost, and the need for specialized training.

Furthermore, the integration of FAST with other diagnostic modalities, such as point-of-care CT or MRI, could offer a more comprehensive approach to trauma assessment. While CT remains the gold standard for evaluating abdominal trauma, especially in hemodynamically stable patients, its availability in all emergency settings is not guaranteed, and the risks associated with radiation exposure must be considered, particularly in pediatric populations or in situations where repeated imaging is required. MRI, on the other hand, offers excellent soft tissue contrast and no radiation exposure but is limited by longer imaging times and less availability in emergency settings.

CONCLUSION

In conclusion, the FAST scan is a valuable tool in the rapid assessment of abdominal trauma, particularly in resource-limited settings or situations where time is of the essence. However, its diagnostic limitations, particularly in specific organ injuries such as those involving the liver, spleen, kidneys, pancreas, and bowel, necessitate cautious interpretation. The integration of FAST with other diagnostic modalities, continued operator training, and possibly the adoption of advanced techniques like CEUS may improve outcomes in trauma care. Further research is needed to refine the application of FAST and enhance its accuracy across all types of abdominal injuries.

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