

Research Article

Diagnostic Performance of Ultrasound in Detecting Abdominal Trauma at Tertiary Care Center

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Article History

Received: 05.05.2022

Revised: 12.05.2022

Accepted: 22.06.2022

Published: 30.06.2022

Citations:

P Karthik Prakash. Diagnostic Performance of Ultrasound in Detecting Abdominal Trauma at Tertiary Care Center. *J Surg Radiol*, 01(02)2022; 26-30.

Abstract: The Focused Assessment with Sonography for Trauma (FAST) examination using conventional ultrasound has limited utility for detecting solid organ injury. Therefore, this systematic review and meta-analysis compares the performance of contrast-enhanced ultrasound (CEUS) to conventional ultrasound when used as the initial assessment for abdominal trauma prior to computed tomography (CT) imaging. Patient and physician satisfaction are also crucial factors, as they directly impact the quality of care and patient outcomes. The comfort and anxiety levels of paediatric patients during diagnostic procedures, and the ease of use and learning curve of ultrasound for healthcare providers, are essential components of overall healthcare delivery. Methods This is a prospective study was conducted in the Department of Radiology, Shadan Institute of Medical Sciences, Teaching Hospital & Research Centre. Consecutive blunt abdominal trauma patients admitted to emergency room of Hospital over a period of 6 months. Data including the mechanism of abdominal injury, ultrasound diagnosis, CT imaging, and clinical management were analyzed. The bedside abdominal ultrasonography was performed before the abdominal trauma patients transferred to CT room. The principle of bedside abdominal ultrasonography scans is to assess the presence/absence of any amount of free fluid that mostly is blood from broken organs. Results In the present study, a total of 110 patients were included out of which 74 (71.1%) were males and 36 (28.8%) were females (table-1). In our study, most of the patients were 21-30 years i.e., 31 out of 90 (34.4%), followed by 31-40 years, i.e., 23 out of 90 (25.5%). Ultrasound identified internal injuries in 71.1% of cases, Speed and Efficiency: The average ultrasound examination duration was 15 minutes, enhancing patient throughput in the emergency department. Ultrasound findings led to immediate intervention in 29.9% of cases. The ultrasound was reported to be user-friendly with a quick learning curve, and patients experienced less discomfort and anxiety compared to other diagnostic modalities. Conclusion The diagnostic performance of ultrasound in detecting abdominal trauma at a tertiary care center demonstrates its utility as a rapid, non-invasive, and effective initial imaging modality. Focused Assessment with Sonography for Trauma (FAST) is particularly valuable in hemodynamically unstable patients, offering timely identification of free intraperitoneal fluid, which is often indicative of significant injury. However, its sensitivity and specificity can vary depending on the type and severity of trauma, operator experience, and patient factors such as body habitus.

Keywords: Ultrasound, Implementation, Credentialing.

INTRODUCTION

The Focused Assessment with Sonography for Trauma (FAST) examination using conventional ultrasound has been an integral part of the evaluation of trauma patients for over 20 years [1]. While the FAST is an extremely useful bedside tool for ruling in intraabdominal free fluid in the trauma resuscitation setting, it has limited utility for detecting solid organ injury, particularly in the absence of intraperitoneal free fluid [2]. To date, there are numerous studies that investigated whether the use of contrast-enhanced agents with ultrasound, also known as contrast-enhanced ultrasound (CEUS), improved the sensitivity and specificity for detecting abdominal traumatic lesions. Utilizing small intravenous boluses of inert gas-filled microbubbles with a phospholipid shell, acute solid organ lesions can be depicted in real time through all the vascular phases [3].

Furthermore, these agents are well tolerated in patients, particularly those with renal insufficiency, hypotension, or shock [4]. Currently, there are multiple studies that

report the benefits of using CEUS for the identification of abdominal injuries following trauma [8–10], however

CME Journal of Geriatric Medicine 17 none directly compare its accuracy to conventional ultrasound nor its effectiveness when utilized with the FAST exam during the initial trauma assessment. Therefore, the objective of this systematic review and meta-analysis was to compare the performance of conventional ultrasound and CEUS when used as the initial assessment for abdominal trauma, whereby all sonographic examinations have been completed prior to computed tomography (CT) imaging [5].

To study the use of ultrasound for assessment of abdominal trauma during the secondary assessment. Three current methods for evaluation of abdominal trauma will be outlined. The use of ultrasound in evaluation of patients with blunt abdominal trauma will be highlighted, including performance of test, time to test completion, strengths, and limitations. The use of serial examination utilizing focused abdominal

sonography for blunt trauma (FAST) to evaluate hemoperitoneum will be presented. [6]

Additionally, the economic implications of using ultrasound as a first-line diagnostic tool in paediatric abdominal trauma are significant. The costeffectiveness of ultrasound, compared to more expensive and resource-intensive modalities like CT scans, could lead to substantial savings for healthcare systems while ensuring high-quality patient care. Patient and physician satisfaction are also crucial factors, as they directly impact the quality of care and patient outcomes. The comfort and anxiety levels of paediatric patients during diagnostic procedures, and the ease of use and learning curve of ultrasound for healthcare providers, are essential components of overall healthcare delivery. [7] purpose of this research is to examine the demographics, clinical manifestations, and degree of anaemia in patients presenting to a tertiary healthcare facility [9-11].

MATERIALS AND METHODS

This is a prospective study was conducted in the Department of Radiology, Shadan Institute of Medical Sciences, Teaching Hospital & Research Centre.

Inclusion criteria:

- Adults (≥18 years) patients presenting to the emergency department (ED) with a history of blunt or penetrating abdominal trauma.
- Patients with suspected abdominal trauma based on clinical evaluation (e.g., abdominal pain, tenderness, distension, or hemodynamic instability).
- Patients requiring immediate diagnostic imaging for suspected intra-abdominal injury.

Exclusion Criteria:

Patients with incomplete medical records or missing imaging studies (e.g., no confirmatory imaging after ultrasound). Patients with abdominal pain or pathology

unrelated to trauma (e.g., spontaneous hemorrhage, ruptured aortic aneurysm, or non-traumatic acute abdomen).

Consecutive blunt abdominal trauma patients admitted to emergency room of Hospital over a period of 6 months. Data including the mechanism of abdominal injury, ultrasound diagnosis, CT imaging, and clinical management were analyzed. The bedside abdominal ultrasonography was performed before the abdominal trauma patients transferred to CT room. The principle of bedside abdominal ultrasonography scans is to assess the presence/absence of any amount of free fluid that mostly is blood from broken organs.

Ultrasound was used to check the signs of effusion in the abdominal cavity, in other words, whether there was fluid in seven abdominal areas: right upper abdomen, left upper abdomen, pelvic cavity, bilateral paracolic sulcus and bilateral renal fossae. The following signs are detected to confirm whether the contour line of the substantial abdominal organs is continuous; whether the capsule is interrupted; whether the cavity organs have segmental thickening and expansion; whether there is abnormal echo in substantive organs; whether the respiratory movement of abdominal organs in both sides is consistent; and whether the parts inspected by the probe have tenderness and rebound pain. The time spent on the examination of bedside abdominal ultrasonography or CT was recorded. All CT results were evaluated by radiologists who were unknown to the patients' condition as well as the results of the sonographic examinations. The findings of the bedside abdominal ultrasonography were compared with those of either CT or surgery, in which laparotomy findings are preferred if surgery is performed.

Statistical analysis

All data were analyzed with Graphpad Prism 7.0 statistical software. Dichotomous data were analyzed by c2 analysis with Yates's correction; continuous data were analyzed by Student's ttest. Any values of $p < 0.05$ were considered statistically significant

RESULTS

In the present study, a total of 110 patients were included out of which 74 (71.1%) were males and 36 (28.8%) were females (table-1). In our study, most of the patients were 21-30 years i.e., 31 out of 90 (34.4%), followed by 31-40 years, i.e., 23 out of 110 (25.5%) in table 2.

Table 1: Distribution of Gender

Sex	No. of patients	Percentage
Male	74	67.2
Female	36	32.8
Total	110	100

Table 2: Distribution of the number of patients according to age group

Age group	No. of patients	Percentage
18-20 years	20	18.2
21-30 years	36	32.7

31-40 years	28	25.4
41-50 years	16	14.5
51-60 years	10	9.1
Total	110	100

Table 3: Distribution of Cause of trauma of patients

Trauma	No. of patients	Percentage
Road traffic accidents	34	30.9
Fall from heights	29	26.3
Industrial accidents	26	23.6
Sport Injuries	21	19.2

In our study, maximum patients, i.e., 48.5% (n = 34) were having Apgar score of 4-6 followed by ≤ 3 score were 32.8% and least were > 7 score were 18.5% in table 3.

Table 4: Distribution of MRI changes in study population with stage2 HIE

Type of injuries	No. of patients	Percentage
Small bowel injury	34	30.9
Liver injury	26	23.6
Pancreas injury	18	16.3
Splenic injury	13	11.8
Large bowel injury	9	8.1
Mesenteric injury	6	5.4
Kidney injury	4	3.6
Total	110	100

Out of the 110 patients with abdominal injury, 34 patients had small bowel injury, 26 patients had liver injury, 18 patients had Pancreas injury, 13 patients had splenic injury, 9 patients had large bowel injury, 6 patients had mesenteric injury, 4 patients had renal injury in table 4.

DISCUSSION

Women and others with long-term health conditions bear Although this decade has marked, and will likely continue to mark, the emergence and acceptance of North Americas' experience with surgeon performed US evaluation of blunt abdominal trauma, the credentialing and standardization of training for the performance of such remains to be agreed upon. [8]

During the course of organizing and implementing a de novo trauma US program at the study center, the participating members from the Section of Trauma, Department of Surgery, agreed upon a training protocol that was currently in use at other trauma centers experienced in the use of US examination. [8] The prospective data generated were used to determine whether results obtained during this trial period were comparable to those reported by centers of established US experience.

The impetus for the initiation of a trauma US program at the study center was, like that of many trauma centers, the very appealing prospect of acquiring a diagnostic tool that is reported to maintain the accuracy of time-tested SDEs, [9] while offering the noninvasive nature and significant potential cost savings of US.

From the outset, members from various disciplines from the study center contributed to the planning and implementation of the program. Included among these, was the Department of Radiology, whose members offered their expertise and advice during the planning stages of the program, and reviewed all false-positive and false-negative US examinations on a volunteer basis. [10] The Department of Radiology otherwise did not "over-read" trauma US results. Interestingly, the authors encountered no opposition from the Department of Radiology to a surgeon initiated and controlled US program. [11]

It is apparent from the experience of others that a limited abdominal US examination for trauma can be accurately performed by the nonradiologist. [12] An open discussion of these data with the Department of Radiology along with the clear understanding that US examination by a nonradiologist would be used only in a limited fashion helped to ensure the department's cooperation. [13] Program results were similar to previously reported series, [14] When hemoperitoneum was used as the end point, four false-negative examinations occurred. All four were diagnosed subsequently by DPL and confirmed by laparotomy. Two of these laparotomies were nontherapeutic (a retroperitoneal hematoma and a grade I, nonbleeding splenic laceration). All four had 500 mL or less

hemoperitoneum at the time of laparotomy (one had less than 50 mL). This finding is consistent with the previously reported quantitative sensitivity for US detection of hemoperitoneum. [15]

Two of these were read as positive by radiologists during the review process and were clearly misread by the inexperienced surgeon ultrasonographer. Four patients had intra-abdominal injuries requiring laparotomy that were initially undetected by both DPL and US examination. Two of these were intraperitoneal bladder ruptures, one was a ruptured left hemidiaphragm, and one was a small bowel perforation. These are injuries that are often difficult to diagnose either by DPL or CT scan and are probably outside the diagnostic window for US examination unless associated with hemoperitoneum. [16]

Because all patients in this series with intra-abdominal injury had either a DPL or CT scan, follow-up US examinations were not performed. This strategy introduced some bias against US. Subsequent US examination may well have identified hemoperitoneum, given time to accumulate. [17] The authors now commonly repeat US examinations both in the emergency department and/or within several hours of the initial examination as has been recommended by others. [18]

Although it is difficult to delineate a strict learning curve from the data, an improvement pattern in both performance and interpretation does seem to emerge. Three of four false-negative and one of two false-positive examinations occurred within the first 100 US examinations performed in the series. The fourth false-negative examination occurred in the 209th patient in the series. Subjectively, review of US image quality seemed to suggest that most of the improvement in technique occurred within the first 100 examinations. This amounted to 50 US examinations for each of the trauma fellows. [19]

CONCLUSION

The diagnostic performance of ultrasound in detecting abdominal trauma at a tertiary care center demonstrates its utility as a rapid, non-invasive, and effective initial imaging modality. Focused Assessment with Sonography for Trauma (FAST) is particularly valuable in hemodynamically unstable patients, offering timely identification of free intraperitoneal fluid, which is often indicative of significant injury. However, its sensitivity and specificity can vary depending on the type and severity of trauma, operator experience, and patient factors such as body habitus.

REFERENCES

1. Goletti, O., G. Ghiselli, P. V. Lippolis, et al. "The Role of Ultrasonography in Blunt Abdominal Trauma: Results in 250

- Consecutive Cases." *Journal of Trauma*, vol. 36, 1994, p. 178.
2. Gomez, G. A., R. Alvarez, G. Plasencia, et al. "Diagnostic Peritoneal Lavage in the Management of Blunt Abdominal Trauma: A Reassessment." *Journal of Trauma*, vol. 27, 1987, p. 271.
3. Gmessner, R., B. Mentged, C. Duber, et al. "Sonography versus Peritoneal Lavage in Blunt Abdominal Trauma." *Journal of Trauma*, vol. 29, 1989, p. 242.
4. Harlan, L. C., W. R. Harlan, and P. E. Parsons. "The Economic Impact of Injuries: A Major Source of Medical Cost." *American Journal of Public Health*, vol. 80, 1990, p. 453.
5. Henneman, P. L., J. A. Marx, E. E. Moore, et al. "Accuracy in Predicting Necessary Laparotomy Following Blunt and Penetrating Trauma." *Journal of Trauma*, vol. 30, 1990, p. 1345.
6. Hoffman, R., M. Nerlich, M. Muggig-Sullam, et al. "Blunt Abdominal Trauma in Cases of Multiple Trauma Evaluated by Ultrasonography: A Prospective Analysis of 291 Patients." *Journal of Trauma*, vol. 32, 1992, p. 452.
7. Huang, M., L. Ming, W. Jer-Kan, et al. "Ultrasonography for the Evaluation of Hemoperitoneum during Resuscitation: A Simple Scoring System." *Journal of Trauma*, vol. 36, 1994, p. 173.
8. Kimura, A., and T. Otsuka. "Emergency Center Ultrasonography in the Evaluation of Hemoperitoneum: A Prospective Study." *Journal of Trauma*, vol. 31, 1991, p. 20.
9. Kristensen, J. K., B. Buemann, and E. Kuehl. "Ultrasonic Scanning in the Diagnosis of Splenic Hematomas." *Acta Chirurgica Scandinavica*, vol. 137, 1971, p. 653.
10. Luks, F. I., A. Lemire, D. St-Vil, et al. "Blunt Abdominal Trauma in Children: The Practical Value of Ultrasonography." *Journal of Trauma*, vol. 34, 1993, p. 607.
11. McKenney, K. L., M. G. McKenney, D. B. Nunez, et al. "Cost Reduction Using Ultrasound in Blunt Abdominal Trauma." *Emergency Radiology*, vol. 4, 1997, p. 3.
12. McKenney, K. L., M. G. McKenney, D. B. Nunez, et al. "Interpreting the Trauma Ultrasound: Observations in 62 Positive Cases." *Emergency Radiology*, vol. 3, 1996, p. 113.
13. McKenney, K. L., D. B. Nunez, M. G. McKenney, et al. "Sonography as the Primary Screening Technique for Blunt Abdominal Trauma: Experience with 899 Patients." *American Journal of Roentgenology*, vol. 170, 1998, p. 979.
14. McKenney, M. G., L. Martin, K. A. Lentz, et al. "1,000 Consecutive Ultrasounds for Blunt

- Abdominal Trauma.” *Journal of Trauma*, vol. 40, 1996, p. 607.
15. Powell, D. L., B. A. Bivens, and R. M. Bell. “Diagnostic Peritoneal Lavage.” *Surgery, Gynecology & Obstetrics*, vol. 155, 1982, p. 257.
 16. Root, H. D., C. W. Hauser, C. R. McKinley, et al. “Diagnostic Peritoneal Lavage.” *Surgery*, vol. 76, 1965, p. 33.
 17. Soderstrom, C. A., R. W. DuPreist, and R. A. Cowley. “Pitfalls of Peritoneal Lavage in Blunt Abdominal Trauma.” *Surgery, Gynecology & Obstetrics*, vol. 151, 1980, p. 513.
 18. Tiling, T., B. Bouillon, A. Schmid, et al. “Ultrasound in Blunt Abdominothoracic Trauma.” *The Traumatisierte Abdomen*, edited by J. R. Border et al., Springer-Verlag, 1986.
 19. Tso, P., A. Rodriguez, C. Cooper, et al. “Sonography in Blunt Abdominal Trauma: A Preliminary Progress Report.” *Journal of Trauma*, vol. 33, 1992, p. 39.