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TO COMPARE THE UTILITY OF ULTRASONOGRAPHY AND COMPUTED TOMOGRAPHY IN EVALUATION OF PATIENTS WITH BLUNT ABDOMINAL TRAUMA IN A TERTIARY CARE CENTRE

Radiology

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ABSTRACT

Background: USG and CT scan have largely supplanted traditional diagnostic methods in identifying blunt abdominal trauma, they each come with drawbacks. While ultrasonography is suggested as a screening tool for blunt abdominal trauma, its precise role and effectiveness relative to other diagnostic methods such as CT remain undefined. **Material And Methods:** Fifty patients with signs and symptoms suggestive of blunt abdominal trauma referred from various wards and outpatients' departments were included in the study. A complete history of the patient was taken and detailed clinical examination was performed after taking written informed consent. Presence of associated injuries were also noted. Relevant laboratory investigations were done. **Result:** US detected 13 out of 20 liver injuries, 14 out of 18 spleen injuries, 5 out of 10 kidney injuries, and 3 out of 6 pancreatic injuries. In contrast, CT identified all cases in these categories, demonstrating its superior diagnostic ability. US also missed adrenal injuries entirely, while CT detected one case. Both modalities performed similarly for hemoperitoneum (free fluid), with US detecting 45 cases and CT detecting 46. However, CT outperformed US in identifying pleural effusion (12 cases vs. 9). US missed 7 liver injuries, 4 spleen injuries, 5 kidney injuries, and 3 pancreatic injuries, most of which were lower-grade (Grade I and II). This further emphasizes CT's superior sensitivity in detecting these injuries. **Conclusion:** CT was found to be much superior modality in comparison to US for detection of organ injury in blunt abdominal trauma.

KEYWORDS

Ultrasonography, blunt abdominal trauma. diagnostic methods, accuracy

INTRODUCTION

Abdominal injuries rank as the third leading contributor to trauma-related fatalities. [1] The abdomen is identified as the third most frequently injured area of the body, impacting 7%–10% of individuals involved in traumatic incidents. [2,3] Moreover, approximately 70%–80% of abdominal traumas are attributed to blunt force.[4] The causes of blunt abdominal trauma (BAT) included motor vehicle collisions (73%), motorcycle accidents (7%), pedestrian-auto collisions (6%), and falls (6%).[5,6]

Sensitivity and specificity are measures of validity of a test. Ultrasonography (USG) is widely regarded as the most effective imaging technique for initially assessing blunt abdominal trauma, particularly in unstable patients.[7] Its noninvasive nature, quick preparation time, and suitability for immediate use by emergency physicians make it a valuable tool in the emergency setting. Abdominal CT (Computed Tomography) imaging is considered the primary diagnostic tool for evaluating abdominal traumas, as it offers accurate visualization of internal organs and facilitates quantification of blood in the abdomen.[8] While USG and CT scan have largely supplanted traditional diagnostic methods in identifying blunt abdominal trauma, they each come with drawbacks.

While ultrasonography is suggested as a screening tool for blunt abdominal trauma, its precise role and effectiveness relative to other diagnostic methods such as CT remain undefined. Given the lack of substantial literature on this correlation, this study aims to assess and contrast the diagnostic efficacy of ultrasound (USG) versus computed tomography (CT) in identifying blunt abdominal trauma, while also examining how well Ultrasonography and CT findings align with postoperative observations. The present study has been undertaken to assess the validity and accuracy of ultra sound and computed tomography among patients seeking care blunt abdominal trauma in our hospital.

MATERIAL AND METHODS

A cross-sectional study was conducted in the Department of Radiodiagnosis, Sri Aurobindo Medical College & PG Institute, Indore. The proposed study duration was one year and half years after the approval from the ethical committee.

Fifty (50) patients irrespective of age and sex referred to the study site with history of blunt abdominal trauma and undergoing ultrasonography and Computed Tomography within the study duration were included. Patients qualifying the inclusion and exclusion criteria were enrolled after taking written informed consent from patients or patient's relatives.

All the patients irrespective of age and sex referred to the study site with history of blunt abdominal trauma undergoing ultrasonography and Computed Tomography with in the study duration; were included. Patients with high creatinine level along with pregnant women and penetrating injuries were excluded from this study.

A pre-structured proforma was used to collect the desired baseline data. Most of the time, sonography was done first followed by Computed tomography scan with a time gap so as to include in the study.

Ultrasounds were performed by PHILIPS AFFINITI 70 G or GE Healthcare Logiq E9 USG Machine. CT scans are performed scans are performed using a PHILIPS 128 slice CT scanner. Pre and post contrast scans will be routinely performed. The CT scans are acquired through portal venous phase approximately 80 seconds after contrast injection. When necessary, sagittal and coronal images will be acquired using the maximum intensity projection (MIP) and MPR techniques.

All the patients for whom both the scans had come negative and those who could not withstand both the tests or who were discharged within a short period after being under observation were excluded from the study. Approval was obtained from institutional ethical committee before the commencement of this study. Written informed consent from patients or patient's relatives after explaining the study protocol in their vernacular language.

The data was coded and entered into Microsoft excel 2010 (Microsoft corp.), analyzed using excel 2010 and SPSS 20.0 for Windows (SPSS inc). The data were processed and the sensitivity, specificity and positive and negative predictive value was calculated.

RESULTS

Out of 50 patients the maximum numbers of patients were in the age group of 26-35 years i.e. 11 subjects (22%). Mean age of the subjects came out to be 33.54 + 16.8 years. The youngest patient was of 2 years and the oldest patient was 69 years old. Male were 42(84%) and females were 8(16%) in this study. Male to female ratio was 5.25:1. Road traffic accident was the most common cause of blunt abdominal trauma, seen in 35 cases (72%), followed by fall from height, seen in 7

cases and hit by an object in 6 cases.

Table 1 compares the performance of ultrasound (US) and computed tomography (CT) in detecting abdominal injuries in 50 cases of blunt abdominal trauma. US detected 13 out of 20 liver injuries, 14 out of 18 spleen injuries, 5 out of 10 kidney injuries, and 3 out of 6 pancreatic injuries. In contrast, CT identified all cases in these categories, demonstrating its superior diagnostic ability. US also missed adrenal injuries entirely, while CT detected one case. Both modalities performed similarly for hemoperitoneum (free fluid), with US detecting 45 cases and CT detecting 46. However, CT outperformed US in identifying pleural effusion (12 cases vs. 9).

Table 1: Showing Spectrum Of Abdominal Injuries On Ultrasound And CT

Injury	Ultrasound (No. of Patient)	CT (No. of Patient)
Liver	13	20
Spleen	14	18
Kidney	5	10
Pancreas	3	6
Bowel & mesentery	2	4
Adrenal	0	1
Hemoperitoneum (Free fluid)	45	46
Pleural effusion	9	12
Total	50	50

Table 2 shows that US missed 7 liver injuries, 4 spleen injuries, 5 kidney injuries, and 3 pancreatic injuries, most of which were lower-grade (Grade I and II). This further emphasizes CT's superior sensitivity in detecting these injuries.

Table 2: Showing Various Cases Missed On Ultrasound Examination In Case Of Blunt Abdominal Injury

Organ injury	Liver injury	Spleen injury	Kidney injury	Pancreas injury
No. of cases	Grade 1-3	Grade I-3	Grade I-3	Grade I-1
	Grade II-4	Grade II-1	Grade II-1	Grade II-1
			Grade III-1	Grade III-1

Table 3 highlights that US missed 3 bowel mesentery injuries and 1 adrenal injury, which were detected by CT. This reinforces CT's effectiveness, especially for more complex or less obvious injuries.

Table 3: Showing Various Cases Missed On Ultrasound Examination In Cases Of Blunt Abdominal Injury

Organ injury	Bowel mesentery injury	Adrenal injury
No. of cases	3	1

Table 4 compares the overall diagnostic accuracy of US and CT. CT consistently showed higher sensitivity and accuracy across all organs: for liver, spleen, kidney, pancreas, bowel, and adrenal injuries, CT demonstrated higher sensitivity (ranging from 75% to 100%) and accuracy (95% to 100%) compared to US. US had lower sensitivity, particularly for bowel and adrenal injuries, with 0% sensitivity for adrenal injuries.

Table 4: Overall Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) And Accuracy Of Ultrasound & Ct Examination For Detection Of Organ Injury In Blunt Abdominal Trauma.

Findings	Se		Sp		PPV		NPV		Acc	
	US	CT	US	CT	US	CT	US	CT	US	CT
Liver	65	81	100	100	100	100	81.08	93.75	86	95.12
Spleen	77.80	83.20	100	100	100	100	88.89	94.12	92	95.45
Kidney	50	75	100	100	100	100	88.89	97.56	90	97.73
Pancreas	50	75	100	100	100	100	93.62	97.78	94	97.92
Bowel & Mesentery	40	80	100	100	100	100	94	97.83	94.23	98
Adrenal	0	100	100	100	-	100	98	100	98	100

DISCUSSION

This study aimed to evaluate and compare the diagnostic utility of ultrasonography (US) and computed tomography (CT) in detecting abdominal injuries in patients with blunt abdominal trauma (BAT). A total of 50 patients with clinical signs and symptoms indicative of BAT were included. The study excluded patients with penetrating abdominal injuries and those in hypovolemic or haemorrhagic shock who required emergency laparotomy. The mean age of the patients was 33.54±16.8 years, ranging from 2 to 69 years, which is consistent with findings from similar studies, such as that of **Marathu KK et al**. [9] Road traffic accidents (RTAs) emerged as the predominant cause of BAT, responsible for 72% of cases, in agreement with previous studies by **Kadeem KM et al**. [10], which reported an 80% incidence of RTA-induced trauma.

Ultrasonography is widely regarded as a rapid and non-invasive diagnostic tool, particularly useful for detecting intraperitoneal fluid in BAT cases. However, it is limited in its ability to differentiate between fluid types (e.g., blood, urine, bile, or ascites), as noted by **Christiano JG et al.** [11] and **Abu-Zidan FM et al**. [12] For this reason, clinical correlation is essential when making critical management decisions. On the other hand, CT remains the gold standard for diagnosing solid organ injuries, retroperitoneal haemorrhage, and bowel injuries due to its superior sensitivity and ability to accurately quantify injuries.

Organ-Specific Findings

Liver Injuries:

In our study, liver injuries were identified in 20 cases of blunt abdominal trauma. Ultrasound detected 13 of these cases, with a sensitivity of 65%, specificity of 100%, positive predictive value (PPV) of 100%, and an accuracy of 86%. In contrast, computed tomography (CT) identified all 20 cases with a higher sensitivity of 81% and accuracy of 95%. These findings align with studies such as those by **Kumar S et al.** [13], who also reported superior diagnostic performance of CT for liver injuries, with a sensitivity of 93.3%. Similarly, **Prakash NB et al.** [14] reported a US sensitivity of 80%, specificity of 98.5%, PPV of 94.1%, NPV of 94.2% and accuracy of 94.25%, detecting 17 liver injuries compared to 21 on CT. **Goletti O et al.** [15] found similar results, with US showing an 80% sensitivity for liver injuries. Our findings are further corroborated by **Babu B et al.** [16] who reported that US detected only 16 out of 35 liver injuries seen on CT, with lower sensitivity (45.7%) and predictive accuracy (72%), reinforcing the notion that CT remains the gold standard in liver trauma assessment.

Splenic Injuries:

Splenic injuries were detected in 18 cases in our study. US identified 14 of these cases, resulting in a sensitivity of 77.8% and an accuracy of 92%. CT, however, detected all 18 cases, with a sensitivity of 83.2% and accuracy of 95.45%. These results are in agreement with **Prakash NB et al.** [14], who reported that US had a sensitivity of 79.3% for splenic injuries, while CT identified six additional cases missed by US. Similarly, **Krupnick AS et al.** [17] noted that 12 of 32 splenic injuries were initially missed by US and that US had a lower sensitivity (62-78%) in detecting splenic injuries, often underestimating the severity. Our study further supports the conclusion that while US can be reasonably sensitive for splenic injuries, particularly in detecting higher-grade injuries, it is prone to missing lower-grade injuries, which are better identified by CT. This is also consistent with the findings of **Babu B et al.**, [16]who reported that US detected only 12 out of 23 splenic injuries, with a sensitivity of 52.2% and an overall accuracy of 80%.

Kidney Injuries:

In our study, US detected only 5 out of 10 kidney injuries, resulting in a sensitivity of 50% and accuracy of 90%, while CT detected all 10 cases, with a sensitivity of 75% and accuracy of 97.73%. These results match those of **Edwards A et al.** [18], who reported that kidney US demonstrated sensitivities between 79-100%, with a negative predictive value (NPV) between 97-100% for Grade III-V injuries when compared to CT. Additionally, **Jalli R et al.** [19] found that US detected only 40% of renal injuries seen on CT, with a sensitivity of 48% and accuracy of 79%. Similarly, **Prakash NB et al.** [14] found that US had a sensitivity of 83.3% and specificity of 98.6% for detecting renal injuries. However, our results are more in line with the findings of **Babu B et al.** [16], who reported that US detected 10 out of 17 renal injuries identified by CT, with a sensitivity of 58.8% and accuracy of 82.6%. The lower detection rate of US in renal trauma can be attributed to the deeper location of the kidneys and the often subtle nature of low-grade renal injuries, which are better visualized with cross-sectional imaging like CT.

Pancreatic Injuries:

Pancreatic injuries were detected in 6 cases in our study, with US identifying 3 of these (50% sensitivity), while CT detected all 6, achieving a sensitivity of 75% and accuracy of 97.92%. The difficulty

of detecting pancreatic injuries on US is well known due to the pancreas' retroperitoneal location and subtle injury patterns. Our findings are consistent with **Song Q et al.** [20], who reported that US detected only 21 out of 40 pancreatic injuries, and with **Odedra D et al.** [21], who found that CT sensitivities for pancreatic injuries ranged from 33-100%, while US sensitivities ranged from 27-96%. However, **Prakash NB et al.** [14]reported a 100% sensitivity and accuracy for US in detecting pancreatic injuries, which differs from our findings. This variation may be explained by differences in operator skill or patient population, highlighting the importance of clinical context in using US for pancreatic trauma.

Bowel and Mesenteric Injuries:

In our study, bowel and mesenteric injuries were among the most challenging to detect using US, with only 2 out of 5 cases identified (40% sensitivity). In contrast, CT identified 4 out of 5 cases (80% sensitivity and 98% accuracy). This reinforces the known limitations of US in detecting these injuries, which are often occult and difficult to visualize. Similar findings were reported by **Prakash NB et al.** [14], where US failed to detect any of the 4 bowel injuries identified on CT. **Yoshii H et al.** [22] and **Nnamonu MI et al.** [23] also reported high false-negative rates on US for abdominal visceral injuries, particularly in gastrointestinal trauma. These results affirm that CT remains the superior modality for detecting bowel and mesenteric injuries due to its cross-sectional capabilities and superior contrast resolution.

Adrenal Injuries:

Adrenal injuries were rare, with only one case identified in this study, which was missed by US, yielding 0% sensitivity. In contrast, CT detected the injury with 100% sensitivity and accuracy. These findings are consistent with studies by **Valentino M et al.**, [24] who reported that US detected only 4 out of 10 adrenal/kidney lesions, compared to 8 out of 10 identified by CT. **Miele V et al.** [25] also emphasized the limitations of US, particularly in detecting adrenal and urinary tract injuries, suggesting that more advanced modalities like contrast-enhanced CT are required for adequate assessment of these injuries.

Hemoperitoneum and Pleural Effusion:

In our study, hemoperitoneum was the most common finding, detected by US in 45 out of 50 cases (90%) and by CT in 46 cases (92%). This high detection rate of free intraperitoneal fluid using US is consistent with the findings of **Matharu KK et al.** [9], which supports US's utility in identifying hemoperitoneum. However, pleural effusion was more accurately detected by CT, which identified 12 cases compared to 9 on US, further illustrating CT's superior sensitivity in detecting secondary complications of blunt abdominal trauma.

Clinical Implications

The findings of this study indicate that while ultrasonography is a valuable initial diagnostic tool, particularly for detecting hemoperitoneum, its limitations in identifying solid organ and bowel injuries make CT indispensable for a comprehensive evaluation of patients with blunt abdominal trauma. The present study's results align with **Abu-Zidan FM et al.** [12], reinforcing the role of CT as the gold standard for trauma imaging, particularly in cases involving complex injuries such as those of the pancreas, bowel, and adrenal glands.

CONCLUSION

Ultrasonography is valuable initial modality for evaluation of patients with abdominal trauma. It is low cost readily available and portable diagnostic modality. CT is required in most ultrasound positive patients to delineate the exact extent of injury and to exclude any other significant injuries. CT was found to be much superior modality in comparison to US for detection of organ injury in blunt abdominal trauma.

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