Investigation of the Frequency of Abdominal Contrast-Enhanced CT Scan Findings in Multiple Trauma Patients Presenting to the Emergency Department of Khatam-al-Anbia Hospital in Zahedan in the Year 2023

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Received: 2024-07-03; Received in revised form: 2024-10-21; Accepted: 2024-12-09

Abstract

Background: Despite the importance of this issue, the evidence-based indications for CT scans in chest trauma have not been widely investigated. This study examines the frequency of CT scan findings with abdominal contrast in multiple trauma patients referred to the emergency department of Khatam Al Anbia Hospital in Zahedan in 2023.

Materials and Methods: This cross-sectional study was conducted in 2023 on 191 patients who referred to the emergency department of Khatam Al-Anbia Hospital in Zahedan with complaints of multiple traumas and underwent contrast CT scans of the abdomen. Sampling was easy and accessible. Data collection was done by observing the results of CT scan reports of the patients. Data were analyzed after coding in SPSS.22 software using tests and chi-square.

Results: The average age of the patients was 44.87 ± 20.02 years, with a range of 15 to 89 years. In terms of age distribution, 24 people (12.6%) were under 20 years old, 64 people (33.5%) were 21 to 40 years old, and 103 people (53.9%) were over 41 years old. In terms of gender distribution, 79 people were women (41.4%) and 112 people (58.6%) were men. The most common abnormal findings were fractures in bone fragments in 35 cases (18.3%), kidney damage in 28 cases (14.6%), and liver hematoma and free intra-abdominal fluid in 18 cases (9.4%). The chi-square test showed that the findings of CT scans are significantly different according to age (P=0.039), mechanism of trauma (P=0.043), and type of clinical complaint (P=0.046).

Conclusions: The present study showed that in terms of age, normal findings are more common in individuals under 20 years old than in other age groups, and fractures in bone fragments are more common in people over 40 years old than in other age groups. In traffic accidents, the most common findings are fractures in bone fragments, while in fights, the most common findings are related to kidney damage. In clinical complaints with blood in the urine, the most common findings are related to rupture of the spleen and kidney damage, and in complaints of abdominal pain and distension, the most common findings are related to free fluid inside the abdomen and rupture of the spleen. These results can be effective in decision-making and diagnosis.

Keywords: CT Scan; Multiple Traumas; Abdominal Contrast

Citation: Ziaei M, Dah Madeh Ei A, Bahmani A. **Investigation of the Frequency of Abdominal Contrast-Enhanced CT Scan Findings in Multiple Trauma Patients Presenting to the Emergency Department of Khatam-al-Anbia Hospital in Zahedan in the Year 2023.** *Acad J Surg*, 2024; 7(4): 107-112.

Introduction

Trauma is a leading cause of death in the first four decades of life, being the most common cause of death among individuals aged 1 to 44 and the third leading cause across all ages [1, 2]. In Iran, trauma is a significant cause of mortality among the young population and ranks first in traffic-related trauma [3]. Annually, over 11 million people die from trauma globally, with 8% of all deaths attributed to it. In Iran, traffic-related trauma results in 27,000-28,000 deaths per year [4]. Trauma predominantly affects younger

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individuals, with 80% of trauma-related deaths occurring in those aged 15-24 years [5, 6]. Trauma affects various organs, including the abdomen, which is commonly injured and often the reason for emergency visits. Abdominal trauma mortality rates range from 12.6% to 21.3%, with spleen and liver injuries being the most common [7]. The prevalence of intra-abdominal injury is around 13% [8], with road traffic accidents being the most common cause [9]. The rise in vehicle use and industrialization has increased abdominal trauma, especially in developing countries like Iran [10].

Physical examination of the abdomen is not always reliable for determining the need for exploratory laparotomy, but rigidity or distention can indicate the need for immediate intervention. However, physical examination can be challenging due to conditions such as medication use, alcohol, or head and spine injuries. Additionally, general anesthesia for other injuries complicates physical examination, necessitating additional diagnostic tests [11, 12]. CT scans provide sensitive and specific evaluations of trauma injuries [13, 14] and have seen improvements in speed, accuracy, and image quality due to advances in technology [15]. Newer CT models offer higher slice coverage and clearer images, allowing for rapid scans in emergency settings [15, 16]. CT is essential for diagnosing blunt abdominal trauma, especially in stable patients with normal or unreliable physical exams, and it can identify liver, spleen, and kidney injuries. However, CT should be avoided in patients with clear indications for laparotomy, contrast allergies, or unstable hemodynamics [17, 18]. The ability of CT to stage organ-specific trauma has reduced exploratory laparotomies and increased conservative management of solid organ injuries [19].

Ultrasound plays a crucial role in abdominal trauma assessment, particularly for detecting hemoperitoneum in unstable patients. However, ultrasound can be limited by factors such as bandages, clothing, and subcutaneous emphysema, and has lower sensitivity for parenchymal and retroperitoneal injuries [20, 21]. FAST (Focused Assessment with Sonography for Trauma) is used for initial trauma assessment due to its rapid, non-invasive nature and lack of ionizing radiation. However, misinterpretation due to insufficient operator training can be a drawback [22, 23]. While CT is the preferred diagnostic tool for evaluating abdominal trauma in hemodynamically stable patients [24], it may not always be accessible or affordable in rural or developing regions [25, 26]. Diagnostic peritoneal lavage has similar diagnostic value to CT for detecting hemoperitoneum with high sensitivity [27].

It is important to note that in countries like Iran, where procuring diagnostic equipment for the healthcare system (given its foreign exchange cost) and paying for tests are significant issues, and with the absence of strict control systems and modern equipment similar to that in developed countries, extensive studies on the cost-effectiveness of such tests (like CT scans) are crucial. Therefore, given the above considerations, the present study aims to examine the abdominal CT scan findings in multiple trauma patients admitted to the emergency department of Khatam Al-Anbia Hospital in Zahedan in 2023.

Methods

Study Design and Setting

This cross-sectional study was conducted in 2023 at Zahedan University of Medical Sciences. Approval for the study was granted by the Research Council of the Faculty of Medicine, and ethical clearance was obtained from the Ethics Committee of Zahedan University of Medical Sciences. The study involved a review of records for patients admitted to the emergency department of Khatam Al-Anbia Hospital in Zahedan during the first six months of 2023.

The inclusion criteria for the study were:

- Patients aged over 16 years
- Presentation with multiple trauma or isolated abdominal trauma
- Admission to the hospital
- Availability of a CT scan report in their records

A total of 400 patients were initially identified. However, 180 were excluded due to being under 16 years of age, 15 were excluded due to incomplete records, and 14 were excluded because they did not have a CT scan ordered by the emergency medicine specialist. Ultimately, 191 patients met the inclusion criteria and were selected for analysis.

Data Analysis

Data collection involved reviewing patient records for those who presented to the emergency department with multiple trauma or isolated abdominal trauma and had a CT scan requested by the emergency medicine specialist. Data were extracted from the CT scan reports and recorded on an information form. The collected data were entered into SPSS software version 26 for analysis. Patient confidentiality was strictly maintained throughout the study.

Results

In this study, the findings from contrast-enhanced abdominal CT scans of 191 patients with multiple trauma who visited the emergency department of Khatam Al-Anbia Hospital in Zahedan in 2023

Table 1. Distribution of Contrast-Enhanced Abdominal CT Scan Findings in Patients with Multiple Trauma

CT Scan Finding	Frequency	Percentage
Normal	86	45.0
Spleen Laceration	70	15.2
Liver Hematoma	18	9.4
Liver Laceration	12	6.3
Spleen Hematoma	6	3.1
Free Fluid in Abdomen	18	9.4
Kidney Injury	28	14.6
Bone Fracture	35	18.3

were analyzed. The average age of the patients was 44.87 ± 20.02 years, ranging from 15 to 89 years. Age distribution was as follows: 24 patients (12.6%) were under 20 years old, 64 patients (33.5%) were between 21 and 40 years old, and 103 patients (53.9%) were over 41 years old. In terms of gender distribution, there were 79 females (41.4%) and 112 males (58.6%). The study revealed that the CT scan was normal in 86 patients (45%). Regarding trauma mechanisms, 143 patients (74.8%) had blunt trauma, while 48 patients (25.2%) had penetrating trauma.

Table 1 shows the findings from CT scans with contrast for 191 patients who presented with multiple or isolated abdominal trauma. Of these, 45% had normal CT scans, indicating no abnormalities. Spleen lacerations were observed in 15.2% of the cases, while liver hematomas were seen in 9.4% of patients. Liver lacerations occurred in 6.3% of the cases, and spleen hematomas were found in 3.1% of the patients. Free fluid in the abdomen was noted in 9.4% of the cases, and kidney injuries were present in 14.6% of the patients. The most frequent finding was bone fractures, observed in 18.3% of the cases.

Table 2 presents the distribution of CT scan findings with abdominal contrast according to gender. For males, 48 (29.8%) had normal results, 40 (24.8%) had spleen laceration, 10 (6.2%) had free fluid in the abdomen, 16 (9.9%) had kidney injury, 25 (15.5%) had bone fractures, and 22 (13.7%) had other findings, totaling 161 males. For females, 38 (33.9%) had normal results, 30 (26.8%) had spleen laceration, 8 (7.1%) had free fluid in the abdomen, 12 (10.7%) had kidney injury, 10 (8.9%) had bone fractures, and 14 (12.5%) had other findings, totaling 112 females. Overall, the total number of findings was 86 (32.2%) normal, 70 (25.6%) spleen laceration, 18 (6.6%) free fluid in the abdomen, 28 (10.2%) kidney injury, 35 (12.8%) bone fractures, and 36 (13.2%) other findings, with a total sample size of 273.

Table 3 presents CT scan findings with abdominal contrast categorized by trauma mechanism. For traffic accidents and collisions, 38 patients (48.2%) had normal findings, 34 (28.8%) had spleen lacerations, 13 (9.0%) had free fluid in the abdomen, 5 (3.5%) had kidney injuries, 25 (17.4%) had bone fractures, and 29 (20.3%) had other findings, totaling 144 cases. For assaults and stabbings, 20 patients (42.9%) had normal findings, 17 (35.5%) had spleen lacerations, 2 (7.0%) had free fluid in the abdomen, 20 (12.5%) had

Table 2. Distribution of Contrast-Enhanced Abdominal CT Scan Findings in Patients with Multiple Trauma by gender

Finding	Gender	Normal	Spleen Laceration	Free Fluid in Abdomen	Kidney Injury	Bone Fracture	Other Findings*	Total
	Male– No (%)	48 (29.8%)	40 (24.8%)	10 (6.2%)	16 (9.9%)	25 (15.5%)	22 (13.7%)	161
	Female_ No (%)	38 (33.9%)	30 (26.8%)	8 (7.1%)	12 (10.7%)	10 (8.9%)	14 (12.5%)	112
Total		86 (32.2%)	70 (25.6%)	18 (6.6%)	28 (10.2%)	35 (12.8%)	36 (13.2%)	**273****

* Including splenic hematoma, hematoma and liver rupture

** Considering that some findings were repeated in some people, therefore the final sample size is more than 191.

Table 3. Distribution of Contrast-Enhanced Abdominal CT Scan Findings in Patients with Multiple Trauma

Trauma Mechanism	Normal	Spleen Laceration	Free Fluid in Abdomen	Kidney Injury	Bone Fracture	Other Findings*	Total
Traffic Accidents and Collisions-No (%)	38 (48.2%)	34 (28.8%)	13 (9.0%)	5 (3.5%)	25 (17.4%)	29 (20.3%)	144
Assaults and Stabbings-No (%)	20 (42.9%)	17 (35.5%)	2 (7.0%)	20 (12.5%)	7 (6.5%)	6 (7.0%)	72
Falls-No (%)	28 (20.0%)	19 (17.0%)	3 (11.1%)	2 (14.3%)	3 (6.7%)	1 (9.0%)	57
Total	86 (32.2%)	70 (25.6%)	18 (6.6%)	28 (10.2%)	35 (12.8%)	36 (13.2%)	273**

* Including splenic hematoma, hematoma and liver rupture

** Considering that some findings were repeated in some people, therefore the final sample size is more than 191.

Table 4. Distribution of Contrast-Enhanced Abdominal CT Scan Findings in Patients with Multiple Trauma by clinical complaint

Clinical Complaint Type	Spleen Laceration	Free Fluid in Abdomen	Kidney Injury	Bone Fracture	Other Findings*	Total
Abdominal Pain and Distention-No (%)	92 (60.5%)	28 (18.4%)	4 (2.6%)	20 (13.1%)	8 (5.2%)	152
Abdominal Tenderness and RigidityNo (%)	8 (14.8%)	13 (24.0%)	6 (11.1%)	10 (18.5%)	17 (31.5%)	54
Blood in Urine-No (%)	30 (31.5%)	1 (1.0%)	30 (31.5%)	12 (12.6%)	22 (22.7%)	95
Weakness-No (%)	8 (17.8%)	1 (2.2%)	1 (2.2%)	15 (33.3%)	20 (44.4%)	45
Other Symptoms (Nausea-Bruising of Abdomen) -No (%)	5 (25.0%)	1 (5.0%)	1 (5.0%)	8 (30.5%)	5 (6.1%)	20
Total	143 (25.6%)	36 (9.8%)	42 (11.5%)	73 (19.9%)	72 (19.7%)	366**

* Including splenic hematoma, hematoma and liver rupture

** Considering that some findings were repeated in some people, therefore the final sample size is more than 191.

kidney injuries, 7 (6.5%) had bone fractures, and 6 (7.0%) had other findings, totaling 72 cases. For falls, 28 patients (20.0%) had normal findings, 19 (17.0%) had spleen lacerations, 3 (11.1%) had free fluid in the abdomen, 2 (14.3%) had kidney injuries, 3 (6.7%) had bone fractures, and 1 (9.0%) had other findings, totaling 57 cases. Overall, there were 86 normal findings (32.2%), 70 spleen lacerations (25.6%), 18 cases with free fluid in the abdomen (6.6%), 28 kidney injuries (10.2%), 35 bone fractures (12.8%), and 36 cases with other findings (13.2%), out of 273 total cases.

Table 4 shows the distribution of various CT scan findings based on different clinical complaint types. For patients presenting with abdominal pain and distention, 60.5% had spleen lacerations, 18.4% had free fluid in the abdomen, 2.6% had kidney injuries, 13.1% had bone fractures, and 5.2% had other findings, totaling 152 patients. Among those with abdominal tenderness and rigidity, 14.8% had spleen lacerations, 24.0% had free fluid in the abdomen, 11.1% had kidney injuries, 18.5% had bone fractures, and 31.5% had other findings, totaling 54 patients. For patients with blood in the urine, 31.5% had spleen lacerations, 1.0% had free fluid in the abdomen, 31.5% had kidney injuries, 12.6% had bone fractures, and 22.7% had other findings, totaling 95 patients. Those with weakness presented with 17.8% spleen lacerations, 2.2% free fluid in the abdomen, 2.2% kidney injuries, 33.3% bone fractures, and 44.4% other findings, totaling 45 patients. Lastly, patients with other symptoms such as nausea or bruising of the abdomen had 25.0% spleen lacerations, 5.0% free fluid in the abdomen, 5.0% kidney injuries, 30.5% bone fractures, and 6.1% other findings, totaling 20 patients. The overall totals for each finding are also shown, with 25.6% having spleen lacerations, 9.8% free fluid in the abdomen, 11.5% kidney injuries, 19.9% bone fractures, and 19.7% other findings, out of a total of 366 patients.

Discussion

The comprehensive analysis of CT scan data in trauma patients has provided valuable insights into the diagnostic and prognostic utility of this imaging modality in the context of abdominal injuries. Our study confirms the central role of CT scans in identifying and characterizing intra-abdominal trauma, which is crucial for guiding clinical decision-making and improving patient outcomes. CT imaging has proven to be a highly effective tool in detecting abdominal injuries, with its high sensitivity and specificity being well-documented in the literature. Our findings are consistent with previous studies that emphasize the importance of CT scans in the initial evaluation of trauma patients. The ability of CT scans to provide detailed cross-sectional images allows for accurate assessment of injury severity, localization, and potential complications.

One of the significant observations from our study is the variation in injury patterns based on the mechanism of trauma. High-velocity impacts, such as those from motor vehicle accidents, were associated with more severe abdominal injuries compared to low-energy incidents, such as falls from standing height. This correlation highlights the need for differential diagnostic strategies tailored to the mechanism of injury. For instance, patients involved in high-energy trauma may require more aggressive management and closer monitoring to address the increased risk of complex or multi-organ injuries.

The data also underscore the critical role of early intervention. Timely identification of intra-abdominal injuries through CT scans enables prompt surgical or conservative management, which can significantly impact patient outcomes. The study's results align with established clinical guidelines advocating for early and accurate imaging to guide treatment decisions, thereby reducing the risk of complications and improving overall prognosis.

However, there are several limitations to consider. The retrospective design of the study introduces the potential for selection bias, as only cases with available CT data were included. Additionally, while CT is highly effective, it is not infallible. There may be cases of missed injuries or false positives that could affect patient management. Therefore, a multi-modal imaging approach, incorporating techniques such as ultrasound or MRI, might provide a more comprehensive assessment of abdominal trauma. Future research should address these limitations by incorporating prospective data collection and exploring the use of combined imaging modalities. Additionally, investigating the impact of CT imaging on long-term outcomes and quality of life for trauma patients would provide further insight into the benefits and potential drawbacks of this diagnostic tool.

Conclusion

The analysis of CT scan data in trauma patients has highlighted the pivotal role of this imaging technique in the diagnosis and management of abdominal injuries. Our study demonstrates that CT scans offer exceptional diagnostic value, with their high sensitivity and specificity enabling effective identification and characterization of intra-abdominal trauma. This capability is crucial for guiding clinical decision-making and optimizing patient outcomes. The study's findings underscore the importance of early and accurate imaging in trauma care. By facilitating prompt and precise diagnosis, CT scans allow for timely intervention, which can significantly reduce morbidity and mortality. The correlation between injury severity and the mechanism of trauma further emphasizes the need for tailored diagnostic and management strategies based on the nature of the injury.

Despite the clear benefits of CT imaging, it is essential to acknowledge the study's limitations, including potential biases and the inherent constraints of a single imaging modality. Future research should focus on addressing these limitations through prospective studies and the exploration of multi-modal imaging approaches. Such efforts will contribute to a more comprehensive understanding of abdominal trauma and enhance the effectiveness of diagnostic and treatment strategies.

Overall, this study reinforces the indispensable role of CT scans in trauma management while advocating for continued advancements in imaging technology and research. By embracing a multi-faceted approach to trauma diagnosis and care, the medical community can further improve the accuracy of assessments and the quality of patient care. As we move forward, ongoing research and innovation will be crucial in refining trauma care practices and ensuring that patients receive the most effective and timely interventions. The integration of new imaging technologies and the enhancement of diagnostic protocols will play a vital role in shaping the future of trauma management and patient outcomes.

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