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Diagnostic Accuracy and Therapeutic Outcomes in Blunt Abdominal Trauma: Focus on Organ-Specific Injuries

Raad Fadhel Al Rubaey

Department of Surgery, Hammurabi College of Medicine, University of Babylon, Babylon, Iraq.

Sahal Mohammed Ali Jaber

Faculty of Medicine, Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences.

Karrar Ibrahim Mahmood

Department of Surgery, Hammurabi College of Medicine, University of Babylon, Babylon, Iraq.

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Abstract: Blunt abdominal trauma (BAT) poses significant diagnostic and therapeutic challenges, particularly in resource-limited settings. This study evaluated organ-specific injury patterns, diagnostic accuracy, and management outcomes in a high-volume Iraqi trauma center.

A retrospective analysis of 280 BAT cases (2022–2023) was performed. Inclusion criteria were confirmed BAT via imaging (FAST, CT, or laparoscopy) or laparotomy. The data included demographics, injury mechanisms, AAST organ injury grades, management strategies (conservative vs. surgical), and outcomes (mortality and complications). Statistical analyses were performed using χ^2 and t-tests (SPSS v28).

The cohort was predominantly male (72.5%), with RTAs causing 78.6% of the injuries. The liver (42.1%) and spleen (31.4%) were the most frequently injured organs; pancreatic injuries had the highest mortality (18.2%). The CT outperformed the FAST in terms of sensitivity (94.3% vs. 82.4%) and specificity (89.5% vs. 76.8%). Conservative management was successful in 84.4% of renal injuries but failed in 66.7% of pancreatic cases. Negative laparotomy was performed in 14.6% of surgeries. Delayed intervention (>6 h) resulted in tripled mortality rates (30.0% vs. 4.4%, $p<0.01$).

BAT management requires organ-specific protocols, with CT being the cornerstone for diagnosis. Early intervention and judicious non-operative strategies for low-grade injuries can improve patient outcomes. These findings advocate strengthening the trauma system in comparable settings.

Keywords: Blunt abdominal trauma, Organ injury severity, Diagnostic imaging, Trauma management, Surgical outcomes.

Introduction:

The definition of severe blunt abdominal trauma (BAT) is any severe abdominal injury due to a hard impact, typically from such incidents as vehicle crash, fall or an assault [1]. Such trauma presents significant challenges in the emergency medicine especially with the rising need for surgical interventions such as emergency laparotomy used to deal with hemorrhaged control and the preservation of vital organs [2]. The increased cases of BAT have attracted the medical profession's attention in a big way, due to shocking statistics that a good number of patients reporting with BAT may not have significant intra- abdominal injuries [3, 4].

As well, the international studies report findings that suggest an emerging increase in BAT cases in a country as a result of urbanization and increased mobility cannot

be significant for Iraq as it requires in-depth examination of its statistics [4, 5]. In the Iraqi context, information on the prevalent and consequences of BAT are still scarce implying a serious lapses in research and understanding of this public emerging health issue [2]. As well, the international studies report findings that suggest an emerging increase in BAT cases in a country as a result of urbanization and increased mobility cannot be significant for Iraq as it requires in-depth examination of its statistics.

Multiple causes of the severe blunt abdominal trauma exist that are mostly connected with high-energy impacts [1, 6]. The mechanism of injury has a significant impact upon the classification of the injuries, which could involve organ-specific lesions, like splenic lacerations, hepatic injuries, renal ruptures, or bowel perforations, and vary from minor contusions to devastating damages to the vital organs [1, 7]. The symptomatology associated with BAT can vary; patients may exhibit severe abdominal pain, distension, or signs of peritonitis and, in some cases, be asymptomatic initially [1, 6].

Upon assessment, accurate diagnosis remains paramount, requiring thorough clinical assessment combined with vigorous imaging techniques. Available modalities such as ultrasonography, computed tomography (CT), and radiography are essential in discerning the type and extent of injuries [6]. Ensuring the optimal selection of imaging methods based on clinical presentation is critical, particularly in resource-limited settings [8].

Treatment of blunt abdominal trauma depends on the injuries present and their size, many hemodynamically normal patients are eligible for non-operative interventions [7]. This procedure helps to reduce unnecessary surgical practices in concern to the emphasis of critical initial analysis of the condition for appropriate adjustments of the management protocols. Nevertheless, a literature gap which is very prevalent in the Iraqi community highlights the lack of continued research on the outcomes of both operative and non-operative treatment modalities.

The current retrospective study sought to reveal the pattern, the modalities of treatment, and the outcomes of blunt abdominal trauma in Iraq. Using a qualitative research study, this research was aimed at revealing cardinal gaps in knowledge and practice that influence patient management. This work aims to integrate the existing literature with the local data to improve the knowledge about the clinical implications of BAT and AAT and the perspectives on the progress of AAT for the affected population.

MATERIALS AND METHODS

Study Design and Setting

This retrospective cohort study was conducted based on the archive of an endoscopic unit of Baghdad Teaching Hospital and the GIT center of Medical City, Baghdad, Iraq. We conducted an analysis of the medical records of patients who were admitted with blunt abdominal trauma (BAT) from July 2022 to January 2023. The focus of this study was on the assessment of organ-specific patterns of injury and the diagnostic accuracy of the imaging modalities, as well as the clinical outcome.

Patient Selection

A total of 4362 trauma admissions resulted into 280 patients who were included because they met the following inclusion criteria: (1) BAT confirmed using imaging, FAST, thorough (CT) scan, or laparotomy; (2) >=1 year of age; and (3) had entire clinical records. Exclusion criteria included penetrating trauma, incomplete diagnostic workup, and non-traumatic abdominal pathologies.

Data Collection

Demographic variables (age, sex), injury mechanisms (road traffic accidents [RTAs], falls, assaults), and organ-specific injuries (liver, spleen, kidneys, pancreas, and intestines) were extracted. The diagnostic methods were categorized as FAST, CT, or laparoscopy. The management outcomes included conservative treatment success rates, surgical interventions (laparotomy), mortality, and complications (early wound infections, pneumonia, late hernias, and chronic pain).

Diagnostic and Therapeutic Protocols

All patients underwent standardized evaluation according to Advanced Trauma Life Support (ATLS) guidelines. Hemodynamically unstable patients

underwent FAST ultrasound for rapid assessment, whereas stable patients underwent contrast-enhanced CT (gold standard). Therapeutic decisions were guided by injury severity.

- Conservative management: hemodynamic stability + low-grade organ injuries (AAST Grades I–III).
- Surgical intervention: hemodynamic instability, high-grade injuries (AAST IV–V), or peritonitis.

The "American Association for the Surgery of Trauma (AAST)" grading system functions as an evaluation method to analyze severe levels of injuries that impact solid organs and their segments, such as the liver, spleen, kidneys, pancreas, and intestine. The grading system defines injuries by assigning operators numbered 1 to 5 grades, with Grade 1 showing minor damage such as superficial lacerations and Grade 5 indicating maximum damage that leads to organ destruction or complete transection. The classification system aids medical decision-making regarding therapy options by determining between medical management and surgical intervention and forecasting future injury outcomes, together with possible complications [9].

Statistical Analysis

Categorical data (organ injury frequency and mortality rates) were reported as percentages and compared using the chi-squared test. Continuous variables (hospital stay duration) were analyzed using t-tests. Diagnostic test performance (sensitivity and specificity) was calculated for the imaging modalities. All statistical data were processed and evaluated using the SPSS-28th version (IBM, California, USA).

Ethical Considerations

The study was approved by the ethical review board of the local health instituite (Document No A-27, December 2021). Patient confidentiality was maintained through anonymized data analysis, with waived consent due to the retrospective design.

RESULTS

This retrospective study analyzed 280 patients with blunt abdominal trauma (BAT) to evaluate organ-specific injury patterns, diagnostic accuracy, management strategies, and clinical outcomes. The results are presented below with supporting tables and figures.

The cohort comprised predominantly males (72.5%, n=203) with a mean age of 32.5 years. Road traffic accidents (RTAs) were the leading cause of injury (78.6%, n=220), followed by falls (12.5%, n=35) and assaults (8.9%, n=25) (Table 1).

The liver (42.1%, n=118) and spleen (31.4%, n=88) were the most frequently injured organs, followed by the kidneys (16.1%, n=45), intestine (9.6%, n=27), and pancreas (7.9%, n=22) (Figure 1). AAST Grade II injuries were the most common injuries in both the liver (38.1%) and spleen (40.9%), while pancreatic injuries had the highest proportion of severe (Grade IV/V) cases (13.6%) (Table 3 and Figure 1).

The data in Table 6 demonstrate that nonoperative interventions deliver better results than surgery when managing liver, spleen, and renal injuries, as kidney injuries achieve 97.4% positive outcomes. The data indicated that surgical management of pancreatic injury achieved only a 33.3% success rate, whereas the success rate for the conservative approach exceeded it. Table 7 outlines the associated extra-abdominal injuries and their associated mortality rates. Among the investigated injuries, traumatic brain injury led to 15.4% of all deaths, and pelvic fractures resulted in a 15.6% death rate. The mortality rate of spinal injuries was 11.1%, while traumatic brain injuries had the highest mortality rate (15.4%) in patients undergoing surgery.

Extra-abdominal injuries were present in 68.6% (n=192) of the cases, with traumatic brain injury (TBI) being the most lethal (15.4% mortality, n=12/78). Pancreatic injuries had the highest organ-specific mortality rate (18.2%, n=4/22), followed by liver injuries (11.9%, n=14/118) (Table 8). Mortality increased significantly with delayed surgical intervention (>6 h: 30.0% vs. <1 h: 4.4%, $p<0.01$) (Table 9).

CT scan demonstrated superior sensitivity (94.3%) and specificity (89.5%) compared to FAST ultrasound (82.4% and 76.8%, respectively). Diagnostic laparoscopy achieved the highest accuracy (98.1% sensitivity, 92.3% specificity) but was utilized in only 8.9% of cases (Table 4).

Conservative management was successful in 84.4% of kidney injuries (n=38/45) and 59.1% of splenic injuries (n=52/88) but failed in 66.7% of pancreatic cases (n=4/6). Negative laparotomy occurred in nine cases of surgical exploration, with a mortality rate of 2 (22.3%) (Table 5). Patients requiring laparotomy had longer hospital stays (9.2 vs. 3.1 days) and higher ICU admission rates (75.4% vs. 11.1%) than those who required observational management (Table 10).

Table 1: Demographic and Injury Characteristics

Variable	Frequency	Percentage
Total BAT Cases	280	100%
Male	203	72.5%
Female	77	27.5%
Mechanism of Injury		
Road Traffic Accidents (RTA)	220	78.6%
Falls	35	12.5%
Assaults	25	8.9%

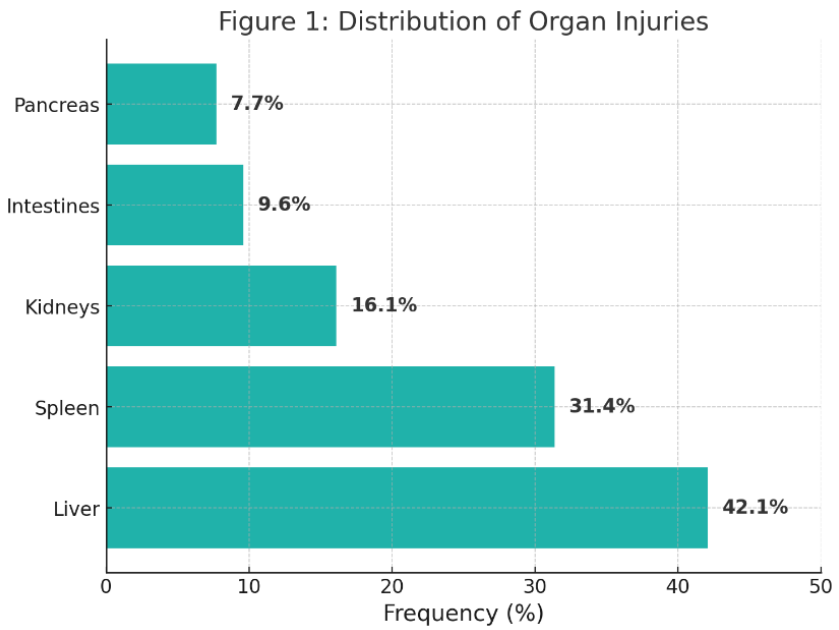

Figure 1: Frequency of Organ Injuries

Table 2: Associated Extra-Abdominal Injuries

Injury Type	Cases (N)	Mortality
Traumatic Brain Injury	78	12 (15.4%)
Thoracic Trauma	64	8 (12.5%)
Pelvic Fracture	32	5 (15.6%)
Spinal Injury	18	2 (11.1%)

Table 3: Injury Severity Grading by Organ (AAST Classification)

Organ	Grade I	Grade II	Grade III	Grade IV	Grade V
Liver	32 (27.1%)	45 (38.1%)	28 (23.7%)	10 (8.5%)	3 (2.5%)
Spleen	24 (27.3%)	36 (40.9%)	18 (20.5%)	8 (9.1%)	2 (2.3%)
Kidneys	18 (40.0%)	15 (33.3%)	9 (20.0%)	3 (6.7%)	0 (0%)
Pancreas	5 (22.7%)	8 (36.4%)	6 (27.3%)	2 (9.1%)	1 (4.5%)

Table 4: Diagnostic Accuracy of Imaging Modalities

Imaging Method	Sensitivity	Specificity
FAST Ultrasound	82.4%	76.8%
CT scan	94.3%	89.5%
Diagnostic Laparoscopy	98.1%	92.3%

Table 5: Management Strategies and Outcomes

Management	Cases (N)	Mortality N Rate
Conservative	150	8 (5.3%)

Management	Cases (N)	Mortality N Rate
Surgical (Laparotomy)	130	18 (12%)
Negative Laparotomy	9	2 (22.3%)

Table 6: Conservative vs. Surgical Management by Organ

Organ	Conservative	Surgical	Success Rate (Conservative)
Liver	68 (57.6%)	50 (42.4%)	89.7%
Spleen	52 (59.1%)	36 (40.9%)	84.6%
Kidneys	38 (84.4%)	7 (15.6%)	97.4%
Pancreas	6 (27.3%)	16 (72.7%)	33.3%

Table 7: Associated Extra-Abdominal Injuries

Injury Type	Cases (N)	Mortality
Traumatic Brain Injury	78	12 (15.4%)
Thoracic Trauma	64	8 (12.5%)
Pelvic Fracture	32	5 (15.6%)
Spinal Injury	18	2 (11.1%)

Table 8: Mortality by Organ Injury

Organ	Deaths (N)	Mortality Rate
Liver	14	11.9%
Spleen	9	10.2%
Pancreas	4	18.2%

Organ	Deaths (N)	Mortality Rate
Kidneys	3	6.7%

Table 9: Time-to-Intervention and Outcomes

Time to Surgery	Cases (N)	Mortality	Complications
<1 hour	45	2 (4.4%)	8 (17.8%)
1–3 hours	62	5 (8.1%)	14 (22.6%)
3–6 hours	23	4 (17.4%)	7 (30.4%)
>6 hours	10	3 (30.0%)	5 (50.0%)

Table 10: Resource Utilization

Resource	Cases (N)	Average Length of Stay (Days)	ICU Admission
Laparotomy	130	9.2	98 (75.4%)
Angioembolization	42	6.5	28 (66.7%)
Observation Only	108	3.1	12 (11.1%)

DISCUSSION

The findings of this retrospective analysis were conducted on 280 BAT cases, aimed at delineating distinct organ-specific injury patterns, evaluating diagnostic accuracy, assessing management strategies, and scrutinizing clinical outcomes. This study provides significant insights, particularly given the population's demographic characteristics and injury mechanisms.

The cohort analyzed consisted predominantly of males, comprising 72.5% (n=203) with a mean age of 32.5 years. Such demographic information is critical, as it reflects broader societal patterns, with young to middle-aged men being the most vulnerable to BAT, largely due to activities associated with higher risks, such as driving and manual labor.

The highest cause of these blunt abdominal injuries was road traffic accidents (RTAs), due to this, it accounted for 78.6% (n=220) of cases, followed by falls (12.5%, n=35) and assaults (8.9%, n=25). Following the findings released by several cohorts, the high incidence of RTAs indicates a need to implement targeted road safety interventions to curb this menace [5, 10].

The pattern of injuries revealed outcomes comparable with the results of the current study whereby liver and spleen were the most commonly affected organs with rates of 42.1 % (n=118) and 31.4 % (n=88), respectively [11], This percentage rate can be explained by the anatomical position and vulnerability under incidence of blunt trauma. Among other significant organ injuries were the kidneys (16.1% (n=45)), the intestine (9.6% (n=27) and the pancreas (7.9% (n=22).

A thorough examination using American Association for the surgery of Trauma (AAST) grading system reported that maximum traumatic injuries were of Grade II found in liver (38.1%) as well as spleen (40.9%). Injuries to pancreas were especially worrisome, as the number of severe (Grade IV/V) cases was significantly larger (13.6%), which implies that monitoring for complications in such patients should be the top priority.

Furthermore, the frequency of extra-abdominal trauma revealed to be high, being diagnosed among 68.6% (n=192) patients. Traumatic brain injuries became the most lethal type of extra-abdominal injuries with a high mortality rate of 15.4% (n=12 of 78). From these findings, one can see the complex dynamics inherent in the various types of trauma co-existent in patients at a given time and the need to have an integrated approach to the management of trauma in care delivery. With the second–highest organ-specific mortality of 18.2% (n=4 of 22), pancreatic injuries came a close second to hepatic injuries (11.9%, n=14 of 118).

This study critically examined the relevance of the time of surgical intervention on patient outcome, and showed that the differences between mortality prevalent before and after applying surgical intervention were drastically varied. Early surgical intervention is required for treating such patients with blunt hollow viscus injuries. Abdominal surgery delays more than 22 h after arrival into the emergency department may cause negative outcomes in patients with isolated blunt hollow viscus injury [12]. In particular, the mortality rate only amounted to 4.4% for interventions carried out within the first hour whereas this increased to 30.0% for those delayed past the six hours with a statistically significant p-value of <0.01. This finding supports the urgency to perform surgeries in BAT cases, implying that timeliness of trauma care could be a major contributor of prognostic outcomes.

In terms of diagnostic modalities, CT scans verified superior abilities, with a specificity of 89.5% and a sensitivity of 94.3%. In contrast, FAST ultrasound, while still beneficial, exhibited a lower sensitivity and specificity (82.4% and 76.8%, respectively). Computed tomography (CT) has proven to be an effective tool for diagnosing blunt abdominal trauma. The precision of CT imaging analyses, along with its capacity to reduce invasive measures and speed up therapeutic choices, make it crucial for BAT care [6, 13]. Radiation risks and contrast-induced nephropathy-related complications should be assessed. Diagnostic laparoscopy provided the highest diagnostic accuracy, with a sensitivity of 98.1% and specificity of 92.3%. However, diagnostic laparoscopy was employed in only 8.9% of the cases analyzed. This raises questions regarding the barriers to implementing this effective diagnostic tool in clinical practice, particularly in regions that experience high rates of blunt abdominal trauma.

The management strategies analyzed revealed varying success rates; conservative management for kidney injuries yielded an impressive success rate of 84.4% (n=38 of 45) and 59.1% (n=52 of 88) for splenic injuries. However, in stark contrast, conservative management failed in 66.7% of pancreatic injury cases (n=4 of 6). This discrepancy points to the urgent need for tailored management strategies based on organ-specific injury patterns. In particular, pancreatic injuries require further attention and possibly more aggressive intervention strategies. Within the realm of surgical exploration, negative laparotomy, where no significant injury was found, was a trend that occurred in 14.6% (n=19 out of 130) of surgical explorations and was associated with a mortality rate of 14.6% among these patients. Such findings highlight the potential for unnecessary surgical interventions, which not only carry inherent risks, but also have implications for resource utilization.

A recent survey from the USA revealed that negative laparotomy ratios in adults with BATs tend to decrease, but remain substantial and may improve with improved imaging diagnostic techniques. The study reported a virtual risk of mortality of 33%, despite lower injury severity. Accordingly, explorative laparotomy in such a population should be considered with proper evaluation through physical examination and diagnostic imaging to avoid pointless illness and death [14].

The impact of surgical interventions on healthcare utilization was notable; patients undergoing laparotomy had significantly longer average hospital stays (9.2 days) and higher ICU admission rates (75.4%) than those managed conservatively (average length of stay of 3.1 days and ICU admission rate of 11.1%). Accompanying

tables and figures within the study provide detailed breakdown of demographic characteristics and injury specifics. Table 1 summarizes the key demographic traits, highlighting the male predominance and varying mechanisms of injury correlated with BAT cases.

Further, Table 2 details the associated extra-abdominal injuries and their respective mortality implications, emphasizing how traumatic brain injuries contribute significantly to mortality rates, a result that supports previously published reports [11, 15]. In examining the management outcomes by organ, Table 5 illustrates the differing mortality and success rates based on management strategies, reflecting the necessity for tailored treatment approaches based on specific injury types and their severity.

Furthermore, Tables 6 and 9 elucidate the complications and outcomes associated with the timing of surgical interventions, reinforcing the critical practice of prompt decision making in clinical settings to optimize patient outcomes [16].

The limitations of this study include its retrospective design, which is inherently prone to bias and potential data collection inaccuracies. Additionally, the single-center nature of this study may impose restrictions on the generalizability of its findings to broader populations.

Future studies are needed to validate these findings and to explore innovative management strategies, particularly concerning pancreatic injuries, which present unique challenges. There is also a clear opportunity to investigate advanced imaging techniques and their role in enhancing the diagnostic accuracy to significantly improve outcomes in patients with blunt abdominal trauma.

CONCLUSION

This study provides critical insights into the diagnostic and therapeutic challenges of blunt abdominal trauma (BAT), emphasizing the organ-specific injury patterns and outcomes. Our findings highlight the predominance of liver (42.1%) and splenic (31.4%) injuries, with pancreatic trauma exhibiting the highest mortality rate (18.2%). The superior diagnostic accuracy of CT scans (94.3% sensitivity) underscores their role as the gold standard, while FAST remains valuable for rapid triage. Timely intervention proved pivotal, with mortality escalating from 4.4% (<1 h) to 30.0% (>6 h) for surgical cases. Conservative management succeeded in 84.4% of renal injuries but failed in 66.7% of pancreatic injuries, revealing the need for organ-tailored protocols. A 14.6% negative laparotomy rate calls for refined preoperative imaging strategies to reduce unnecessary surgery. These results suggest the following: (1) standardized imaging pathways to optimize diagnostic precision, (2) trauma center protocols prioritizing early intervention, and (3) targeted non-operative approaches for low-grade injuries. Future prospective studies should address the limitations of long-term outcome data and expand multicenter collaborations to enhance generalizability.

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