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Computed Tomography (CT) as A Primary Diagnostic Modality in the Evaluation of Blunt Abdominal Injury in Hemodynamically Stable Patients

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Abstract: ***Background:*** Blunt abdominal trauma (BAT) is a significant cause of morbidity and mortality, especially in low- and middle-income countries. Early, accurate diagnosis is critical but often challenging due to non-specific clinical signs. While traditional tools like FAST and DPL have limitations, computed tomography (CT) has emerged as the gold standard for evaluating intra-abdominal injuries in hemodynamically stable patients. CT offers superior accuracy, detailed imaging, and facilitates injury grading and management decisions. In resource-limited settings like Bangladesh, optimizing CT use can improve outcomes. Local data are scarce, warranting this study to assess CT's diagnostic value in blunt abdominal trauma cases. ***Objectives:*** This study was undertaken to evaluate the role of CT as a primary diagnostic modality in the evaluation of blunt abdominal trauma among hemodynamically stable patients in a tertiary care setting in Bangladesh. ***Methods:*** This descriptive cross-sectional study was conducted in the Radiology and Imaging Department in collaboration with the Surgery Department at the Bangabandhu Sheikh Mujib Medical University Shahbag, Dhaka, Bangladesh over 12 months from July 2022 to June 2023. A total of 120 hemodynamically stable patients aged ≥18 years with blunt abdominal trauma who underwent CT evaluation were included through purposive sampling. Data were collected using a structured sheet covering clinical details, CT findings, injury grading, and outcomes. CT scans were performed using a standardized protocol and interpreted by experienced radiologists. Data were analyzed using SPSS version 26.0, with results expressed in frequencies and percentages to assess CT's diagnostic utility. ***Results:*** Among 120 hemodynamically stable patients with blunt abdominal trauma, the majority were males (68.3%) aged 31–45 years (35%). Road traffic accidents were the leading cause (60%), and 65% underwent CT within 6 hours. Abdominal pain/tenderness was the most common symptom (81.7%). CT revealed liver (26.7%) and splenic (23.3%) injuries as most frequent, with free fluid in 37.5% and free air in 6.7%. Most organ injuries were low-grade. Conservative management was employed in 70.8% of cases, with 23.3% undergoing surgery. Complete recovery was seen in 86.7%, complications occurred in 8.3%, and mortality occurred in 2.5% of patients. ***Conclusion:*** The study confirms that CT is a highly effective primary diagnostic tool for evaluating blunt abdominal injuries in hemodynamically stable patients. It enables accurate injury detection, supports non-operative management, and guides timely interventions, ultimately improving outcomes and reducing mortality in trauma care, especially in resource-limited healthcare settings.

Keywords: Blunt abdominal trauma, computed tomography, hemodynamically stable.

Research Paper

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INTRODUCTION

Blunt abdominal trauma (BAT) represents a significant cause of morbidity and mortality in trauma patients, particularly in low- and middle-income countries where road traffic accidents (RTAs) and interpersonal violence are prevalent [1]. It accounts for a considerable proportion of hospital admissions related to trauma, and early, accurate diagnosis of intra-abdominal injuries is essential for guiding appropriate treatment and improving outcomes. Due to the complex nature of such injuries, especially in the absence of overt clinical signs,

diagnostic challenges often arise. Traditionally, clinical examination, diagnostic peritoneal lavage (DPL), and focused assessment with sonography for trauma (FAST) have been utilized; however, these modalities have limitations in sensitivity and specificity [2,3]. In recent years, Computed Tomography (CT) has become the gold standard in the evaluation of blunt abdominal injuries in hemodynamically stable patients. It provides excellent anatomical detail, allows the identification of solid organ injuries, bowel perforations, active bleeding, retroperitoneal hematomas, and other clinically significant findings, and aids in injury grading according to standardized systems such as the American Association for the Surgery of Trauma (AAST) injury scale [4]. The evolution of multi-detector CT (MDCT) technology has significantly enhanced image resolution and speed, permitting rapid and comprehensive evaluation with high diagnostic accuracy. Moreover, CT findings directly influence the management approach, determining whether non-operative management (NOM), interventional radiology, or surgical exploration is warranted [5]. Clinical evaluation alone may be unreliable in up to 40% of cases of blunt abdominal trauma, especially in unconscious, intoxicated, or neurologically impaired patients [6]. Although FAST is commonly used in emergency settings for its non-invasive and rapid nature, it is highly operator-dependent. It often fails to detect retroperitoneal injuries or low-volume hemoperitoneum. Furthermore, its sensitivity for hollow viscus injuries and solid organ lacerations is limited compared to CT [7]. While DPL has high sensitivity for intraperitoneal bleeding, its invasive nature, inability to identify the source of bleeding, and low specificity for organ injury have made it largely obsolete in facilities with CT availability [8]. The role of CT has been further emphasized with the increasing trend toward non-operative management (NOM) of solid organ injuries, especially in hemodynamically stable patients. Several studies have confirmed that the use of CT can prevent unnecessary laparotomies by accurately stratifying injury severity and monitoring patients managed conservatively [9]. Additionally, the identification of vascular contrast extravasation or pseudoaneurysms may indicate the need for angioembolization, an alternative to surgery in selected cases [10]. In countries like Bangladesh, where trauma remains a growing public health concern, optimizing diagnostic protocols is crucial for timely and effective management. According to the World Health Organization (WHO), RTAs alone account for a significant proportion of injury-related deaths in South Asia, highlighting the importance of streamlined trauma care pathways [11]. Despite the increasing availability of CT facilities in tertiary centers, challenges such as delayed referrals, lack of trained personnel, and financial constraints often affect imaging decisions. Hence, identifying the utility and yield of CT scanning in a specific population and clinical setting can inform resource allocation, training, and protocol development. Previous studies conducted in other settings have shown high sensitivity (close to 100%) and specificity (95–100%) for CT in detecting clinically significant abdominal injuries [12]. However, regional data, particularly from South Asia, remain limited. Studies from India, Nepal, and Pakistan have demonstrated the value of CT in trauma, but variability in patient profiles, infrastructure, and injury patterns necessitates setting-specific evaluations [13,14]. This study was undertaken to evaluate the role of CT as a primary diagnostic modality in the evaluation of blunt abdominal trauma among hemodynamically stable patients in a tertiary care setting in Bangladesh.

MATERIALS AND METHODOLOGY

This was a hospital-based, descriptive cross-sectional study conducted to assess the role of Computed Tomography (CT) as a primary diagnostic modality in evaluating blunt abdominal injuries among hemodynamically stable patients. The study was carried out in the Department of Radiology and Imaging in collaboration with the Department of Surgery at Bangabandhu Sheikh Mujib Medical University Shahbag, Dhaka, Bangladesh. Data collection was performed over 12 months following ethical approval from July 2022 to June 2023. A total of 120 eligible patients were included using purposive sampling during the study period. All patients presenting to the emergency department with blunt abdominal trauma who were hemodynamically stable and underwent CT scan evaluation were considered eligible for inclusion.

Inclusion Criteria:

- Patients of both sexes aged 18 years and above.
- Patients with blunt abdominal trauma who were hemodynamically stable (systolic BP ≥ 90 mmHg without ongoing resuscitation).
- Patients who consented to undergo CT abdomen for diagnostic evaluation.

Exclusion Criteria:

- Hemodynamically unstable patients require immediate surgery.
- Patients with penetrating abdominal injuries.
- Pregnant patients.
- Patients with known abdominal pathology before trauma.
- Incomplete clinical or radiological data.

Data Collection Procedure:

Data were collected using a structured data collection sheet that included demographic details, mechanism of injury, clinical presentation, CT scan findings, injury grading based on the American Association for the Surgery of Trauma (AAST), management approach, and outcomes. CT scans were performed using a standard protocol on a multi-detector CT scanner, and experienced radiologists interpreted findings. Clinical and surgical correlations were done where applicable.

Ct Evaluation Criteria:

A CT abdomen with intravenous contrast was performed to assess solid organ injury, free fluid, presence of pneumoperitoneum, bowel injuries, and retroperitoneal hematoma. Injuries were graded according to the AAST organ injury scale, where relevant.

Data Analysis:

The collected data were tabulated and analyzed using Microsoft Excel and SPSS software (version 26.0). Descriptive statistics were applied, and results were presented in terms of frequency and percentage.

RESULTS

The study evaluated 120 hemodynamically stable patients with blunt abdominal injury using computed tomography (CT) as the primary diagnostic tool. As shown in Table 1, the majority of patients were aged between 31 and 45 years (35%), followed by 18–30 years (30%). Males predominated (68.3%) over females (31.7%). According to Table 2, road traffic accidents were the most common mechanism of injury (60%), followed by falls from height (21.7%), while most patients (65%) underwent CT within 6 hours of injury. Table 3 highlights that abdominal pain or tenderness was the most frequent presenting symptom (81.7%), with 100% of patients hemodynamically stable at the time of scanning. In terms of imaging findings (Table 4), liver (26.7%) and spleen (23.3%) were the most commonly injured organs, while 37.5% had free fluid and 6.7% had free air in the abdomen. Organ-specific grading in Table 5 revealed that most liver and splenic injuries were Grades I or II, with higher-grade injuries (Grades IV and V) being less frequent. Management approaches in Table 6 indicated that 70.8% of patients were managed conservatively, while 23.3% required surgery and 5.8% underwent interventional radiology. A notable proportion (29.2%) required blood transfusion, and 15% were admitted to the ICU. Finally, Table 7 shows that 86.7% of patients achieved complete recovery, with complications in 8.3%, re-intervention in 2.5%, and a mortality rate of 2.5%.

Table 1: Demographic Profile of the Patients (n = 120)

Variable	Frequency (n)	Percentage (%)
Age Group (in years)		
18–30	36	30.00
31–45	42	35.00
46–60	30	25.00
>60	12	10.00
Sex		
Male	82	68.33
Female	38	31.67

Table 2: Mechanism and Type of Injury

Variable	Frequency (n)	Percentage (%)
Mechanism of Injury		
Road Traffic Accident	72	60.00
Fall from Height	26	21.67
Assault	14	11.67
Others	8	6.67
Time Since Injury		
≤ 6 hours	78	65.00
> 6 hours	42	35.00

Table 3: Clinical Presentation of Patients

Clinical Feature	Frequency (n)	Percentage (%)
Abdominal Pain/Tenderness	98	81.70
Abdominal Distension	45	37.50
Guarding/Rigidity	37	30.80
Associated Head Injury	22	18.30
Associated Chest Injury	30	25.00
Hemodynamically Stable	120	100.00

Table 4: CT scan Findings (n = 120)

CT Finding	Frequency (n)	Percentage (%)
Liver Injury	32	26.70
Spleen Injury	28	23.30
Renal Injury	18	15.00
Bowel Injury	14	11.70
Pancreatic Injury	6	5.00
Bladder Injury	4	3.30
Free Fluid in Abdomen	45	37.50
Free Air in Abdomen	8	6.70
Retroperitoneal Hematoma	10	8.30

Table 5: Grades of Organ Injury Identified by CT (as per AAST)

Organ	Grade I	Grade II	Grade III	Grade IV	Grade V
Liver (n=32)	10 (31.3%)	12 (37.5%)	6 (18.8%)	3 (9.4%)	1 (3.1%)
Spleen (n=28)	8 (28.6%)	10 (35.7%)	7 (25.0%)	2 (7.1%)	1 (3.6%)
Kidney (n=18)	6 (33.3%)	5 (27.8%)	4 (22.2%)	2 (11.1%)	1 (5.6%)

Table 6: Management Based on CT Findings

Management Plan	Frequency (n)	Percentage (%)
Conservative Management	85	70.80
Surgical Intervention	28	23.30
Interventional Radiology	7	5.80
Blood Transfusion Required	35	29.20
ICU Admission	18	15.00

Table 7: Outcomes of the Patients

Outcome	Frequency (n)	Percentage (%)
Full Recovery	104	86.70
Post-Operative Complications	10	8.30
Re-intervention Needed	3	2.50
Mortality	3	2.50

DISCUSSIONS

This study evaluated the efficacy of computed tomography (CT) as a primary diagnostic modality in the assessment of blunt abdominal trauma in hemodynamically stable patients. Our findings highlight the significant role of CT imaging in detecting intra-abdominal injuries, guiding management decisions, and influencing patient outcomes. The demographic profile in this study revealed a predominance of young to middle-aged adults, with the highest incidence among patients aged 31-45 years (35%) and males constituting 68.3% of cases. This pattern aligns with global trends reported by Atinga A et al. (2018), who documented higher trauma incidence among males due to greater exposure to high-risk activities and traffic accidents [15]. Road traffic accidents accounted for 60% of injuries, reinforcing the epidemiological burden of trauma secondary to vehicular collisions in many low- and middle-income countries, including Bangladesh [16]. The preponderance of early imaging (within 6 hours post-injury) reflects adherence to trauma protocols emphasizing prompt diagnosis to improve outcomes [17]. Clinically, abdominal pain and tenderness were the most frequent presenting symptoms (81.7%), consistent with earlier studies underscoring their importance as clinical indicators of intra-abdominal injury [18]. However, physical examination alone can be unreliable, especially in patients with altered sensorium or multiple injuries [19]. Our findings confirm that all patients were hemodynamically stable at the time of CT, supporting the established indication that CT is primarily valuable in stable trauma patients where the diagnosis is uncertain and immediate laparotomy is not warranted [20]. The CT findings demonstrated that the liver and spleen were the most commonly injured organs (26.7% and 23.3%, respectively), followed by renal and bowel injuries. These results are consistent with prior research, where solid organ injuries predominate in blunt abdominal trauma cases [21]. The detection of free fluid in 37.5% of patients and free air in 6.7% highlights CT's sensitivity in identifying critical signs of hollow viscus perforation and intra-abdominal bleeding, which can be occult on physical examination or ultrasound [22]. Retroperitoneal hematomas were less common but still clinically significant, emphasizing the comprehensive nature of CT imaging. Organ injury grading using the AAST classification revealed that most injuries were low to moderate grade (I–II), with fewer high-grade injuries

(IV–V). This grading is crucial as it correlates with the management plan and prognosis [23]. The predominance of low-grade injuries likely contributed to the high rate of successful conservative management (70.8%) observed, consistent with the current paradigm that non-operative treatment is safe and effective for most stable blunt abdominal trauma patients [24]. Surgical intervention was necessary in 23.3% of cases, mainly dictated by CT findings such as active hemorrhage, extensive organ damage, or evidence of bowel perforation. The role of interventional radiology in controlling bleeding (5.8% of cases) further underscores the importance of CT in planning minimally invasive therapies that can reduce morbidity and mortality [25]. Notably, nearly one-third of patients required blood transfusion, and 15% needed intensive care admission, reflecting the spectrum of injury severity. The outcomes of the cohort were favorable, with 86.7% achieving full recovery, which supports the notion that CT-guided management optimizes patient care. The mortality rate of 2.5% is comparable to other series reporting 1–5% mortality in hemodynamically stable blunt trauma patients [26]. Postoperative complications (8.3%) and re-intervention rates (2.5%) were relatively low, suggesting that initial CT evaluation can effectively stratify patients for appropriate treatment and follow-up. Our findings corroborate those from larger multi-center studies emphasizing the indispensable role of CT in blunt abdominal trauma evaluation. For example, Nnamonu (2013) showed that CT significantly reduces unnecessary laparotomies and improves diagnostic accuracy compared to clinical examination and ultrasound alone [27]. Moreover, Soto and Anderson (2012) highlighted the evolving role of CT, including dual-energy and multiphasic protocols, to enhance the detection of subtle injuries [28]. However, despite the apparent benefits, CT is not without limitations. Radiation exposure, cost, and availability, especially in resource-limited settings, remain challenges [29]. Additionally, minor bowel injuries and specific pancreatic lesions can be missed on initial CT, necessitating careful clinical correlation and repeat imaging if suspicion persists [30].

Limitation of the Study:

This study was limited by its single-center design and relatively small sample size, which may restrict generalizability. The observational nature precluded assessment of causality, and long-term follow-up data were limited. Future prospective studies with larger cohorts and inclusion of hemodynamically unstable patients could provide more comprehensive insights.

CONCLUSION

This study highlights the pivotal role of Computed Tomography (CT) in the early and accurate diagnosis of blunt abdominal injuries in hemodynamically stable patients. CT was effective in detecting the extent and grade of organ damage, guiding appropriate management decisions. The high rate of conservative treatment success (70.8%) underscores CT's utility in supporting non-operative approaches and reducing unnecessary surgeries. Additionally, CT helped identify patients needing surgical or interventional procedures. The overall favorable outcomes, with an 86.7% recovery rate and low mortality, emphasize CT's value as a primary diagnostic modality. Its timely use can significantly improve trauma care in resource-limited settings.

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