Original Research

DIAGNOSTIC MODALITIES, MANAGEMENT, AND OUTCOMES OF BLUNT ABDOMINAL TRAUMA: A PROSPECTIVE OBSERVATIONAL STUDY AT A TERTIARY CARE CENTER

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ABSTRACT

Background: Blunt abdominal trauma (BTA) is a major contributor to morbidity and mortality worldwide, particularly in developing countries where road traffic accidents are increasing. Prompt diagnosis using appropriate imaging techniques and timely therapeutic intervention are crucial for improving patient outcomes. This study aimed to evaluate the diagnostic modalities, management approaches, and clinical outcomes among patients presenting with blunt abdominal trauma at a tertiary care institution. **Methods:** A hospital-based observational descriptive study was conducted among 100 patients admitted with blunt abdominal trauma to the Department of General Surgery, Father Muller Medical College and Hospital, Mangalore, India, over an 18-month period from October 2022 to April 2024. Data regarding mechanism of injury, clinical presentation, diagnostic investigations, treatment strategies, and outcomes were collected and analyzed. Categorical variables were analyzed using Chi-square and Fisher's exact tests, with statistical significance set at $p < 0.05$. **Results:** Most patients were male (83%), with the highest incidence in the 21–30-year age group (21%). Road traffic accidents were the leading cause of injury (68%). The liver was the most frequently affected organ (40%), followed by the spleen (29%). All patients underwent ultrasonography and contrast-enhanced computed tomography. Conservative management was successful in 75% of cases, whereas 25% required surgical intervention. The overall survival rate was 90%, while the mortality rate was 10%. The highest procedure-specific mortality was observed in patients undergoing exploratory laparotomy with ileostomy (60%), whereas conservatively managed patients demonstrated the lowest mortality (4%). **Conclusion:** Non-operative management is a safe and effective treatment option for hemodynamically stable patients with solid organ injuries resulting from blunt abdominal trauma. This approach is associated with lower mortality rates and shorter hospital stays compared to operative management.

Keywords: Blunt Abdominal Trauma, Solid Organ Injury, Non-Operative Management, Exploratory Laparotomy, FAST, Contrast-Enhanced Computed Tomography.

INTRODUCTION

Blunt trauma to the abdomen represents a significant public health concern worldwide and remains a common cause of emergency surgical admissions, particularly among individuals in the younger and economically productive age groups [1]. The abdominal cavity contains several vital organs, including the liver, spleen, kidneys, and intestines, making it particularly vulnerable to injury from external forces. Damage to these organs may lead to severe hemorrhage, visceral perforation, peritonitis, and other life-threatening complications if not promptly recognized and appropriately managed [2]. Trauma continues to contribute substantially to global morbidity and mortality, particularly among individuals under the age of 45 years [3].

In developing countries such as India, the incidence of blunt abdominal trauma has increased in recent years due to rapid urbanization, industrial development, and a growing number of motor vehicles [4]. Road traffic accidents remain the most common cause of blunt abdominal trauma, followed by falls from height, assaults, and occupational

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 01-02-2025
Date Acceptance: 13-02-2026
Date of Publication: 14-03-2026

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injuries [5]. These injuries frequently affect young adults who are actively engaged in occupational and social activities, thereby imposing a considerable socioeconomic burden.

The clinical presentation of blunt abdominal trauma can vary widely and may sometimes be misleading. Patients may present with symptoms ranging from mild abdominal discomfort to signs of peritonitis and hemorrhagic shock. Diagnosis can be particularly challenging in patients with altered consciousness, intoxication, or associated injuries involving the head, chest, or extremities [6]. Unlike penetrating trauma, where the trajectory of the injury may provide clues about the affected organs, blunt trauma often presents without obvious external signs despite significant intra-abdominal injury. Consequently, delayed diagnosis remains a recognized cause of preventable morbidity and mortality, highlighting the importance of a systematic and protocol-driven approach to patient evaluation [7].

Advances in diagnostic imaging have significantly improved the assessment and management of blunt abdominal trauma over the past few decades. The Focused Assessment with Sonography for Trauma (FAST) has become an essential component of the initial trauma evaluation and is widely recommended in Advanced Trauma Life Support (ATLS) guidelines [8]. FAST allows rapid bedside detection of free intraperitoneal fluid and is particularly valuable in hemodynamically unstable patients. The reported sensitivity of FAST ranges from 69% to 96%, with specificity exceeding 92% [9]. In unstable patients, its diagnostic sensitivity may approach 100% [10].

Despite its advantages, ultrasonography is operator dependent and has limitations in identifying specific organ injuries or hollow viscus perforations. For hemodynamically stable patients, contrast-enhanced computed tomography (CECT) has emerged as the gold standard for evaluating blunt abdominal trauma [11]. CECT provides detailed visualization of abdominal organs and enables accurate detection of solid organ injuries, mesenteric damage, hollow viscus perforations, and active vascular bleeding. Furthermore, it allows grading of organ injuries according to the American Association for the Surgery of Trauma (AAST) injury scale, which assists clinicians in determining the most appropriate management strategy.

The management of blunt abdominal trauma has evolved significantly over the past three decades. Historically, exploratory laparotomy was routinely performed for suspected intra-abdominal injuries. However, with improvements in diagnostic imaging and critical care monitoring, the management approach has shifted toward selective non-operative management (NOM) [12]. This strategy was initially developed in pediatric trauma care and later adopted in adult practice after accumulating evidence demonstrated that many solid organ injuries in hemodynamically stable patients can be managed conservatively with careful monitoring and serial imaging [13]. Studies have reported success rates exceeding 90% for non-operative management of hepatic, splenic, and renal injuries in appropriately selected patients [14].

Nevertheless, surgical intervention remains necessary in patients with persistent hemodynamic instability, signs of peritonitis, hollow viscus perforation, or ongoing intra-abdominal bleeding despite resuscitative measures. Outcomes in blunt abdominal trauma depend on multiple factors, including the mechanism and severity of injury, organs involved, associated injuries, and the timeliness of diagnosis and treatment. Early identification and appropriate management of injuries have been shown to improve survival and reduce complications [15].

In this context, the present study was conducted to evaluate the diagnostic modalities used, the management strategies adopted, and the clinical outcomes of patients presenting with blunt abdominal trauma at a tertiary care center in southern India.

Aims and Objectives

1. To study the modes of injury and clinical presentation of various structures involved in blunt abdominal trauma.
2. To assess the type of management in various trauma patients, namely operative and conservative management.
3. To assess the outcomes of blunt abdominal trauma in terms of mortality and morbidity.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational descriptive study was carried out in the Department of General Surgery at Father Muller Medical College and Hospital in Mangalore, India. This tertiary care facility has extensive trauma care capabilities, such as 24-hour emergency services, sophisticated radiological imaging, and intensive care support.

Study Period

The study was conducted over a period of 18 months from October 1, 2022 to April 30, 2024.

Study Population

Patients who presented to the emergency room with a history of blunt abdominal injuries during the study period were assessed. A total of 100 patients who met the inclusion criteria participated in the trial.

Inclusion Criteria

Patients admitted with a history of blunt trauma to the abdomen were included in the study. Children who sustained abdominal trauma while playing were also included.

Exclusion Criteria

Patients with a Glasgow Coma Scale (GCS) score below 5 and patients who succumbed due to failure of initial resuscitative measures in the emergency room were excluded from the study.

Sample Size Calculation

The sample size was calculated using the formula:

$n = Z\alpha^2 p(1-p)/e^2$

Where,

$Z\alpha = 1.96$ at 95% confidence interval,

p = prevalence,

e = allowable error (4%).

The minimum required sample size was calculated to be 32 patients at a 95% confidence interval. However, using a purposive sampling technique, data were obtained from 100 patients admitted during the study period.

Method of Data Collection

A thorough clinical history, including demographic information (age and sex), presenting symptoms, mechanism of injury, related injuries, and mental status, was taken once the patient or the accompanying first responder in the emergency room gave their informed consent. A thorough physical examination was conducted to evaluate hemodynamic status, vital parameters, injury severity, and the presence of any associated trauma. Detailed abdominal examination comprising inspection, palpation, percussion, and auscultation was performed, and the neurological status of the patient was also assessed and documented.

Injury Assessment and Grading

All patients underwent radiological evaluation using ultrasonography (FAST) and contrast-enhanced computed tomography (CECT) of the abdomen. The American Association for the Surgery of Trauma (AAST) organ injury scale was used to grade injuries to solid organs such the liver, spleen, and kidneys. This scale is commonly used to categorize the severity of abdominal injuries and inform treatment choices.

Management Protocol

Patients were managed according to Advanced Trauma Life Support (ATLS) guidelines. Patients were divided into groups for either conservative (non-surgical) or operational care based on clinical observations, hemodynamic status, and imaging results. Surgical intervention, including exploratory laparotomy, was performed in patients with hemodynamic instability, signs of peritonitis, hollow viscus injury, or evidence of ongoing intra-abdominal bleeding.

Statistical Analysis

Data were entered and analyzed using Microsoft Excel and OpenEpi statistical software (version 2.2.61). Both descriptive and inferential statistical methods were applied. Baseline characteristics were summarized using frequencies and percentages.

Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. Fisher's exact test was applied when more than 20% of the expected cell counts were less than 5 or when any expected cell count was less than 1. All statistical analyses were conducted at a 5% level of significance, and a p-value < 0.05 was considered statistically significant.

Ethical Considerations

Before the trial started, the Institutional Ethics Committee of Father Muller Medical College in Mangalore granted ethical approval. The patient or emergency room first responder provided verbal informed consent, and all patient data was kept private during the trial.

RESULTS

A total of 100 patients presenting with blunt abdominal trauma were included in this study. The results are presented under demographic characteristics, clinical presentation, and organ involvement, mechanism of injury, diagnostic investigations, management modalities, and patient outcomes.

Demographic Profile

Table 1. Age Distribution of Patients with Blunt Abdominal Trauma (N = 100)

Age Group (Years)	No. of Patients	Percentage (%)
1–10	3	3.0
11–20	20	20.0
21–30	21	21.0
31–40	17	17.0
41–50	15	15.0
51–60	8	8.0
61–70	7	7.0
71–80	7	7.0
81–90	2	2.0
Total	100	100

The highest proportion of patients belonged to the 21–30 years age group (21%), followed by the 11–20 years group (20%). Patients aged 11–40 years accounted for 58% of cases, indicating that blunt abdominal trauma predominantly affected young adults.

The study demonstrated a male predominance, with 83 males (83%) and 17 females (17%), resulting in a male-to-female ratio of approximately 4.9:1.

Clinical Features

Table 2. Distribution of Patients According To Clinical Features

Clinical Feature	No. of Patients (n=100)	Percentage (%)
Pain abdomen	100	100.0
Hematuria	16	16.0
Abdominal distension	14	14.0
Vomiting	13	13.0
Urinary retention	1	1.0
Jaundice	1	1.0

Abdominal pain was the most common presenting symptom, observed in all patients (100%). Hematuria (16%), abdominal distension (14%), and vomiting (13%) were the next most frequent symptoms.

On clinical examination, 96% of patients presented with tenderness, guarding, and rigidity, while isolated tenderness was observed in 3% and tenderness with guarding in 1%.

Organ Involvement

Table 3. Distribution of Patients Based on Organ Involvement

Organ Involved	No. of Patients (n=100)	Percentage (%)
Liver	40	40.0
Spleen	29	29.0
Kidney	9	9.0
Small bowel	6	6.0
Pancreas	4	4.0
Mesentery	4	4.0
Adrenal gland	3	3.0
Large bowel	2	2.0
Urinary bladder	1	1.0
Rectus sheath	1	1.0
Bile duct	1	1.0

The liver was the most commonly injured organ (40%), followed by the spleen (29%) and kidney (9%). Hollow viscus injuries were less frequent, including small bowel (6%) and large bowel (2%) injuries.

Mode of Injury

Table 4. Distribution of Patients Based on Mode of Injury

Mode of Injury	No. of Patients (n=100)	Percentage (%)
Road traffic accident	68	68.0
Fall from height	23	23.0
Slip and fall	3	3.0
Assault	2	2.0
Cattle injury	1	1.0
Iatrogenic	1	1.0
Landslide	1	1.0
Workplace injury	1	1.0
Total	100	100

Road traffic accidents constituted the predominant mechanism of injury, accounting for 68% of cases. Falls from height were the second most common cause (23%), followed by slips and falls (3%), assaults (2%), and other causes including cattle injury, iatrogenic injury, landslide, and workplace injury (1% each).

Diagnostic Investigations

All patients (100%) underwent ultrasonography (FAST) and contrast-enhanced computed tomography (CECT). Serial hemoglobin monitoring was performed in 91% of patients, urine routine examination in 17%, and erect abdominal X-ray in 15% when hollow viscus injury was suspected.

Management Modalities and Outcomes

Table 5. Distribution of Patients Based on Treatment Modality, Mortality, and Mean Hospital Stay

Treatment Modality	Patients (n)	Percentage (%)	Deaths (n)	Mortality (%)	Mean LOS (Days)
Conservative management	75	75.0	3	4.0	9.3
Exploratory laparotomy	11	11.0	3	27.3	13.3
Exploratory laparotomy + ileostomy	5	5.0	3	60.0	13.8
Exploratory laparotomy + splenectomy	5	5.0	1	20.0	18.8
Suturing	2	2.0	0	0.0	14.5
Primary closure	1	1.0	0	0.0	10.0
Rectus sheath hematoma evacuation	1	1.0	0	0.0	5.0
Total	**100**	**100**	**10**	**10.0**	—

The majority of patients (75%) were managed conservatively, while 25% required surgical intervention.

The overall mortality rate was 10%, with 90% of patients recovering.

The highest procedure-specific mortality was observed in exploratory laparotomy with ileostomy (60%), followed by exploratory laparotomy alone (27.3%) and exploratory laparotomy with splenectomy (20%). Conservatively managed patients had the lowest mortality (4%).

Small bowel injuries accounted for 40% of deaths, while injuries involving the liver, spleen, pancreas, urinary bladder, kidney, and mesentery each contributed 10% of mortality cases.

The mean hospital stay was shortest in the conservative management group (9.3 days) and longest among patients undergoing exploratory laparotomy with splenectomy (18.8 days).

DISCUSSION

This observational descriptive study evaluated 100 patients presenting with blunt abdominal trauma at a tertiary care center and provides insights into the demographic characteristics, injury patterns, diagnostic approaches, management strategies, and clinical outcomes associated with this condition.

The age distribution in the present study demonstrated the highest incidence of injury in the 21–30 years age group (21%), which is consistent with findings reported in several Indian studies. Baghmare et al. reported that approximately 30% of patients belonged to the same age group in their observational study conducted in central India [1]. Similarly, Trehan et al. documented that 42.42% of patients were within the 11–30 years age group [2]. This trend may be attributed to the increased exposure of young adults to high-risk activities, occupational hazards, and vehicular travel, making them more susceptible to trauma.

A significant male predominance (83%) was observed in the present study. Comparable findings have been reported by Sisodia et al., who documented 82.3% male patients in their retrospective analysis from central India [3]. Mehta et al. also reported a male-to-female ratio of 3.7:1 in their study conducted in Karnataka [4]. The higher proportion of male patients may be explained by their greater participation in outdoor occupations, transportation-related activities, and risk-prone behaviors.

Abdominal pain was the most common presenting symptom (100%) among patients in this study, which is consistent with the typical clinical

presentation of blunt abdominal trauma. Additional symptoms such as hematuria (16%), abdominal distension (14%), and vomiting (13%) were also observed. Sankpal et al. reported abdominal pain in 88% of patients and abdominal distension in 52% of cases [5]. Furthermore, the presence of clinical signs such as tenderness, guarding, and rigidity in 96% of patients in this study indicates significant intra-abdominal pathology and highlights the importance of thorough clinical examination in trauma assessment.

In the present study, the liver was identified as the most frequently injured organ (40%), followed by the spleen (29%). These findings are consistent with those reported by Solanki et al., who documented liver injuries in 34% of patients and splenic injuries in 16% [6]. Trehan et al. similarly observed that the liver was the most commonly affected organ (34.20%), followed by the spleen (22.51%) [2]. However, some studies have reported splenic injury as the predominant organ involvement. Madhusudhan et al., for example, reported splenic injuries in 67% of cases and liver injuries in 23% [7]. Such variations may be related to differences in the mechanism of injury, trauma severity, and patient demographics across study populations.

Road traffic accidents represented the most common mechanism of injury (68%) in this study, followed by falls from height (23%). Similar patterns have been observed in other studies conducted in the Indian subcontinent and other developing regions. Amuthan et al. reported an identical 68% incidence of road traffic accidents in their study from Tamil Nadu [8]. Arumugam et al. reported road traffic accidents in 61% of patients and falls from height in 25% [9]. Likewise, Ghimire et al. in Nepal identified road traffic accidents as the leading cause of blunt abdominal trauma in 56.43% of cases, followed by falls from height in 36.43% [10]. These findings emphasize the significant contribution of road traffic accidents to trauma-related injuries and highlight the need for improved road safety measures and stricter enforcement of traffic regulations.

All patients in this study underwent ultrasonography and contrast-enhanced computed tomography (CECT) as part of the diagnostic evaluation. This comprehensive imaging approach differs from the findings of Tandon et al., where only 7 out of 59 patients underwent CECT [11]. The routine use of CECT in the present study reflects the institutional protocol and availability of advanced imaging facilities at the study center. FAST examination is widely recognized as a rapid and reliable screening tool in trauma settings, with reported sensitivities ranging from 69% to 96% and specificities exceeding 92% [9]. However, CECT remains the gold standard imaging modality for hemodynamically stable patients, owing to its superior ability to detect solid organ injuries, hollow viscus perforations, mesenteric injuries, and vascular bleeding [12].

Non-operative management was adopted in the majority of patients (75%) in the present study, reflecting the global shift toward conservative management of blunt abdominal solid organ injuries in hemodynamically stable patients. Roza et al. reported conservative management in 58% of patients, while Pandey et al. documented a similar approach in 68% of cases [13,14]. In contrast, Gilkar et al. reported that 66% of patients required emergency laparotomy, with only 33% managed conservatively [15]. These differences may be attributed to variations in injury severity, patient selection criteria, and institutional protocols. Numerous studies have demonstrated that non-operative management can achieve success rates exceeding 84–90%, particularly when supported by advanced imaging techniques and close clinical monitoring [14].

The overall mortality rate of 10% observed in this study is comparable to several previously published reports. Baghmare et al. reported a mortality rate of 16% [1], while Kani et al. documented a 30-day mortality of 11.42% in their study from Goa [16]. Singh et al. reported a mortality rate of 11.68% from a Level I trauma center in Lucknow [17]. In contrast, lower mortality rates of 5% and 4% were reported by Sisodia et al. and Mehta et al., respectively [3,4]. Variations in mortality rates across studies may be influenced by factors such as injury severity, associated extra-abdominal injuries, time to presentation, and availability of intensive care facilities.

The observation that small bowel injuries accounted for the highest proportion of deaths (40%) in the present study underscores the diagnostic challenges associated with hollow viscus injuries. Tandon et al. similarly reported bowel injury as the predominant injury in 46.9% of patients [11]. Delayed recognition of hollow viscus injuries can result in peritoneal contamination, sepsis, and subsequent deterioration of patient outcomes.

The lower mortality rate observed among conservatively managed patients (4%) compared to surgically treated patients (20–60%) should be interpreted cautiously. This finding likely reflects the fact that patients requiring surgical intervention often present with more severe injuries, hemodynamic instability, or hollow viscus perforations. Similar observations were reported by Pande et al. from the United Kingdom, where early laparotomy was associated with a mortality rate of 51.5% compared with 20% in delayed laparotomy cases, highlighting the influence of injury severity rather than the surgical procedure itself [18]. Additionally, the shorter hospital stay observed among conservatively managed patients (9.3 days) compared with surgically treated patients (13.3–18.8

days) is consistent with findings reported by Kiran et al. [19].

Finally, the higher mortality observed in the 21–30 years age group (50% of deaths) corresponds with the demographic pattern of trauma victims and has also been reported by Baghmare et al. [1]. The predominance of male fatalities (80%) further reflects the higher incidence of trauma among males in the study population.

Limitations

The present study has certain limitations. The relatively small sample size of 100 patients may limit the generalizability of findings. Being a single-center study, the results may not be applicable to other settings. The absence of long-term follow-up limits the understanding of chronic sequelae and delayed complications. The strict inclusion and exclusion criteria may have excluded certain patient subgroups that could have provided additional insights. A larger, multi-institutional prospective study with extended follow-up would be needed to validate these findings and identify additional prognostic factors.

Strengths of the Study

The present study has several strengths. First, the prospective observational design allowed for systematic data collection and minimized recall bias during the evaluation of patients with blunt abdominal trauma. Second, a uniform diagnostic imaging protocol was followed for all patients, with ultrasonography and contrast-enhanced computed tomography performed as part of the standard evaluation, ensuring consistent injury assessment across the study population. Third, the study included patients managed with both conservative (non-operative) and operative treatment strategies, allowing for a comprehensive evaluation of management outcomes and comparison of treatment approaches within the same clinical setting. These factors enhance the reliability of the findings and contribute valuable data regarding the management and outcomes of blunt abdominal trauma in a tertiary care center.

CONCLUSION

The present study confirms that blunt trauma abdomen remains a significant cause of morbidity and mortality, predominantly affecting young males through road traffic accidents. The liver and spleen were the most commonly injured solid organs, while hollow viscus injuries, particularly of the small bowel, carried the highest mortality risk. Conservative management, employed in 75% of patients, demonstrated excellent outcomes with a mortality rate of only 4% and a shorter mean hospital stay of 9.3 days, reaffirming its role as the preferred management strategy for hemodynamically stable patients with solid organ injuries. Contrast-enhanced computed tomography and ultrasonography remain indispensable diagnostic tools for the comprehensive evaluation of blunt abdominal trauma. Early diagnosis, protocol-driven resuscitation, judicious use of diagnostic modalities, and timely surgical intervention when indicated are the cornerstones of effective management. From this study, we conclude that non-operative management of solid organ injuries in hemodynamically stable patients is safe, feasible, and associated with reduced morbidity, mortality, and length of hospital stay. Enhanced road safety measures, public health awareness, and strengthening of trauma care infrastructure are essential to reduce the burden of blunt abdominal trauma

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How to cite this article: Dr. Sheldon Mathais, Dr. Vishnu P S, Dr. Kona Venkat Vihari, PHARMACEUTICO-ANALYTICAL STUDY OF NIRGUNDIGHRITA AND EVALUATIONOF ITS ANTIOXIDANT AND ANTIMYCOBACTERIAL ACTIVITY W.R.T. TUBERCULOSIS: A STUDY PROTOCOL, Asian J. Med. Res. Health Sci., 2026; 4 (1):672-679.
Source of Support: Nil, Conflicts of Interest: None declared.