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Patterns of Organ Injury and Management Strategies in Abdominal Trauma: A Five-Year Retrospective Study at a Tertiary Care Centre in South India

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Abstract

Background

Abdominal trauma remains a major cause of morbidity and mortality worldwide, particularly among young adults in low- and middle-income countries. The epidemiological profile and management strategies vary across regions, necessitating institution-specific data to optimize trauma care. This study evaluated the patterns of abdominal trauma, management strategies, and clinical outcomes in patients treated at a tertiary care referral centre in South India.

Methods

A retrospective observational study was conducted at the Department of General Surgery of a tertiary care centre in South India. Medical records of 200 consecutive patients admitted with blunt or penetrating abdominal trauma between January 2016 and December 2020 were reviewed. Demographic characteristics, mechanisms of injury, injury patterns, imaging findings, treatment strategies, associated injuries, and clinical outcomes were analysed.

Results

Of the 200 patients included, 182 (91%) sustained blunt abdominal trauma, and 18 (9%) sustained penetrating trauma. Road traffic accidents were the most common mechanism of injury, with falls from vehicles accounting for 45 (22.5%) cases. The liver was the most frequently injured organ, with 70 (35%) cases, followed by the spleen with 60 (30%) cases and the small bowel with 41 (20.5%) cases. Non-operative management was employed in 58 (82.9%) cases of hepatic injury and 51 (85%) cases of splenic injury. Chest trauma was the most common associated extra-abdominal injury. Overall, in-hospital mortality was 10% (20 cases), with all deaths occurring in patients who sustained blunt abdominal trauma.

Conclusions

Blunt abdominal trauma secondary to road traffic accidents constitutes the predominant pattern of injury in our setting. Non-operative management was the most frequently employed treatment strategy for solid organ injuries, particularly hepatic and splenic injuries, whereas operative intervention was predominantly required for patients with hollow viscus injuries. These findings reflect the management practices observed at our institution.

Categories: Trauma, General Surgery, Emergency Medicine
Keywords: abdominal trauma, blunt abdominal trauma, liver injury, non-operative management, penetrating abdominal trauma, trauma audit

Introduction

Trauma remains one of the leading causes of mortality and disability in India and disproportionately affects the economically productive age group (15-44 years) [1,2]. Abdominal trauma constitutes an important component of polytrauma and continues to present significant diagnostic and therapeutic challenges because of its heterogeneous mechanisms, varied clinical presentations, and associated multisystem injuries.

Among all anatomical regions, the abdomen is the third most commonly affected site in trauma, with up to 25% of abdominal injuries requiring surgical management [3]. The spleen and liver are the most commonly injured solid organs in Western countries, with 70% of patients with blunt abdominal trauma demonstrating splenic and hepatic injuries [4]. While advances in multidetector computed tomography, focused assessment with sonography in trauma (FAST), interventional radiology, and critical care have considerably improved

diagnosis and outcomes, timely recognition of clinically significant injuries remains crucial for reducing preventable morbidity and mortality. Furthermore, the increasing acceptance of selective non-operative management has substantially altered the treatment paradigm for hemodynamically stable patients with solid organ injuries.

Patterns of abdominal trauma vary considerably according to regional demographics, mechanisms of injury, referral practices, and available trauma systems. Understanding these regional variations is essential for optimizing institutional protocols, resource allocation, and trauma care delivery. Hence, the collection of such information on abdominal trauma through a registry can help improve the coordination and delivery of patient care.

This study was undertaken to evaluate the clinical presentations, mechanisms of injury, and the role of operative and non-operative management in blunt and penetrating abdominal trauma. It also aims to assess demographic and injury-related factors, patterns of organ involvement, associated injuries, comorbidities, and factors influencing patient outcomes.

Materials And Methods

Study design and setting

This retrospective observational study was conducted in the Department of General Surgery at a tertiary care teaching hospital and regional trauma referral centre. Medical records of patients who presented with abdominal trauma during the study period were retrospectively reviewed to evaluate the epidemiological profile, injury characteristics, management strategies, and clinical outcomes.

Study population

All consecutive patients diagnosed with abdominal trauma who were admitted during the study period were screened for eligibility. The inclusion criteria were patients who presented to the Department of Surgery with blunt or penetrating abdominal trauma, with solid organ injury, hollow viscus injury, or a combination of these and other injuries, between January 2016 and December 2020. Patients with incomplete records, transferred patients, and those who were dead on arrival were excluded from the study. A consecutive sampling approach was employed, and all eligible patients identified during the study period were included. The final study population comprised 200 patients. No a priori sample size calculation was performed, as the study included all eligible cases available within the defined study period. The total number of screened patients and the exact number of exclusions could not be reliably reconstructed from the retrospective records. There was no randomisation, allocation, or blinding involved in the study.

Data collection

Patient information was extracted from hospital medical records, operative notes, radiological reports, discharge summaries, and electronic medical records and recorded in a designated Excel spreadsheet. The following variables were recorded: demographic characteristics (age and sex), mechanism of injury, mode of trauma (blunt or penetrating), time interval from injury to hospital presentation, associated injuries, hemodynamic status at admission, clinical examination findings, imaging findings (including FAST and CT, wherever available), injured abdominal organs, American Association for the Surgery of Trauma (AAST) organ injury grade (2018 version), management strategy (operative or non-operative), surgical procedures performed, blood transfusion requirements, ICU admission, duration of hospital stay, postoperative or in-hospital complications, and mortality. AAST grades were obtained from the abdominal CT reports available in the trauma patients' records.

Initial assessment and resuscitation were performed according to the principles of Advanced Trauma Life Support (ATLS). Hemodynamically unstable patients or those with clinical evidence of peritonitis underwent emergency exploratory laparotomy. Hemodynamically stable patients with appropriately selected solid organ injuries were managed non-operatively with close clinical observation, serial abdominal examinations, laboratory investigations, and repeat imaging whenever indicated. Patients who were hemodynamically stable at admission and remained stable, those without peritonitis or hollow viscus injuries, and those with an AAST grade of IV or lower were selected for non-operative management. Decisions regarding operative intervention were made by the treating surgical team based on institutional trauma protocols and individual patient characteristics.

Outcome measures

The primary outcome measures included demographic profile, mechanisms of injury, injured abdominal organs, and treatment modality. The secondary outcome measure was in-hospital mortality.

Hemodynamic instability was defined as systolic blood pressure below 90 mmHg, diastolic blood pressure below 60 mmHg, and mean arterial pressure (MAP) below 65 mmHg.

Successful non-operative management was defined as avoidance of operative intervention (laparotomy) for the injured abdominal organ during the index hospital admission.

Failure of non-operative management was defined as the requirement for operative intervention following an initial trial of non-operative treatment. In-hospital mortality was recorded as a separate outcome.

Statistical analysis

All patient data were recorded in a Microsoft Excel spreadsheet, and appropriate analyses were performed using the SPSS software (version 27; IBM Corp., Armonk, NY, USA).

As this was a descriptive study, averages were summarised using means and medians, with SDs and IQRs. Continuous variables were assessed for normality and expressed as mean ± SD or median with IQR, as appropriate. Categorical variables were summarised as frequencies and percentages. Corresponding 95% CIs for proportions were calculated using the Wilson score method. Missing values were not imputed, and available data were analysed on a variable-by-variable basis. The results were presented in tables and graphical representations, such as bar graphs, box plots, pie charts, and histograms, generated using Microsoft Excel and SPSS, wherever necessary.

Ethical considerations

The study was approved by the Institutional Ethics Committee for Observational Studies, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry (DHR REG. NO.EC/NEW/INST/2020/331 on February 12, 2021). As this was a retrospective review of hospital records using anonymized patient data, the requirement for individual informed consent was waived in accordance with institutional policy.

Results

Baseline characteristics

The study population was predominantly male, with 169 (84.5%) male patients and a male-to-female ratio of approximately 5.5:1. The mean age of the study population was 37.6 years, and the highest proportion of patients belonged to the 20-30-year age group (Table *1*). Most patients, 164 (82%), had no documented comorbid illnesses, while diabetes mellitus and hypertension were present in 16 (8%) and 10 (5%) patients, respectively. The median interval between injury and hospital presentation was 12.1 hours (interquartile range, 18.8 hours).

Age group (years)	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
<20	14	7	3	1.5	17	8.5
20-30	50	25	6	3	56	28
30-40	33	16.5	6	3	39	19.5
40-50	35	17.5	9	4.5	44	22
50-60	19	9.5	3	1.5	22	11
≥60	18	9	4	2	22	11
Total	169	84.5	31	15.5	200	100

TABLE 1: Age and sex distribution of patients with abdominal trauma (N = 200).

Mechanism of injury

Road traffic accidents constituted the predominant mechanism of injury. Falls from vehicles were the single most common mechanism, accounting for 45 (22.5%) cases, followed by two-wheeler versus four-wheeler collisions in 30 (15%) cases, two-wheeler versus two-wheeler collisions in 27 (13.5%) cases, and falls from a height in 24 (12%) cases. The average height of falls that caused solid organ injuries was between 15 and 20 feet. Penetrating injuries were predominantly caused by stab wounds. Detailed mechanisms of injury are presented in Figure *1*.

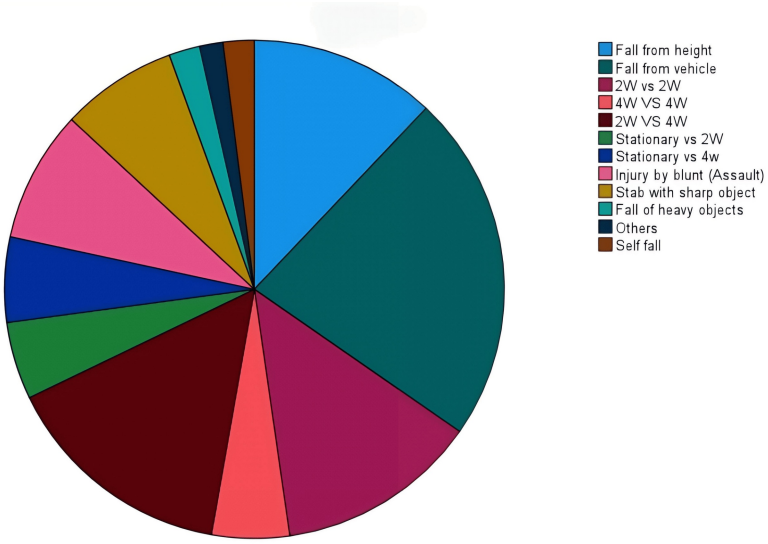


FIGURE 1: Different mechanisms of injury among patients with abdominal trauma.

Pattern of abdominal injuries

The liver was the most frequently injured abdominal organ, with 70 (35%) cases, followed by the spleen with 60 (30%) cases and the small bowel with 41 (20.5%) cases. Renal injuries were observed in 17 (8.5%) patients, and adrenal injuries were noted in 3 (1.5%) patients, with one patient sustaining both renal and adrenal injuries. Mesenteric, colonic, pancreatic, retroperitoneal, and duodenal injuries were less common (Table *2*). Blunt trauma accounted for the overwhelming majority of hepatic and splenic injuries, whereas penetrating trauma more frequently involved hollow visceral organs such as the small bowel and colon (Figure *2*).

Organ affected	Blunt trauma (n = 182)	% (95% CI)	Penetrating trauma (n = 18)	% (95% CI)
Liver	69	37.9 (31.18-45.14)	1	5.56 (1.01-25.76)
Spleen	60	32.96 (26.5-40.1)	0	0
Small bowel	33	18.13 (13.21-24.37)	8	44.4 (24.56-66.28)
Duodenum	1	0.55 (0.1-3.04)	0	0
Colon	6	3.29 (1.52-7.00)	4	22.2 (9.0-45.2)
Pancreas	6	3.29 (1.52-7.00)	1	5.56 (1.01-25.76)
Retroperitoneum	6	3.29 (1.52-7.00)	1	5.56 (1.01-25.76)
Kidneys and adrenal glands	19	10.44 (6.78-15.73)	0	0

TABLE 2: Proportions of blunt and penetrating trauma involving different abdominal organs.

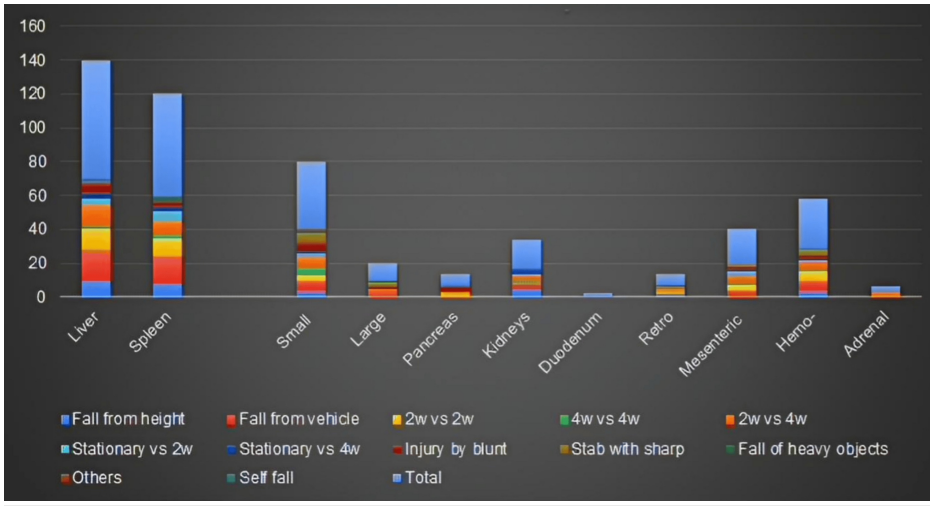


FIGURE 2: Various modes of injury affecting different abdominal organs.

Associated injuries and physiological status

Associated extra-abdominal injuries were common. Chest injuries represented the most frequent associated injury, occurring in 30 (15%) patients, followed by pelvic injuries in 15 (7.5%) patients, spinal injuries in 14 (7%) patients, upper limb injuries in 12 (6%) patients, head injuries in 12 (6%) patients, and lower limb injuries in 5 (2.5%) patients, as shown in Table 3. Hemodynamic instability at presentation was documented in 22 (11%) patients, whereas 178 (89%) patients presented with stable hemodynamic parameters.

Associated injury	Number of cases (N = 200)	Percentage (%)	95% CI
Chest injury	30	15	10.71-20.61
Upper extremity injury	12	6	3.47-10.19
Lower extremity injury	5	2.5	1.07-5.72
Pelvic injury	15	7.5	4.60-12.00
Head injury	12	6	3.47-10.19
Spinal injury	14	7	4.22-11.41

TABLE 3: Proportions of various associated injuries.

Radiological evaluation

CT was performed in the majority of patients. CT imaging was not obtained in 42 patients (21%), primarily because of hemodynamic instability, an immediate indication for surgery, penetrating injuries requiring exploration, or obvious pneumoperitoneum on plain radiography. Ultrasonography and plain radiography were routinely performed as part of the initial evaluation.

Clinical outcomes

The median duration of hospital stay was 8 days (interquartile range, 6 days). Among the 200 patients, 20 (10%) died during their hospital stay, with all deaths occurring among patients who sustained blunt abdominal trauma.

Management

Non-operative management was the predominant treatment strategy for solid organ injuries. Among patients with hepatic trauma, 58 of 70 (82.9%) were managed conservatively, while only 12 (17.1%) required operative intervention, as shown in Table 4. Among the 12 operated cases, five had concurrent hollow viscus injuries that required resection and anastomosis or stoma creation, and two patients who underwent

perihepatic packing died secondary to sepsis. Similarly, 51 of 60 (85%) patients with splenic injuries were managed non-operatively. In contrast, all patients with small bowel, large bowel, and duodenal injuries underwent operative management. Surgical intervention for liver and splenic injuries was generally reserved for patients with high-grade injuries, hemodynamic instability, or associated hollow viscus injuries. Patients could have sustained injuries to more than one organ.

Organ affected	Non-operative management	NOM % (95% CI)	Operative management	Operative % (95% CI)
Liver	58	82.9 (72.3-89.9)	12	17.14 (10.1-27.6)
Spleen	51	85 (73.9-91.9)	9	15 (8.1-26.11)
Kidneys	15	88.2 (65.6-96.7)	2	11.8 (3.28-34.33)
Pancreas	5	71.43 (35.9-91.78)	2	28.57 (8.2-64.1)
Small bowel	0	0	41	100 (91.43-100)
Retroperitoneum	4	57.14 (25.1-84.18)	3	42.86 (15.8-74.95)
Large bowel	0	0	10	100 (72.25-100)
Duodenum	0	0	1	100 (20.66-100)

TABLE 4: Proportions of different organ injuries managed non-operatively versus operatively.

Small bowel injuries were observed in 41 (20.5%) patients. Among them, eight patients had penetrating injuries, and the remaining patients had blunt injuries. Among the patients with penetrating trauma, two of the eight underwent primary repair of the perforations, while the remaining patients underwent resection and anastomosis of the injured segment. Among patients with blunt injuries, six underwent resection and stoma creation, while the remaining patients underwent resection and anastomosis of the injured segment. Of the 10 (5%) patients with colonic injuries, two underwent resection and stoma creation, one underwent right hemicolectomy and diverting ileostomy, four underwent primary repair, and three underwent resection and anastomosis.

In this study, seven (3.5%) of the 200 patients had pancreatic injuries, of which one was due to penetrating trauma and the remaining injuries were secondary to blunt abdominal trauma. Two patients underwent surgical management. One patient with penetrating trauma had a minor capsular tear and gastric perforation, which were managed with primary repair of the capsular tear and gastric perforation. The other patient underwent necrosectomy for pancreatic injury due to blunt trauma. The remaining patients, who were managed conservatively, had complete or near-total transections that were managed with percutaneous drainage. However, the available retrospective data did not permit a sufficiently detailed assessment of these parameters or a meaningful comparison of outcomes between treatment groups.

Discussion

Abdominal trauma continues to be a major cause of morbidity and mortality worldwide, particularly among young adults in low- and middle-income countries. This retrospective study evaluated the epidemiological profile, injury characteristics, management strategies, and clinical outcomes of 200 patients with abdominal trauma treated at a tertiary care referral centre in South India over a five-year period. The principal findings of the present study were: (1) abdominal trauma predominantly affected young males; (2) blunt abdominal trauma, largely secondary to road traffic accidents, was the most common type of injury; (3) the liver and spleen were the most frequently injured abdominal organs; (4) selective non-operative management was employed in the majority of haemodynamically stable patients with solid organ injuries; and (5) hollow viscus injuries almost invariably required operative intervention. These findings are consistent with contemporary trauma literature and reflect the changing paradigm in abdominal trauma management [1-4].

The predominance of young male patients observed in the present study is in agreement with previous Indian and international studies, which have consistently demonstrated that trauma disproportionately affects males in the second and third decades of life [5]. This demographic group is more frequently exposed to road traffic accidents, occupational hazards, and high-energy mechanisms of injury, explaining the higher incidence of abdominal trauma. The mean age of 37.6 years and male predominance of 169 (84.5%) patients observed in our study are comparable to findings reported by several institutional series [4-5]. According to the study by Kane V and Dhandore CD, approximately 44% of injuries occurred in the 20-30-year age group, with a male-to-female distribution of 93.8% and 6.12%, respectively [6].

From the data obtained, it was noted that the average height of falls that caused solid organ injuries was

between 15 and 20 feet. This is consistent with the results of a UK study, which showed that falls from a height of more than 20 feet caused significant morbidity and solid organ injuries, with a positive laparotomy rate of 3% [7].

Blunt abdominal trauma constituted 182 (91%) of all injuries in our cohort, whereas penetrating trauma accounted for only 18 (9%). This pattern differs from reports from many Western trauma centres, where penetrating trauma contributes a larger proportion of abdominal injuries, but closely resembles data from other Indian centres. The predominance of blunt trauma in our study is attributable to the high incidence of road traffic accidents, which collectively accounted for the majority of injuries. This observation underscores the continuing burden of road traffic trauma in India and highlights the need for improved road safety measures, stricter enforcement of traffic regulations, and public awareness initiatives.

The liver was the most frequently injured abdominal organ, followed by the spleen and small bowel. Although splenic injury has been reported as the most common solid organ injury in several published series, hepatic injury predominated in the present study. This variation may be explained by differences in referral patterns, mechanisms of injury, and regional trauma epidemiology. Nevertheless, injuries to the liver and spleen together accounted for nearly two-thirds of all abdominal organ injuries, reaffirming their susceptibility following blunt abdominal trauma [8-10].

Why did liver injuries predominate?

Interestingly, the liver was the most frequently injured abdominal organ in the present study, whereas several previous studies have reported the spleen as the most commonly injured solid organ following blunt abdominal trauma [9,10]. The predominance of high-energy road traffic accidents, particularly falls from moving vehicles and high-velocity collisions, may have resulted in injury mechanisms favouring hepatic trauma. These findings highlight the importance of interpreting the mechanism-of-injury data within the context of local demographics and correlating them with imaging characteristics. However, injury energy, referral patterns, physiological variables, and ISS were not analysed in this study.

According to the study by Goan YG et al., the results of hepatic injury management were comparable to those of our study, and the outcomes of patients managed conservatively were satisfactory, with relatively shorter lengths of hospital stay and earlier return to normal enteral feeding [11]. The increasing acceptance of non-operative management represents one of the significant advances in modern trauma surgery and is supported by current international guidelines, which recommend conservative management for haemodynamically stable patients. The proportions of patients managed non-operatively in the present study are comparable to those reported in contemporary literature [12,13].

Among the 60 (30%) patients with splenic injuries, 24 (12%) sustained grade III injuries, followed by 19 (9.5%) who sustained grade II injuries. The majority of these patients were managed conservatively, with 51 of 60 (85%) patients managed non-operatively and nine of 60 (15%) managed operatively. The only surgical procedure performed in this group of patients was emergency open splenectomy with repair of other organ injuries [14].

The incidence of small bowel injuries was noted to be the third highest, after hepatic and splenic injuries. A total of 41 (20.5%) patients with abdominal trauma had associated small bowel injuries, and all of them underwent operative management. In another study by Bruscagin V et al., the incidence was reported to vary between 4% and 15% [15]. Based on a literature review, it was noted that the most commonly injured parts of the hollow viscera were the jejunum and ileum, and the management options were similar [16-18].

The overall in-hospital mortality rate was 10% (20 patients), with all deaths occurring among patients with blunt abdominal trauma. Alternatively, we could have utilised parameters such as the Injury Severity Score (ISS), reduced diastolic arterial pressure, and delay in presentation [19]. The mortality observed in the present study is comparable to rates reported from other tertiary referral centres managing complex polytrauma patients [20].

Strengths

The strengths of the present study include a relatively large sample size, evaluation of abdominal trauma over a five-year period using standardised institutional trauma protocols, and inclusion of patients managed at a high-volume tertiary referral centre. A review of previous similar studies also showed that they utilised sample sizes within a similar range, and the results of the present study were consistent with those of other studies. The retrospective study design was considered suitable for analysing outcomes and management strategies.

Limitations

Owing to its retrospective design, the analysis depended on the completeness and accuracy of hospital records. Limitations related to injury severity adjustment, limited access to interventional radiology, and the presence of selection bias require greater emphasis. The lack of angioembolisation could be attributed to the

local trauma system and may have directly affected management choices and external validity. An additional limitation was the delay between the time of injury and presentation to the hospital, with a median delay of 12.1 hours and maximum delays of up to five days for solid organ injuries. Factors that could not be assessed in this study might have been evaluated using a prospective study design. In addition, as this was a single-centre study, the findings may not be generalisable to all trauma systems.

Implications

The implications of this study are that newer strategies for the optimal management of trauma patients can be devised based on a better understanding of the proportions of various organ injuries and tailored to individual patients. Despite significant advances in trauma care, comprehensive institutional trauma registries remain limited in many parts of India. Institution-specific audits, such as the present study, are essential for evaluating current management protocols, identifying areas for quality improvement, and refining existing evidence-based trauma care pathways. Further studies with larger sample sizes and prospective study designs could provide useful data and help establish more precise consensus recommendations for the management of specific grades of organ injuries.

Conclusions

This retrospective study describes the epidemiological profile, injury patterns, and management strategies of 200 patients with abdominal trauma treated at a tertiary care centre in South India. Abdominal trauma predominantly affected young adults and was largely attributable to blunt mechanisms of injury, particularly road traffic accidents. The liver was the most frequently injured abdominal organ, followed by the spleen and small bowel.

Non-operative management was the most frequently employed treatment strategy for both hepatic and splenic injuries, whereas small bowel injuries were managed operatively in this cohort. The overall in-hospital mortality rate was 10%. However, the retrospective design and limited assessment of injury severity, physiological parameters, and treatment failure limit the assessment of comparative treatment effectiveness and independent mortality predictors. These findings provide an institutional overview of abdominal trauma patterns and management practices while highlighting the influence of available healthcare resources on treatment strategies. Further prospective multicentre studies incorporating standardised trauma severity assessments, predefined outcome measures, and adequate follow-up are necessary to evaluate treatment effectiveness, identify predictors of adverse outcomes, and improve the evidence base for abdominal trauma management in resource-limited settings.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Praveen Ravichandran, Sathasivam Sureshkumar, Vikram Kate

Acquisition, analysis, or interpretation of data: Praveen Ravichandran, Sathasivam Sureshkumar, Palanivel Chinnakali

Drafting of the manuscript: Praveen Ravichandran, Sathasivam Sureshkumar, Vikram Kate, Palanivel Chinnakali

Critical review of the manuscript for important intellectual content: Sathasivam Sureshkumar, Vikram Kate, Palanivel Chinnakali

Supervision: Vikram Kate

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee for Observational Studies, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry issued approval DHR REG. NO.EC/NEW/INST/2020/331. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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