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Original Research Article

LIVER AND SPLENIC INJURIES IN ABDOMINAL TRAUMA: DIAGNOSTIC AND MANAGEMENT CHALLENGES

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Abstract

Background: Among the most important parts of managing abdominal trauma are damage to the liver and spleen. Many people are injured or die as a result of blunt trauma, which is most often caused by falls, assaults, and road traffic accidents (RTAs). Improving outcomes requires early and accurate diagnosis in addition to optimum care techniques.

Aims: Examining the relative merits of conservative and surgical approaches to treating liver and splenic injuries, this research seeks to provide light on the difficulties inherent in diagnosis and treatment.

Materials & Methods: One hundred and eighty individuals who had suffered severe abdominal injuries were the subjects of a year-long retrospective cross-sectional investigation. We looked at things like results, diagnostic procedures, management approaches, and demographic information.

Results: The majority of injuries (58.9%) were caused by road traffic accidents, with splenic injuries being more common (57.8%) than liver injuries (42.2%). For patients with stable haemodynamics, conservative treatment was successful in 77.8% of instances; for patients with unstable haemodynamics, surgical intervention was reserved. Patients with haemoglobin levels < 10% and those who presented later (>48 hours post-injury) had a significantly greater mortality rate.

Conclusion: Patients who are stable and have low-grade damage to the liver or spleen may benefit greatly from nonoperative treatment. The reduction of mortality and morbidity can only be achieved by early diagnosis and prompt management.

Keywords: Blunt abdominal trauma, liver injuries, splenic injuries, road traffic accidents, nonoperative management, surgical intervention.

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1. INTRODUCTION

Trauma is one of the primary worldwide health challenges, contributing considerably to morbidity and death across all age categories. Abdominal trauma, notably affecting the liver and spleen, accounts for a considerable number of these occurrences, with blunt force mechanisms such as road traffic accidents (RTAs), falls, and assaults being the leading causes (Anderson et al., 2007; Goyal et al., 2020). The anatomical placement and vascularity of the liver and spleen leave them especially prone to harm after forceful trauma. These injuries provide distinct diagnostic and treatment issues, requiring thorough examination and quick intervention. The rising frequency of RTAs, due to urbanization, motorization, and socio-economic developments, has increased the incidence of blunt abdominal trauma globally. In India, where this research was done, RTAs are the most prevalent cause of trauma-related mortality (Aubakirova et al., 2013). Liver injuries, sometimes accompanied with severe bleeding, and splenic injuries, with their possibility of delayed rupture, are essential in deciding patient outcomes. Early and accurate evaluation employing diagnostic modalities such as Focused assessment with Sonography for Trauma (FAST) and contrast-enhanced computed tomography (CT) is crucial in directing therapeutic options (Bloom & Gibbons, 2024; Hassan et al., 2011). The main method for treating abdominal trauma in the past was surgery.

However, developments in imaging and monitoring methods have transformed the sector, emphasizing nonoperative treatment (NOM) for hemodynamically stable patients with low-grade injuries. Studies have demonstrated that NOM, accompanied by diligent monitoring and interventional radiology, greatly lowers morbidity and needless laparotomies (Bee et al., 2001; Bhullar et al., 2013). Conversely, surgical surgery remains necessary for unstable patients or those with high-grade injuries, when delayed identification or management may lead to consequences such as septic shock, coagulopathy, and mortality (Rajkumar et al., 2018; Kashuk et al., 2010). The difficulty of treating liver and splenic injuries derives from various aspects, including the variety in damage grading, patient stability, and the possibility for multi-organ involvement. This research intends to address these problems by examining the incidence, diagnostic methods, and therapy results in patients with acute abdominal trauma affecting the liver and spleen. Furthermore, it underscores the significance of early hospital presentation and solid diagnostic techniques in boosting survival rates. This detailed research tries to bridge gaps in current information and give useful recommendations for doctors addressing similar instances.

1.1 AIMS AND OBJECTIVES

- **Aim:** To analyze diagnostic and management challenges for liver and splenic injuries in abdominal trauma.
- **Objectives:**
    - To study the incidence and pattern of liver and splenic injuries in blunt abdominal trauma.
    - To evaluate the role of diagnostic tools like FAST, CT, and clinical examination in management.
    - To compare the outcomes of conservative and surgical interventions.

2. LITERATURE REVIEW

2.1 Mechanisms of Injury

The most frequent and serious consequences of abdominal trauma are injuries to the liver and spleen, which may be caused by blunt force mechanisms such as falls, assaults, and road traffic accidents (RTAs). Though the spleen's

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delicate nature makes it vulnerable to rupture—including delayed rupture—which may greatly complicate therapy, the highly vascularised liver—the biggest internal organ—is able to cause massive haemorrhage when wounded. The majority of blunt abdominal trauma cases are caused by road traffic accidents (RTAs), according to studies. The number of occurrences is on the increase due to urbanisation and the rising density of vehicles throughout the world. The youthful, productive 20-to 40-year-old age bracket is particularly vulnerable to road traffic accidents (RTAs), which continue to rank as India's top cause of trauma-related death. Since men are more likely to be exposed on the job and to move about a lot, this demographic trend is a reflection of that (Anderson et al., 2007; Aubakirova et al., 2013). While assaults and falls are less common, they nonetheless cause a large number of injuries to the liver and spleen. More severe damage is often associated with RTAs with larger impact forces, however the severity is generally determined by the mechanism of injury. It is crucial to design focused preventative efforts and optimise treatment results by understanding the processes underlying these injuries.

2.2 Diagnostic Modalities

Liver and splenic injury management relies on prompt and precise diagnosis. By giving doctors a clear picture of the size and kind of an injury, imaging technology has completely altered the diagnosis procedure. In emergency situations, Focused Assessment with Sonography for Trauma (FAST) is a commonly used non-invasive diagnostic method that is quick and doesn't need invasive procedures. It is especially helpful for patients with haemodynamic instability because it identifies free fluid in the abdomen, which is a sign of intra-abdominal damage. Injuries cannot be graded or parenchymal damage identified by FAST, despite its great sensitivity and specificity. However, in patients who are haemodynamically stable, the diagnostic imaging modality of choice for solid organ damage is contrast-enhanced computed tomography (CECT). It helps doctors evaluate the extent of damage and devise treatment plans by providing clear images of vascular injuries, current haemorrhage, and pseudoaneurysms. Research has shown that CECT is crucial for differentiating between low-grade injuries that may be treated conservatively and high-grade injuries that need surgical intervention. Supplemental diagnostic tools include X-rays and laboratory testing. Haemoglobin levels and coagulation profiles are crucial for evaluating patient stability and directing resuscitation efforts; erect abdominal X-rays may detect pneumoperitoneum, which indicates bowel perforation (Bloom & Gibbons, 2024; Hassan et al., 2011).

2.3 Management Strategies

Haemodynamic stability, injury grade, and co-occurring injuries are three variables that dictate how to treat liver and splenic injuries. For patients who are haemodynamically stable and have low-grade injuries, nonoperative treatment (NOM) has been the go-to strategy. To reduce bleeding, this therapy makes use of interventional radiology procedures such angioembolization in addition to careful monitoring and fluid resuscitation. NOM has greatly cut down on needless laparotomies, which has improved recovery times and decreased morbidity. Nevertheless, surgical intervention is often necessary for individuals who are haemodynamically unstable or who have sustained high-grade injuries. For patients with persistent bleeding, peritonitis, or other potentially fatal consequences, laparotomy is still the gold standard therapeutic option. Although surgical care may save lives, it comes with a risk of complications such as septic shock, coagulopathy, and wound infections, which are more common. One promising new approach to trauma therapy is angioembolization, which may reduce the need for surgical intervention while still producing great results for patients with Grade III-IV injuries. Bee et al. (2001) and Bhullar et al. (2013) note that treatment methods are being further refined via the integration of standardised protocols and modern imaging modalities. This integration places an emphasis on individualised care that is suited to each patient's particular requirements.

3. MATERIALS AND METHODS

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- **Study Design**

The study was designed as a retrospective cross-sectional analysis. This approach enabled the review of pre-existing data on liver and splenic injuries due to blunt abdominal trauma, focusing on diagnostic methods, management strategies, and outcomes over a specific timeframe.

- **Sample Size**

A total of 180 patients were included in the study, with the sample size determined using Cochran's formula. This ensured that the sample was statistically adequate for reliable and generalizable results, balancing precision with practical feasibility.

- **Inclusion Criteria**

Patients aged above 12 years with documented cases of blunt abdominal trauma involving liver and/or splenic injuries were included. This criterion focused the study on the most relevant injuries while excluding pediatric cases with distinct clinical considerations.

- **Exclusion Criteria**

Patients with penetrating abdominal trauma, retroperitoneal injuries, or concurrent severe head, chest, or musculoskeletal trauma requiring emergency surgical intervention were excluded to maintain a clear focus on liver and splenic injuries.

- **Statistical Analysis**

Data were analyzed using SPSS 26.0. Chi-square tests were used for categorical data, while Fisher's exact test was employed for smaller sample sizes. A p-value of <0.05 was considered statistically significant, ensuring robust analysis of associations and outcomes.

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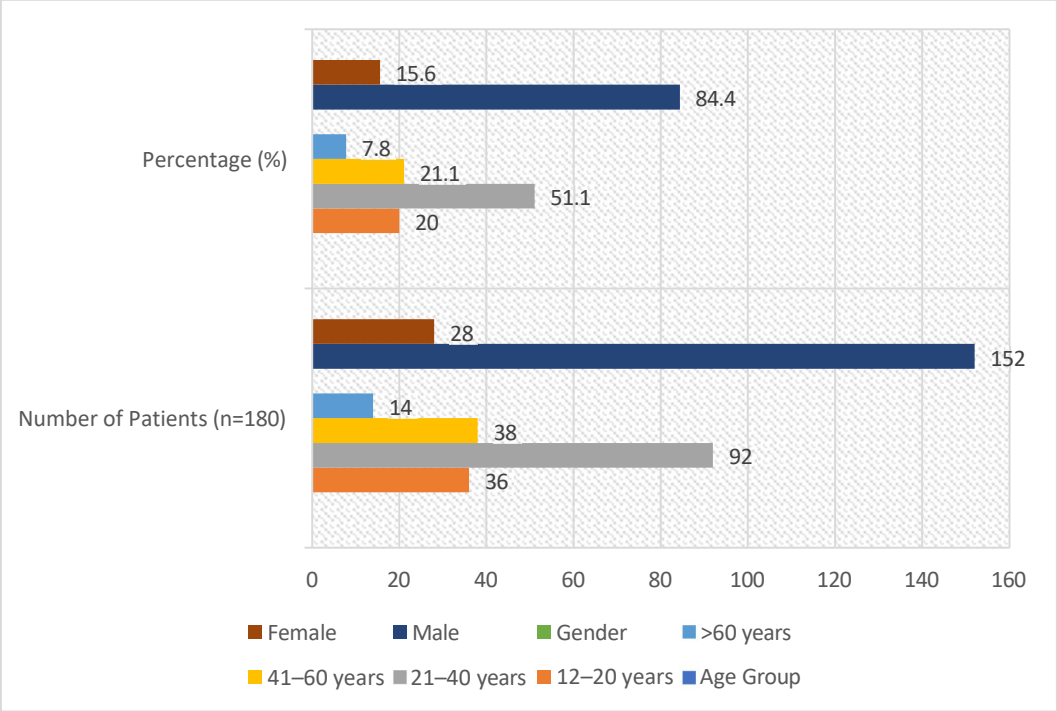
4. RESULTS

4.1 Demographics

According to the data, men in the productive age bracket are more likely to have acute abdominal damage than females [Table1]. This highlights the need of implementing focused treatments to decrease the morbidity and death rates associated with trauma in populations at high risk.

Table 1: Demographic Distribution of Patients

Demographic Factor	Number of Patients (n=180)	Percentage (%)
Age Group		
12–20 years	36	20.0
21–40 years	92	51.1
41–60 years	38	21.1
>60 years	14	7.8
Gender		
Male	152	84.4
Female	28	15.6



The majority of blunt abdominal trauma patients (51.1% of the total) were found in the 21–40 age bracket, with a mean age of 32.6 years. This result is in line with worldwide tendencies, which show that trauma is more common among young people because of their greater exposure to dangerous situations and high-speed mobility, such as when driving or working. This is despite the fact that this demographic is at its most economically productive and active. Twenty percent of those hurt were between the ages of twelve and twenty-one, a demographic particularly susceptible to severe injuries maybe as a result of lack of life experience or risky habits. The large proportion of males (84.4% of the total) suggests that men are more likely to partake in risky behaviours, such as those involving driving, working in hazardous environments, or being physically active outside. On the

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other hand, women were less likely to be impacted, accounting for just 15.6% of instances. This is probably because they were exposed to these risk factors less often. To decrease the occurrence of trauma and its related consequences, it is crucial to implement targeted preventative strategies for these high-risk populations, as shown by these demographic trends.

4.2 Causes of Injury

According to the causes study, the leading cause of blunt abdominal injuries was road traffic accidents (RTAs), followed by assaults and falls [Table2, Fig1]. The current tendencies in trauma epidemiology are mirrored by these results.

Table 2: Causes of Injury

Cause of Injury	Number of Patients (n=180)	Percentage (%)
Road Traffic Accidents (RTAs)	106	58.9
Falls	42	23.3
Assaults	19	10.6
Others	13	7.2

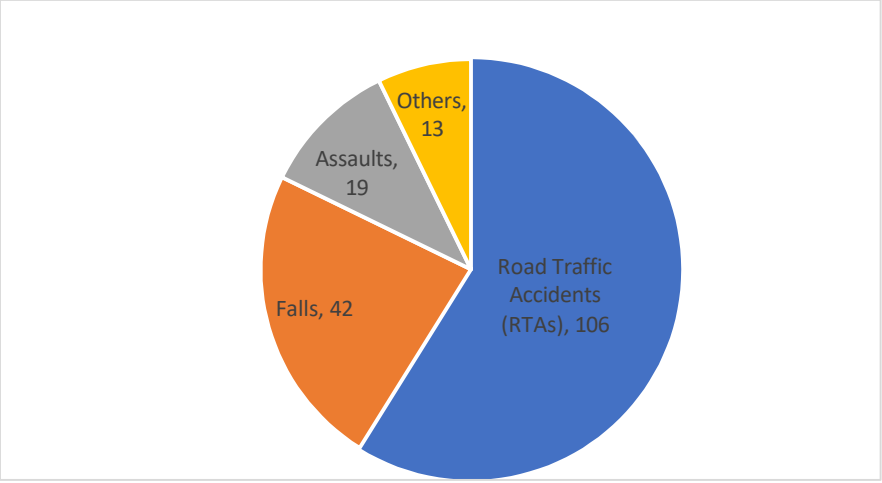

Fig 1: Causes of Injury

With 58.9% of the total cases, road traffic accidents (RTAs) were shown to be the leading cause of blunt abdominal injuries. Inadequate road safety measures, poor infrastructure, and careless driving lead to frequent crashes, which is a result of the rising motorisation and urbanisation in many places. This high prevalence is a reflection of these factors. The high prevalence of injuries caused by falls (23.3%) highlights the seriousness of mishaps in both the workplace and the home. At 10.6%, assaults constitute interpersonal violence and highlight the need for public safety measures and interventions by law enforcement. The remaining 7.2% were due to other causes, such as injuries caused by large items or animals. These results highlight the need of promoting road safety, raising awareness of hazards in the workplace, and implementing social changes to decrease violence as focused preventative interventions.

4.3 Injury Patterns

Spleen was the organ most often damaged in cases of severe abdominal trauma**.** The majority of injuries were of Grade II, but Grade IV & V injuries were more likely to result in death.

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Table 3: Distribution of Injuries by Organ and Severity

Organ Injured	Severity Grade	Number of Patients (n=180)	Percentage (%)
Spleen	Grade I	17	9.4
	Grade II	39	21.7
	Grade III	19	10.6
	Grade IV	17	9.4
	Grade V	12	6.7
Liver	Grade 1	16	8.9
	Grade II	31	17.2
	Grade III	18	10.0
	Grade IV	08	4.4
	Grade V	03	1.7

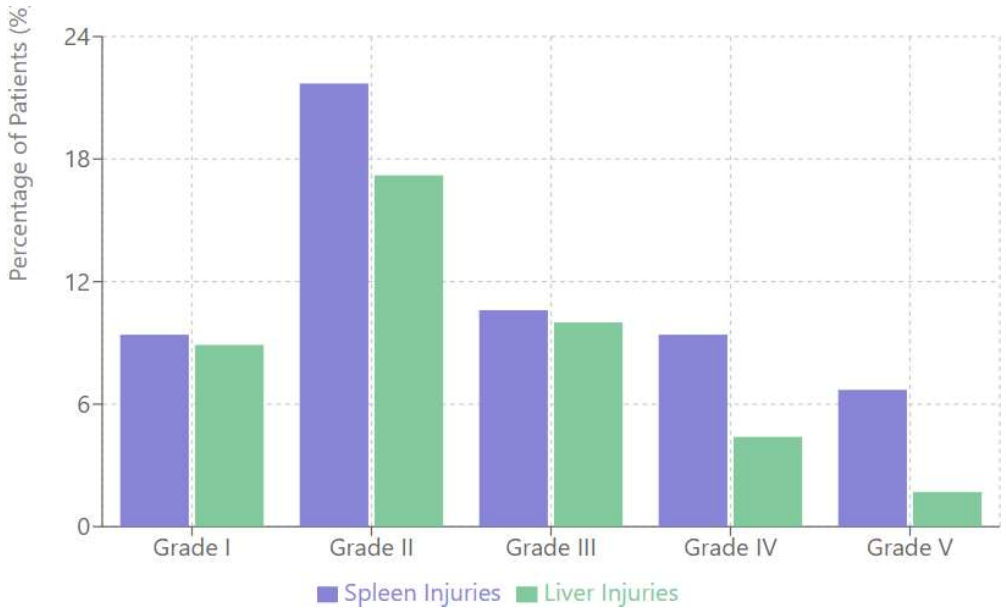

Fig 2: Distribution of Liver and Splenic Injuries by Severity Grade

The analysis of injury patterns revealed distinct distributions between splenic and hepatic trauma severity. Among the 180 patients studied, splenic injuries demonstrated a higher overall prevalence, with Grade II injuries being the most frequent pattern observed. Specifically, splenic Grade II injuries accounted for 21.7% (39 patients) of all cases, followed by Grade III at 10.6% (19 patients). Grade I and Grade IV splenic injuries showed equal distribution at 9.4% each (17 patients), while Grade V injuries were observed in 6.7% of cases (12 patients).

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Hepatic injury patterns displayed a similar tendency toward lower-grade injuries but with generally lower frequencies compared to splenic trauma. Grade II liver injuries predominated at 17.2% (31 patients), while Grade III injuries occurred in 10.0% of cases (18 patients). Grade I hepatic injuries were documented in 8.9% of patients (16 patients). Notable was the marked decrease in frequency for high-grade liver injuries, with Grade IV and V injuries occurring in only 4.4% (8 patients) and 1.7% (3 patients) of cases, respectively [Table3, Fig2].

The comparative analysis between organs revealed that splenic injuries were more prevalent across all severity grades. This disparity was particularly pronounced in higher-grade injuries (IV and V), where splenic trauma occurred approximately twice as frequently as hepatic trauma [Fig3]. The data demonstrated a bell-shaped distribution pattern for both organs, with peak frequency at Grade II and declining frequencies toward both extremes of the grading scale.

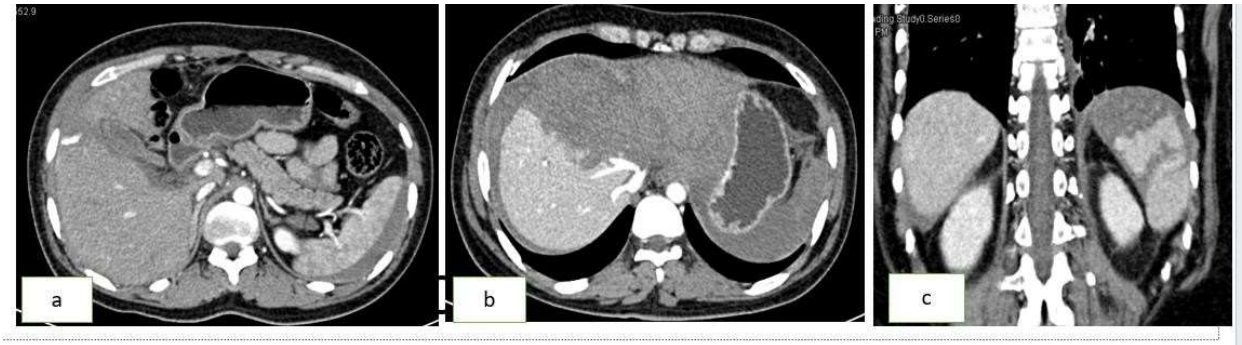

Fig3 Contrast CT abdomen showing (a) grade IV liver injury with active bleed(b) grade V liver injury and (c) grade IV splenic injury

4.4 Management Approaches

For patients who were stable and had minor injuries, nonoperative treatment (NOM) was the way to go. However, for patients who were haemodynamically unstable or had serious injuries, surgical intervention was necessary [Table4].

Table 4: Management Approaches and Survival Rates

Management Approach	Number of Patients (n=180)	Percentage (%)	Survival Rate (%)
Nonoperative Management (NOM)	**140**	**77.8**	**96.3**
Surgical Intervention	**40**	**22.2**	**85.0**

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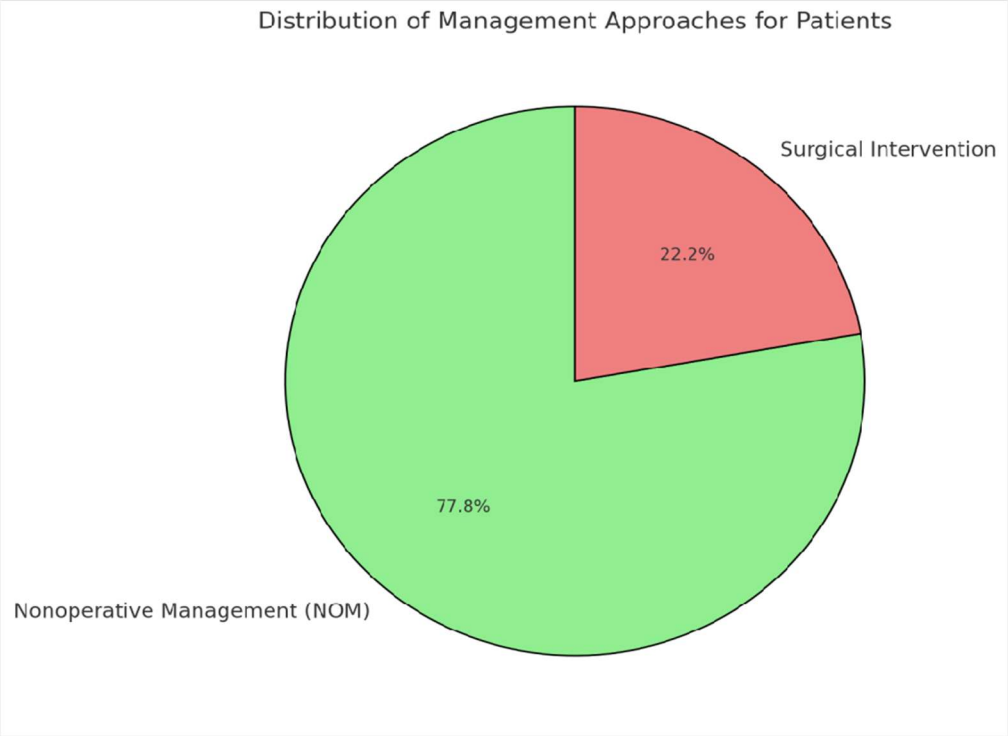

Fig 4: Management Approaches

The majority of cases (77.8%) were managed conservatively, which shows that it works for patients who are haemodynamically stable and have low-grade injuries [Fig4]. With the use of imaging, fluid resuscitation, and close monitoring, these patients were able to achieve a survival percentage of 96.3%. Patients who were haemodynamically unstable or had severe injuries need surgical intervention in 22.2% of instances [Fig5]. Despite their life-saving benefits, these procedures came with increased risks of complications, including as coagulopathy and septic shock. Based on the patient's stability and the degree of their injuries, personalised treatment is crucial, as shown by the outcomes.

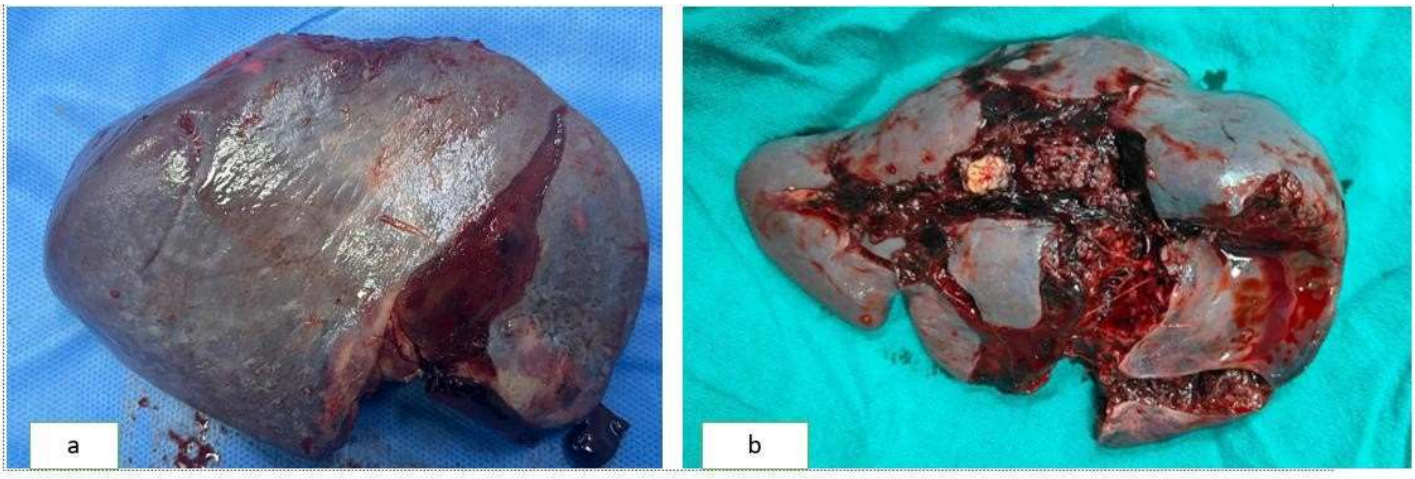

Fig5 Post operative images are showing (a) Grade IV splenic injury and (b) grade V splenic injury.

4.5 Outcomes

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Late presentation and low haemoglobin levels were major determinants of mortality. Improving survival results required early intervention and effective resuscitation.

Table 5: Factors Affecting Mortality

Factor	Mortality Rate (%)
Late Presentation (>48 hrs)	15.2
Early Presentation (<48 hrs)	3.5
Hb <10 gm%	21.4
Hb ≥10 gm%	1.6

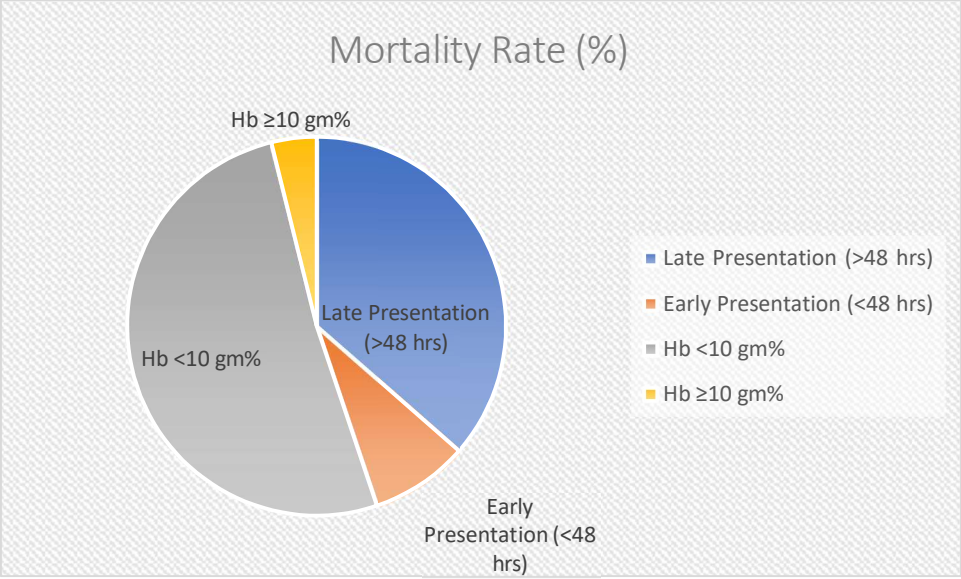

Fig 6: Mortality Rate

With notable variations according to the date of presentation and haemoglobin levels, the overall death rate in this research was 6.7%. The death rate was 15.2% for patients who presented more than 48 hours after injury, as opposed to 3.5% for those who presented within 48 hours. The need of prompt medical assistance in situations of trauma is highlighted by this. Furthermore, individuals whose haemoglobin levels were below 10 gm% had a significantly lower chance of survival (78.6% vs. 98.4% in the other group) [Table5, Fig6]. The importance of stabilisation and resuscitation in enhancing survival outcomes is emphasized by these results.

5. DISCUSSION

Diagnosis precision, prompt action, and the patient's physiological condition greatly impact the prognosis of liver and splenic injuries, which continue to be significant obstacles in the treatment of abdominal trauma. In line with both regional and worldwide statistics, our research found that blunt abdominal trauma was most often caused by road traffic accidents (RTAs) (Anderson et al., 2007; Aubakirova et al., 2013). There are a lot of trauma instances because people aren't paying attention to traffic safety rules, there are more cars on the road, and cities are becoming busier. Because of their greater involvement in high-risk activities, such as driving, working in hazardous environments, and engaging in outdoor pursuits, young men (those between the ages of 21 and 40) bore a disproportionate share of the burden (Goyal et al., 2020; Tandon et al., 2022). These results highlight the need for preventative measures, such as more stringent traffic regulations, safety protocols in the workplace, and education programs focused on those most at risk.

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The management of damage to the liver and spleen depends on prompt and precise diagnosis. According to Bloom and Gibbons (2024) and Hassan et al. (2011), the first-line tool in emergency situations is Focused Assessment with Sonography for Trauma (FAST). This method provides quick and non-invasive identification of hemoperitoneum, a vital sign of intra-abdominal damage. Although FAST is widely used, it does not have the capability to grade injuries or detect modest parenchymal damage; hence, more sophisticated imaging methods are required. According to Becker et al. (1998) and Anderson et al. (2007), the most reliable method for identifying solid organ injuries in stable patients is contrast-enhanced computed tomography (CECT). This kind of imaging provides precise information about the extent of damage, including any current bleeding or vascular injuries. With this degree of accuracy, doctors can tell which injuries may be treated with nonoperative treatment (NOM) and which ones need surgery. In order to assess the patient's stability and decide if resuscitation or transfusion is necessary, laboratory measurements, especially haemoglobin levels, are crucial (Da Luz et al., 2014; Rossaint et al., 2006).

This study's results support the use of NOM for patients who are haemodynamically stable and have low-grade injuries to the liver or spleen. Bee et al. (2001) and Bhullar et al. (2013) found that interventional radiology procedures including angioembolization and close monitoring greatly decreased the need for surgical intervention, which in turn lowered morbidity and improved recovery times. Nevertheless, in environments with limited resources, it may not be possible to implement NOM due to the need for strong infrastructure and trained staff to provide constant monitoring. The gold standard of care for patients who are not stable or who have severe injuries is surgical intervention. Complications include septic shock, coagulopathy, and wound infections are more common with surgical therapy, despite the fact that it saves lives (Rajkumar et al., 2018; Tandon et al., 2022).

The time of hospital presentation and first resuscitation has a substantial impact on outcomes in cases with splenic and hepatic injuries. The importance of prehospital treatment and quick transport networks was highlighted by the fact that patients who were admitted within 48 hours after injury had much higher survival rates than those who were admitted later (Mutschler et al., 2013). Death rates were greater for patients whose haemoglobin levels were below 10 gm%, highlighting the need for intensive resuscitation and transfusion procedures in these instances (Gonzalez et al., 2016; Shapiro et al., 1999).

There are significant ramifications for trauma treatment systems from these results. To begin with, the fact that NOM was successful calls attention to the fact that more people should have access to interventional radiology and advanced imaging, especially in areas with limited resources. Secondly, the fact that prehospital care, such as ambulance services and trauma triage protocols, is crucial, as the effects of presentation timing and resuscitation are substantial. Finally, since RTAs cause trauma so often, there has to be a public health push for road safety, stronger enforcement of traffic regulations, and infrastructure upgrades.

6. CONCLUSION

The most common cause of liver and splenic injuries in abdominal trauma is vehicle accidents, which is a major concern for trauma care providers. There has to be a focus on prevention and better safety standards since these accidents disproportionately impact young men of working age. Tools such as FAST and contrast-enhanced CT provide timely and accurate diagnosis, which is crucial for directing appropriate treatment options. This research confirms that nonoperative treatment (NOM) is effective for patients who are haemodynamically stable and have low-grade injuries. NOM offers lower morbidity and good survival rates. Patients experiencing haemodynamic instability or severe injuries, however, still need surgical intervention. The need of prompt action and strong resuscitation methods is highlighted by the fact that factors like delayed presentation and low haemoglobin levels considerably deteriorate results. In order to decrease mortality and morbidity, the results emphasise the need of establishing prehospital care networks, increasing access to sophisticated imaging, and enhancing trauma care

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infrastructure. Innovative methods, such as less invasive procedures and diagnostics backed by artificial intelligence, should be the focus of future research, which should also priorities prospective studies. Improving patient outcomes and lowering the worldwide burden of abdominal trauma may be achieved by tackling these obstacles and creating more efficient trauma treatment systems.

6.1 LIMITATIONS

- Retrospective design with limited generalizability.
- Underrepresentation of penetrating trauma and high-grade multi-organ injuries.

6.2 FUTURE DIRECTIONS

- Prospective studies to validate findings.
- Exploration of advanced imaging and minimally invasive techniques.

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