



Original Research Article

PREDICTIVE FACTORS DETERMINING FAILURE OF NON-OPERATIVE MANAGEMENT OF HIGH-GRADE SPLENIC INJURY IN TERTIARY CARE HOSPITAL IN RURAL INDIA: A RETROSPECTIVE OBSERVATIONAL ANALYTICAL STUDY

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ABSTRACT

Background: Splenic trauma is the leading cause of morbidity and mortality due to blunt abdominal trauma in India. Although non-operative management (NOM) is the standard of care in most haemodynamically stable patients, its failure in high-grade (grades III-V) splenic injuries remains a major concern. Early identification of patients with high risk factors of such failure is essential to improve outcomes.

Aim: This study aimed to identify factors associated with failure of NOM in high-grade blunt splenic trauma patients.

Materials and Methods: Present retrospective observational study was conducted at a tertiary care rural hospital. Patients with high grade blunt splenic trauma were included. Patients who underwent immediate surgery for hollow viscus injury, discharged prematurely, or transferred before recovery were excluded. Data was collected as per pre-structured proforma on demographics, injury mechanism, clinico-radiological findings and management details. Failure of NOM was defined as the need for surgery due to hemodynamic instability or development of peritonitis after an initial conservative trial. Statistical analysis was done using Medcalc (version 23.4).

Results: Thirty-two patients (27 males, five females) were included. The mean age was 32.6 ± 14.9 years. Sixteen patients (50%) had grade III, nine (28.1%) grade IV, and seven (21.9%) grade V injuries. Fourteen (43.7%) were managed with NOM, while 18 (56.3%) underwent surgery. Factors associated with NOM failure included older age, extra-abdominal injuries, higher injury grade, elevated shock index and lower Glasgow Coma Scale scores. Gender, comorbidities, and ICU stay were not significantly associated.

Conclusion: NOM is feasible in selected patients with blunt splenic injuries. Failure is associated with older age, high-grade injury, extra-abdominal trauma, elevated shock index and low GCS. Careful selection and close monitoring are essential.

Key words: Blunt abdominal trauma, High grade Splenic injury, Non-operative Management, Splenectomy, Predictive Factors.

INTRODUCTION

Blunt abdominal trauma is a significant cause of morbidity and mortality in India, accounting for approximately 79% of all abdominal injuries.^[1] The spleen is the most common organ injured in blunt abdominal trauma in up to 60% of cases with a reported high mortality rate of around 8.5%.^[1] The important mechanisms of splenic injury include direct impact from road traffic accidents and deceleration injury due to fall from height, both of which may result in splenic rupture or laceration. The patient may initially present in a haemodynamically stable condition only to worsen slowly in the ward due to initial concealed bleeding. Early recognition of such at risk patients is critical, to avert haemodynamic instability, morbidity and mortality. Management of splenic trauma has evolved considerably over the past few decades. These can be broadly categorized into three approaches which include non-operative management (NOM), interventional radiology with embolization, and, rarely, operative management through partial or total splenectomy.^[2] Splenectomy was regarded as the standard treatment for splenic trauma; however, increasing recognition of the spleen's essential roles in blood filtration, storage and immune defense, has highlighted the importance of splenic preservation. Hence, surgical practice has evolved from routine splenectomy to spleen-preserving procedures due to high morbidity and mortality arising from overwhelming post-splenectomy infection. Technological advances in imaging, critical care, and interventional techniques over last four decades have enabled the safe implementation of non-operative management in hemodynamically stable patients.^[3] NOM is currently employed in up to 70% of patients, with success rates exceeding 80%.^[4] Its advantages over operative management include reduced hospital stay and costs, avoidance of non-therapeutic laparotomies, lower rates of intra-abdominal complications and transfusion requirements, decreased mortality, preservation of splenic immune function, and prevention of OPSI.^[5] Despite these favorable outcomes, failure of NOM remains a significant clinical concern, particularly in high-grade splenic injuries, where delayed surgical intervention may result in life-threatening hemorrhage. Reported failure rates of NOM range from 4% to 15%, with higher rates observed in severe injuries.^[5] One study documented failure rates of 34.5% and 60% for Grade IV and Grade V injuries, respectively.^[6]

Early identification of patients at high risk for non-operative management failure is therefore essential, as delayed recognition and intervention in cases of late splenic rupture are associated with increased morbidity and mortality. Furthermore, accurate prognostic risk stratification enables optimal resource allocation and informs clinical decision-making. Hence, the present study was undertaken to identify clinical and radiological predictors

associated with failure of NOM in patients with high-grade splenic injuries treated at a tertiary care hospital in rural India.

MATERIALS AND METHODS

This was a retrospective observational and analytical study conducted at a tertiary care hospital in rural India over a six-month study period. After Ethics committee approval [DMIHER(DU)/IEC/2024/393 dated 30/12/2024], permission for data access was secured from the hospital authorities. Patient data were identified through the medical records department and records from the preceding one year were reviewed. All patients admitted with blunt abdominal trauma who were diagnosed with high-grade splenic injury (Grades III–V) were considered eligible for inclusion in the analysis. Patients with polytrauma involving chest and head injuries were included if no other abdominal organ required emergency laparotomy, while those who underwent immediate surgery for hollow viscus injury, were discharged prematurely, or transferred before complete recovery were excluded. Data were extracted using a standardized proforma, including demographics, mechanism of injury, clinical findings, imaging results, laboratory investigations, transfusion requirements, and details of interventional or operative management. Imaging studies, including chest radiographs, ultrasonography, and contrast-enhanced computed tomography, were reviewed to assess splenic injury grade, location, and associated intra-abdominal trauma. Non-operative management strategies were recorded, including hemodynamic monitoring, immobilization, and indications for conversion to operative management or interventional radiology procedures. Failed NOM was defined as the need for surgery ("celiotomy" reported in the emergency procedure-type field or "splenic surgery" reported in the surgery-type field) in patients with NOM within 48 h after admission.^[7] Mean (standard deviation) were calculated for the continuous variables and *t*-test or Mann–Whitney test was used to test the significance. The categorical variables were expressed in proportion. Multivariate analysis of the predictors for failure of NOM was performed by binary logistic regression. Statistical analysis was performed using Medcalc (version 23.4).

RESULTS

A total of 32 patients with splenic injury were included in the study, comprising 27 males (84.4%) and five females (15.6%). The most common age group affected was 10–29 years (34.4%), followed by 30–49 years (25%), 50–59 years (18.8%), and ≥60 years (21.9%). According to the AAST grading, 16 patients (50%) sustained grade III, nine (28.1%) had grade IV, and seven (21.9%) had grade V splenic injuries (Table 1). Comorbidities included diabetes mellitus (21.9%), hypertension (12.5%), and

respiratory disorders (6.3%). Associated abdominal injuries involved the liver (21.9%), stomach (12.5%), bowel (9.4%), and diaphragm (6.3%). The mean vital parameters at presentation were: heart rate $81.9 \pm 10.4/\text{min}$, systolic BP $118.6 \pm 16.5 \text{ mmHg}$, diastolic BP $76.1 \pm 8.9 \text{ mmHg}$, and respiratory rate $18.9 \pm 2.6/\text{min}$, suggesting that most patients were initially hemodynamically stable.

Of the total, 14 patients (43.7%) were successfully managed non-operatively, while 18 (56.3%) required surgical intervention. The success rate of NOM was higher among younger patients, with 50% of those aged 10–29 years managed successfully compared to only 22.2% in the failure group. The association between increasing age and failure of NOM was found to be borderline significant ($p = 0.054$). The GCS score also demonstrated a significant relationship with NOM outcome ($p = 0.045$). Patients with mild injury (GCS 13–15) showed a 50% NOM success rate, whereas those with moderate (GCS 9–

12) and severe (GCS 3–8) scores had higher rates of NOM failure (38.9% and 50%, respectively). High-grade splenic injury (grade IV–V) was significantly associated with failure of NOM ($p = 0.016$). Among those with successful NOM, 78.6% had grade III injury, while 72.2% of patients in the failure group had grade IV or V injuries (Table 2). Comorbidities, mechanism of injury, and associated abdominal injuries did not show statistically significant associations with NOM outcome ($p > 0.05$). Multivariable logistic regression analysis identified older age (OR = 1.063; $p = 0.011$), high-grade splenic injury (OR = 3.53; 95% CI = 1.326–5.3; $p < 0.001$), GCS (OR = 1.9; 95% CI = 0.24–4.1; $p = 0.002$) and shock index > 0.9 (OR = 2.9; 95% CI = 0.306–7; $p = 0.002$) as significant predictors of failure of non-operative management. Gender ($p = 0.447$) and requirement of ventilation ($p = 0.41$) were not found to be statistically significant predictors of NOM failure (Table 3).

Table 1: Baseline, demographic and clinical characteristics of the subjects

Parameter	N	%
Gender		
Male	27	84.4
Female	5	15.6
Age group		
10 - 29 years	11	34.4
30-49 years	8	25.0
50-59 years	6	18.8
≥ 60 years	7	21.9
Comorbidities		
Hypertension	4	12.5
Diabetes Mellitus	7	21.9
Respiratory disorder	2	6.3
No records	3	9.4
Mechanism of injury		
RTA	21	65.6
Fall	9	28.1
Assault	2	6.3
AAST grading		
Grade III	16	50.0
Grade IV	9	28.1
Grade V	7	21.9
GCS		
Mild (13-15)	9	28.1
Moderate (9-12)	11	34.4
Severe (3-8)	12	37.5
Associated organs involved		
Liver	7	21.9
Diaphragm	2	6.3
Stomach	4	12.5
Bowel	3	9.4

Table 2: Comparison between successful and failure of NOM

Parameter	Successful NOM (N=14)		Failure of NOM (N=18)		Significance
Gender					
Male	11	78.6	16	88.9	P = 0.43
Female	3	21.4	2	11.1	
Age group					
10 - 29 years	7	50.0	4	22.2	P = 0.054
30-49 years	4	28.6	4	22.2	
50-59 years	1	7.1	5	27.8	
≥ 60 years	2	14.3	5	27.8	
Comorbidities					
Hypertension	2	14.3	2	11.1	P = 0.464
Diabetes Mellitus	4	28.6	3	16.7	
Respiratory disorder	2	14.3	0	0.0	

Mechanism of injury					
RTA	7	50.0	14	77.8	P = 0.24
Fall	6	42.9	3	16.7	
Assault	1	7.1	1	5.6	
AAST grading					
Grade III	11	78.6	5	27.8	P = 0.016
Grade IV	2	14.3	7	38.9	
Grade V	1	7.1	6	33.3	
Associated abdominal injuries					
Liver	2	14.3	5	27.8	P = 0.36
Diaphragm	0	0.0	2	11.1	P = 0.20
Stomach	1	7.1	3	16.7	P = 0.42
Bowel	1	7.1	2	11.1	P = 0.70
GCS					
Mild (13-15)	7	50.0	2	11.1	P = 0.045
Moderate (9-12)	4	28.6	7	38.9	
Severe (3-8)	3	21.4	9	50.0	

Table 3: Multivariable logistic regression analysis of various factors vs. outcome

Parameter	OR	95% CI	Significance
Gender	0.23	-0.3717 to 0.8206	P = 0.447
Age	1.063	0.9889 to 1.176	P = 0.011
High grade splenic injury	3.53	1.326 to 5.337	P < 0.001
Shock Index > 0.9	2.9	0.3060 to 7.078	P = 0.002
Need of Ventilation	0.305	0.01523 to 5.264	P = 0.41

DISCUSSION

The present study investigated the factors associated with failure of NOM in high-grade splenic injuries following blunt abdominal trauma. Although NOM is now the standard of care for hemodynamically stable patients, its success depends on careful patient selection, continuous clinical monitoring, and timely access to adjunctive interventions such as splenic artery embolization (SAE). Our findings demonstrate that increasing age, high-grade splenic injury, and elevated shock index (>0.9) were significant predictors of NOM failure, whereas gender and the need for ventilatory support were not statistically significant.

Over recent decades, the management of splenic injuries has shifted toward conservative strategies. This change is attributable to the recognition that up to 80% of splenic injuries can be managed nonoperatively, combined with advancements in CT imaging, interventional radiology, and critical care.^[8] The success of NOM is further supported by the spleen's protection within the ribcage, its inherent capacity for self-healing, and a high rate of spontaneous haemostasis. Despite these advantages, in the present cohort only 43.8% of patients underwent NOM, consistent with previous reports, reflecting the challenges of applying conservative management to high-grade injuries. Pachani et al. similarly reported that approximately 40% of patients with splenic trauma were managed conservatively.^[9] High-grade injuries emerged as a particularly strong predictor of NOM failure (OR 3.53, $p < 0.001$), in line with prior studies identifying AAST grade IV–V as a reliable indicator of nonoperative failure. The increased risk likely reflects the greater parenchymal disruption, devascularization, and vascular injury inherent to severe splenic trauma, which predispose patients to delayed hemorrhage despite initial

stability. Supporting these findings, Boyuk et al. demonstrated that splenic injury grade significantly influenced NOM success, while Malhotra et al. reported higher failure rates of conservative management among patients with elevated Injury Severity Scores.^[10,11]

Advanced age was also independently associated with NOM failure (OR 1.063; $p = 0.011$). This association is consistent with previous reports linking older age to diminished physiologic reserve and impaired tissue healing. Hemodynamic status emerged as another critical determinant of outcome. An elevated shock index (>0.9) significantly predicted NOM failure ($p = 0.002$), reinforcing prior observations that shock index serves as an early marker of occult hemorrhage and correlates with the need for operative intervention. Accordingly, sustained hemodynamic stability remains a fundamental prerequisite for successful NOM. Zenaidi et al. similarly identified age ≥ 55 years, hypotension on admission, shock, transfusion of three or more units of packed red blood cells, and associated pancreatic or hollow viscus injuries as predictors of NOM failure.^[12]

Strength of the study: These findings underscore the importance of integrating injury severity, patient age, and physiologic status into risk stratification for NOM. In high-grade splenic trauma, vigilant monitoring, early imaging, and rapid access to interventions such as SAE are essential to optimize outcomes. Recognizing these predictors can guide clinicians in selecting appropriate candidates for NOM and in planning timely escalation when necessary.

Limitations of the study: The present study is limited by its small sample size and single-center design, which may restrict the generalizability of the findings. The retrospective nature also restricts control over some confounders (e.g., transfusion

timing, subtle vascular blush on imaging). Larger, prospective multicentric studies are needed to validate these predictors and establish standardized criteria for NOM selection in different clinical settings.

Future implication: Identifying predictive factors for failure of NOM will help distinguishing patients requiring ICU admission, close clinical and laboratory monitoring, incidental imaging and conversion to operative management. This may help differentiate patients who need prolonged admission and who can be discharged early leading to better resource allocation while ensuring patient care and safety.

CONCLUSION

Non-operative management of splenic injury remains an effective and safe strategy in carefully selected, hemodynamically stable patients with close monitoring. Patient factors like older age, injury grades including high-grade splenic trauma (grade IV–V), high shock index (>0.9) and low GCS score were found to significantly predict failure of conservative management. These factors warrant vigilant clinical monitoring and may necessitate early surgical intervention to prevent adverse outcomes.

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