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A PROSPECTIVE ANALYSIS OF OPERATIVE VERSUS NON-OPERATIVE MANAGEMENT OF GRADE III SPLENIC INJURY: OUTCOMES AND EFFICACY IN TRAUMA CARE

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Abstract

Background: The spleen is the most commonly injured solid organ in blunt abdominal trauma. While splenectomy was historically the mainstay, non-operative management (NOM) has gained prominence in hemodynamically stable patients. This study compares the efficacy and outcomes of NOM and operative strategies in Grade III splenic injuries.

Methods: A prospective observational study was conducted in the Department of General Surgery, Saveetha Medical College (January 2022–January 2025). Thirty adult patients with radiologically confirmed Grade III splenic injury (AAST classification) were enrolled. Patients were managed based on hemodynamic status: 18 underwent NOM, while 12 required operative intervention. Data on demographics, transfusion needs, complications, hospital stay, spleen preservation, and mortality were analyzed using appropriate statistical tests, with $p < 0.05$ considered significant.

Results: Spleen preservation was significantly higher in the NOM group (83.3%) compared to the operative group (16.6%) ($p<0.001$). The mean hospital stay was shorter in NOM patients (5.3 ± 1.2 days) versus operative patients (8.2 ± 1.8 days, $p=0.002$). Blood transfusion requirement (>2 units) was markedly lower in NOM patients (16.6%) than operative patients (75%, $p=0.01$). Complications occurred in 5.5% of NOM patients versus 41.6% in operative cases ($p=0.03$). NOM failed in 3 patients (16.6%) who later required surgery. Thirty-day mortality was 0% in the NOM group and 16.6% in the operative group ($p=0.04$).

Conclusion: NOM is safe and effective for hemodynamically stable Grade III splenic injuries, offering higher spleen preservation, fewer complications, and no observed mortality compared to operative management. Surgery should be reserved for unstable patients or failed NOM. Larger multicentric studies are warranted to refine selection criteria and establish standardized management algorithms.

Keywords: Splenic injury; Blunt abdominal trauma; Non-operative management (NOM); Splenectomy; Spleen preservation; Trauma surgery outcomes

INTRODUCTION

The spleen is the most frequently injured intra-abdominal organ following blunt abdominal trauma, accounting for nearly 25–30% of solid organ injuries [1]. Advances in imaging, intensive monitoring, and interventional radiology have shifted the paradigm of splenic trauma management from operative splenectomy to non-operative management (NOM), particularly in hemodynamically stable patients [2,3]. Preservation of the spleen is crucial, given its role in immune function and the risk of overwhelming post-splenectomy infection (OPSI) that carries significant long-term morbidity and mortality [4].

The American Association for the Surgery of Trauma (AAST) splenic injury scale classifies splenic injuries from Grade I to V, guiding management decisions [5]. Grade III splenic injuries—characterized by capsular lacerations >3 cm or parenchymal/subcapsular hematomas >50% of surface area—represent

a clinically challenging category [6]. While lower-grade injuries are routinely managed conservatively, higher grades often necessitate operative intervention. Grade III, therefore, lies in a "gray zone," where the decision between NOM and surgery remains highly debated [7].

Multiple studies have reported favorable outcomes of NOM in selected Grade III cases, with spleen salvage rates exceeding 80% in stable patients [8,9]. However, predictors of NOM failure include persistent hemodynamic instability, transfusion requirements, and associated intra-abdominal injuries [10]. Operative management, although definitive, carries risks of higher transfusion needs, surgical site infections, and increased length of hospital stay [11]. Moreover, splenectomy is linked to lifelong susceptibility to sepsis and thromboembolic complications [12].

In recent years, international trauma guidelines have strongly advocated NOM as the first-line approach in stable Grade III injuries, supported by improved critical care and the availability of interventional radiology [13,14]. Despite this, regional differences persist in practice patterns due to variability in resources, surgeon expertise, and institutional protocols [15]. Evidence from South India on this subject remains limited, highlighting the need for prospective data to guide local management strategies.

This study aims to prospectively analyze and compare operative versus non-operative management of Grade III splenic injuries in a tertiary care setting. By evaluating outcomes such as spleen preservation, hospital stay, transfusion requirements, complications, and mortality, we seek to provide evidence to optimize trauma care in resource-limited contexts.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of General Surgery, Saveetha Medical College and Hospital, Chennai, over a period of three years from January 2022 to January 2025. The study compared outcomes of operative and non-operative management (NOM) in patients with Grade III splenic injuries, classified according to the American Association for the Surgery of Trauma (AAST) spleen injury scale [1].

Study Population

A total of **30 consecutive patients** aged ≥18 years presenting with radiologically confirmed Grade III splenic injuries were enrolled. Diagnosis was established using **contrast-enhanced computed tomography (CECT) of the abdomen**, performed in all hemodynamically stable patients at admission.

Inclusion Criteria

- Adults aged 18 years and above
- Radiologically confirmed Grade III splenic injury (AAST classification)
- Hemodynamically stable at admission

Exclusion Criteria

- Patients with **polytrauma** and life-threatening associated injuries
- Known **hematologic disorders or coagulopathy**
- Prior splenic surgery
- Pregnant or lactating women

Treatment Protocol

Patients were allocated into two groups based on clinical decision-making:

Non-operative management group (NOM, n = 18): Managed with hemodynamic monitoring, serial abdominal examinations, bed rest, restricted activity, and blood transfusion as required. Patients were closely observed in a high-dependency unit with repeat imaging if deterioration was suspected.

Operative management group (OM, n = 12): Patients underwent laparotomy, with splenectomy being the most common procedure. Splenorrhaphy was attempted where feasible.

Failure of NOM was defined as clinical deterioration requiring delayed surgical intervention.

Data Collection

Data were recorded in a **structured case sheet**, including:Demographic variables (age, sex),Mechanism of injury,Hemodynamic status at admission,Imaging findings,Treatment modality and intraoperative findings (if operated)

Outcomes: spleen preservation rate, hospital stay, blood transfusion requirement, complications, and 30-day mortality

Outcome Measures

The primary outcome was spleen preservation. Secondary outcomes included hospital length of stay, transfusion requirements, complication rates, and 30-day mortality.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the Student's t-test. Categorical variables were expressed as percentages and analyzed using the Chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of Saveetha Medical College and Hospital (Approval No: IEC/GS/2021/112). Written informed consent was obtained from all patients prior to enrolment. Patient confidentiality was maintained throughout.

RESULTS

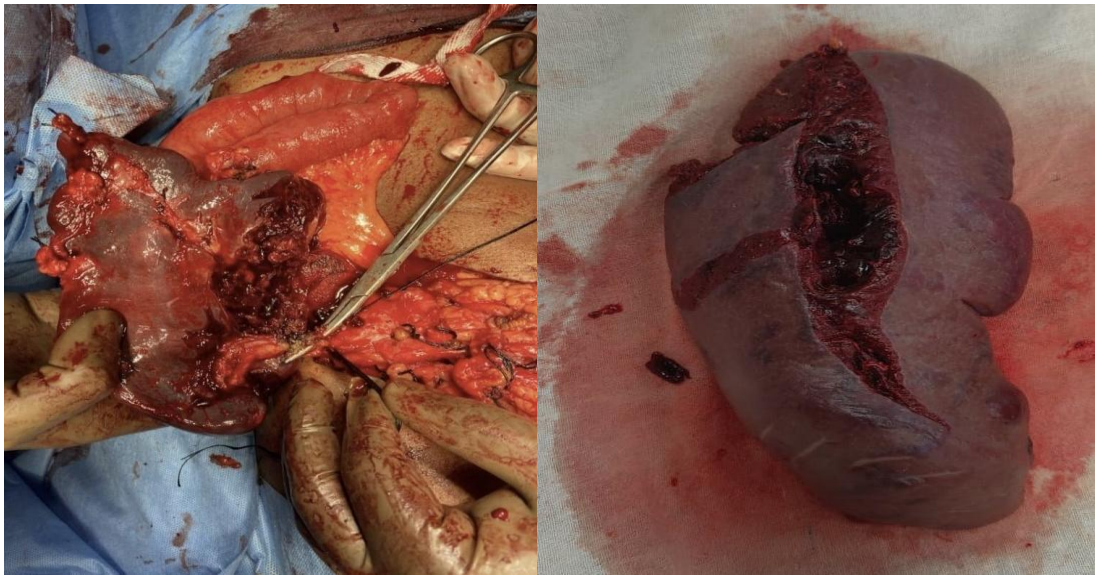

Figure 1 and 2. Depicting intraoperative findings of splenic injury

A total of 30 patients with Grade III splenic injury were prospectively enrolled between January 2022 and January 2025. Of these, 18 patients (60%) were managed with non-operative management (NOM), while 12 patients (40%)underwent operative intervention. The two groups were comparable in terms of baseline demographics, with the mean age being 34.2 ± 8.1 years in the NOM group and 36.5 ± 7.4 years in the operative group (p = 0.42), showing no significant difference.

Hospital Stay

The mean duration of hospital stay was significantly shorter in the NOM group (5.3 ± 1.0 days) compared to the operative group (8.2 ± 1.8 days, p = 0.002). This indicates that patients managed conservatively had quicker recovery and earlier discharge, reflecting the efficacy of non-operative strategies.

Transfusion Requirement

A marked difference was observed in blood transfusion needs. Only 3 patients (16.6%) in the NOM group required transfusion of more than 2 units, whereas 9 patients (75%) in the operative group required similar transfusion support (p = 0.01). This highlights that surgical intervention carried a higher physiological burden and blood loss, necessitating greater transfusion support.

Spleen Preservation

Splenic salvage was significantly superior in the NOM cohort, where 15 out of 18 patients (83.3%) retained their spleen. In contrast, only 2 of 12 operative patients (16.6%) had spleen preservation, as splenectomy was the predominant operative procedure (p < 0.001). This underscores the spleen-conserving advantage of non-operative management.

Complications

The overall complication rate was substantially lower in the NOM group (5.5%, 1 patient with rebleed) compared to the operative group (41.6%, 5 patients). Complications in the operative group included surgical site infection, intra-abdominal abscess, postoperative hemorrhage, and pulmonary complications (p = 0.03).

Failure of NOM

Three patients (16.6%) initially managed non-operatively required delayed surgery due to clinical deterioration. One patient developed rebleeding, while two others had persistent abdominal pain and

worsening hemoperitoneum on follow-up imaging. These patients underwent splenectomy and recovered uneventfully thereafter.

Mortality

There were no deaths in the NOM group (0%), while 2 patients (16.6%) in the operative group succumbed within 30 days (p = 0.04). The causes of mortality were postoperative hemorrhage with shock in one patient and severe pulmonary complications in another.

Parameter	NOM Group (n=18)	Operative Group (n=12)	p-value
Mean Age (years)	34.2 ± 8.1	36.5 ± 7.4	0.42 (NS)
Hospital Stay (days)	5.3 ± 1.0	8.2 ± 1.8	0.002
ransfusion Requirement (>2 units	3 patients (16.6%)	9 patients (75%)	0.01
NOM Failure (Delayed Surgery)	3/18 (16.6%)	—	—
Spleen Preservation	15/18 (83.3%)	2/12 (16.6%)	<0.001
Complications	1 (5.5%)	5 (41.6%)	0.03
30-day Mortality	0	2 (16.6%)	0.04

Table 1. Baseline deographics of study group

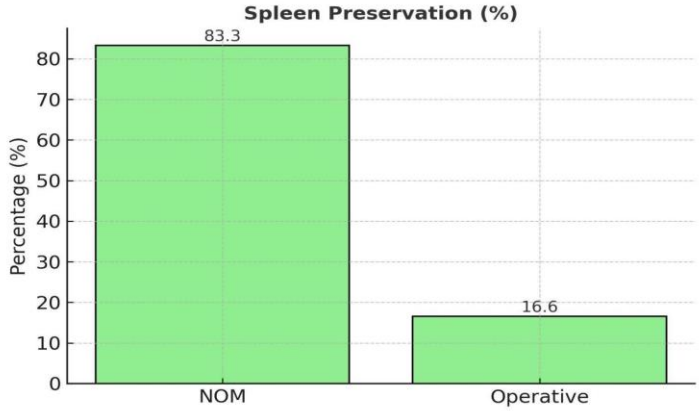

Figure 1. Percentage of spleen preservation among study groups

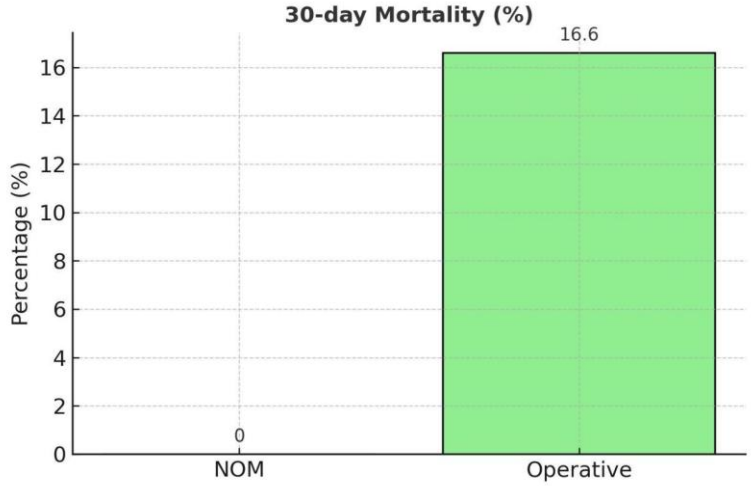

Figure 2. Percentage of 30 day mortality among study groups

DISCUSSION

Management of splenic injuries has undergone a paradigm shift over the past two decades, moving from operative splenectomy toward non-operative management (NOM), particularly in hemodynamically stable patients. This transition has been driven by the recognition of the spleen's vital immunologic function and the long-term risk of overwhelming post-splenectomy infection (OPSI) [1,2]. The present prospective analysis adds to the growing body of evidence by demonstrating that NOM in Grade III splenic injuries is both safe and effective in selected patients.

In our study, 83.3% of patients managed non-operatively preserved their spleen, with significantly fewer complications and shorter hospital stays compared to the operative cohort. These findings are consistent with recent multi-institutional and meta-analytic studies, which report splenic salvage rates of 70–90%

for Grade III injuries when managed conservatively under close monitoring [3–5]. The lower transfusion requirements in the NOM group (16.6% vs. 75%) further highlight the clinical benefits and reduced physiological burden associated with spleen preservation.

However, NOM is not without challenges. Three patients (16.6%) failed conservative management and required delayed surgery. Predictors of failure, as identified in earlier studies, include large hemoperitoneum, ongoing transfusion requirement, and associated injuries [6,7]. The solitary rebleed in our series underscores the importance of vigilant monitoring and timely escalation when deterioration occurs.

Operative management, although definitive, was associated with higher complication rates (41.6%) in our cohort, aligning with prior reports of postoperative infections, pulmonary complications, and hemorrhage [8,9]. Furthermore, the observed 16.6% mortality in the operative group contrasts with the absence of deaths in the NOM group, emphasizing the importance of patient selection in trauma care. While surgery remains the standard for unstable patients or NOM failures, avoiding unnecessary splenectomy in stable cases reduces both morbidity and long-term risks [10].

The study's limitations include its small sample size and single-center nature, which may limit generalizability. Nevertheless, the findings strongly support the adoption of NOM as the first-line strategy for hemodynamically stable Grade III splenic injuries, provided adequate imaging, intensive monitoring, and surgical readiness are available. Future multicenter prospective trials with larger cohorts are warranted to refine risk stratification and establish robust guidelines.

CONCLUSION

Our prospective analysis demonstrates that non-operative management (NOM) is a safe and effective strategy for hemodynamically stable patients with Grade III splenic injuries. Compared to operative management, NOM resulted in higher spleen preservation rates, shorter hospital stays, reduced transfusion requirements, fewer complications, and no mortality. Although a small subset of patients required delayed surgery, the overall outcomes strongly favor conservative management when close monitoring and advanced imaging are available.

Surgical intervention, while lifesaving in unstable cases or failed NOM, carried a higher burden of morbidity and mortality. These findings are in line with global evidence supporting spleen-preserving strategies in trauma care. However, our study is limited by its single-center design and small sample size, warranting larger multicenter studies to validate predictors of NOM success and refine treatment algorithms.

Ultimately, NOM should be the preferred first-line approach in stable Grade III splenic injuries, with vigilant monitoring to promptly identify failures.

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