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CLINICAL STUDY ON CONSERVATIVE MANAGEMENT OF BLUNT SPLENIC INJURY

Surgery

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ABSTRACT

Background: Spleen is the most common intra-abdominal organ to be injured in blunt abdominal trauma and currently most cases are treated nonoperatively. Aim of this study was to evaluate the efficacy of Non-Operative Management (NOM) of blunt splenic injury and to point out the predictors of failure of NOM. **Methods:** Over a 12 month period (June 2021- May 2022), 16 hemodynamically stable patients with blunt splenic injury admitted in Department of General Surgery in Silchar Medical College and Hospital were evaluated prospectively. Association of various factors were analysed using SPSS statistical software version 22 to find out efficacy of NOM as well as to point out predictors of NOM. **Results:** NOM was successful in 81.3% of patients and 18.8% were converted to operative management (NOM failure). Statistical analysis showed that Systolic BP and Haemoglobin at the time of admission, Number of blood transfused, Injury Severity Score (ISS), USG finding of grade of hemoperitoneum, American Association for Surgery of Trauma (AAST) grade of splenic injury, Duration of hospital stay were significantly associated with the outcome of NOM success (P value < 0.05). Age, Sex, Mode of injury, Pulse rate at the time of admission had no significant relation with the outcome. AAST grade IV splenic injury or higher, Massive hemoperitoneum, ISS > 25, Haemoglobin <8 gm%, Requirement of 4 or more units of blood and New-onset hemodynamic instability were independent predictors of failure of conservative management. **Conclusion:** Conservative management of blunt splenic injury is safe and effective as long as patients are selected based on strict inclusion/exclusion criteria.

KEYWORDS

Blunt Splenic Injury, Non-Operative Management, AAST Grade, Injury Severity Score

INTRODUCTION

Trauma is defined as "cellular disruption caused by an exchange with environmental energy that is beyond the body's resilience". It deals with the deleterious effects of kinetic energy on the human frame [1]. Trauma is the fourth cause of death in the overall population [2]. Abdominal trauma can be classified as blunt or penetrating according to the agent and its mechanism of action [2]. The spleen is the most frequently injured organ in abdominal blunt trauma, mainly because of its highly vascularized parenchyma and its anatomic location. Spleen is the only structure involved in almost 46% of blunt trauma (BT). On the other hand the liver (41.7%), kidneys (16.4%), mesentery (15.1%), small and large bowel (10.1% and 6.3%, respectively), pancreas (5%) and omentum may concur with splenic injuries in the remaining part of BT [2]. It was Reigner in 1890 who first did a splenectomy in a labourer who fell from height and presented with a thready pulse and abdominal distension [3]. Splenectomy was the only treatment proposed for splenic trauma until the 1960s. However, things changed with the recognition of the immunological functions of spleen. With the risk of developing Overwhelming Post Splenectomy Infection [OPSI], treating trauma surgeons were forced to find methods to salvage the damaged spleen. At present, Nonoperative management is the most commonly employed method of splenic salvage. The first change in the attitude towards OM occurred with the article by King and Schumacker in 1952, which showed that patients who underwent a splenectomy had a greater susceptibility to infection by *Streptococcus pneumoniae* [4]. In 1968, Upadhyaya and Simpson proposed Non-Operative Management (NOM) in a study on 52 Paediatric patients with splenic trauma [4].

The pathophysiology of blunt splenic injury can include direct compression of the organ in the left upper quadrant or a deceleration mechanism that tears the splenic capsule or parenchyma, mainly at areas fixed or tethered to the retroperitoneum [5]. Bleeding from an injured spleen can be ongoing at the time of presentation or frequently will have stopped. Nonoperative management of splenic injuries is based on this spontaneous cessation of bleeding [6]. The ultimate goal of NOM is to preserve the spleen and it is based on specific principles and criteria. NOM procedures include conservative medical treatment and angioembolization (AE) without access to the peritoneal cavity. Advantages of NOM for minor splenic trauma (grades I and II according to the American Association for the Surgery of Trauma-AAST), have been extensively reported, whereas its value for severe splenic injuries (AAST grades IV and V) is still under debate. In recent years, a non-operative approach for blunt spleen injuries has become the first choice in hemodynamically stable patients with grades 1, 2 and 3 injuries. Preservation of the spleen decreases the risk of early surgical complications such as adjacent organ injury, wound infection, pancreatitis, pleural effusion, and atelectasis as well as late splenectomy complications such as sepsis, serious infections and thromboembolic events [7,8].

NOM is feasible in hospitals where full time Surgeons, blood banks, easy access to imaging methods and ICU setup are available. Most patients with low grade injury (grade 1 to 3) according to AAST and even patients with high grade lesions (grade 4 and 5) may initially undergo NOM provided they are hemodynamically stable. Several factors have been studied in the literature, including age, degree of splenic injury, Injury Severity Score (ISS) values, hemoperitoneum volume by imaging, blood transfusions, hemoglobin value, pulse rate and systolic BP at time of admission and duration of hospital stay. The aim of this study is to evaluate the efficacy of conservative management of blunt splenic trauma and to point out the predictors of failure of conservative management and to form an idea to decide when to abandon conservative management and opt for surgical approach

METHODS

- Over a 12 month period (June 2021- May 2022), 16 hemodynamically stable patients with blunt splenic injury admitted in Department of General Surgery in Silchar Medical College and Hospital, Assam were evaluated prospectively
- All patients underwent an initial assessment upon arrival to the emergency room using the Advanced Trauma Life Support (ATLS) protocol that describes the absolute priorities using the acronym ABCDE: A (Airway), B (Breathing), C (Circulation), D (Disability) and E (Exposure).
- Injury Severity score (ISS) was used to assess the extent of overall injury, and injuries were graded using AAST grading for solid organ injuries and patients underwent radiological evaluation (USG/CECT abdomen) to confirm source and severity of injury

Inclusion Criteria

1. Patients aged more than 18 years with valid consent
2. Patients with blunt abdominal trauma with radiographic evidence (USG/CECT abdomen) of splenic injury
3. Hemodynamically stable at time of presentation

(Hemodynamically stable: defined as
a) Good volume pulse.
b) Pulse rate ≤ 100 beats per minute.

c) Systolic blood pressure ≥ 100 mm of Hg.)

Exclusion Criteria

1. Age less than 18 years
2. Hemodynamically unstable at time of admission

Table 1: Organ injury scale (OIS) of the American Association for Surgery of Trauma (AAST): 2018 revision (Spleen) [10]

Grade	Type	Injury description
I	Haematoma	Subcapsular, < 10% surface area
	Laceration	Capsular tear, < 1% parenchymal depth
II	Haematoma	Subcapsular, 10–50% surface area
		Intra-parenchymal, < 5 cm in diameter
	Laceration	1–3 cm parenchymal depth
III	Haematoma	Subcapsular, > 50% surface area
		Ruptured subcapsular or parenchymal haematoma ≥5 cm
	Laceration	> 3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Parenchymal laceration involving segmental or hilar
		vessels producing > 25% devascularisation
	Vascular	Any injury in the presence of a splenic vascular injury or
		active bleeding confined within splenic capsule
V	Laceration	Shattered spleen
	Vascular	Any injury in the presence of splenic vascular injury with
		active bleeding extending beyond the spleen into the peritoneum

Statistical Analysis

All the data collected were coded and entered in Microsoft Excel sheet which was re-checked and analysed using SPSS statistical software version 22. Quantitative variables were summarised using mean and standard deviation (SD). Categorical variables were represented using frequency and percentage. Independent sample t test was used to test statistical significance of difference between means of variables among different independent groups. Pearson Chi-square test and Fisher's Exact test were used for comparing categorical variables between groups. A p value of <0.05 was considered statistically significant.

RESULTS

During the 1 year study period, a total of 16 hemodynamically stable patients diagnosed with blunt splenic injury were admitted in which the youngest was 18 years old and the eldest was 47 years old. The mean and median of age distribution were 32.13+/-8.86 and 30 respectively. Out of those 16 patients, 12(75%) were in the age group of 20-40 years.

Analysis of sex distribution showed 14(87.5%) were males and 2(12.5%) were females. The distribution of mode of injury from the history given by the patients showed 9 patients (56.3%) were presented following road traffic accidents, 4 (31.3%) were with history of fall from height and 2 patients (12.5%) had given history of physical assault.

According to these findings of our study a picture can be framed out that blunt splenic injury mostly occurred in young adult males following road traffic accident.

Table 2: Distribution of Age, Sex and Mode of Injury

Age-years	
Mean ± SD	32.13±8.86
Median(IQR)	30(24.75-39.50)
Age-no(%)	
≤20 years	1(6.3)
21-30 years	8(50)
31-40 years	4(25)
41-50 years	3(18.8)
Sex-no(%)	
Male	14(87.5)
Female	2(12.5)
Mode of injury-no(%)	
RTA	9(56.3)
Fall from height	5(31.3)
Physical assault	2(12.5)

Analysis of Pulse Rate (PR) at the time of admission showed a mean PR of 88+/-6.65 beats per minute (bpm) and a median PR of 89 bpm. The lowest recorded pulse in the study group was 76 bpm and the highest was 100 bpm. Values of Systolic Blood Pressure (SBP) at time of admission were also analysed. The Mean SBP was 108.63+/-5.2 mmHg and the Median SBP was 110 mmHg. All patients were maintaining a SBP more than or equal to 100 mmHg.

The emergency blood investigations showed a Mean Haemoglobin (Hb) value of 9.31+/-0.96 gm/dL and a Median value of 9.5 gm/dL. A Hb value more than 8 gm/dL was noted in 13 (81.3%) patients and less than or equal to 8 gm/dL was noted in 3 (18.8%) patients.

USG FAST (Focused Assessment with Sonography for Trauma) done at time of admission showed that 7(43.8%) patients had mild hemoperitoneum, 6(37.5%) patients had moderate hemoperitoneum and 3(18.8%) patients had massive hemoperitoneum.

Table 3: Analysis of Pulse Rate (PR), Systolic Blood Pressure (SBP), Haemoglobin (Hb) and USG FAST at the time of admission

Pulse rate-beats per minute	
Mean ± SD	88±6.65
Median(IQR)	89(82.50-91.50)
Systolic BP-mm Hg	
Mean ± SD	108.63±5.20
Median(IQR)	110(104.50-110)
Hemoglobin-gm/Dl	
Mean ± SD	9.31±0.96
Median(IQR)	9.50(8.62-10)
Hemoglobin-no(%)	
>8	13(81.3)
≤8	3(18.8)
USG finding at time of admission-no(%)	
Mild hemoperitoneum	7(43.8)
Moderate hemoperitoneum	6(37.5)
Massive hemoperitoneum	3(18.8)

Since patients were hemodynamically stable all underwent Contrast Enhanced CT Scan of abdomen and AAST (American Association for the Surgery of Trauma) grade assessment done accordingly. AAST Grade 1 splenic injury noted in 5(31.3%) patients, grade 2,3 and 4 injury observed in 6(37.5%), 3(18.8%) and 2(12.5%) patients respectively.

An Injury Severity Score (ISS) of less than or equal to 25 noted in 13(81.3%) patients and more than 25 noted in 3(18.8%) patients. The Mean ISS was 14.81+/-8.76 and Median ISS was 10.

Patients then underwent conservative management by strict monitoring of vitals and serial blood transfusions. The Mean units of blood transfused was 2.25+/-1.18 and transfusion of more than 4 units of Packed Red Blood Cells (PRBC) required for 3(81.3%) patients. The Mean duration of hospital stay was 10.06+/-3.78 in which 3 patients stayed more than 15 days in the hospital.

Table 4: Analysis of Injury Severity Score (ISS), Blood Transfusion, AAST grade and Duration of Hospital Stay

ISS score	
Mean ± SD	14.81±8.76
Median(IQR)	10(9-16.25)
ISS score-no(%)	
≤25	13(81.3)
>25	3(18.8)
Number of units of blood transfused	
Mean ± SD	2.25±1.18
Median(IQR)	2(1.25-2.75)
Number of units of blood transfused-no(%)	
≤4	13(81.3)
>4	3(18.8)
AAST grade-no(%)	
Grade I	5(31.3)
Grade II	6(37.5)
Grade III	3(18.8)

Grade IV	2(12.5)
Duration of hospital stay-days	
Mean ± SD	10.06±3.78
Median(IQR)	9(8-10)

NOM successfully completed in 81.3% (13 patients) of patients and 18.8% were converted to operative management (NOM failure) due to new onset of hemodynamic instability on the course of hospitalisation.

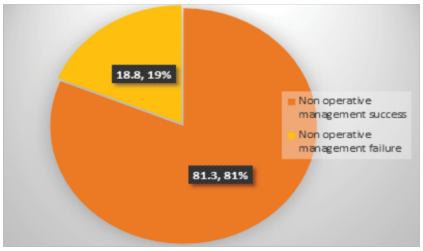

Figure 1: Outcome

Table 6: Association of various factors with outcome

Variable	Non operative management outcome		P value
	Success (N=13)	Failure (N=3)	
Age			
Mean ± SD	32±9.41	32.67±7.57	0.911
Age			
≤20 years	1(100)	0	0.297
21-30 years	7(87.5)	1(12.5)	
31-40 years	2(50)	2(50)	
41-50 years	3(100)	0	
Sex			
Male	11(78.6)	3(21.4)	1.000
Female	2(100)	0	
Mode of injury			
RTA	7(77.8)	2(22.2)	0.764
Fall from height	4(80)	1(20)	
Physical assault	2(100)	0	
Pulse rate			
Mean ± SD	86.46±5.95	94.67±6.11	0.050
Systolic BP			
Mean ± SD	110±4.61	102.67±3.05	0.022*
Hemoglobin			
Mean ± SD	9.65±0.68	7.83±0.28	0.001*
Hemoglobin			
>8	13(100)	0	0.002*
≤8	0	3(100)	
Number of units of blood transfused			
Mean ± SD	1.77±0.59	4.33±0.57	<0.001*
Number of units of blood transfused			
≤4	13(100)	0	0.002*
>4	0	3(100)	
ISS score			
Mean ± SD	10.92±2.78	31.67±2.30	<0.001*
ISS score			
≤25	13(100)	0	0.002*
>25	0	3(100)	
USG finding at time of admission			
Mild hemoperitoneum	7(100)	0	<0.001*
Moderate hemoperitoneum	6(100)	0	
Massive hemoperitoneum	0	3(100)	
AAST grade			
Grade I	5(100)	0	0.009*
Grade II	6(100)	0	
Grade III	2(66.7)	1(33.3)	
Grade IV	0	2(100)	
AAST grade			
Less than Grade IV	13(92.9)	1(7.1)	0.025*
Grade IV	0	2(100)	
Duration of hospital stay			
Mean ± SD	8.38±1.12	17.33±1.52	<0.001*

*statistically significant

Statistical analysis showed that systolic BP and Haemoglobin value at the time of admission, number of unit of blood transfused, Injury Severity Score (ISS), USG finding of grade of hemoperitoneum, AAST grade of splenic injury, duration of hospital stay were significantly associated with the outcome of NOM success (P value < 0.05). On the other hand age, sex, mode of injury, Pulse rate at the time of admission had no significant relation with the outcome.

AAST grade IV splenic injury or higher, massive hemoperitoneum, ISS > 25, Hb value <8 gm%, requirement of 4 or more units of blood were not in favour of successful outcome in NOM.

DISCUSSION

Over a 12 month period (June 2021- May 2022) study on 16 hemodynamically stable patients with blunt splenic injury in our institute a NOM success rate of 81.3% was noted, which is similar to the past literature, which quotes rates around 80%. The study done by Roberto Cirocchi et al [6] showed a NOM success rate of 85.7% and in the study of KK Tan et al [9] it was 73.8%. We studied variables like age, sex, mode of injury, systolic BP and Pulse rate at admission, Haemoglobin value, number of units of blood transfused, ISS, AAST grade of injury, grade of hemoperitoneum in USG at the time of admission and duration of hospital stay.

In our study it is noted that AAST grade 4 or more, Hb < 8 gm%, massive hemoperitoneum and requirement of 4 or more units of blood transfusion and ISS >25 were associated with a higher risk of failing conservative management which is comparable with findings of KK et al [9] in which ISS >15, AAST grade >3, Low admission Systolic BP, high transfusion requirement were the main factors associated with NOM failure. Old age was also a factor associated with NOM failure according to the study by KK Tan et al [9] but our study showed no statistical significance between age and outcome.

No complications occurred in patients who underwent NOM. We must however emphasize patients who underwent NOM had less severe spleen injuries due to the exclusion criteria for NOM. The study by Di Saverio et al [11] highlighted how patients with grade IV through V splenic injury were at increased risk for developing complications and had a higher NOM failure rate, even though NOM is being utilized increasingly more for high-grade lesions. Similarly, the study by Peitzman et al [12] showed that the NOM failure rate was more in patients with AAST grade >3 which is comparable with our study.

Study by Roberto Cirocchi et al [6] highlighted that hemodynamic stability at time of admission (with Systolic BP>90 mmHg, PR,100bpm and AAST grade<4) was the main factor which leads to successful NOM. Non-operative management can be advantageous as it preserves splenic function and prevents laparotomy-associated complications and also avoids complications from Overwhelming Post-Splenectomy Infection (OPSI). Patients are now receiving more preventative treatment and are less likely to have OPSI. Our patients were vaccinated against *Pneumococcus*, *Meningococcus* and *Haemophilus.*

CONCLUSION

Spleen is the most common intra-abdominal organ to be injured in blunt abdominal trauma and previously it was thought that splenectomy is the only mode of treatment. The questions on complications of splenectomy and Overwhelming Post-Splenectomy Infection (OPSI) made a way to the NOM of splenic trauma in hemodynamically stable patients. Currently most cases are treated nonoperatively. The advantages include, reduction of costs, of non-therapeutic laparotomy rates, of intra-abdominal complications, of blood component transfusions, of morbidity and mortality. It also avoids exposure to post-splenectomy infection by encapsulated organisms.

In our study conservative management was successful in 81.25% of patients and it was associated with decreased blood transfusion requirement, lesser duration of stay in the hospital and was associated with minimal complications. Patients with AAST grade IV splenic injury, massive hemoperitoneum, high ISS, Hb <8 gm% and increased transfusion requirements were associated with a higher risk of failing conservative management. Initial pulse rate, sex, age and Mode of injury did not appear to influence the outcome of the study.

So, we can conclude that, conservative management of blunt splenic injury is safe and effective as long as patients are selected based on strict inclusion/exclusion criteria.

AAST grade IV splenic injury or higher, massive hemoperitoneum, ISS > 25, Hb value <8 gm%, requirement of 4 or more units of blood and new-onset hemodynamic instability were independent predictors of failure of conservative management.

Statements and Declarations

Ethics Approval and Consent to Participate: Ethical committee clearance has been obtained and certificate attached.

Conflict of Interest: The authors declare no competing interests**.**

Author Contribution:

The study conception and design, acquisition of data, analysis and interpretation of data and drafting of manuscript were done by Dr. Nithin M K. The study was overseen and critical revision was done by Dr. Siddhartha Sankar Bhattacharjee to make final corrections.

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