

ARE PREDICTIVE FACTORS FOR SUCCESSFUL NON-OPERATIVE MANAGEMENT OF SPLENIC TRAUMA IN ADULTS STILL UNPREDICTABLE?Naveed Nabi*¹, Ajaz Ahmad Malik², Munir Ahmad Wani³, Irshad Ahmad⁴, Beigh Firdous⁵, Mir Showkat⁶¹Senior Resident, Department of General Surgery, Sheri Kashmir Institute of Medical Sciences Medical College Srinagar.²Professor, Department of General and Minimal Invasive Surgery SKIMS Srinagar.³Additional Professor, Department of General and Minimal Invasive Surgery SKIMS Srinagar.⁴Senior Resident, Department of General Surgery, Sheri Kashmir Institute of Medical Sciences Medical College Srinagar.⁵Dr. Firdous Ahmad Beigh, Department of General Surgery SKIMS, Srinagar.⁶Dr. Showkat Ahmad Mir, Department of General Surgery SKIMS, Srinagar.***Corresponding Author: Dr. Naveed Nabi**

Senior Resident, Department of General Surgery SKIMS Medical College, Srinagar.

Article Received on 06/02/2020

Article Revised on 27/02/2020

Article Accepted on 17/03/2020

ABSTRACT

Background: Recognition of spleen as a vital organ of reticulo-endothelial system with some important immunological functions has changed the management strategy of blunt splenic trauma from splenectomy to non-operative techniques with greater emphasis on splenic preservation. After considerable success in pediatric population non-operative management of splenic trauma is frequently employed in adults as well, with commendable success rates. However, keeping in view the increased mortality and morbidity associated with failure of non-operative strategy, there is a need to identify positive predictors of successful non-operative management of splenic trauma in adults which are still a matter of debate. **Objectives:** The principal objective of our study was to study the predictive factors for successful non-operative management of splenic trauma in adults. **Materials and Methods:** It was an observational prospective and retrospective study conducted in Sheri-Kashmir Institute of Medical Sciences Srinagar India. All patients who met our inclusion criteria were monitored in HDUs (High Dependency Units) and all clinical and laboratory parameters were recorded on predesigned proforma. Collected data was finally analysed using SPSS v 20.0. **Results:** Among 44 patients included in our study, more than two-third (34;77.3%) were <40 years of age. Males were affected more commonly (84.1%) than females (15.9%). Most common mode of trauma was Road traffic accidents (52.3%) followed by fall from height (43.2%). In our study, 90.9% patients were successfully managed conservatively and only 9.1% underwent splenectomy. On CT scan grading, majority of patients (59%) had Grade III injuries. Conservatively managed patients had stable hemodynamic parameters on admission (mean PR of 88.7 bpm and mean Blood pressure of 112/71 mm of Hg). Initial mean Hemoglobin concentration and Hematocrit levels were 10.43g/dl (10.43+2.45) and 31.55% (31.55+7.39) respectively, in the conservative group, and the mean number of blood transfusions required in this group was <1 (0.78+1.09) in comparison to >2 transfusions required in splenectomy group. Number of days of hospital stay was 6.30(6.30+1.91) in conservatively managed patients as opposed to 8 days (8.00+2.70) in splenectomised patients. **Conclusion:** Splenic Injuries are mostly seen in the age group of <40 years (77.3%) which represents the young and economically productive group. Parameters depicting stable hemodynamics are strong positive predictive factors for successful NOM. Better oxygenation at the cellular level (like Hemoglobin, pH and lactate levels) also help in predicting a successful outcome of conservative management.

KEYWORDS: Splenic trauma, Non-operative Management, Blunt Abdominal Injuries.**INTRODUCTION**

The great ancient Roman physician Galen described the spleen as “Plenum mysterii organum” or “the organ full of mystery” as he struggled to elucidate its function. The mystery continued for over a millennium, as no one challenged his theory that the spleen functioned to

remove the evil humor “black bile” produced by the liver. As understanding of physiology and anatomy improved, we learnt that the spleen stored and removed aging red cells and platelets and produced opsonins and properdin. Trauma is the fourth common cause of death in the overall population and the first one in individuals

below the age of 40 years in western countries.^[1,2] Abdominal trauma can be classified as blunt or penetrating, according to the agent and its mechanism of action.^[1-3] The Spleen is the most frequently injured organ in abdominal blunt trauma, mainly because of its highly vascularised parenchyma and its anatomical location.

Splenectomy was the only treatment proposed for splenic trauma until 1960s. The first change in attitude towards operative management occurred with the article by King and Schumacher 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 of 52 pediatric patients with splenic trauma.^[5] However, in the adult trauma population, the development of NOM was a slow evolutionary process and it is one that continues to advance. Today, 95% of splenic injuries in the pediatric population are successfully managed non-operatively. In the adult population, the numbers are substantially lower, with 60-70% of all splenic injuries managed non-operatively, with a failure rate of about 10%.^[6] Majority of failures occurring in first 24 hours.

Cirocchi *et al.*^[7] conducted a study reporting 85.7% of blunt splenic injuries managed conservatively with no failure rates among the conservative group. This demonstrates the importance of an accurate assessment of patients on arrival and of using strict inclusion criteria for NOM. In 2005, a study by Pietzman.^[8] demonstrated that 30-40% of NOM failures were due to inappropriate selection of patients, particularly with regards to hemodynamic instability and initial misdiagnosis. There is a need to standardize the inclusion criteria and hence decrease the morbidity and mortality associated with failures of NOM which has been reported to increase from 4%, for patients whose spleens were successfully managed non-operatively, to 16.5%, for those who failed non-operative management.^[6] The main objective of our study was to identify the predictors of successful NOM of Splenic trauma and hence help the standardisation effort.

MATERIALS AND METHODS

This was an observational, prospective (May 2016-April 2018) and retrospective (2012-April 2016) study conducted in patients admitted with Blunt Abdominal Trauma resulting in splenic injury in our centre.

Patients above 15 years of age admitted with blunt splenic trauma with or without associated intra-abdominal or extra-abdominal injuries were included in the study. Patients with concomitant severe head trauma or with medical comorbidities and those having haematological disorders affecting coagulation were excluded.

Procedure

Patients who met the inclusion criteria were studied after taking a proper history about mode and mechanism of trauma. In each patient, a thorough physical examination was done with particular attention to hemodynamic status and physical findings on per-abdominal examination like tenderness, guarding and rebound tenderness. Then a full Baseline work up was done which included complete blood count, liver and renal function tests, serum electrolytes along with lactate and hematocrit. Serum amylase and coagulation profile was also done. Hemodynamically stable patients with FAST positive were subjected to CECT Abdomen and pelvis to access the source and grade of injury. All patients with Grade I/II/III splenic injuries and selective Grade IV Splenic injuries were kept in HDUs (High Dependency Unit) and were managed conservatively. Strict bed rest was advised and strict monitoring of vitals along with serial measurement of hematocrit was done. Repeat FAST scans were also done to monitor the amount of hemoperitoneum. Some patients were given blood transfusions also depending on haemoglobin concentration and hematocrit. Patients who were successfully managed conservatively were discharged with proper advice about bed rest, level of activity allowed, possible complications which may arise and need of follow up. On follow up, patients were examined thoroughly and investigated accordingly for any development of complications. None of the patients in our study underwent a follow up CT scan. Some patients developed minor complications which were managed conservatively.

Retrospective data pertaining to splenic trauma patients was collected from Medical Records Department of Sheri Kashmir institute of Medical Sciences from year 2012 up to April 2016.

The data was stored in a secured drive protected by a password to maintain the privacy of patient credentials.

Statistical Analysis

Data was entered in M.S Excel and analyzed using software SPSS v 20.0. Results were represented in the form of tables and graphs. Data is presented as percentages for categorical data, and means \pm SD for ordinal and continuous data. Statistical analyses were performed using the chi-square test or Fisher's exact test for discrete variables and student t-test or Mann Whitney U test for continuous variables. All differences with a p value < 0.05 were considered statistically significant.

OBSERVATIONS AND RESULTS

A total of 44 patients were included in the study. 40 patients (90.9%) were successfully managed conservatively and 4 patients (9.1%) underwent splenectomy. More than two-third of patients (34; 77.3%) were less than 40 years of age and more than half of these (20; 58.82%) were aged less than 30. Only 1 patient (2.9%) under the age of 40 underwent

splenectomy; whereas among the remaining 10 patients aged >40 years, 3 (30%) underwent splenectomy.

Males out-numbered the females (84.1% vs. 15.9%). Most common mode of trauma was Road Traffic Accident (23; 52.3%) followed by fall from height (19; 43.2%). Sports related injuries were present in two patients (4.5%). Guarding was present in 13 patients (29.5%) and rebound tenderness in 4 patients (9.1%). Among these 4 patients, 3(75%) belonged to splenectomy group and only 1(25%) belonged to conservative group.

Clinical, haematological and biochemical parameters like Pulse Rate, Blood Pressure, haemoglobin, hematocrit, Total leukocyte count (TLC), serum albumin levels were also compared between the two groups (Table 1). On admission mean Haemoglobin level in splenectomy group was 7.85 g/dl (7.8500±1.2819), and in conservative group it was 10.437 g/dl (10.437±2.4506). Initial mean Hematocrit in splenectomy group was 23.5% (23.5000± 4.7958), and in conservative group it was 31.55% (31.5525±7.3913).

Initial VBG (venous blood gas) parameters were also compared (Table 1). In splenectomy group mean pH was 7.24 (7.245±0.047) and in conservative group it was 7.32 (7.321±0.052). The difference was found to be statistically significant with a p-value of 0.008 (<0.05). A serum lactate level on admission was 4.075 (4.075±0.880) in splenectomy group and in conservative group it was 2.70 (2.70±0.989). The result was found to be statistically significant with a p-value of 0.011 (<0.05).

CT grading of splenic trauma showed 11 patients (25%) with Grade II injury, 26 patients (59%) with Grade III splenic trauma, 4 patients (9.1%) with Grade IV and 3 patients (6.8%) with grade V injury. About 54.5% patients included the study had additional injuries, besides splenic injury.

Mean No. of blood transfusions given to patients who underwent splenectomy was 2.25 (2.25±1.500), where as in conservative group it was 0.78 (0.78±1.097). No. of days of Hospital stay was 8 (8.00±2.708) in splenectomy group, where as in patients who underwent successful NOM were hospitalised for 6.30 (6.30±1.911) days. However, the difference was statistically not significant.

	Clinical Management		Total	OR (95% CI)	P-value
	Splenectomy	Conservative			
Age					
< 40 Years	1	33	34	0.071 (0.006-0.784)	0.032
	2.9%	97.1%	100.0%		
>= 40 years	3	7	10		
	30.0%	70.0%	100.0%		
Rebound Tenderness					
Present	3	1	4	117.000 (5.765-2374.33)	0.001
	75.0%	25.0%	100.0%		
Absent	1	39	40		
	2.5%	97.5%	100.0%		
Guarding					
Present	3	10	13	9.000 (0.838-96.627)	0.071
	23.1%	76.9%	100.0%		
Absent	1	30	31		
	3.2%	96.8%	100.0%		
Splenic injury					
Grade II	0	11	11	Constant 0.434 (0.008-23.239) 9.857 (0.323-300.425) 161.000 (2.672-9700.63)	0.000
	0.0%	100.0%	100.0%		
Grade III	0	26	26		
	0.0%	100.0%	100.0%		
Grade IV	1	3	4		
	25.0%	75.0%	100.0%		
Grade V	3	0	3		
	100.0%	0.0%	100.0%		

Cross Tabulation

Table 1: Comparison of means of different parameters.

	Splenectomy Mean±SD	Conservative Mean±SD	p-value
Age (years)	41.75±6.238	30.53±10.544	0.044
Hospital Stay (Days)	8.00±2.708	6.30±1.911	0.109 0.100*
Pulse Rate	118.50±9.292	88.78±8.957	0.000
SBP	83.50±12.477	112.70±10.790	0.000
DBP	52.0000±9.09212	71.0500±10.69855	0.001
Hb (g/dl)	7.8500±1.28193	10.4375±2.45061	0.045
HCT (%)	23.5000±4.79583	31.5525±7.39130	0.040
pH	7.2450±0.04726	7.3210±0.05242	0.008
pCO2	45.75±4.349	38.25±5.619	0.013
HCO3-	16.8500±2.49332	20.7175±3.22879	0.025
Lactate	4.0750±0.88081	2.7000±0.98995	0.011
No. of Blood Transfusions	2.25±1.500	0.78±1.097	0.017 0.036*

*P-value using Mann-Whitney U test



Image 1: CECT of one of our study patient with Grade III Splenic Injury.



Image 2: CT scan of another patient with Grade III splenic Injury.

DISCUSSION AND CONCLUSION

Trauma continues to be the leading cause of death among the people aged less than 40 years, with around 10% of mortalities attributable to abdominal injuries. The mortality rates in India for trauma are 20 times higher than that for developed countries, primarily owing to lack of pre-hospital care at the site of trauma and while transportation to the medical facility. Non-operative management of splenic trauma has now become the standard of care even in adults but is subservient to the facilities of imaging and serial clinical and biochemical monitoring. In our study, 90.9% patients with blunt splenic trauma were successfully managed conservatively and 4 patients (9.1%) underwent splenectomy. Among them, 3 patients had Grade V splenic injury, which underwent immediate splenectomy and 1 patient had grade IV splenic injury that failed conservative trial and underwent splenectomy.

Gender is not considered as an important factor for NOM failure in the literature. However, one study determined a higher NOM failure in men.^[9] Gender was not found to be a predictive factor in our study. Road Traffic Accidents were the commonest mode of trauma (52.3%) followed by fall from height (43.2%). The results are consistent with the previous studies by Ting-Min Hsieh *et al.*,^[10] John L. Kendall *et al.*^[11]

In our study, 84% of males in the age group of 20-39 were found to be affected with splenic injury. This age group represents the economically productive age and portrays an economic loss to the family and the nation and the reason for their high incidence of splenic injuries reflects their high activity levels and participation in high risk activities. High incidence of road traffic accidents in our study may be attributed to recklessness and negligent driving, poor maintenance of vehicles, driving under the influence of alcohol or drugs and complete disregard of traffic rules.

Stable hemodynamic parameters continue to be the strongest predictive factors for considering a patient for conservative management. Our study also reinforced the previous results of the study carried by M. Bala *et al.*^[12] Similarly Olthof's Delphi study showed a consensus on the need for hemodynamic stability as a core factor for successful non operative management.^[13] Initial Hemoglobin concentration/ Hematocrit and the need for transfusion of blood products within first 24 hours are also valuable predictive factors for crucial decision making about conservative management. Mean number of blood transfusions received by patients in conservative group was <1, as against >2 transfusions received by the patients who underwent splenectomy. The results are in agreement with the previous studies carried out by Velmahos *et al.*,^[14] Boyuk *et al.*^[15]

Malhotra and colleagues observed in their study that patients with higher ISS (Injury Severity Score), high admission lactate levels and lower systolic blood

pressures are likely to fail the conservative trial of management.^[16] Somewhat similar results were derived from our study also. Patients with more acidic pH (<7.24) on admission and higher lactate levels (>4.075) underwent splenectomy and were not feasible for safe non-operative trial. In univariate analysis initial admission pH nearing normal range and lower lactate levels may be considered as positive predictive factors for successful non-operative management.

CT grading according to revised AAST guidelines also help in decision making about NOM. In general, the lower the injury grade the more likely the patient can be managed non-operatively. However, CT scan is notorious in underestimating the injury grade,^[17] so injury grade alone should not guide the surgeon for management. With the facility of angioembolization which is presently lacking at our centre, more and more high grade splenic injuries can be managed non-operatively. Some studies have observed that failure rates of non operative management were higher in patients with concomitant other solid organ injuries. In our study, additional solid organ injury did not adversely jeopardize the outcome of conservative trial of management, probably because the additional solid organ injuries in our study were low grade injuries. Associated orthopedic, spine and thoracic injuries significantly increased the length of hospital stay. In our study average length of hospital stay in conservative group was 6.3±1.91 days. To understand the risk of outpatient rupture of spleen and to reduce its risk, it is important to understand the time course to splenectomy for those patients initially managed non-operatively. Smith and colleagues^[18] concluded that a 3-5 day period of observation after injury may be adequate to ensure splenic salvage.

Taking into consideration the way solid organ injuries of abdomen present to us, in particular the splenic trauma, our study shows that most common mode of blunt splenic trauma in adults is RTA with maximum patients being in their third and fourth decade of life. Majority of splenic trauma patients can be managed non-operatively but the decision making should take into consideration the various clinical, bio-chemical and radiological factors which predict successful non-operative management, because the morbidity and risk of mortality after failure of NOM cannot be ignored. NOM is not a prudent in elderly patients owing to their limited physiological reserves. Parameters depicting stable hemodynamics (like Pulse Rate, Blood Pressure, Pulse Pressure) and better oxygenation at the cellular level (like Hemoglobin, pH, and lactate levels) are positive predictors for successful NOM. In the absence of facility of angioembolization, presence of contrast extravasation and/or Grade V injury on initial CT scan should be regarded as an indication for surgery. NOM is now considered to be a choice not only to avoid unnecessary surgery associated complications but even avoiding a normal individual from lack of a spleen for future, of

which the need is still unknown as the organ spleen still is considered to be an important part of reticuloendothelial system of the body with varied mysterious, still unknown functions, thereby protecting it may be advantageous to the life of a trauma patient.

Conflict of Interest

The Authors declare no conflict of interest.

Funding:

None.

REFERENCES

- Costa G, Tiemo SM, Tomassini F, Venturini L, Frezza B, Cancrini G et al. The epidemiology and clinical evaluation of abdominal trauma. An analysis of multidisciplinary trauma registry. *Ann Ital chir*, 2010; 81: 95-102.
- Buccoliero F, Ruscelli P: Trauma splenico. In *La gestione del trauma. Dal territorio al Trauma Center. Italiana di chirurgia*, 2010; 138-150.
- Sanders MN, Civil I. Adult splenic injuries: treatment patterns and predictive indicators. *Aust NZ J Surg*, 1999; 69: 430-432.
- Surgeons. A Co. Manual ATLS (Advanced Trauma Life Support) by American College of Surgeons. 6th ed.
- Upadhyaya P: Conservative management of Splenic trauma: history and current trends. *Pediatr Surg Int*, 2003; 19: 617-627.
- Peitzman AB, Heil B, Rivera L, et al. Blunt splenic injury in adults: Multi-institutional Study of the Eastern Association for the Surgery of Trauma. *J Trauma*, 2000; 49: 177-89.
- Cirocchi R, Corsi A, Castellani E, Barberini F, Renzi C, Cagini L et al. Case series of Non-Operative Management vs. Operative Management of Splenic injury after Blunt Trauma. *Ulus Travrna Acil Cerr Derg*, 2014; 20(2): 91-96.
- Pietzman AB, Harbrecht BG, Rivera L, Heil B; Eastern Association for the Surgery of Trauma multi-institutional trials work group. Failure of observation of Blunt splenic injury in Adults: variability in practice and adverse consequences. *J Am Coll Surg*, 2005; 201: 179-187.
- Gonzalez M, Bucher P, Ris F, Anderegg E, Morel P. Splenic trauma: predictive factors for failure of non-operative management [in French]. *J Chir (Paris)*, 2008; 145: 561-7.
- Hsieh TM, Tsai TS, Liang JL, Lin CC. Non-operative management attempted for selective high grade blunt hepato-splenic traumas a feasible strategy. *World Journal of Emergency Surgery*, 2014; 9(1): 51.
- Kendall JL, Kestler AM, Whitaker KT, Adkisson MM, Haukoos JS. Blunt abdominal trauma patients are at very low risk for intraabdominal injury after emergency department observation. *West J Emerg Med*, 2011; 12(4): 496-504.
- Bala M, Edden Y, Mintz Y, Kisselgoff D, Gercenstein I, Rivkind AI, Farugy M and Almogy G. Blunt Splenic Trauma: Predictors for Successful Non-Operative Management. *IMAJ*, 2007; 9: 857-861.
- Olthof DC, van der Vlies CH, van der Vlies CH, Joosse P, van Delden OM, Jurkovich GJ et al. PYTHIA Collaboration Group. Consensus strategies for the non operative management of patients with blunt splenic injury: a Delphi study. *J Trauma Acute Care Surg*, 2013; 74: 1567-74.
- Velmahos GC, Chan LS, Kamel E, et al. Non-operative management of splenic trauma: have we gone too far? *Arch Surg*, 2000; 135: 674-9.
- Boyuk A, Gumus M, Onder A, et al. Splenic injuries: factors affecting the outcome of non-operative management. *European Journal of Trauma and Emergency Surgery*, 2012; 38: 269-74.
- Malhotra AK, Carter RF, Lebman DA, Carter DS, Riaz OJ, Aboutanos MB et al. Preservation of splenic immunocompetence after splenic artery angioembolization for blunt splenic injury. *J Trauma*, 2010; 69: 1126-31.
- Ameh EA, Chirdan LB, Nmadu PT. Blunt abdominal trauma in children: epidemiology, management, and management problems in a developing country. *Pediatr Surg Intr*, 2000; 16(7): 505-509.
- Smith J, Armen S, Cook CH, Martin LC. Blunt splenic injuries: have we watched long enough? *J Trauma*, 2008; 64: 656-65.