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Original Research Paper

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HEMODYNAMIC STATUS- PREDICTOR OF OUTCOME IN NON OPERATIVE MANAGEMENT OF ISOLATED TRAUMATIC SPLENIC INJURY

Dr. Shiwani Thakur	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. Naseer Ahmad Awan	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. Shaukat Jeelani	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. UmerMushtaq	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. Ishfaq Gilkar	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. JavaidPeer	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr. Irshad Ahmad	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.
Dr.Yaser Hussain Wani*	Department of General Surgery, Government Medical College Srinagar, University of Kashmir, Jammu and Kashmir, India.*Corresponding Author

ABSTRACT

Background: Blunt abdominal trauma is the most common cause of splenic injury and spleen is the most common organ injured in trauma patients both in children and adults. Abdomino-pelvic ultrasound is very efficient radiological investigation in the diagnosis of splenic injuries; it can detect intraperitoneal hemorrhage, splenic capsular tears, and the vascularity of the spleen. Moreover, computed tomography (CT) scan is investigation of choice in hemodynamically stable.CT also guides the surgeon towards management of injuries, and maintaining the low threshold for surgical intervention in correlation with hemodynamic unstable patient with traumatic splenic injury.CT also guides the surgeon towards management of injuries, and maintaining the low threshold for surgical intervention in correlation with hemodynamic unstable patient with traumatic splenic injury. However, even patients with CT scan finding of "blush on CT", indicating higher grades of injury, if hemodynamically stable still can be managed successfully with NOM as per literature. **Methods:** This is a hospital based prospective observational study, done on 45 hemodynamically stable patients of splenic trauma, in Accident and Emergency Department of General Surgery, Government Medical College and hospital Srinagar, over a period of 24 months from September 2018 to September 2020. **Results:**Haemodynamics Status of patient: Our study showed that various parameters defining haemodynamic status of patient are predictors for outcome of study. Various parameters are-Pulse rate (P-value 0.001), Systolic blood pressure (P-value <0.001), Diastolic blood pressure (P-value 0.001), Haemoglobin (P-value <0.001), Haematocrit (P-value <0.001), and Blood transfusions (P-value <0.001). All parameters showed statistical significance with P-values <0.001. **Conclusion:** Success of NOM increases, if patient is hemodynamically stable which is predicted by various parameters like pulse rate, blood pressure, urine output, fall in hemoglobin and hematocrit, number of blood transfusions, saturation, temperature and others. NOM in splenic trauma should be management of choice in all hemodynamically stable patients, regardless of blood group and neurological status of patient on admission.Success of isolated splenic injury depends on multiple factors such as availability of ICUs, high dependency units for strict monitoring,blood banks and availability of multidisciplinary team efforts encompassing anesthetics, trauma surgeons, radiologists, for successful outcome. NOM of isolated splenic trauma, is associated with very low morbidity, no complications, and no mortality, when applied in hemodynamically stable patient. Every patient of splenic trauma who is considered for NOM, should be properly counselled about emergency signs and should be advised to report to emergency if any of emergency signs were present. This group of patients must be closely monitored for delayed bleeding in case of NOM of splenic trauma.

KEYWORDS : Non-operative Management, Splenic Trauma, Hemodynamic status

INTRODUCTION:

Blunt abdominal trauma is the most common cause of splenic injury and spleen is the most common organ injured in trauma patients both in children and adults.[1,2] The blunt splenic injuries (BSI) management in traumata patients has evolved and improved from surgical management to conservative Non-operative management(NOM).[3,4,5]Preserving spleen in patients with splenic trauma, has evolved after many studies & reports established for existence of syndrome of overwhelming post splenectomy infection (OPSI).[6,7] Patients, who underwent splenectomy, have more than 5% life time risk of OPSI, with a mortality between 50-80%.[8,9,10] Other complications of splenectomy, that accounts to very high morbidity & mortality, especially intra-abdominal hemorrhage, can be fatal, if not treated adequately, or identified late. Also, after knowing the importance of immunological functions of spleen, its becomes very important to preserve spleen whenever possible.[11]

Abdomino-pelvic ultrasound is very efficient radiological investigation in the diagnosis of splenic injuries; it can detect intraperitoneal hemorrhage, splenic capsular tears, and the vascularity of the spleen. Moreover, computed tomography (CT) scan is investigation of choice in hemodynamically stable.[12] CT also guidesthe surgeontowards management of injuries, and maintaining the low threshold for surgical intervention in correlation with hemodynamic unstable patient with traumatic splenic injury. However, evenpatients

with CT scan finding of "blush on CT", indicating higher grades of injury, still can be managed successfully with NOM as per literature.[13]

The clinical presentation of patients can vary in different age groups, as some present with pain in left upper quadrant and left shoulder tip or diffuse abdominal pain. Others may present with injury to left lower chest which has been shown to present in 43% of splenic injury patients.[14]With the advancement in radiological imaging such as ultrasonography & computed tomography ; and with introduction of new concepts of damage control studies, critical care & intervention radiology, there has been a drastic improvement in management of patients with trauma surgery.15 Focused Abdominal Sonography for Trauma (FAST) is a protocol algorithm in trauma patients, which is performed by treating doctors in emergency units after specific training. Operators are trained to look for free intra-abdominalfluid. As the resuscitation of trauma patients started in emergency units, simultaneously FAST scan can be performed. As FAST scan is veryaccessible, quick to perform, portable, and non-invasive, it is particularly useful in hemodynamically unstable patients.16 Computed tomography scanning has now become the gold standard forimaging in blunt abdominal trauma, and in the identification of splenicinjuries in accident and emergency departments.[17] NOM of splenic injury has now been accepted as standard treatment of choice for AAST splenic injury grade I, II and III, whereas its safety in higher grades of splenic trauma is still under debate in literature.18

AIMS & OBJECTIVES:

1. To study the clinical presentation of different grades intraumatic splenic injury.
2. To evaluate the outcomes of non-operative management in traumatic splenic injuries, in hemodynamically stable patients.

MATERIALS AND METHODS:

Study Place: Study was done in Accident and Emergency Department of General Surgery, Government Medical College and hospital Srinagar after taking clearance from ethical committee of institution. We included all patients with blunt abdominal trauma who arrived in emergency department of general surgery at GMC Srinagar under different surgical units.

Study Duration:24 months from September 2018 to September 2020

Study Design: This is a hospital based prospective observational study.

Study Population: This study conducted over a period of 24 months on total of 45 patients of splenic injury attending Accident and Emergency Department of General Surgery, Government Medical College and hospital Srinagar after taking clearance from ethical committee of institution. We included all patients with blunt abdominal trauma who arrived in emergency department of general surgery at GMC Srinagar under different surgical units.

Inclusion Criteria

Hemodynamically stable patients
Blood transfusions <4 units
Imaging documented splenic injury
Isolated splenic injury

Exclusion Criteria

Hemodynamically unstable patients.
Multisystemic trauma.
Lesion other than splenic lesion possibly requiring surgical intervention.
Patients with bleeding diathesis.
Patients on anticoagulant drugs.

Study Techniques

On reception at surgical casualty the patients were immediately shifted to emergency resuscitation unit and fluid resuscitation was started after obtaining blood samples for baseline investigations and blood grouping. Patients were resuscitated according to Advanced Trauma Life Support (ATLS) guidelines. Baseline characteristics of patients with trauma such as age, gender, heart rate, blood pressure, mode of injury, time since injury, any medical illness especially bleeding diathesis, anticoagulant therapy were recorded. The patients under resuscitation who did not responds to standard bolus fluid were shifted to emergency theater for more aggressive fluid resuscitation therapy.

Multidisciplinary approach in resuscitation and stabilization alongside the attempt to screen intra-abdominal solid visceral injury was adopted in collaboration with anesthetists and radiologist. Patients who became hemodynamically anesthetists and radiologist. Patients who became hemodynamically stable after initial fluid resuscitation or presented with normal hemodynamics were accompanied to radiology suit for FAST Scan. FAST Scan was followed by CECT abdomen for further characterization and grading of Splenic injury. Splenic Injury was categorized using the Organ Injury Scale of American Association for the Surgery of Trauma (AAST). Blood samples were drawn at admission such as Hemoglobin, Haematocrit, Platelet count, urea, creatinine, blood sugars, Na+/ K+, ABG, ALP, AST, ALT, PT/INR and Blood grouping. Hemodynamically stable patients after initial fluid resuscitation or patients with normal hemodynamics at presentation with isolated splenic injury began non-operative management.Hemodynamically unstable patients, non-responders & with concomitant visceral injuries were excluded from the study and were taken for operative management.Non-Operative management consisted of Admission of all grade I, II, III or higher splenic injuries to High Dependency Units. Consider ICU admission for grade IV or V splenic injuries. Monitoring hourly vital signs such as heart rate, blood pressure, temperature, respiratory rate, fluid balance with estimating input and output of fluids in the body, No. of packed red cell transfused; Strict bed rest; Nil by mouth and intravenous access; Serial haematocrit and hemoglobin 4 hourly for 24–48 h. If haematocrit is stable for 24–48 h and there have been no adverse haemodynamic events; Transfer the patient to regular ward; Advance diet; Daily haematocrit and hemoglobin; Bed rest for another 48–72 h and then ambulate in the hospital. If remains stable and tolerating diet, discharge day after ambulation begins (usually 5–7 days after admission). Patient isinstructed to return to Emergency Department, if developing worsening left upper quadrant pain, dizziness, syncope, fever or hypotension; Patient is allowed back to school; Avoid sport; Patient is allowed back to sports activity: 6 weeks after Grade I–II injury; 3 months after Grade III–IV injury with improvement on repeat CT.

Follow Up: Patients were followed weekly for 4 weeks, thereafter fortnightly for 3 months then monthly. On follow up general Physical examination, Hemoglobin, Haematocrit, Ultrasonography was done to note resolution of hematoma and hemoperitoneum. Patients were allowed to resume work according to grades of splenic Injury as follows:19,20

GRADE I-II - Light Activities- 2 weeks; Sports Activities- 6-8weeks
GRADE ≥III- Light Activities-4-8weeks; Sports Activities-10-12 weeks
GRADE IV, V- Light Activities10-12 weeks; Sports Activities-10-12weeks.

Statistical Analysis:

Statistical package for social science software [SPSS20.0] is used for statistical analysis. Categorical variables are expressed as percentages, whereas continuous variables are expressed as mean, standard deviation values. The difference between normally distributed numeric variables were evaluated by Student's t-test or one way analysis of variance. Fischer's exact is employed for comparison of categorical variables as the sample size is small. Statistical significance is assumed for P-value or Fisher's Exact value <0.05.

RESULTS:

[1] FALL IN HEMOGLOBIN

Fall in HB in 24hrs		Grade of Injury					Total
		Grade I	Grade II	Grade III	Grade IV	Grade V	
NO	Count	3	6	9	0	0	18
	%	6.7%	13.3%	20.0%	0.0%	0.0%	40.0%
YES	Count	0	2	18	5	2	27
	%	0.0%	4.4%	40.0%	11.1%	4.4%	60.0%
Total	Count	3	8	27	5	2	45
	%	6.7%	17.8%	60.0%	11.1%	4.4%	100.0

P - 0.004

Out of 45 patients of Splenic trauma in study, 27 patients had fall in hemoglobin, no patients had Grade I injury, 2 patients had Grade II injury, 18 patients had Grade III injury, 5 patients had Grade IV injury, and 2 Patients had Grade V Splenic injury.

Fall in HB in 24hrs *Conservative Management				
Fall in HB IN 24hrs		Conservative Management		Total
		Successful	Unsuccessful	
NO	Count	18	0	18
	% of Total	40.0%	0.0%	40.0%
YES	Count	20	7	27
	% of Total	44.4%	15.6%	60.0%
Total	Count	38	7	45
	% of Total	84.4%	15.6%	100.0%

P - 0.031

Out of 45 patients of splenic trauma in study, 27 patients had fall in hemoglobin, of which 20 patients had successful Non-operative management.

(II) FALL IN HEMATOCRIT

Fall in HCT in 24hrs		Grade of Injury					Total
		Grade I	Grade II	Grade III	Grade IV	Grade V	
NO	Count	3	6	9	0	0	18
	%	6.7%	13.3%	20.0%	0.0%	0.0%	40.0%
YES	Count	0	2	18	5	2	27
	%	0.0%	4.4%	40.0%	11.1%	4.4%	60.0%
Total	Count	3	8	27	5	2	45
	%	6.7%	17.8%	60.0%	11.1%	4.4%	100.0%

P - 0.004

Out of 45 patients of Splenic trauma in study, 27 patients had fall in hematocrit, no patients had Grade I injury, 2 patients had Grade II injury, 18 patients had Grade III injury, 5 patients had Grade IV injury, and 2 Patients had Grade V Splenic injury.

Fall in HCT in 24hrs		Conservative Management		Total
		Successful	Unsuccessful	
NO	Count	18	0	18
	%	40.0%	0.0%	40.0%
YES	Count	20	7	27
	%	44.4%	15.6%	60.0%
Total	Count	38	7	45
	%	84.4%	15.6%	100.0%

P - 0.031

Out of 45 patients of splenic injury, 27 patients had fall in hematocrit, of which 20 patients had successful Non-operative management.

(III) GCS

GCS		Grade of Injury					Total
		Grade I	Grade II	Grade III	Grade IV	Grade V	
13/15	Count	0	0	2	1	0	3
	%	0.0%	0.0%	4.4%	2.2%	0.0%	6.7%
15/15	Count	3	8	25	4	2	42
	%	6.7%	17.8%	55.6%	8.9%	4.4%	93.3%
Total	Count	3	8	27	5	2	45
	%	6.7%	17.8%	60.0%	11.1%	4.4%	100.0%

P - 0.596

Out of 45 patients of Splenic trauma in study, only 3 patients had fall in GCS, out of them, none of patient had Grade I injury, none of patient had Grade II injury, 2 patients had Grade III injury, 1 patient had Grade IV injury, and none of the patient had Grade V Splenic injury.

GCS		Conservative Management		Total
		Successful	Unsuccessful	
13/15	Count	2	1	3
	%	4.4%	2.2%	6.7%
15/15	Count	36	6	42
	%	80.0%	13.3%	93.3%
Total	Count	38	7	45
	%	84.4%	15.6%	100.0%

P -0.405

Out of 45 patients of trauma in study, only 3 patient presents with GCS of 13/15, rest all patients had GCS of 15/15.

(IV) BLOOD GROUP

Blood Group		Conservative Management		Total
		Successful	Unsuccessful	
0-	Count	0	1	1
	%	0.0%	2.2%	2.2%
0+	Count	1	2	3
	%	2.2%	4.4%	6.7%
A+	Count	5	1	6
	%	11.1%	2.2%	13.3%
AB+	Count	3	1	4
	%	6.7%	2.2%	8.9%
B-	Count	2	0	2
	%	4.4%	0.0%	4.4%
B+	Count	7	0	7
	%	15.6%	0.0%	15.6%
O-	Count	2	1	3
	%	4.4%	2.2%	6.7%
O+	Count	18	1	19
	%	40.0%	2.2%	42.2%
Total	Count	38	7	45
	%	84.4%	15.6%	100.0%

P-0.027

(V) COMPLICATION

Complication		Grade Of Injury					Total
		Grade I	Grade II	Grade III	Grade IV	Grade V	
NO	Count	3	8	27	5	1	44
	%	6.7%	17.8%	60.0%	11.1%	2.2%	97.8%
YES	Count	0	0	0	0	1	1
	%	0.0%	0.0%	0.0%	0.0%	2.2%	2.2%
Total	Count	3	8	27	5	2	45
	%	6.7%	17.8%	60.0%	11.1%	4.4%	100.0%

P - 0.044

Out of 45 patients in study, only 1 patient develop complication (Left lower lobar Pneumonia) who had grade V splenic trauma and undergo splenectomy.

Complication		Conservative Management		Total
		Successful	Unsuccessful	
NO	Count	38	6	44
	%	84.4%	13.3%	97.8%
YES	Count	0	1	1
	%	0.0%	2.2%	2.2%
Total	Count	38	7	45
	%	84.4%	15.6%	100.0%

P - 0.156

Out of 45 patients in study, only 1 patient develops complication (Left lower lobar Pneumonia).

(VI) SIGNIFICANT VARIABLES

Group Statistics					
	Conservative Management	N	Mean	Std. Deviation	P – Value
PULSE	Successful	38	95.21	12.673	0.001
	Unsuccessful	7	112.86	5.699	
SBP	Successful	38	111.97	8.970	<0.001
	Unsuccessful	7	82.86	4.880	
DBP	Successful	38	70.00	6.975	0.001
	Unsuccessful	7	60.00	.000	
HB	Successful	38	10.952632	2.0621082	<0.001
	Unsuccessful	7	6.842857	.6827814	
HCT(%)	Successful	38	31.757895	4.1635894	<0.001
	Unsuccessful	7	22.228571	1.4020393	
PLT	Successful	38	165.55	109.093	0.042
	Unsuccessful	7	78.43	9.163	
WBC	Successful	38	10.347368	5.1171538	0.812
	Unsuccessful	7	10.828571	3.0576212	
AST	Successful	38	42.79	13.812	0.641
	Unsuccessful	7	45.29	4.680	
ALP	Successful	38	61.95	24.446	0.443
	Unsuccessful	7	69.43	16.400	
ALT	Successful	38	46.29	30.886	0.802
	Unsuccessful	7	43.29	10.062	
Transfusions	Successful	38	.71	.802	<0.001
	Unsuccessful	7	3.14	1.773	
Hospital Stay (days)	Successful	38	8.03	1.515	0.009
	Unsuccessful	7	10.00	2.769	

DISCUSSION

We enrolled a total of 45 patients in our study and studied different parameters. Out of all studied parameters, Hemodynamic status of patient as predicted from Pulse rate, Systolic and Diastolic Blood pressure, Hemoglobin, Hematocrit, and Number of blood transfusions showed statistical significance with P-value <0.001, however GCS, Blood groups of patients showed no statistical significance.

Haemodynamics Status of patient: Our study showed that various parameters defining haemodynamic status of patient are predictors for outcome of study. Various parameters are- **Pulse rate** (P-value 0.001), **Systolic blood pressure** (P-value <0.001), **Diastolic blood pressure** (P-value 0.001), **Haemoglobin** (P-value <0.001), **Haematocrit** (P-value <0.001), and **Blood transfusions** (P-value <0.001). All parameters showed statistical significance with P-values <0.001. The results of the study are comparable to study conducted by **Velmahos GC et al. in 2000**[21], who studied some of above parameters and concluded that higher grades of splenic injury require transfusion with more units of bloodwhile being managed non operatively. Splenic injury grade III or higher are haemodynamically unstable indicated as low haemoglobin level (<9gm/dl) associated with tachycardia (>100/min) is an indication for blood transfusion more than 1U of blood were identified as independent risk factors for failure of NOMSI. Our study also showed comparable results that haemodynamically unstable patients with low Haemoglobin, low haematocrit, low blood pressure (SBP and DBP), higher grade ofinjury, and more number of blood transfusions are risk factors for unsuccessful non-operative management of splenic trauma.**T. Michel,S. Roy,T. Henrik et al. in 2020**[22]conducted a study and concluded that,even though splenic injury severity does not dictate therapy decision making, the current study reveals that higher splenic injury grades do predict persistent hemodynamic instability and thereby the need for early surgical intervention. Our study shows comparable results in view that, patients with higher grades of splenic trauma, presents with early or late hemodynamic instability and hence more chances of splenectomy, on the other hand patients with lower grades of splenic injury, who remain hemodynamically stable has successful outcome of NOM splenic injury.

GCS: In our study, out of 45 patients, only 2 patients had GCS-13/15, rest all patients had GCS-15/15. Our study showed that GCS had no statistical significance with P-value 0.405.**T.Michel, S. Roy et al in 2019**[23]studied NOM in splenic trauma patients with low GCS and concluded that, the presence of neurologicimpairment is associated with prolonged ICU-stay and hospitalization, likely due to the management of the neural injury and related prolonged hemodynamic monitoring itself. We therefore recommend institutions with adequate monitoring facilities, to attempt non-operative management for splenic injury in all hemodynamicallystable patients without hollow organ injuries, regardlessof neurological status. Our study also concluded similar results that, NOM in splenic trauma patients should be treatment of choice regardless of neurological status of patient.

Blood group: In our study, blood groups showed no statistical significance with P-value 0.027.

Complications: Only 1 patient with grade V splenic injury, who had splenectomy develops (Left lower zone pneumonic consolidation), which showed no statistical significance with P-value 0.156.

In our study, none of the patients of splenic trauma had **Peritonitis**, and none of them had **Mortality**. Statistical significance of these parameters - Peritonitis, Mortality can't be computed as they are all constant.

CONCLUSION:

Success of NOM increases, if patient is hemodynamically stable which is predicted by various parameters like pulse rate, blood pressure, urine output, fall in hemoglobin and hematocrit, number of blood transfusions, saturation, temperature and others. NOM in splenic trauma should be management of choice in all hemodynamically stable patients, regardless of blood group and neurological status of patient on admission.Success of isolated splenic injury depends on multiple factors such as availability of ICUs, high dependency units for strict monitoring, blood banks and availability of multidisciplinary team efforts encompassing anesthetics, trauma surgeons, radiologists, for successful outcome.NOM of isolated splenic trauma, is associated with very low morbidity, no complications, and no mortality, when applied in hemodynamically stable patient.Every patient of splenic trauma who is considered for NOM, should be properly counselled about emergency signs and should be advised to report to emergency if any of emergency signs were present.This group of patients must be closely monitored for delayed bleeding in case of NOM of splenic trauma.

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