

## Original Research Article

# Study of outcomes in patients with conserved blunt liver and splenic injuries

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### ABSTRACT

**Background:** Blunt abdominal injuries in the modern day are common due to vehicular accidents. Young males are more commonly involved and liver and spleen are the commonest organs injured. During the last century, the management of blunt force trauma has changed from observation and expectant management in the early part of the 1900s to operative intervention for all injuries, to the current practice of selective operative and nonoperative management.

**Methods:** We studied outcomes of conservatively managed liver and splenic injuries in 51 patients who presented to a tertiary referral center over a period of 1 year. Patient demographics and outcomes were studied.

**Results:** Males in the age group of 16-30 years were commonly involved. Liver was the commonest organ injured. Both liver and spleen were injured together only in 3 patients. One patient of liver injury was subjected to delayed surgery and 2 patients of splenic injury failed conservative management. Thus, the success rate of conservative management of blunt liver injuries was 96.87% and in splenic injuries was 90.91%.

**Conclusions:** Outcome of conservative management of blunt liver and splenic injuries is extremely good, especially in patients who maintained hemodynamic stability. Nonoperative management of blunt liver splenic injuries should be the treatment modality of choice in hemodynamically stable patients with any grades of injuries.

**Keywords:** Blunt abdominal trauma, Conservative management, Hemodynamic stability, Liver injuries, Splenic injuries

### INTRODUCTION

Blunt abdominal injuries are predominantly due to vehicular accidents and to a lesser extent due to direct blows to the abdomen. Among the intra-abdominal viscera, the liver and spleen are the commonly injured organs. The management of traumatic liver injuries has changed during recent years, and the patient outcomes have markedly improved. Surgical treatment was the standard procedure for all kinds of trauma-related liver injuries. An improved understanding of the natural course of liver injuries and the development of new interventional radiological techniques have changed the

paradigm toward a more non-surgical patient management.<sup>1</sup> Also, the management of blunt force trauma to the spleen has changed from observation and expectant management in the early part of the 1900s to operative intervention for all injuries, to the current practice of selective operative and nonoperative management.<sup>2</sup> Pachter et al, in 1998 showed that 65% of all blunt splenic injuries and could be managed nonoperatively with minimal transfusions, morbidity, or mortality, with a success rate of 98%. It is thus fair to say that good judgement can save more lives than heroic surgeries.<sup>3</sup>

This study aimed to find out the outcomes of conserved blunt liver and splenic injuries presenting to us over a period of 1 year.

## METHODS

This was a prospective observational study conducted at a tertiary Trauma care center in Mumbai. Analysis of 51 patients of conserved blunt liver and/or splenic injuries admitted in the trauma ICU of Tertiary care hospital was done over a period of one year between February 2003 to January 2004.

Maintenance of hemodynamic stability was one of the most important parameters for patients included in the study.

Patients with Glasgow coma score (GCS) <9, severe fracture pelvis, Retroperitoneal hematoma (diagnosed radiologically and/or clinically) and patients with bilateral amputations and fracture spine were excluded from the study.

Patients were strictly monitored for hemodynamic stability and abdominal girth in the ICU.

Conservative or Non operative management (NOM) failed when hemodynamic stability was not maintained. Concomitantly, if there was an increase in abdominal girth, peritoneal signs wherein hollow viscus injury could not be ruled out and a falling hematocrit values were considered in the NOM failure group. At least any one of the above criteria with an ICU stay of 24 hours was considered to be failure of NOM.

General assessment of the patient was done in order to evaluate other conditions such as head injuries, chest injuries, long bone injuries etc.

The patients were subjected to biochemical and radiological investigations like X-ray chest, X-ray abdomen, Ultrasound (USG) abdomen and CT scan of abdomen, Injuries were graded as per USG and CT abdomen findings.

### Severity indices

Both physiologic and anatomic indices are required to effectively characterize injury severity.

#### Revised trauma score (RTS)

A physiologic evaluation of the patient done on admission involved the following 3 parameters.<sup>4</sup>

- Estimation of the respiratory rate.
- Estimation of systolic blood pressure
- Estimation of the degree of impaired consciousness was done using Glasgow Coma Scale (GCS)

Revised trauma score was then calculated as follows :

**Table 1: Revised trauma score variables.**

Glasgow coma scale	Systolic BP (mm hg)	Respiratory rate	Coded value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

$$RTS=0.9368 (GSCc)+0.7326 (SBPc)+0.2908 (RRc).$$

The weights used are determined by logistic regression of a baseline data set (MTOS). RTS takes values below 0 and values more than 7.8408 are associated with improved prognosis.

#### Injury severity score<sup>5</sup>

The Index of anatomic injury severity (AIS) is a list of several hundred injuries each with an assigned severity score that can range from 1 (minor injuries) to 6 (severe injuries that are nearly always fatal).

The patient's injuries were sorted into 6 body parts viz: head and neck, face, chest, abdomen and pelvic contents, extremities and pelvic girdle and external

Injury severity score=

$$[(\text{Highest region score})^2] + [(\text{second highest region score})^2]+[(\text{third highest region score})^2]$$

#### Outcome norms

Survival probability norms are defined using the trauma and injury severity scale (TRISS) index.<sup>6</sup>

The TRISS index is used to calculate the probability of survival based on the patient's characteristics using the following components.

#### Components

- Revised Trauma Score (RTS) on admission.
- Injury Severity Score (ISS) based on final diagnosis.
- Score for patients age (0 if age greater than or equal to 54. 1 If age less than or equal to 55 years. Hence, age score is 0 for all patients in this study group.
- Coefficient based on regression analysis of MTOS study results.

For any type of blunt injury, the coefficients are  $b_0 = -1.2470$ ;  $b_1 = 0.9544$ ;  $b_2 = -0.0768$ ;  $b_3 = -1.9053$ . Using the above 4 components, the probability of survival (Ps) is calculated by logistic function:

$$Ps = 1/(1 + e^{-b})$$

Where "e" is the base of the natural logarithm system, and where,  $b = b_0 + b_1(RTS) + b_2(ISS) + \dots$

To maximize the consistency of data and to avoid incongruous or missing data or inappropriate coding the various trauma surgeons on duty were asked to give a detailed description of the various injuries and operative findings as well as a uniform method of evaluation of physiologic status was adapted. Scoring of the various injuries was done.

## RESULTS

51 cases of conserved blunt abdominal trauma were studied over a period of 1 year. Majority of the patients were in the age group of 16-30 years (45.1%). This was followed by patients in age group of 31-55 years (33%). 8 patients were less than 15 years and 3 patients were more than 55 years. The study had patients predominantly in the reproductive age group.

42 patients (82.4%) of patients in the study group were males and only 9 (17.6%) were females. Modes of injury of the patients in the study group was also analyzed.

Distribution of the sustained visceral injuries was documented. Liver was the commonest (32 i.e. 62.7%) followed by spleen (19 i.e. 37.3%). Both liver and spleen were involved in only 3 patients (5.8%). Liver and splenic injuries were graded by ultrasound and CT scan.

Of the 32 patients with liver injuries, 14 patients had grade 2 injuries, 9 patients had grade 3 and only 3 patients had grade 4 injuries on ultrasound. Fifteen patients (46.8%) had grade 2, 7 patients (21.9%) had grade 3 injuries. 4 patients each had grade 1 & grade 4 injuries of the liver on CT scan.

**Table 2: ISS in various grades of liver injury (as on CT scan).**

Grades of liver injury	Mean ISS	Number	Standard deviation
Grade 1	19.25	4	4.113
Grade 2	12.67	15	6.184
Grade 3	14.43	7	6.876
Grade 4	23	4	4.820
CT not done	4	2	0.000
<b>Total</b>	<b>13.38</b>	<b>32</b>	<b>7.115</b>

Of the 22 patients with Splenic injuries, 11 patients (50%) had grade 2 injuries, 8 patients (36.4%) had grade 3 injuries and 3 patients had grade 1 injury. 11 patients (50%) had grade 2 injuries, 9 patients (40.9%) had grade 3 and only 2 patients (9.1%) had grade 1 splenic injuries

on CT scan. ISS in various grades of liver injury as per CT Scan has been tabulated in Table 2.

ISS in various grades of splenic injury as per CT Scan has been tabulated in Table 3. The RTS for the patients studied has been tabulated in Table 4.

**Table 3: ISS in various grades of splenic injury (CT scan).**

Grades of splenic injury	Mean ISS	Number	Standard deviation
Grade 1	12.5	2	6.364
Grade 2	9.73	11	6.436
Grade 3	12.11	9	4.512
<b>Total</b>	<b>10.95</b>	<b>22</b>	<b>5.568</b>

**Table 4: Revised trauma score (RTS).**

RTS	Frequency	Percentage (%)
6.376	1	2.0
6.904	2	3.9
7.841	48	94.1
<b>Total mean 7.040</b>	<b>51</b>	<b>100</b>

**Table 5: Probability of survival (PS).**

PS (%) of patients	Frequency	Percentage (%)
94-95	2	3.9
95-96	3	5.9
96-97	0	0
97-98	4	7.8
98-99	8	15.7
99-100	34	66.7
<b>Total mean- 98.769</b>	<b>51</b>	<b>100</b>

**Table 6: Patients subjected to delayed surgery in liver injury.**

Grades on CT scan (liver injury)	Delayed surgery		Total
	Done	Not done	
Grade 1		4 (100%)	4 (100%)
Grade 2		15 (100%)	15 (100%)
Grade 3		7 (100%)	7 (100%)
Grade 4	1 (25%)	3 (75%)	4 (100%)
CT not done*		2 (100%)	2 (100%)
<b>Total</b>	<b>1</b>	<b>31</b>	<b>32</b>

\*Patients who showed grade 1 liver injury on USG and whose CT Scan was not done.

Probability of survival (PS) has been documented in Table 5.

Table 6 documents the patients subjected to delayed surgery and the grades of liver injury as per CT scan.

Table 7 documents the patients subjected to delayed surgery in splenic injury and the grades of splenic injury on CT scan.

**Table 7: Patients subjected to delayed surgery in splenic injury**

Grades on CT scan (splenic injury)	Delayed surgery		Total
	Done	Not done	
<b>Grade 1</b>	2 (100%)	2 (100%)	2 (100%)
<b>Grade 2</b>	11 (100%)	11 (100%)	11 (100%)
<b>Grade 3</b>	7 (100%)	7 (100%)	7 (100%)
<b>Total</b>	2 (22.2%)	7 (77.8%)	9 (100%)
<b>Total</b>	2 (9.1%)	20 (90.9%)	22 (100%)

## DISCUSSION

During the study period of one year, 51 cases of conserved blunt abdominal injuries were studied. As males constituted major part of the working population, they were more prone to injuries. Our study had a predominance of male patients as compared to female patients with a ratio of 42:9.

A study carried out by Slotta et al, showed a male: female ratio of 42:22.1. Similarly, a study carried out by Patel et al, showed a ratio of 39:3.7 Also, a study carried out by Mucha et al, showed a male: female ratio 163:74 i.e. 68% of patients were males.<sup>8</sup> Study carried out by Cox et al shows a male: female ratio of 2.7:1.<sup>9</sup>

The age distribution of the involved patients showed that the incidence of trauma in the age category of 16 - 30yrs was maximum (45.1%) followed by 33.3% in the age group of 31-55 years. Carmona et al, in a study at San Francisco general hospital have reported a male: female ratio of 3.5: 1 and an average of 29 years.<sup>10</sup>

Mucha et al, in their studies of 237 cases found 78% of splenic trauma in their second and third decade.<sup>8</sup> Trunkey et al, found liver trauma to be most common in 20-30 years of age group.<sup>11</sup> This is probably due to the fact that people in their second and third decade constitute a major part of the active population. They are therefore more prone to industrial and vehicular accidents.

Amongst the 51 patients studied by us 29 patients (56.9%) had liver injuries. 19 patients (37.3%) had splenic injuries and 3 patients (5.8%) had combined liver and splenic injuries.

A study carried out by Falimirski et al, showed that out of 37 patients managed non-operatively, 24 patients sustained hepatic injuries, 12 patients sustained splenic injuries and one patient sustained both liver and splenic injuries.<sup>12</sup>

All our patients were subjected to ultrasonography which could grade the liver and splenic injury according to the dimensions of the injury sustained on USG.

Of the liver injuries, 18.8% were grade 1, 43.7% were grade 2, 28.1% were grade 3 and 9.38% were grade 4. Grade 5 & 6 injuries were not encountered in our study group.

Similarly, amongst the splenic injury, 13.6% had grade 1, 50% had grade 2 and 36.4% had grade 3 injuries. No grade 4 and grade 5 injuries were encountered in our study.

Single greatest factor permitting safe, non-operative management of blunt abdominal injury is CT scan<sup>13</sup>. It can accurately delineate anatomy of the injury and provide accurate information about the amount of hemoperitoneum and intra-abdominal injuries. CT scan gives a better yield than DPL.<sup>14,15</sup>

Matsubara et al found CT scan to be accurate in 88% cases.<sup>16</sup> 49 out of 51 of our patients were subjected to CT abdomen. 2 patients whose CT abdomen was not done were grade 1 liver injuries on ultrasound.

Amongst the liver injuries, 12.5% of patients had grade 1, 46.8% had grade 2, 21.8% had grade 3, 12.5% had grade 4 injuries. Similarly, among splenic injuries, 13.6% had grade 1, 50 % had grade 2 and 36.4% had grade 3, Grade 4 and 5 splenic injuries were not encountered in our study.

Study of injury severity score (ISS) amongst our patients showed mean ISS of 12.55 with standard deviation of ±6.73.

When ISS of liver injuries were studied, grade 1 injuries had a lowest mean ISS of 9.25 with a standard deviation (SD) of ±4.113 while grade IV injuries had a mean ISS of 23 with a SD of ±4.830 (Table 2) Study conducted by Al Mulhin et al, showed a mean ISS of 16.2 with a SD of ±6.1.<sup>17</sup>

The mean ISS of patients who failed conservative management in the study conducted by Al Mulhin et al was 26.1 with a SD of ±8.5.<sup>17</sup>

This is comparable to our study wherein a patient of grade 4 injury failed conservative management; the mean ISS being 23 with a SD of  $\pm 4.830$ .

When the ISS of splenic injuries were studied it was found that the mean ISS in these patients was 10.95 with the SD of  $\pm 5.568$  (Table 3). 2 patients who failed conservative or non-operative management (NOM) belonged to grade 3 injuries which had an ISS of 12.11 with a SD of  $\pm 4.512$ .

A study carried out by Myers et al showed a mean ISS of 15(b) (where  $p < 0.00001$ ) for patients who underwent conservative management successfully. Patients in this study who failed conservative management showed an ISS of 28(b) (where  $p < 0.04$ ).<sup>18</sup>

Using the ISS and the revised trauma score (RTS), we calculated the probability of survival (PS) using a trauma and injury severity scale (TRISS) index in our patients.

The mean probability of survival was 98.769% in our patients (Table 4 and 5).

This holds true to the outcome of our study wherein all patients survived and went home. Patients undergoing delayed surgery failed conservative or non-operative management (NOM) were analyzed.

It was seen that 1 patient (3.13%) of liver injuries was subjected to delayed surgery (Table 6) and 2 patients (9.09%) of splenic injuries failed conservative management (Table 7).

Thus, there was a success rate of 96.87% in conservative management of blunt liver injuries and a success rate of 90.91% in splenic injuries.

Out of the 3 patients who underwent delayed surgery, 1 was grade 4 liver injury for whom hemostatic suturing was done. The other 2 patients were grade 3 splenic injuries for whom splenectomy was done.

The grades of injuries on exploration were a confirmation of the CT scan findings.

All the 3 patients who were explored on day 2 were persistently hypotensive despite fluid resuscitation and were having an increase in abdominal girth.

Study carried out by Croce et al showed a success rate of 90% in conserved liver trauma patients.<sup>19</sup> As per the study of Brasel et al conservative management, succeeded in 96% of patients with liver injuries.<sup>20</sup>

Bonariol et al in his study was successful in managing 88.8% patients of liver trauma conservatively.<sup>21</sup>

Parks et al in his study found a success rate of 94% in patients of liver trauma who were subjected to conservative management.<sup>22</sup>

Study conducted by Aseervatham R et al, showed that NOM failed in 10% of patients of splenic trauma.<sup>23</sup>

Study carried out by Nix JA et al, showed a failure rate of 11.4% in conserved splenic injuries.<sup>24</sup>

Bee et al, found a failure rate of 9% when NOM was considered for blunt splenic injuries.<sup>25</sup> Meguid et al, found a failure rate of 12% in conserved splenic injuries.<sup>26</sup>

Myers et al, succeeded in 89% of conserved splenic injury patients.<sup>18</sup> However, Shapiro et al had a higher success rate of 97% in conserved splenic injuries.<sup>27</sup> Peitzman et al, showed a decline in failure of NOM of splenic injuries of 13.5% in 1993 to 10.8% in 1997.<sup>28</sup>

Thus, the outcome of conservative management as regards to success, paralleled most of the studies mentioned above. As far as the outcome goes, all the 51 patients were discharged and there was no mortality.

## CONCLUSION

Males in the productive age group were more likely to present with blunt abdominal injuries. The outcome of blunt liver and splenic injuries in our study matched with most of the outcomes in international studies. Conservative or Non-operative management remains the treatment modality in blunt Liver and Splenic injuries with hemodynamic stability.

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