Research Article

Evaluation of the outcome of non-operative management in blunt abdominal solid organ injury

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ABSTRACT

Background: Blunt injury to abdomen is one of the most common injuries caused by road traffic accidents. The advent of newer imaging techniques with high resolution Computerised Tomography (CT) scanners has enabled the clinicians to exactly diagnose the extent of the intra-abdominal injuries. These injuries are commonly managed by surgery, but the shift to selective non operative management (NOM) of blunt injuries to abdominal solid organs is one of the most notable trends in the care of trauma.

Methods: The present study is a prospective one to evaluate the outcome of non-operative management of blunt trauma abdomen conducted at Sri Ramachandra Medical College and Research Institute, Sri Ramachandra University, Chennai from the month of April 2011 to September 2013.

Results: Out of 50 cases, the most common organ to be injured was the liver (32 cases) and of which 27 cases were managed by non-operative method and it is statistically significant ($p=0.008$). Of the 50 patients, 15 patients got converted. 8 patients (16%) were converted due to fall in Hb, 6 patients (12%) converted due to fall in Hb and hypotension, and one patient (2%) was converted due to persistent fever and features of peritonitis. 35 patients were managed conservatively. 12 out of 15 patients (80%) who underwent laparotomy developed complications, in comparison only 5 out of 35 patients (15%) who were treated conservatively had complication.

Conclusions: In our study, non-operative management was successful in 70% of the patients with good outcome.

Keywords: Blunt abdominal trauma, Solid organ injury, Non operative management, Surgery

INTRODUCTION

Blunt injury to abdomen is one of the most common injuries caused by road traffic accidents. It can also result from fall from height, assault with blunt objects, industrial mishaps, sport injuries, bomb blast etc. The rapid deceleration cause the shearing force to tear tissues at interfaces between tissues that are relatively fixed compared to surrounding structures or crush the tissues between external force and vertebral column or rapidly raise the intra-abdominal pressure from external compression causing rupture of hollow organs.¹

The advent of newer imaging techniques with high resolution Computerised Tomography (CT) scanners has enabled the clinicians to exactly diagnose the extent of the intra-abdominal injuries. These injuries are commonly managed by surgery, but the shift to selective non operative management (NOM) of blunt injuries to abdominal solid organs is one of the most notable trends in the care of trauma. The increasing use of non-operative management is based on low failure rates reported in most of the retrospective studies.²

Preservation of the spleen was initially applied in paediatric trauma and later in adults with success rate of 90-95% in children and only 70-80% in adults. Non

operative management of liver injuries has an even higher success rate, exceeding 90% and in renal injuries with success rates over 90%. Pancreatic injuries has a mixed review, most of the patients are managed nonoperatively. Velmahos et al support that the liver is a sturdy organ and concluded that in the absence of peritoneal signs and irreversible instability, all liver injuries can be treated conservatively regardless the magnitude of injury.^{3,4}

The NOM of solid abdomen organ injuries is now established for haemodynamically stable patients. The present study is a prospective one to evaluate the outcome of non-operative management of blunt trauma abdomen in a Tertiary Care Centre. Haemodynamically unstable patients with FAST (Focused Assessment with Sonography for Trauma) positive underwent emergency laparotomy.

METHODS

A prospective study was conducted at Sri Ramachandra Medical College and Research Institute, Sri Ramachandra University, Chennai from the month of April 2011 to September 2013 after obtaining institutional ethics committee clearance. The aim of the study was to evaluate the outcome of non-operative management in blunt trauma abdomen, analyze the criteria for conversion to operative management, and identifies the organ with best outcome in non-operative management and to formulate a protocol for NOM of blunt intra-abdominal solid organ injury.

This study included all patients above 18 years with blunt injury abdomen who were haemodynamically stable and presented to emergency room (ER) with history of trauma. Haemodynamically unstable patients, patients with hollow viscus injury, contrast enhanced computed tomography (CECT) showing a blush (indicative of active and on-going bleed) and those with other injury requiring explorative laparotomy were excluded from the study.

On presentation to ER all the patients were assessed and resuscitated if necessary, in accordance with ATLS protocol. Demographic details and history including the mechanism of injury were recorded. All the patients underwent FAST and once stable, they were further evaluated with CECT abdomen and pelvis for details of solid organ injury and its grade.

Patients who satisfied the inclusion criteria were included in the study and admitted to the intensive care unit. For all patients' blood pressure, heart rate, Glasgow Coma Scale (GCS) score, haemoglobin (Hb), packed cell volume (PCV), abdomen girth chart, associated injuries and its influence on the patients outcome and hospital stay, length of hospital stay (LOS), total blood products (TBP) transfused, time of conversion (TOC) and the reasons for conversion, complications in the converted

group, outcome of each patients and mortality if any were recorded.

Figure 1: Protocol for nonoperative management blunt injury abdomen.

Patients Hb and PCV were monitored every 4th hourly in the first 24 hours, 6th hourly in the second 24 hours and twice daily in third 24 hours. Similar monitoring was done for blood pressure, heart rate and abdominal girth chart. If there was any fall in haemoglobin or blood pressure, or an increase in heart rate or abdominal girth chart, appropriate measures to stabilize including blood transfusion were given. In spite of all these measures, if the patients were still haemodynamically unstable, they were taken up for emergency laparotomy.

Once operated, these cases were categorized as converted cases. If the conversion occurred within the first 24 hours of hospital stay, then these cases were excluded from the study. The complications and duration of stay were recorded. Patients were closely followed up throughout their stay in the hospital until the final outcome, either discharge or death.

Statistical Analysis

The percent differences were calculated between the nonoperated and converted groups. Chi Square test was used for statistical analysis using SPSS 22 software, p values <0.05 were considered to be statistically significant.

RESULTS

After initial evaluation, responders to resuscitation and haemodynamically stable patients of 50 in number were included in the study. The youngest patient was 18 years old and the oldest person was 80 years of age with mean age of 33 years. Maximum numbers of patients were between the ages of 21 to 40 years (Table 1).

Table 1: Age group distribution.

	Frequency	Percent	Valid percent	Cumulative percent
Valid <20 years	6	12.0	12.0	12.0
21-40 years	35	70.0	70.0	82.0
>40 years	9	18.0	18.0	100.0
Total	50	100.0	100.0	

Of the 50 cases, 15 underwent conversion to operative management and 35 were non operatively managed. Males dominated in both the groups. The most common mode of injury was road traffic accident (n=40), followed by fall from height (n=7) and slip& fall (n=3). Age, sex and mode of injury had no statistical significance in converting to operative management. FAST was positive in 100% in the operated group. Out of 50 cases, 32 cases had isolated liver injury and we managed 27 cases by NOM and only 5 cases required operative intervention. 11 cases had isolated splenic injury and 6 cases were converted and 5 treated by NOM. We had 3 cases of liver injury combined with splenic injury out of which 2 cases had to be converted and one by NOM. There were 2 cases of liver with kidney injury managed by NOM. We had 2 cases of splenic injury with kidney injury and both cases were converted (Figure 1). So our study shows that liver is the organ that can be managed best by NOM and it is statistically significant (p=0.008) (Table 2).

■ liver injury ■ splenic injury ■ liver + splenic injury ■ liver-kidney 4% ■ splenic-kidney

Figure 1: Percentage of abdominal organs injured following blunt trauma abdomen.

Table 2: CECT abdomen findings of various types of abdominal organ injuries and the percentage of cases that were managed by nom and its statistical significance.

CT Findings		Converted		Total
		Yes	No	
Liver injury	Count	5	27	32
Total	% of	10.0%	54.0%	64.0%
Splenic injury	Count	6	5	11
Total	% of	12.0%	10.0%	22.0%
Liver injury+ Splenic injury	Count	2	1	3
Total	% of	4.0%	2.0%	6.0%
Liver injury+ Kidney injuries	Count	0	2	2
Total	% of	0%	4.0%	4.0%
Splenic injuries+ count	Count	2	0	2
Kidney injuries	% of	4.0%	0%	4.0%
% of total				
Total	Count	15	35	50
	% of	30.0%	70.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2 - sided)
Pearson Chi-Square	13.749a	4	0.008
Likelihood Ratio	14.372	4	0.006
Linear - by - Linear	6.568	1	0.010
N of Valid Cases	50		

a-7 cells (70.0%) have expected count less than 5. The minimum expected count is .60

The CT grading of solid organ injury had no influence on the decision to convert to operative management as it was not statistically significant (Table 3).

Table 3: CT grading of solid organ injury and the percentage of cases converted with the statistical data.

Ct Grade		Converted		Total
		Yes	No	
Grade 1	Count	2	12	14
	% Of Total	4.0%	24.0%	28.0%
Grade 2	Count	4	8	12
	% Of Total	8.0%	16.0%	24.0%
Grade 3	Count	2	7	9
	% Of Total	4.0%	14.0%	18.0%
Grade 4	Count	5	5	10
	% Of Total	10.0%	10.0%	20.0%
Grade 5	Count	2	2	4
	% Of Total	4.0%	4.0%	8.0%
Grade 6	Count	0	1	1
	% Of Total	0%	2.0%	2.0%
Total	Count	15	35	50
	% Of Total	30.0%	70.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2 - sided)
Pearson Chi-Square	5.064a	5	0.408
Likelihood Ratio	5.384	5	0.371
Linear – by – Linear	2.187	1	0.139
N of Valid Cases	50		

a - 8 cells (66.7%) have expected count less than 5. The minimum expected count is 0.30

Maximum number of associated injury in this study were soft tissue injury with 26 patients, followed by 10 patients with head injury, 5 patients had lung injuries and other injuries seen were fractures, but it had no influence on conversion.

At admission, the mean Hb taken for first 24hrs was 10.632, with a minimum of 7.7 and maximum of 15.5. And mean PCV was 30.094. Third 24hrs has Hb with mean value of 11.29 and minimum of 9.0 and maximum of 15.0. Abdomen girth (ABG) mean value for first 24 hrs was 87.16, second 24hrs was 87.40 and third 24hrs was 87.76. Mean heart rate (HR) for first 24 hrs was 102.84/min, second 24hrs was 99.49/min and third 24hrs was 93.96/min. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) showed mean value of 111/78mmhg at first 24hrs, second 24hrs shows 111/79mmhg and third 24 hrs showed 102/90mmhg (Table 4). Mean value Hb at the time of arrival to hospital for the converted patients was 10.46. And mean value of Hb just before conversions to operative management were 9.6.

Table 4: Descriptive Statistics showing the first three days of patients Hb, PCV, ABG, HR, SBP, DBP after admission with the minimum, maximum and mean of each variable.

	N	Minimum	Maximum	Mean	Std.Deviation
Hb.124	50	7.7	15.5	10.632	1.4216
PCV.124	50	23.7	46.0	30.094	4.0248
Hb.224	43	15.4	27.2	19.217	2.2819
PCV.224	43	22.0	43.7	30.365	4.0892
Hb.324	34	9.0	15.0	11.297	1.2468
PCV.324	34	17.7	45.1	31.149	5.0012
ABG.124	50	71	107	87.16	9.794
ABG.224	45	71	106	87.40	10.063
ABG.324	33	70	106	87.76	10.059
HR.124	50	85	122	102.84	7.732
HR.224	43	83	118	99.49	7.636
HR.324	34	78	113	93.96	7.276
SBP.124	50	90	255	111.04	22.564
DBP.124	50	62	98	78.96	4.709
SBP.224	42	80	138	111.43	11.438
DBP.224	42	65	110	79.54	6.479
SBP.324	35	83	120	101.02	8.250
DBP.324	35	83	100	90.64	5.073
Valid N (listwise)	33				

All the 15 patients (100%) who failed conservative management received blood transfusions whereas only 20 out of 35 (57%) in the conservatively managed group required blood transfusions. Maximum number of blood products used in converted group was 7 and in the conservative group were 4. Mean number of blood products used in converted cases was 3.4 and that in the conservatively treated group was 1.2. This was not statistically significant.

Out of 50 patients in this study, 15 patients got converted. 8 patients (16%) were converted due to fall in Hb, 6 patients (12%) converted due to fall in Hb and hypotension, and one patient (2%) was converted due to

persistent fever and features of peritonitis. 35 patients were managed conservatively (Table 5).

Table 5: Reasons for conversion from NOM.

Valid	Frequency	Percent	Valid percent	Cumulative percent
Fall in Hb	8	16.0	16.0	16.0
Persistent Fever	1	2.0	2.0	18.0
Fall in Hb, Hypotension	6	12.0	12.0	30.0
Not Converted	35	70.0	70.0	100.0
Total	50	100.0	100.0	

Out of 8 who had fall in Hb alone, 2 died. Of the 6 who had fall in Hb& hypotension, 1 expired (Figure 2).

Figure 2: Reasons for conversion and their outcome.

Most of the patients, who underwent laparotomy, were converted in the first 24 to 48 hrs of conservative management. Mean number of hospital stay among converted group was 11.9 and NOM was 10.8, though not statistically significant.

Table 6: Complications among the NOM and converted patients with the statistical significance proven by chi square test.

Complication		Converted Yes	No	Total
Yes	Count	12	5	17
	% within converted	80.0%	14.3%	34.0%
No	Count	3	30	33
	% within converted	20.0%	85.7%	66.0%
Total	Count	15	35	50
	% within converted	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2 - sided)	Exact Sig. (2 - sided)	Exact Sig. (1-sided)
Pearson Chi-Square	20.206 b	1	0.000		
Continuity Correction a	17.384	1	0.000		
Likelihood Ratio	20.383	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear – by – Linear	19.802	1	0.000		
N of Valid Cases	50				

a-Computed only for a 2x2 table

b-0 cells (.0%) have expected count less than 5. The minimum expected count is 5.

Out of 50 cases, 17 developed complications like bronchopneumonia 8 cases (16%), deep vein thrombosis 3 cases (6%), wound infection 5 cases (10%) and pulmonary embolism 1 case (2%). 33 patients (66%) didn't have any complications. 12 out of 15 patients (80%) who underwent laparotomy developed complications, in comparison only 5 out of 35 patients (15%) who were treated conservatively had complication. This finding was statistically significant (Table 6).

32 cases out of 35(91.4%) who were managed conservatively were discharged. 12 cases out of 15 (80%) cases who were converted to operative management were discharged. Death among both converted and conservative group seem to be same i.e. 3 patients each (Figure 3).

And even though this is not statistically significant, there were more number of patients who were discharged after conservative management.

Figure 3: Outcome of the patients among both the groups

DISCUSSION

With increasing popularity of non-operative management, it is important to analyze optimal practical management guidelines for observation in cases of blunt solid organ injury of the abdomen. Selective NOM has served to reduce the rate of negative operative exploration. This poses a new set of challenges with regards to observation of these patients and management of their potential complications.^{5,6}

In our study of NOM, age and sex of the patient did not have any influence on the outcome. Majority of our patients were male and maximum number of patients was in the age group of 21 to 40 years. The mean age was 33 years. The most common mode of injury was due to RTA, which is similarly stated in the study from Nigeria and in an Indian study. All the cases who were converted to operative management had free fluid initially in the ultrasound. This analysis is similar to the study done in 2003 by Velhamos GC. Out of 15 cases who were converted, 11 cases got converted within 48 hours and other four cases within 72 hours. The timing of conversion to operative management was similar to other studies.⁷⁻⁹

Our study showed a higher percentage of injuries of the liver, whereas other studies show that the most common organ to be injured is the spleen. There were 32 cases of isolated liver injury and only 16% of these cases were converted. Therefore the success rate of NOM for isolated liver injury is 84%. This dropped to 81% when combined liver and other organ injuries were included. In comparison, Magrayet al from India had a success rate of only 73% in liver injury. The percentage of isolated splenic injury that got converted was 49% and this slightly increased to 50% when combined injuries were included. The study conducted by Velmahos et al shows similar values on splenic trauma, showing the maximum number of failures in splenic injury. In our study, we did not have isolated kidney injury but we did have combined injuries like liver with splenic injury and the conversion percentage was 67%. Not all the studies the literature have analyzed the combined injury and its outcome.¹⁰⁻¹²

The reasons for conversion in most of the studies were fall in haemoglobin. In our study, the most common reason for conversion was fall in haemoglobin, followed by fall in haemoglobin with hypotension and also persistent fever with peritonitis.^{13,14}

The mean value of Hb at the time of arrival to hospital for the converted patients was 10.46 and was 9.6 just before conversion. In our study there was no cut off value for the fall in haemoglobin, below which we decide to convert to laparotomy, which is similar to the study conducted in 2009 by George A Giannopoulos. The mean systolic blood pressure at the time of admission in converted group was 102 mmHg and 80 mmHg just before conversion. Study conducted by Raza M in Oman also

explains that they the failure group had a mean fall BP <90 mmHg. Mean Heart Rate at the time of conversion was 108/min. In our study we had also monitored abdomen girth chart but it was not statistically significant and it did not influence the decision to conversion to laparotomy.^{15,16}

57% patients in non-operative group required blood transfusion whereas all the 15 (100%) patients who failed conservative management and underwent surgery required blood transfusion. Mean no of blood products used in converted cases were 3.4 and in NOM are 1.2. In our study there was no cut off value for Haemoglobin and decision for blood transfusion was empirical.

Out of 50 cases, 33 cases did not have any complication during the hospital stay and 17 patients had complications. On further analysis, 80 percent of operated group developed complications whereas only 14.3% of the conservatively managed patients developed complications. This analysis is statistically significant.

The mean duration of hospital stay in converted group was 12 days and conservatively managed group was 11 days. Though this is not statistically significant, the reason for the long stay in the group with non-operative management was mainly due to their associated injuries and not due to the blunt abdominal injury per se. The overall success rate in the non-operative management of blunt abdominal solid organ injuries was 64%. Morbidity was significantly higher in the group that failed NOM. Mortality was also higher in the converted group. Study done in Oman by Raza M has similar findings.¹⁶

CONCLUSION

Our study proves that non operative management is a safe and effective method in the treatment of blunt injury abdomen. The most common mode of injury in our study was due to road traffic accidents. FAST showed free fluid in the abdomen in all the patients who failed non-operative treatment. The most common organ to be injured was the liver, followed by spleen. The CT grade of injury did not influence the decision to convert to operative management. Mean haemoglobin at the time of conversion was 9.6. Abdominal girth measurement did not influence the decision to convert to operative management. Blood transfusions needed for the non-operative management group were lesser than for the operated group.

In our study, non-operative management was successful in 70% of the patients with good outcome. In cases with liver injury, conversion rate was low with good outcome and therefore, Liver is the best organ to be managed conservatively following blunt trauma. The highest rate of failure of non-operative management was seen in splenic injury. The timing of the decision to convert to operative management was predominantly (73%) in the first 48 hours after admission. Criteria for conversion in

our study were fall in haemoglobin, hypotension, and persistent fever with signs of peritonitis despite on-going resuscitation.

Morbidity was found to be more in converted group than conservatively managed group and it was statistically significant. Percentage of mortality in operated group was more than the non-operated group. From our study we want to conclude that the predictors of conversion to operative management are:

- Isolated splenic injury,
- Fall in Hb <10 gms% despite on-going resuscitation and
- Fall in BP <90 mmHg despite on-going resuscitation.

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