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Original Research Article

Parameters for therapeutic laparotomy in blunt trauma abdomen

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ABSTRACT

Background: The rapid identification of potentially life threatening intra-abdominal injury is critical for patients who sustain blunt abdominal trauma. There has been a shift from operative to non-operative management (NOM) in hemodynamically stable blunt trauma abdomen patients. The aim of present study was to determine the certain clinical and radiological parameters for therapeutic laparotomy (TL) in blunt trauma abdomen in adult patients.
Methods: A prospective observational study was conducted on victims of blunt trauma who presented to our level II Emergency Department from May 2012 to June 2014. Their clinical, laboratory and radiological parameters were collected, evaluated and analyzed. A previously developed ultrasound scoring system was applied to FAST findings. Patients were followed to determine if they underwent TL or NOM.
Results: A total of 7750 polytrauma patients with suspected blunt trauma abdomen underwent FAST. 338 (4.36%) patients had a positive FAST, out of which 144 were included, 93 (64.58%) patients were selected for NOM, and 51 (35.4%) patients underwent TL. NOM was successful in 76 (81.73%) patients, whereas 17 (18.27%) failed NOM and were operated. Using recursive partitioning analysis, the most important predictor for a TL, was whether the patient has an ED SBP of ≤90mmHg while other parameters include, ED pulse rate >110/min; total fast score >3; large amount of hemoperitoneum; presence of abdominal guarding, pallor and polytrauma.
Conclusions: There are certain immediately available clinical, and radiological parameters, which if validated by a prospective, large sample size study could help in deriving a decision rule or even a scoring system that would determine the need for therapeutic laparotomy in blunt trauma abdomen patients.

Keywords: Blunt trauma abdomen, Focussed assessment with sonography for trauma, Non-operative management, Pnuemoperitoneum, Polytrauma, Therapeutic laparotomy

INTRODUCTION

Deaths and taxes are the most quoted inevitabilities of life; trauma qualifies as a legitimate third. The saga of trauma is a reflection of the story of man. Trauma remains the most common cause of death for all individuals between the ages of 1 and 44 years and is the fifth most common cause of death regardless of age.[1] Abdomen is the third most commonly injured region with injuries requiring surgery occurring in about 20% of civilian trauma victims.[2] The spleen is the most often injured organ and may be the only intra-abdominal injury in over 60% of cases. Liver and hollow viscus injuries follow in decreasing incidence.[1]

Rapid ultrasound examination of the abdomen following blunt trauma (FAST- focused abdominal sonogram for trauma) consists of looking for fluid (usually blood) in four defined areas: 1. sub-hepatic (hepato-renal interface), 2. subsplenic (lieno-renal interface), 3. pericardial - through a subxiphoid window, and 4. Pelvic-using a full bladder as an acoustic window. After its introduction in the early 1970s computerized axial tomography (CT) rapidly came to be utilized for all parts of the body. In the 1980s a number of reports attested to its utility in evaluating the abdomen in hemodynamically stable blunt trauma patients.[3] There is a trend of using clinical decision rules in point of care decision making in various clinical situations.[4-7] The process of developing an accurate and valid clinical decision rule has been described in detail.[8] Clinical decision rules need to be accurate , practical, easy to apply, and derived from information that is readily available to the clinician. The development of a clinical decision rule to determine the parameters for therapeutic laparotomy in blunt trauma abdomen patients would enhance patient care and allow for better utilization of resources.

High rate of operative complications caused paradigm shift from operative to non-operative management (NOM) in hemodynamically stable blunt trauma abdomen patients.[9,10] There is no established protocol in this part of world for the management of blunt abdominal trauma patients. Authors hypothesized that in the setting of blunt trauma abdomen in adults, there are certain clinical and radiological parameters available at the time of admission or soon after resuscitation in emergency department, which determine the need of therapeutic laparotomy in them.

METHODS

The present prospective observational study was conducted in the Department of General and Minimal Access Surgery, Sher-i-Kashmir Institute of Medical Science, a high-volume tertiary care hospital in Srinagar from 2012 to 2014. All patients with blunt trauma abdomen, who presented either directly or were referred to authors' institute, were admitted to the Level II Accident and Emergency unit which was well equipped with resuscitation facilities, radio-imaging unit, emergency laboratory and 24 hours operation theatre availability. Patients, who presented in shock or had a penetrating abdominal injury or were less than 14 years of age, were excluded from the study.

On arrival the patients were assessed and resuscitated if necessary, as per ATLS guidelines. A brief history and physical examination formed an important part of evaluation. All patients underwent Focused Abdominal Sonography for Trauma (FAST). Patients who had a positive FAST and were hemodynamically stable underwent CECT abdomen and/ or chest. Authors selected certain clinical and radiological parameters for analysis on the basis of their biological plausibility, immediate clinical availability, practicality and probable influence on clinical decision making. These included: age (categorized as < or >60years); ED pulse (< or >110 per min); ED systolic blood pressure (< or >90mmhg); presence of pallor; presence of abdominal tenderness, distension, or guarding ; chest injury (either radiological or clinical rib fractures, flial chest, pneumothorax, hemothorax, mediastinal injury); head injury (EDH, SDH or contusions of brain); skeletal injury (fractures of pelvis, spine or extremities; GCS score (< or >13); quantification of free fluid on FAST, as described by Huang et al, and quantification of hemoperitonium on CECT, as described by Federle et al.[11,12]

A total of 7750 polytrauma patients with suspected blunt trauma abdomen underwent FAST. 338 (4.36%) patients had a positive FAST, out of which 194 were excluded. The 144 included patients underwent CECT abdomen. On the basis of clinical and radiological parameters, 93 (64.58%) patients were selected for Non-Operative Management (NOM), 51 (35.4%) patients underwent therapeutic laparotomy as they either showed active contrast extravasation or hollow viscus injury on CT scan. NOM patients were shifted to HDU/ICU, closely monitored with repeated clinical assessment. The protocol included evaluation of vitals, Pulse BP, RR, temperature, urine output, 12 hourly hemoglobin, and hematocrit estimation for first 72 hours. Other laboratory investigations were ordered as per requirement. Follow up ultra sound abdomen were done on a daily basis or incase a patient showed signs of clinical deterioration. NOM was successful in 76 (81.73%) patients. Whereas 17 (18.27%) patients showing signs of ongoing hemorrhage (tachycardia with pulse rate >110 beats per minute, drop in systolic BP to less than 90mmhg, drop in hemoglobin or hematocrit, despite resuscitation), evidence of hollow viscus injury within 24 hours (n= 3), failed NOM and were operated. They were grouped in therapeutic laparotomy group.

The primary outcome variable for current study was to determine the parameters for therapeutic laparotomy in blunt trauma abdomen. Authors defined therapeutic laparotomy as definitive surgical intervention that was needed to treat an intra-abdominal injury. Surgical interventions considered therapeutic as- splenic injury requiring resection; hepatic injury requiring definitive hemostasis, repair or resection; renal injury requiring repair or resection; hollow viscus injury requiring repair or resection; other site of bleeding requiring ligation or definitive repair for hemostasis

Statistical analysis

All the continuous variables were described by descriptive statistics and all categorical variables in terms of frequency and percentages. The standard statistical methods like Students t test, chi square test and fisher exact test were used to analyze the statistical data. All the statistical results so obtained were discussed on 5% level

of significance, i.e., p <0.05 considered as significant. The statistical software "Statistical Package for Social Sciences (SPSS v 20)" was used to analyze the data.

RESULTS

Total 144 patients were enrolled in the study and divided into non-operative management success (NOM-S, n=76) and therapeutic laparotomy (TL, N=68) groups. There were no significant different observed between two groups in terms of age, nature of trauma, prehospital care, injury grading of liver and kidney, head injury (EDH, SDH, brain contusions etc.), and chest injury (hemothorax, pneumothorax, rib fractures, lung contusions etc.) as depicted in Table 1.

The patients who were operated upon initially and the patients who failed NOM were said to have undergone therapeutic laparotomy to treat their intra-abdominal injury.

Table 1: Comparison of demographic data and nature of trauma amongst two groups.

Variable		NOM-S, (n=76)	TL, (n=68)	P value
Mean age (in years)		31.99±13.38	33.69±13.22	0.444
Sex	Female	12 (15.8%)	17 (25.0%)	0.169
	Male	64 (84.2%)	51 (75.0%)	
Nature of trauma	1: RTA	53 (69.7%)	53 (77.9%)	0.456
	2: FFH	21 (27.6%)	13 (19.1%)	
	3: Assault and others	2 (2.6%)	2 (2.9%)	
Liver injury	1: Grade I	6 (21.4%)	1 (5.0%)	0.142
	2: Grade II	8 (28.6%)	8 (40.0%)	
	3: Grade III	11 (39.3%)	5 (25.0%)	
	4: Grade IV	3 (1.7%)	6 (30.0%)	
Kidney injury	1: Grade I	2 (20.0%)	5 (33.3%)	0.051
	2: Grade II	3 (30.0%)	1 (6.7%)	
	3: Grade III	3 (30.0%)	0 (0.0%)	
	4: Grade IV	2 (20.0%)	6 (40.0%)	
	5: Grade V	0 (0.0%)	3 (20.0%)	
Head injury		4 (5.3%)	3 (4.4%)	1.000
Chest injury		26 (34.2%)	17 (25.0%)	0.228

Table 2: Various parameters compared between two groups.

Variables	NOM-S	TL	P value
ED Pulse, beats/minute	91.11±9.8	108±12.75	0.000
ED SBP, mmHg	104±11.01	93.35±12.91	0.000
ED DBP, mmHg	67.79±8.72	58.16±7.33	0.000
HB (at admission), g/dl	10.53±1.88	8.70±1.82	0.000
HCT (at admission), %	32.98±4.82	27.27±7.38	0.000
Total FAST Score	2.84±0.98	4.16±1.14	0.000
Time Since Injury, hours	3.20±2.84	2.34±1.66	0.030

Compared with 76 patients who underwent conservative management successfully, patients in the therapeutic laparotomy had a higher mean ED pulse rate, lower mean ED systolic and diastolic blood pressure, lower mean hemoglobin and hematocrit level at admission, higher Total FAST Score, lower mean time gap between injury and arrival at hospital as shown in Table 2. However, the patients in the therapeutic laparotomy group had a higher rate of presence of pallor, abdominal guarding, polytrauma and higher rate of abdominal distention. The proportion of patients with mild and moderate amount of hemoperitoneum in conservative management was more than in operated group (31.6% and 46.1% vs 5.3% and 25%; P <0.001) respectively, while the ratio reversed in case of large amount of hemoperitoneum (22.4% vs 69.1%; P <0.001). Patients in the operative group had higher rate of grade IV and V splenic injury than in the conservative management group but less rate of grade I, II and III splenic injury. Patients in the therapeutic laparotomy group had a higher rate of liver injury with polytrauma than the patients who were managed successfully by conservative management. The patients

in the therapeutic laparotomy group had greater amounts of blood transfused than in the conservative management successful group. Complication rate was high and hospital stay was longer in therapeutic laparotomy group, (Table 3).

Table 3: Comparison of patients with successful non operative management versus therapeutic laparatomy.

Variables		NOM-S	TL	P value
Pallor at admission		27 (35.5%)	50 (73.5%)	0.000
Abdominal guarding/ rigidity		24 (31.6%)	50 (73.5%)	0.000
Polytrauma		34 (44.7%)	47 (69.1%)	0.003
Abdominal distention		3 (3.9%)	24 (35.3%)	0.000
Abdominal bruise		37 (48.7%)	39 (57.4%)	0.298
Abdominal tenderness		74 (97.4%)	64 (95.5%)	0.665
CECT abdomen score	1: Mild, 100 - 200ml	24 (31.6%)	4 (5.9%)	0.000
	2: Moderate, 250 - 500ml	35 (46.1%)	17 (25.0%)	
	3: Large, >500ml	17 (22.4%)	47 (69.1%)	
Spleen injury	1: Grade I	7 (15.2%)	5 (13.5%)	0.000
	2: Grade II	22 (47.8%)	3 (8.1%)	
	3: Grade III	16 (34.8%)	7 (18.9%)	
	4: Grade IV	1 (2.2%)	13 (35.1%)	
	4: Grade V	0 (0.0%)	9 (24.3%)	
Skeletal survey	1: Pelvic #	2 (20.0%)	6 (60.0%)	0.040
	2: U/L #	2 (20.0%)	0 (0.0%)	
	3: L/L #	2 (20.0%)	4 (40.0%)	
	4: Spine	4 (40.0%)	0 (0.0%)	
Blood transfusions		4 (5.3%)	32 (47.1%)	0.000
Spleen injury with polytrauma		24 (52.2%).	25 (67.6%)	0.156
Liver injury with polytrauma		13 (46.4%)	16 (80.0%)	0.019
Kidney injury with polytrauma		8 (80.0%)	14 (93.3%)	0.543
Complications		7 (9.2%)	24 (35.3%)	0.002
Length of stay, (days)		6.42±2.69	8.97±6.33	0.000

# indicates highly significant difference between the groups.

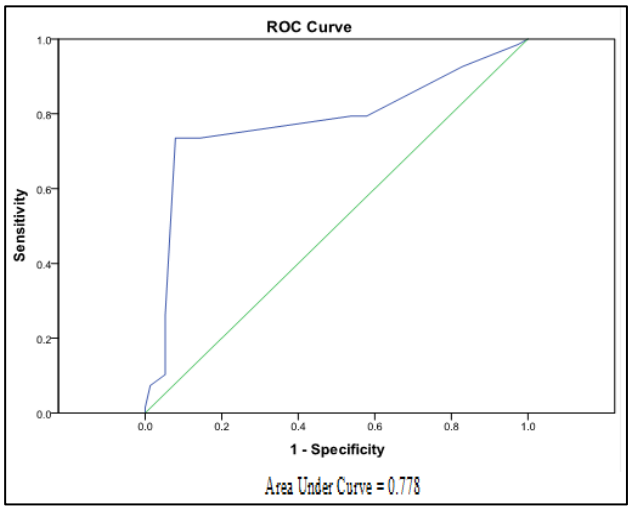

Figure 1: Receiver Operator Characteristic (ROC) curve for Emergency Department systolic blood pressure (ED SBP) of patients with blunt trauma abdomen using therapeutic laparotomy necessary as outcome.

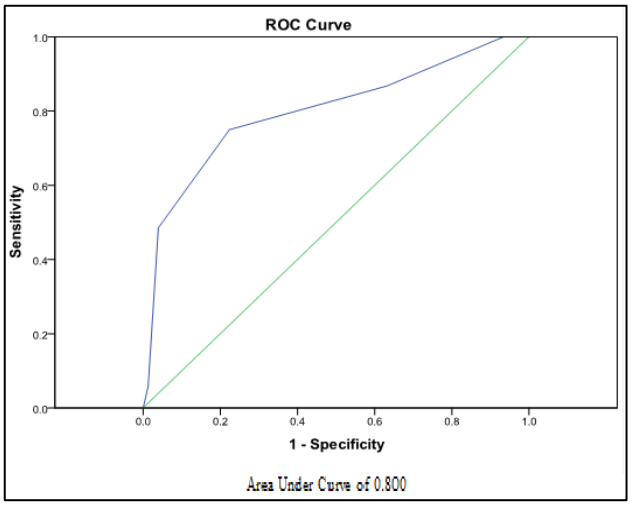

Figure 2: Receiver Operator Characteristic (ROC) curve for Total FAST Score of patients with blunt trauma abdomen using therapeutic laparotomy necessary as outcome.

Using recursive partitioning analysis, the most important predictor for a therapeutic laparotomy, was whether the patient has ED SBP of ≤90mmHg. Of the 144 patients with blunt trauma abdomen, 56 patients had an ED SBP ≤90mmHg out of which 50 patients needed a therapeutic laparotomy (89.3%, P <0.001). The ED SBP gave an area under receiver operator characteristic curve of 0.778 using therapeutic laparotomy necessary as outcome with sensitivity = 73%, and specificity = 95% for ED SBP ≤90mmHg (Figure 1).

The other parameters significant for a need of therapeutic laparotomy include, ED pulse rate >110/min (AUC = 0.869, sensitivity = 70%, specificity = 95%); Total Fast Score >3 that is intraperitoneal fluid of more than 2mm in more than one space or less than 2mm in more than three spaces (AUC = 0.800, sensitivity = 80%, specificity = 75%) (Figure 2); large amount of hemoperitoneum (>500ml); presence of abdominal guarding; hemoglobin levels of less than 10g/dl at admission; presence of pallor and presence of polytrauma.

DISCUSSION

Trauma is rightly called as the "neglected disease of modern developing nations." Trauma causes significant morbidity and mortality in both developed and the developing world. The value of physical examination in the management of blunt trauma abdomen has already been established.[13-16] The use of ultrasound in the initial evaluation of blunt trauma abdomen patients is a routine worldwide, the American College of Surgeons now includes FAST as an adjunct to primary survey in the Advanced Trauma Life Support course.[17] CECT has been used to evaluate the patients of blunt trauma abdomen and found highly specific and sensitive for diagnosing the solid organ injury, the amount of hemoperitoneum, or retroperitoneal traumatic lesions and thus predicting the management option in these patients.[18-22] Increasing success rates have been reported with conservative management of abdominal solid organ injuries after blunt trauma, however, most data are retrospective.

This stimulated us to undertake the current study, on the basis of prospective collection of data, to establish the parameters for therapeutic laparotomy in blunt trauma abdomen. The present study aim was to study the kind of blunt trauma abdomen in adult population peculiar to the valley of Kashmir where the terrain, flora, and fauna contribute to injuries typical to this area. Deep gorges, high mountains, dirt tracks cut on the mountain face which get washed, away with rain, all contribute to major accidents while travelling. This region is an epicenter of seismic activity, so earthquakes and the resultant destruction caused thereof, also contribute to the trauma here. Fall from walnut trees contributes a good proportion to fall from heights as trauma to abdomen during the harvest season (July to November).[23] During the past three decades, Indian administered Kashmir has witnessed an armed conflict and civilian unrest resulting in a large number of causalities, mostly civilians, caused by high-velocity gunshot wounds (mostly from AK-47 assault rifles, widely used in this conflict) and blasts (mostly from grenades and improvised explosive devices).[24] This has provided us a unique opportunity, in our only civilian tertiary care hospital of the Indian state of Jammu and Kashmir, to deal with the traumatic injuries. Authors' set out to study the need of non-operative management or therapeutic laparotomy in blunt trauma abdomen patients on the basis of immediately available clinical parameters, ultrasound findings and CT findings.

In evaluating present data, authors selected parameters like ED pulse rate and ED SBP that were readily available at the time of ED resuscitation and would likely affect clinical decision making in the ED. ED tachycardia (pulse rate >110/min) and ED hypotension (SBP ≤90mmHg) in the presence of a positive FAST examination is clinically intuitive and would need to be factored in any decision rule. Study included abdominal guarding to the analysis because we felt that it could potentially affect the likelihood of needing a therapeutic laparotomy given a positive FAST examination. Polytrauma patients included the blunt trauma abdomen patients with more than one solid organ injury, a single solid organ injury with associated skeletal fractures (spine, extremity or pelvis) or chest injury or head injury. The study included the polytrauma to the analysis because its presence depicts the severity of injury and thus has a bearing on the management of patients.[9,25] Authors added pallor and hemoglobin levels at admission to the analysis as we wished to determine whether the presence of pallor and a low hemoglobin level at admission in the presence of intraperitoneal fluid would enhance the decision making while managing the blunt trauma abdomen patients.

The scoring model given by Huang et al, for quantifying the intraperitoneal free fluid was followed.[11] The thickness of free fluid measured in millimeters in morrisons space, perisplenic space, paracolic gutters, and pelvis is scored accordingly. The total FAST score ranges from 0-8. In their study, 96% of patients with an US score ≥3 required therapeutic laparotomy. While we utilized FAST as a quantitative assessment tool, other studies have utilized FAST as qualitative assessment tool i.e., presence or absence of intraperitoneal free fluid.[26,27] Present study included CECT to our data analysis because of its ability to exactly diagnose the extent of intra-abdominal organ injury, the amount of hemoperitoneum, or retroperitoneal traumatic lesions and thus predicting the management option in blunt trauma abdomen patients. Authors quantified the amount of hemoperitoneum as per Federle et al, into small (<200ml), moderate (250 - 500ml) and large (>500ml).[12] Authors also used organ injury scale to grade the solid organ injuries. While other studies have used the positive ultrasound result or presence of organ injury and hemoperitoneum. in isolation to predict the need for

therapeutic laparotomy without incorporating the clinical variables to the decision making, we have analyzed multiple clinical, and radiological parameters to determine how best to predict which patients would ultimately require therapeutic laparotomy.[11,19,20] These parameters are immediately and dependably available in the emergency department to guide the residents in decision making.

There are several potential limitations to this study. The FAST was done by radiology residents in the emergency department and we did not determine inter-rater reliability, since ultrasound findings are highly operator dependent. While, managing the blunt trauma abdomen patients with solid organ injury by NOM, radiological methods of intervention like selective angiographic embolization was not available at our institute that could have definitely spared few laparotomies.

CONCLUSION

In the evaluation of blunt trauma abdomen patients with positive FAST examination, the presence of ED SBP ≤90mmHg was a strong predictor of need for a therapeutic laparotomy. Other parameters significant for a need of therapeutic laparotomy include, ED pulse rate >110/min, total FAST Score >3, large amount of hemoperitoneum (>500ml) on CECT, presence of abdominal guarding; hemoglobin levels of less than 10g/dl at admission; presence of pallor and presence of polytrauma. These parameters if validated by a prospective, large sample size study could help in deriving a decision rule or even a scoring system that would determine the need for therapeutic laparotomy in blunt trauma abdomen patients.

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