ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

A Prospective Study On Various Decisive Factors For Non-Operative Management Of Blunt Trauma Abdomen With Solid Organ Injury.

Anandan K[1], Rohith Kumar R[2], and TA Bharath[3]*.

[1,2]Assistant Professor, Department of General Surgery, Madras, Medical College, Chennai, Tamil Nadu, India.
[3]Senior Resident, Department of General Surgery, Madras, Medical College, Chennai, Tamil Nadu, India.

ABSTRACT

In this ongoing era of 21st century, trauma is the leading cause of death in individuals between age 1 and 44. In trauma, also road traffic accidents (RTAs) are the major cause of death. Blunt abdominal trauma is a frequent emergency and is associated with significant morbidity and mortality. A prospective analysis of 50 patients of blunt abdominal trauma admitted in Department of General Surgery, Madras, Medical College, Chennai, Tamil Nadu, India a span of 12 months was done. Unstable patients with initial resuscitation underwent focused assessment sonography for trauma (FAST). Failed resuscitation with free fluid in abdomen confirmed by FAST immediately shifted to operation theatre for laparotomy and proceed. Hemodynamically stable patients underwent computerized tomography of abdomen. Most of the patients in our study were in the age group of 21-45 years with M:F ratio of 4:1. RTAs (62%) was the most common mechanism of injury. Spleen (38%) was the commonest organ injured and the most common surgery performed was splenectomy. In total non-operative management (NOM) was done in 58% of cases and surgical management was done in 42% of cases. Appropriate patient selection, early diagnosis and repeated clinical examination and use of appropriate investigations forms the key in management of blunt abdominal trauma. To conclude, initial resuscitation measures and correct diagnosis forms the most vital part of blunt abdominal trauma management.

Keywords: Blunt trauma, Kidney injury, Liver injury, Solid organ injury, Spleen injury

https://doi.org/10.33887/rjpbcs/2023.14.6.47

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Traffic accidents, falls from great heights, and assaults, all of which end in mortality and morbidity, account for 80% to 90% of traumatic abdominal injuries. It will be challenging to decide whether to operate or not if the solid abdominal organs, which are the most frequent victims of acute abdominal trauma, such as the liver, spleen, and kidneys, are injured [1]. Only about 30 to 35 percent of blunt abdominal injuries need surgery. Continuous vitals monitoring and extremely precise imaging techniques have assisted in the recent major shift from operational management to non-operative care of management. There are no peritoneal signs in 40% of cases with severe haemoperitoneum [2]. Conventional methods of diagnosis (history, physical examination) are unreliable due to the masking effect of associated extra-abdominal injuries like altered sensorium (CNS damage or shock), alcohol, drug intoxication, and compensatory physiology of extreme age. An accurate evaluation of the presence, nature, and severity of the damage is necessary for the treatment of abdominal trauma. Hence, imaging tools are usually required for diagnosing organ injuries in hemodynamically stable patients [3]. There has been a major shift in the last 20 years from operative to non-operative care of traumatic injury. It can be challenging to treat a blunt or penetrating injury non-operatively. A trauma team, including an operating surgeon, anesthetist and nursing staff as well as radiographic imaging, including computed tomography and focused assessment with sonography in trauma, are necessary for N.O.M. (ICU and operation suite) [4,5]. The main objective of this study is to identify the factors influencing non-operative management and the causes of failed non-operative care, and to determine whether non-operative therapy is successful in treating blunt abdominal trauma of low and high grade [6,7].

MATERIALS AND METHODS

A prospective analysis of 50 patients of blunt abdominal trauma admitted in the year 2022,at Department of General Surgery, Madras, Medical College, Chennai, Tamil Nadu, India a span of 12 months was done. All patients giving consent and admitted in surgical ICU and ward in Madras medical college and hospital with blunt trauma abdomen who satisfies inclusion and exclusion criteria as listed below.

Inclusion Criteria

- Patient above 12 years of age admitted with blunt trauma abdomen and survived more than 48 hours and followed up till discharge

Exclusion Criteria

- Patients below 12 years of age.
- Patients preexisting liver and renal disorders.
- Patients who survived less than 48 hours and associated poisoning.
- Patients who have taken discharge at request in favor of treatment in other hospitals.
- Blunt trauma abdomen with associated hollow viscous injury.
- Patients with penetrating injury abdomen

After primary survey and stabilization, radiological examination like USG, chest X –ray,Xray abdomen and. X-ray pelvis with both hips and cervical spine are done. Other radiographs are done depending on the extent of patient's injury. All patients admitted in Madras medical college with blunt trauma injury are examined immediately. A detailed history of the incident is taken, a detailed past history is taken to rule out any previous liver and renal pathology. Clinical examination is done irrespective of signs and symptoms. All patient sustaining major trauma are subjected to systematic assessment by primary and secondary survey. Physical examination remains the cornerstone of trauma triage. Primary survey includes ABCDE. Secondary survey includes preprimary survey and examination of whole body from head to toe. CT scan is an adjuvant to secondary survey and is the investigation of choice for all hemodynamically stable cases who are fast positive, and in fast negative when indicated(pelvic fracture, equivocal abdominal swelling, hematuria and dangerous mode of injury).Failure of NOM is defined as laparotomy performed more than 6 hours after admission, after the patient was initially considered for NOM. Patients were then divided to into two groups depending on outcome NOM- S(non-operative management-success) and NOM-F (non-operative management -failure) and groups are compared and

ISSN: 0975-8585

studied. Expected outcome in NOM – S is continuation of non -operative management and followed up till discharge supplemented by radiological investigation such as USG of abdomen and patient resuming to normal activities prior to the trauma. In NOM -F patients, laparotomy along with definitive procedure / damage control surgery is the expected outcome.

Statistical Analysis

Data collected is analyzed using statistical method to find the relationship between survival, morbidity, rate of conversion to operative management. Statistical significance was defined as a P value of less than 0.05. The preceding calculations were made using SPSS software.

RESULT

Chart 1: Distribution Of Age Among Study Participants (N=60)

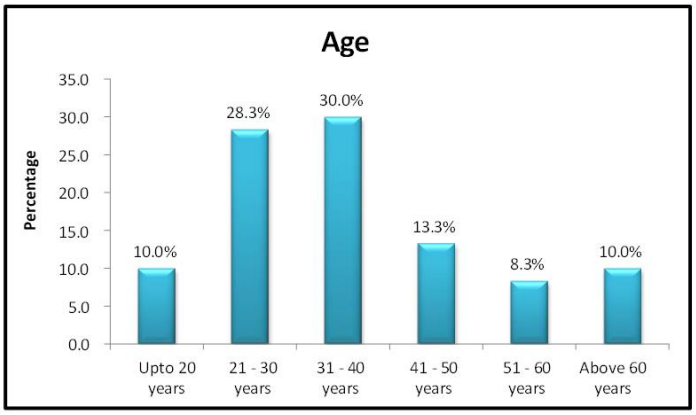

Chart 2: Distribution Of Age With Management Among Study Participants (N=60)

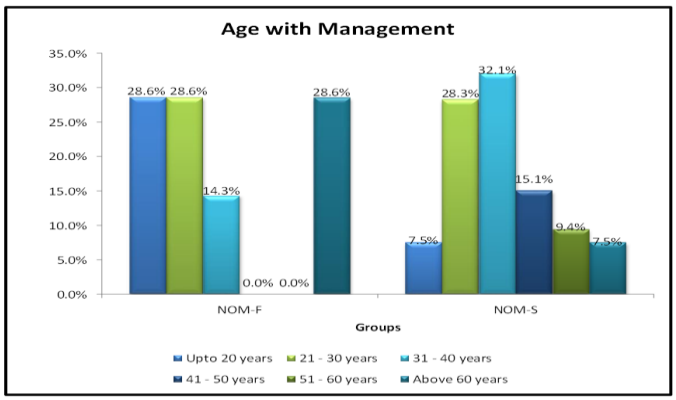

Table 1: Distribution Of Gender With Management By Pearson's Chi-Square Test (N=60)

Gender	Management		Total	p2 - value	p-value
	NOM-F	NOM-S			
Female	1	12	13	0.254	1.000 #
	14.3%	22.6%	21.7%		
Male	6	41	47		
	85.7%	77.4%	78.3%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

ISSN: 0975-8585

Table 2: Comparison Between Mode Of Injury With Management(N=60)

Mode of Injury	Management		Total	p 2 - value	p-value
	NOM- F	NOM- S			
Assault	0	4	4	1.129	0.544 #
	0.0%	7.5%	6.7%		
RTA	6	46	52		
	85.7%	86.8%	86.7%		
Self fall	1	3	4		
	14.3%	5.7%	6.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

Table 3: Comparison Between Blood Transfusion With Management By Pearson's Chi-Square Test

Blood Transfusion	Management		Total	p 2 - value	p-value
	NOM- F	NOM- S			
No	6	44	50	0.254	1.000 #
	85.7%	83.0%	83.3%		
Yes	1	9	10		
	14.3%	17.0%	16.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

Table 4: Comparison Between External Injury With Management By Pearson's Chi-Square Test

External Injury	Management		Total	p 2 - value	p- value
	NOM- F	NOM- S			
No	0	14	14	0.254	1.000 #
	0.0%	26.4%	23.3%		
Yes	7	39	46		
	100.0%	73.6%	76.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

Table 5: Comparison between Quadrant Involved with Management by Pearson's Chi-Square test

Quadrant Involved	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Epigastric Region	3	11	14	8.556	0.128 #
	42.9%	20.8%	23.3%		
Left Hypochondrium	2	16	18		
	28.6%	30.2%	30.0%		
Left Lumbar	0	2	2		
	0.0%	3.8%	3.3%		
Right Hypochondrium	0	21	21		
	0.0%	39.6%	35.0%		
Right Lumbar	1	1	2		
	14.3%	1.9%	3.3%		
Whole Abdomen	1	2	3		
	14.3%	3.8%	5.0%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

ISSN: 0975-8585

Based on site of injury, among N. O.M- S group 20.8% of them had at epigastric region followed by 30.2% at left hypochondrium, 39.6 % right hypochondrium, 3.8% whole abdomen, 3.8% left lumbar and 1 .9 % right lumbar. Among N.O.M - F group 42.9% had site of injury at epigastric region, 28.6% left hypochondrium, 14.3% Right lumbar and remaining 14.3% whole abdomen.

Table 6: Comparison Between Distension Of Abdomen With Management By Pearson's Chi-Square Test

Distension of Abdomen	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Absent	0	45	45	23.774	0.0005 **
	0.0%	84.9%	75.0%		
Present	7	8	15		
	100.0%	15.1%	25.0%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
** Highly Statistical Significance at p < 0.01 level					

Table 7: Comparison Between Tenderness With Management By Pearson's Chi-Square Test

Tenderness	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Absent	0	29	29	7.413	0.011 *
	0.0%	54.7%	48.3%		
Present	7	24	31		
	100.0%	45.3%	51.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
* Statistical Significance at p < 0.05 level					

Table 8: comparison Between Rebound Tenderness With Management By Pearson's Chi-Square Test

Rebound Tenderness	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Absent	4	51	55	12.365	0.009
	57.1%	96.2%	91.7%		
Present	3	2	5		
	42.9%	3.8%	8.3%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
** Highly Statistical Significance at p < 0.01 level					

Table 8: Comparison Between Rigidity With Management By Pearson's Chi-Square Test

Rigidity	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Absent	2	42	44	8.119	0.012 *
	28.6%	79.2%	73.3%		
Present	5	11	16		
	71.4%	20.8%	26.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
* Statistical Significance at p < 0.05 level					

ISSN: 0975-8585

Table 9: Comparison between Renal Angle Tenderness with Management by Pearson's Chi-Square test

Renal Angle Tenderness	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Absent	5	50	55	4.249	0.099 #
	71.4%	94.3%	91.7%		
Present	2	3	5		
	28.6%	5.7%	8.3%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

Table 10: Comparison between Liver Dullness with Management by Pearson's Chi-Square test

Liver Dullness	Management		Total	p 2 - value	p-value
	NOM- F	NOM- S			
Not Obliterated	5	50	55	16.681	0.004 **
	71.4%	94.3%	91.7%		
Obliterated	2	3	5		
	28.6%	5.7%	8.3%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
** Highly Statistical Significance at p < 0.01 level					

Table 11: Comparison between Free Fluid in Abdomen (e-Fast) with Management by Pearson's Chi-Square test

Free Fluid in Abdomen (e-Fast)	Management		Total	p 2 - value	p-value
	NOM- F	NOM- S			
Absent	0	12	12	1.981	0.326 #
	0.0%	22.6%	20.0%		
Present	7	41	48		
	100.0%	77.4%	80.0%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
# No Statistical Significance at p > 0.05 level					

Table 12: Comparison between Chest X-ray with Management by Pearson's Chi-Square test

Chest X-ray	Management		Total	p2 - value	p-value
	NOM-F	NOM-S			
Air under diaphragm	2	0	2	15.665	0.012 *
	28.6%	0.0%	3.3%		
Normal	5	53	58		
	71.4%	100.0%	96.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
* Statistical Significance at p < 0.05 level					

ISSN: 0975-8585

Table 13: Comparison between CT Abdomen with Management by Pearson's Chi-Square test

CT Abdomen	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
Liver & Spleen Injury	1	14	15	22.049	0.0002 **
	14.3%	26.4%	25.0%		
Liver Injury	0	20	20		
	0.0%	37.7%	33.3%		
Multiple Organ Injury	2	0	2		
	28.6%	0.0%	3.3%		
Renal Injury	2	3	5		
	28.6%	5.7%	8.3%		
Splenic Injury	2	16	18		
	28.6%	30.2%	30.0%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
** Highly Statistical Significance at p < 0.01 level					

Table 14: Comparison between Resolution of Hemoperitoneum (USG) with Management by Pearson's Chi-Square test

Resolution of Hemoperitoneum (USG)	Management		Total	p 2 - value	p-value
	NOM-F	NOM-S			
No	7	28	35	5.660	0.035 *
	100.0%	52.8%	58.3%		
Yes	0	25	25		
	0.0%	47.2%	41.7%		
Total	7	53	60		
	100.0%	100.0%	100.0%		
* Statistical Significance at p < 0.05 level					

DISCUSSION

The current study participants were chosen from the Madras medical college and Rajiv Gandhi Government General Hospital Surgical Intensive Care Unit of General Surgery department. Patients were selected according to the inclusion and exclusion criteria according to which 60 patients were selected as study participants after obtaining a detailed informed consent. The study population with 60 study participants had 47 male patients and 13 female patients. Trauma is one of the most common causes of death in the young population (age group between 1 and 45 years). Blunt abdominal trauma (BAT) is very common, and the prevalence of intra-abdominal injury following it has been reported to be as high as 12–15% [8]. The mechanisms resulting in BAT were motor vehicle collision (73%), motorcycle collision (7%),auto-pedestrian collision (6%), and fall (6%) The abdomen is the third most common injured region, in 25% of cases who require surgical interference. Abdominal trauma is classified as either blunt or penetrating. Penetrating abdominal trauma is easily diagnosed, while blunt trauma complications can be missed if the clinical signs are not evident. Haemodynamic instability, disturbed level of consciousness and presence of other injuries in the skull, chest, pelvic bones or extremities, all explain the need of an accurate and rapid imaging tool to diagnose associated abdominal visceral injuries [9]. Contrast enhanced computed tomography (CT) is the radiological golden standard for abdominal visceral injuries. However, renal failure or a previous anaphylactic reaction to contrast material hinders the use of CT in evaluation of some trauma patients. A non-contrast study diminishes the sensitivity of CT in diagnosis of solid organ injuries CT disadvantages include the need for patient transfer to the CT unit, hazards of ionizing radiation or if contrast media is used, patients may not be co-operative or assume the best position if in pain or with disturbed conscious level [10]. Thus, non-elevated arms, or medical devices (catheters, tubes and lines) will cause artefacts decreasing imaging quality .Organ injury can be easily diagnosed by

abdominal ultrasound as well as the presence of free intra-abdominal fluid, which could be blood or intestinal secretions that provides indirect evidence of these injuries. Ultrasound is non-invasive, portable using no ionizing radiation, repeatable, and easily performed in the emergency unit, at the same time with resuscitation methods. Focused abdominal sonography for trauma (FAST) is a fast examination method that could demonstrate intraperitoneal fluid. Several studies found this technique to be sensitive (79–100%) and specific (95.6–100%), particularly in hemodynamically unstable patients [11]. In the present study, majority of the patients (29.4%) were in the age group of >20-30 years followed by 20.6% in the age groups of >10-20 years and >30-40 years. The age of the patients ranged from 17-69 years and the mean age was 35.29 ± 15.84 years. Road traffic accident (RTA) was responsible for 79.4% of blunt abdominal trauma cases, while fall from height and physical assault accounted for 14.7% and 5.9% of cases respectively. vehicular accidents as commonest mode of injury with incidence being 70 % and 80 % respectively. Majority of the patients presented with abdominal pain (91.2%) and abdominal tenderness (91.2%) [12]. The time lapse between injury to admission affects outcome. In our study no patient were presented in first golden hour. Majority of the patients (50%) were present in the hospital in >2-4 hrs after injury while 23.5% and 20.6% of the patients were present in >4-6 and >6 hours respectively. 5.9% patients could be present in ≤2 hours after injury [13]. It is crucial to get the medical aid to trauma patients as early as possible so as to resuscitate the patient before he/she succumbs to the injuries. 3 cases of renal injury were reported, one of them had large renal hematoma, marked intra-abdominal bleeding and hemodynamic instability that urgent exploration and left total nephrectomy were done, the other 2 cases were hemodynamically stable, one of them had sub capsular hematoma while the other had perinephric hematoma and renal laceration; however, ultrasonography could not detect the exact extension of the injury and could not exclude injury of collecting system, CECT was performed, and the case of sub capsular hematoma was treated conservatively while the other case needed surgical treatment [14]. The most commonly injured organ was spleen (38.9%) followed by liver (33.3%), stomach (11.1%), renal (8.3%), pancreas (2.8%), duodenum (2.8%) and bladder (2.8%). Splenic and renal laceration was common in 2 patients. splenectomy was done in higher grade of splenic trauma i.e. grade IV, V. One patient of liver laceration, who was subjected to surgery, required perihepatic packing [15]. The remaining cases of liver trauma were managed conservatively, successfully. Out of four patients of traumatic small bowel injury, in two patients' primary closure of perforation was carried out and remaining two resection anastomosis was carried out. [16]. The hemodynamically stable patient is defined as a patient with a systolic blood pressure (SBP) >90 mmHg, heart rate >120 bpm and without clinical signs of shock. Emergency USG was done on all 34 patients. CT scan was done in 22 patients, out of which 17 solid organ injuries was correctly detected by USG. There were 4 false negative reports of no solid organ injury and 1 report of false positive for solid organ injury in Emergency USG findings [17,18].The sensitivity and specificity of the Emergency USG findings were 80.9% and 92.3% respectively, with the accuracy of 85.2%. The sensitivity and specificity of the CT findings were 100% and 0% respectively, with the accuracy of 100% [19,20].

CONCLUSION

Blunt trauma abdomen with solid organ injury accounts for considerable number of patients in our society. Most common age group affected is 21-40 years. Males are affected in large proportions. Road traffic accidents are the most common mode of injury. So attempts should be made to decrease road traffic accidents by regulating road traffic norms. Emergency trauma care centres with necessary facilities should be established at every Taluk hospital. Efforts for early transport of the patients from the accident site to the trauma centres should be made. Most of the cases will have associated injuries with blunt trauma abdomen like head injury, chest injury, extremity fractures. So Clinical presentation is varied and sometimes confusing. Blunt trauma abdomen is usually less obvious. Hence, thorough examination by multispecialty personnel in a highly established trauma centre is required. X-Ray abdomen-erect is a useful investigation to diagnose hollow viscus injury. Serially decreasing hematocrit value indicates ongoing bleeding. With the advent of e-FAST, DPL are becoming less opted. CECT-Abdomen remains the investigation of choice in dealing with blunt trauma abdomen patients, and becomes more important in deciding operative versus non- operative management. Early diagnosis, clinical examination, reassessment with use of relevant investigations forms the major role in managing Blunt trauma abdomen patients. Associated extra abdominal injuries like head, thoracic and extremity injuries influence the morbidity and mortality of the patients. Over the past two decades, major shift has occurred from the operative line of management to the non-operative management. Because of the wide availability of CT scan and minimally invasive procedures like angioembolization, non-operative management has become the treatment of choice for hemodynamically stable patients.

REFERENCES

[1] Nishijima DK, Simel DL, Wisner DH, Holmes JF. Does this adult patient have a blunt intra-abdominal injury?. JAMA 2012;307(14):1517-27.

[2] Isenhour JL, Marx J. Advances in abdominal trauma. Emergency medicine clinics of North America 2007;25(3):713-33.

[3] Davis JJ, Cohn Jr IS, Nance FC. Diagnosis and management of blunt abdominal trauma. Annals of Surgery 1976;183(6):672.

[4] Shah SM, Shah KS, Joshi PK, Somani RB, Gohil VB, Dakhda SM. To study the incidence of organ damage and post-operative care in patients of blunt abdominal trauma with haemoperitoneum managed by laparoscopy. Journal Of Minimal Access Surgery 2011;7(3):169.

[5] Deunk J, Brink M, Dekker HM, Kool DR, Blickman JG, van Vugt AB, Edwards MJ. Predictors for the selection of patients for abdominal CT after blunt trauma: a proposal for a diagnostic algorithm. Annals of Surgery 2010;251(3):512-20.

[6] Abbasi HR, Mousavi SM, Akerdi AT, Niakan MH, Bolandparvaz S, Paydar S. Pattern of traumatic injuries and Injury Severity Score in a major trauma center in Shiraz, Southern Iran. Bulletin of Emergency & Trauma 2013;1(2):81.

[7] Gwinnutt CL, Driscoll PA. Advanced trauma life support. European Journal Of Anaesthesiology 1996;13(02):95-101.

[8] Giannopoulos GA, Katsoulis IE, Tzanakis NE, Patsaouras PA, Digalakis MK. Non-operative management of blunt abdominal trauma. Is it safe and feasible in a district general hospital?. Scandinavian Journal Of Trauma, Resuscitation And Emergency Medicine 2009;17(1):22.

[9] Hashemzadeh SH, Hashemzadeh KH, Dehdilani M, Rezaei S. Non-operative management of blunt trauma in abdominal solid organ injuries: a prospective study to evaluate the success rate and predictive factors of failure. Minerva Chirurgica 2010;65(3):267-74.

[10] Raza M, Abbas Y, Devi V, Prasad KV, Rizk KN, Nair PP. Non operative management of abdominal trauma–a 10 years review. World Journal of Emergency Surgery 2013;8(1):14.

[11] Hassan R, Aziz AA. Computed tomography (CT) imaging of injuries from blunt abdominal trauma: a pictorial essay. The Malaysian journal of medical sciences: MJMS 2010;17(2):29.

[12] Kendall J, Kestler AM, Whitaker KT, Adkisson MM, Haukoos JS. Blunt abdominal trauma patients are at very low risk for intra-abdominal injury after emergency department observation. Western Journal of Emergency Medicine 2011;12(4).

[13] Baradaran H, Salimi J, Nassaji-Zavareh M, Rabbani AK. Epidemiological study of patients with penetrating abdominal trauma in Tehran-Iran. Acta Medica Iranica 2007;45(4):305-8.

[14] Farrath S, Parreira JG, Perlingeiro JA, Solda SC, Assef JC. Predictors of abdominal injuries in blunt trauma. Revista do Colégio Brasileiro de Cirurgiões 2012;39(4):295-301.

[15] Hedrick TL, Sawyer RG, Young JS. MRI for the diagnosis of blunt abdominal trauma: a case report. Emergency Radiology 2005;11(5):309-11.

[16] Cokkinos D, Antypa E, Stefanidis K, Tserotas P, Kostaras V, Parlamenti A, Tavernaraki K, Piperopoulos PN. Contrast-enhanced ultrasound for imaging blunt abdominal trauma–indications, description of the technique and imaging review. Ultraschall in der Medizin-European Journal of Ultrasound 2012;33(01):60-7.

[17] Kontopodis N, Kaouraki A, Panagiotakis GI, Miliadis O, Volakakis J, Spiridakis K. Diagnosis of intra-abdominal injuries can be challenging in multitrauma patients with associated injuries. Our experience and review of the literature. Il giornale di chirurgia 2013;33(1/2):27-31.

[18] Baker SP, O'neill B. The injury severity score: an update. Journal of Trauma and Acute Care Surgery 1976;16(11):882-5.

[19] Guirguis EM, Hong C, Liu D, Watters JM, Baillie F, McIntyre RW. Trauma outcome analysis of two Canadian centres using the TRISS method. Journal of Trauma and Acute Care Surgery 1990;30(4):426-9.

[20] Rhodes M, Aronson J, Moerkirk G, Petrash E. Quality of life after the trauma center. Journal of Trauma and Acute Care Surgery 1988;28(7):931-8.